Appendix O

Navigation

SOUTH CORRIDOR PROJECT

Portland-Milwaukie Light Rail Project

APPENDIX O. NAVIGATION AND CLIMATE CHANGE SUMMARY

O.1 WILLAMETTE RIVER BRIDGE PROPOSAL

O.1.1 Overview of Bridge and Willamette River

The Portland-Milwaukie Light Rail Project ("Project") proposes constructing a new multi-use Bridge (Bridge) across the Willamette River, between the Marquam (I-5) and Ross Island (Hwy 26) Bridges, and between Oregon Health and Science University's (OHSU) future South Waterfront campus on the west bank and Oregon Museum of Science and Industry (OMSI) on the east bank.[1] The Bridge will link vital employment, education, and research centers in downtown Portland, South Waterfront, and inner Southeast Portland with Milwaukie and Clackamas County. The Bridge will be a cable-stayed structure that accommodates light rail, streetcars, buses, pedestrians, and bicycles, and will be accessible to emergency vehicles. Buses, light rail vehicles, and streetcars will share a set of paved tracks in the center of the Bridge. Two, 14-foot multi-use paths would be on each side of the Bridge, separated from the transit vehicles and tracks by safety barriers.

TriMet, in developing the design concept for the Bridge, conducted a detailed review of the many navigational, engineering, functional, environmental, transportation, cost, and public interest factors critical to the selection of a bridge type. This included a detailed assessment of current and future navigational needs beginning with the Supplemental Draft Environmental Impact Statement (SDEIS) efforts in 2007 and 2008, and continuing through additional engineering for a preferred alternative, the selection of a bridge type, and the preparation of this Final Environmental Impact Statement (FEIS). These efforts included document research, field investigations, and outreach to navigational users and interests, coupled with an extensive open public process to review and refine various design concepts.

The Bridge will cross the Willamette River which is an important regional navigable waterway used for commerce and recreation. It is also an irreplaceable natural resource. The Bridge will cross over shoreline and habitat of green sturgeon and endangered salmon species. The structure approaches and abutments, and the number, location, and type of river piers were carefully evaluated to avoid and minimize the effects on shallow water and riparian habitat, water quality, and greenway development. It was also designed to support plans for hazardous materials remediation in the South Waterfront area by Zidell Marine Company.

The lower Willamette River is within a highly urbanized area with many adjacent residential, commercial, industrial, and recreational uses. This portion of the River is largely channelized, with much of its banks either constrained by riprap or the Portland sea wall. Most of the River's

[1] Figure O-1 shows the proposed location of the Bridge within the region, and Figure O-2 provides a more detailed view of the alignment. Figure O-3 shows the proposed Bridge design.

original off-channel and floodplain habitats have been eliminated or are highly degraded, and its channel largely lacks topographic and habitat diversity.

Upstream from Oregon City, the River is regulated by 11 multipurpose flood control/recreation/hydropower reservoirs operated by the U.S. Army Corps of Engineers (USACE or Corps). These facilities have substantially altered the hydrology of the River compared to its original state. The approximate wetted width (the distance between the water's edge on each side of the stream as measured perpendicular to streamflow) at the location of the proposed Bridge is approximately 1500 feet. The estimated average flow and Federal Emergency Management Agency (FEMA) 100-year flood flow are 32,000 and 400,000 cubic feet per second, respectively.

The Willamette River flows into the Columbia River, which has one of the most developed hydroelectric systems in the world, with 11 major dams on the mainstem in the U.S. and Canada, and many more on its major tributaries.

The Bridge will provide approximately 77.52 feet vertical clearance as measured from the Columbia River Datum (CRD) for approximately 150 feet in the middle of the center span of the Bridge. [2] The Bridge will have two towers, both approximately 180 feet high (from Ordinary High Water - OHW) and 780 feet apart, connecting to cables extending down to the Bridge deck. Each of the towers will be anchored in foundations provided by concrete-capped pier structures in the water. The Bridge towers, including the capped pier structures are designed to have approximately 694 feet of waterway between them.

O.1.2 Purpose and Content

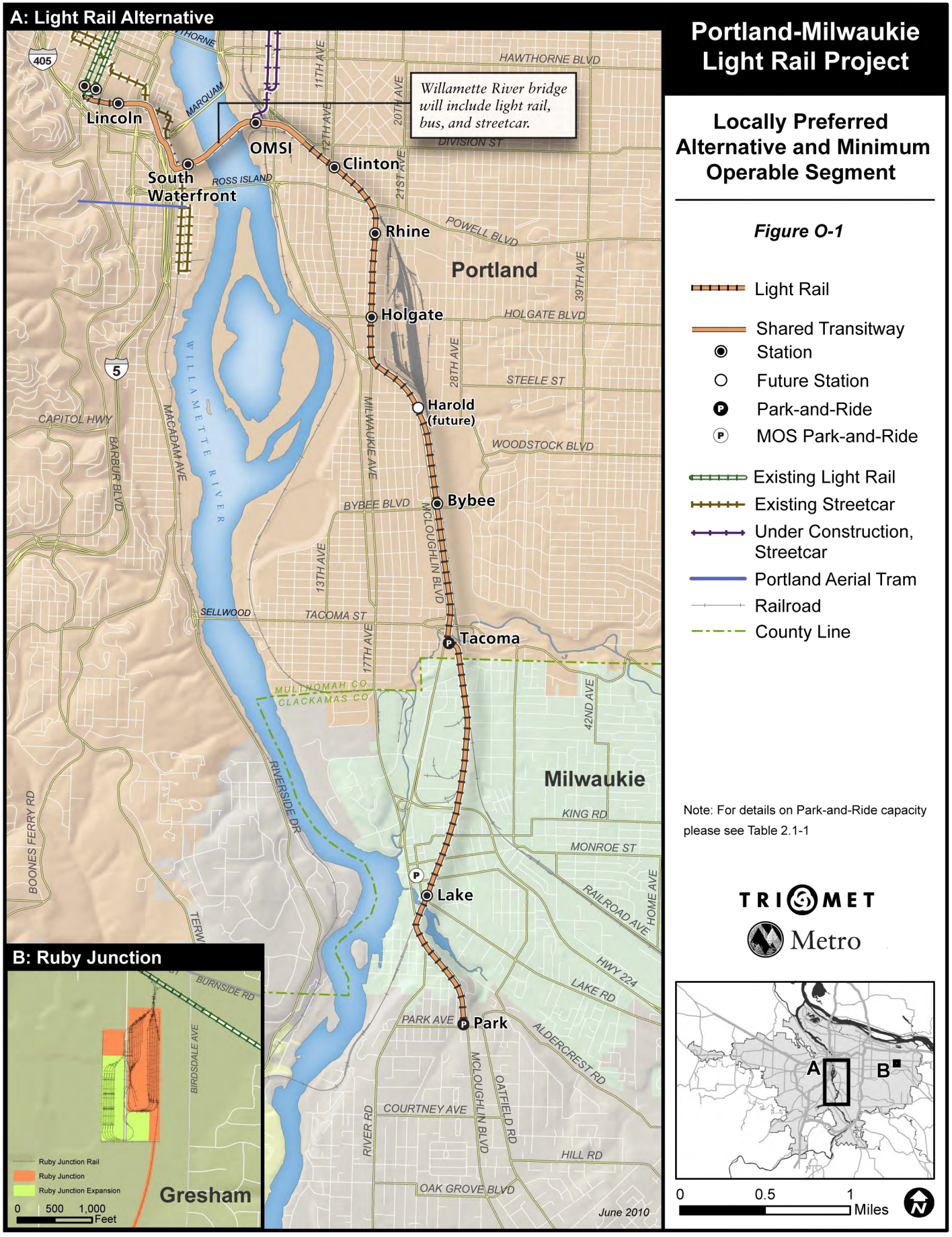
The purpose of this Appendix is to: (1) summarize the detailed design, engineering, and river user survey information developed during the course of the EIS; (2) summarize the permitting process for the Bridge; and (3) summarize the Bridge's anticipated effects on navigation. To that end, this FEIS appendix summarizes the documents listed below. This summary and the technical source documents can be found under a separate cover in the *Portland-Milwaukie Light Rail Project Navigation Technical Report* (TriMet 2010).

- River User Survey Final Report and Additional River User Interviews, concerning existing activity levels, and planned future navigational needs of river users;

- Navigational Passage Analyses, predicting the number of vessels that would be accommodated at varying navigational heights and river levels;

- Technical Memorandum, compiling the best available information on the potential effects of climate change on Willamette River levels over time;

[2] As with all bridges on the Willamette River and other river systems, the vertical navigational clearance fluctuates as river levels change.



Portland-Milwaukie Light Rail Project

Locally Preferred Alternative and Minimum Operable Segment

Figure O-1

- Light Rail
- Shared Transitway
- Station
- Future Station
- Park-and-Ride
- MOS Park-and-Ride
- Existing Light Rail
- Existing Streetcar
- Under Construction, Streetcar
- Portland Aerial Tram
- Railroad
- County Line

Note: For details on Park-and-Ride capacity please see Table 2.1-1

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0 0.5 1 Miles

Portland-Milwaukie Light Rail Project

Willamette River Bridge

Figure O-2

- Light Rail Alternative
- Station
- Existing Streetcar
- Under Construction Streetcar
- Proposed Streetcar

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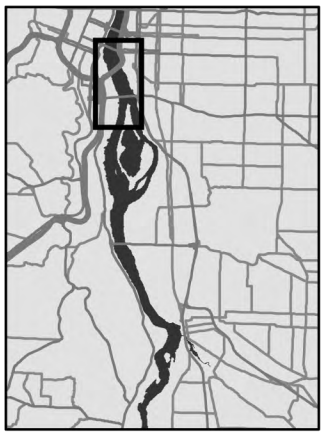
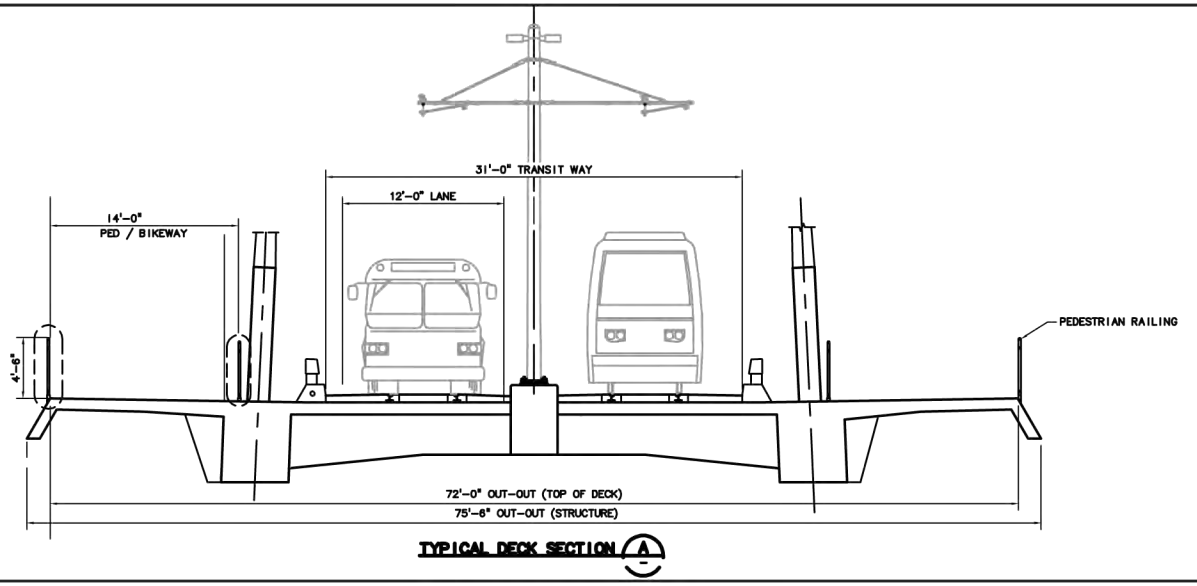
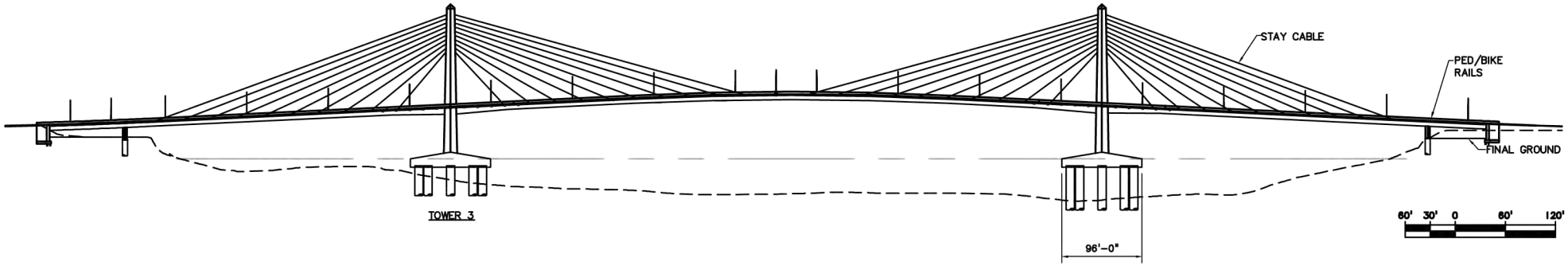
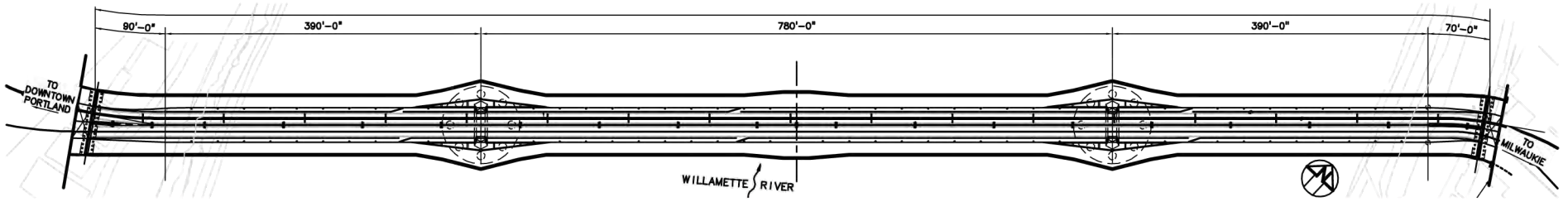


0 500 1,000 Feet

February 2010







Portland-Milwaukie Light Rail Project *Figure O-3*

Willamette River Bridge Design

(Not to Scale)

Refer to Figure H-16 for LPA Phasing Option Bridge Design

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September 2010

- Vertical and horizontal clearance alternatives analyses, including a landside implications summary and a review of other functional and regulatory requirements used to define Bridge design alternatives;

- Current and Future Navigational Needs Research, including City of Portland and Port of Portland maps and studies of land use and port/water-dependent activities and future trade and freight/commodity transport activities dependent on the Willamette River;

- A study of Federal Navigational Channel Conditions, including the status of Columbia and Willamette River dredging activities, and an assessment of future activities that may increase the size of vessels using the Willamette River;

- Correspondence and presentation materials developed in response to public comments on the Bridge height initially proposed in the SDEIS;

- Historic River levels analysis;

- Technical review of how the existence of dams affects flows and water levels on the Columbia and Willamette River systems;

- Vertical clearance analysis, including how the height and corresponding slope of the Bridge would affect individuals with disabilities using the multi-use path; and

- Vertical clearance analysis of potential future navigation uses.

O.1.3 Regulatory Context

Federal authority to permit new bridges is delegated to the United States Coast Guard (USCG) pursuant to Section 9 of the Rivers and Harbors Act of 1899 and the General Bridge Act of 1946. The purpose of the two Acts is to preserve the public's reasonable right of navigation and to prevent interference with interstate and foreign commerce. The Willamette River to River Mile (RM) 183.2 is designated a navigable waterway by the USCG. None of the other streams crossed by the Project is navigable. TriMet will need to obtain a permit from the USCG for the Willamette River Bridge pursuant to the above-cited authorities. TriMet will also need to obtain a Section 10 of the Rivers and Harbor Act of 1889 permit for work being conducted in the river in coordination with the Section 404 permit.

One of the criteria the USCG evaluates in issuing a bridge permit is whether the bridge unreasonably interferes with navigational use (33 U.S.C. Sec. 512). TriMet does not need to accommodate all navigation needs, just those needs that are reasonable. *Id.; Gerosa Inc. v. Dole*, 576 F. Supp. 344 (S.D.N.Y. 1983). This consideration includes looking at current and reasonably expected future uses, such as vessel heights, location of onshore facilities, frequency of use, seasonality of use, and availability of alternative facilities or operations, as well as the reasonable needs of land traffic (highway and rail).

TriMet applied to the USCG for the Bridge permit in July 2010. As part of its process to issue the permit and set the Bridge height, the USCG will look to, among others, this FEIS and NOAA Fisheries' Biological Opinion's evaluation of how the Bridge construction will affect listed threatened or endangered salmonids.

In the vicinity of the Project corridor, the vertical navigational clearance is established by a number of existing fixed-span bridges, including:

- I-5/Marquam Bridge: 120 feet vertical clearance
- Ross Island Bridge: 120 feet vertical clearance
- Sellwood Bridge: 72/75 foot (charted/actual) vertical clearance
- Railroad Bridge: 74 foot vertical clearance
- I-205/Abernathy Bridge: 76 foot vertical clearance
- Oregon City Bridge: 74 foot vertical clearance

To the north of the Project, a number of other bridges feature lift spans, which provide higher clearance, but also impact land transportation when they are raised. The lift span of the Hawthorne Bridge has the highest clearance at 159 feet when the deck is raised. Operators raise the Hawthorne Bridge an average of 200 times per month (300 times per month in the summer).

The lowest vertical clearance in the area is upstream at the Sellwood Bridge at 75 feet. The Sellwood Bridge is scheduled for replacement/renovation through a separate project; however, the new Sellwood Bridge is proposed to be designed with the same 75 feet of vertical clearance. No final decision has yet been made on its height.

River levels on the Willamette River have been extensively measured since 1879, providing a long term view of the seasonal and historic variations within the Willamette River watershed. The variability of the River's levels has declined substantially following the construction of dams within the Willamette and Columbia River systems. For example, the standard deviation for the CRD at the Morrison Bridge is only 2.45 feet, as measured since 1978 when the last major dam affecting the river system was developed.

O.2 NAVIGATIONAL USES

O.2.1 Current Navigational Uses

Navigation on the Willamette River through Portland Harbor has historically focused on the movement of cargo, particularly barges. Today, most marine cargo operations are confined to Port of Portland terminals and private terminals downstream of the Steel Bridge, but significant barge operations still continue along the River. Remaining waterfront industrial facilities upstream of the proposed Bridge include Ross Island Sand & Gravel and Zidell Company's

barge building facility. Sand and gravel are the most common commodities shipped today. While River use for industrial commerce has declined, there has been growth in the cruise, excursion, and chartered boat market on the Willamette River in the past 15 years. There are at least seven passenger and excursion vessel companies operating in the Willamette River, operating about a dozen vessels.

In early 2008, TriMet conducted an assessment of existing vessel traffic and corresponding clearance requirements (*River Users Survey Report*, TriMet 2008) (First Study).[3] TriMet contacted numerous commercial and recreational vessel owners to obtain information on their vessel dimensions and transit patterns in the River reach affected by the Bridge. This First Study led TriMet to initially propose a Bridge with a 75 feet vertical clearance. This vertical clearance would allow most, but not all, river users to pass under the proposed Bridge at most river levels.

Following the release of the SDEIS in 2008 and TriMet's receipt and analysis of public comments on its initial navigation survey, TriMet conducted an additional survey of navigation needs on the River in the fall of 2008 (Second Study). After conducting this Second Study, TriMet increased its proposed vertical Bridge clearance 2.52 feet to 77.52 feet to maximize navigation clearance passage rates while still minimizing land side impacts, environmental concerns, and the resulting increase in costs. As part of the Second Study, TriMet focused on eight potentially affected river users (*Existing River User Follow-Up Final Report*, Riverwise, January 2009). Their feedback is discussed in more detail in section O.5.

Commercial river users of the Willamette reach consist of two primary groups: (1) marine industrial (whose businesses and/or product delivery rely on water transportation); and (2) cruise and excursion. The users within each of these groups have unique operation patterns and requirements.

Table O-1
River Users Survey Response

Name	Vessels	Standard Vertical Clearance [ft]	Minimum Vertical Clearance [ft]	Draft [ft]	Existing Route	Frequency [one-way]
Commercial						
Ross Island Sand & Gravel	Dauby Tug	55	55	9	Ross Island S&G, WR - The Dalles, OR	
	Ross Isle Tug	32		5.7	RISG, Willamette - concrete batch plant	daily
	Derrick barge/Dredge	79	72		in N. Portland Harbor; other various	
	Barges					
Zidell Marine Corp	Barges	50		10	Downriver from 1500' above Ross Island Bridge	4-6 annual

[3] This survey was mailed to approximately 75 known river users. The information provided in Table O-1 below is a compilation of the responses received.

Table O-1
River Users Survey Response

Name	Vessels	Standard Vertical Clearance [ft]	Minimum Vertical Clearance [ft]	Draft [ft]	Existing Route	Frequency [one-way]
	Crane barge	75		17		4-6 annual
Shaver Transportation	Willamette Tug	55		11	Willamette RM 8 to Zidell; occasional trips above Sellwood Bridge	2-3 annual
	Deschutes Tug	55		11		
	Cascade Tug	55		11		
	Clearwater Tug	50		10		
	Vancouver Tug	22		11.1		
	Various barge configurations					
Combined Forestry & Marine Svs Inc	LCI 713	65	65	5	Project dependent; upriver through locks to Newberg.	2-10 month; sometimes more
	Various crane barges	40-60	40-60	3	Typical tow breadth: 45-60'	
	Floating homes	40	40	4-8	Maximum Tow Breadth: 86-90'	
	Tugboats	30-50	50	4-9		
Larson's Marine Services	Tugboat	20	12	5	Lake Oswego-Milwaukie-West Linn - Wilsonville-Newberg	4 month
	Crane Barge	75	30	4	Typical tow breadth: 50'	
	Boat house	38	38	5	Maximum Tow Breadth: 70'	
Portland Spirit	Portland Spirit	44	44	7	Between Willamette Mouth and Champoeg Park at Wilsonville	10 daily on Willamette
	Willamette Star	40	42	5.5	"	
	Crystal Dolphin	44	44	6.5	"	
	Outrageous	22	20	2	"	
	Columbia Gorge	58	58	7	Columbia and Willamette Rivers	

Table O-1
River Users Survey Response

Name	Vessels	Standard Vertical Clearance [ft]	Minimum Vertical Clearance [ft]	Draft [ft]	Existing Route	Frequency [one-way]
Oregon Maritime Museum - non-profit	Sternwheeler Steamer Portland	65	65	7	Planned excursions all from Portland Seawall; downriver and upriver to Milwaukie, Lake Oswego and Oregon City	4 annual
Portland Rose	Sternwheeler Portland Rose	NA		4		
Cruise West	Spirit of Discovery	NA		12	Upriver to Riverplace Marina only	
	Spirit of Alaska			7		
Lindblad Expeditions/Nat'l Geographic	Sea Lion	55		11.1	Upriver to Riverplace Marina only	
	Sea Bird	53		11.1		
Majestic America Lines [incl America Steamboat Co.]	No operations in subject reach					
Promise Charters LLC	Sailboat Promise	68	68	6	Varies between Oregon City and Astoria	10 annual
Grays Harbor Historical Seaport Authority	Lady Washington	87		10.8		40 annual [June]
	Hawaiian Chieftain	75.5		8.3		
Recreational-Private						
Lavine A Linker	Sailboat Prospector	65				
Bernard's Moorage	Various vessels	65				

O.2.2 Land Use and Commerce Factors Affecting Navigation

In addition to the navigation surveys discussed above, TriMet conducted research focusing on marine and multimodal-dependent facilities along the Willamette River, primarily using studies by the City of Portland and the Port of Portland. The infrastructure relied on most by these marine and multimodal-dependent facilities, primarily rail and highway, is located downstream of the Broadway Bridge. Plans for future development of marine and multimodal-dependent

facilities along the River are limited due to increasing regulation over effects on endangered species and water quality.

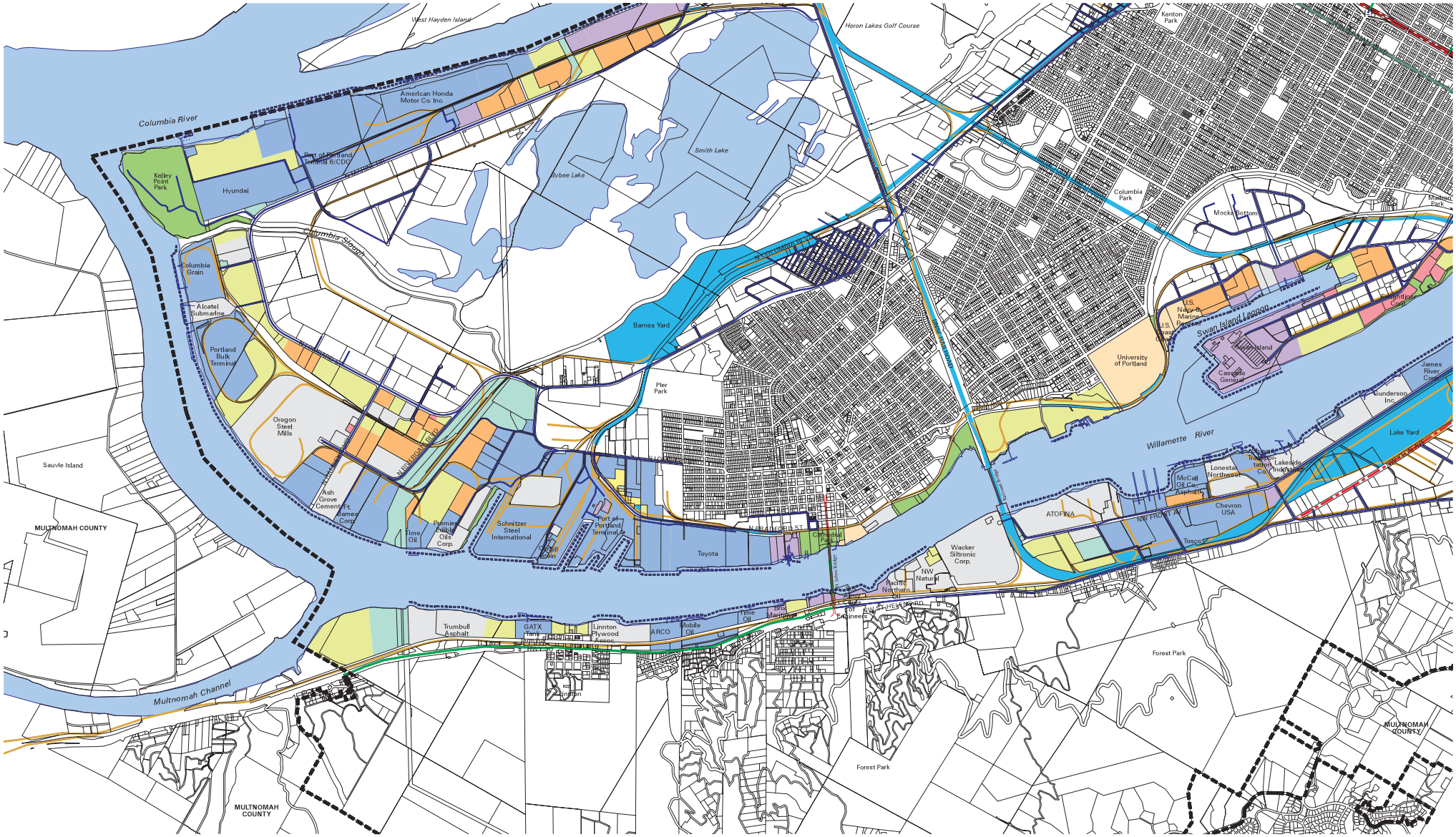
Figures O-4 and O-5 provides the City of Portland "River Atlas" information, which maps the major land uses along the Willamette River, showing that the largest concentration of industrial and port lands is to the north of the proposed Project. The maps also encompass the City of Portland's plans for the South Waterfront area, once a heavily water-dependent use area, which Figure O-4 is now envisioned as a mixed-use neighborhood with integrated shoreline and near shore habitat restoration elements, more typical of waterfront land use trends both locally and nationally.

O.3 FUTURE NAVIGATION

In addition to looking at minimum horizontal and vertical clearances for current navigational activities, TriMet has been analyzing reasonable future navigational uses. TriMet looked at recent and prospective growth changes at the Port of Portland and the City of Portland, maintenance of the Federal Navigational Channel (e.g., dredging), and relevant US Department of Transportation (USDOT), USACE and USCG regulations. In general, as the region experiences economic growth, there will be growth in the navigational use of the river. Marine cargo levels are predicted by the Port to nearly double by 2035, much of which is expected to focus on the port facilities downstream of the proposed Bridge site and on terminals on the Columbia River.

O.3.1 Federal Navigation Channel

The Federal Navigational Channel stretches from the mouth of the Columbia River near Astoria, Oregon to the railroad bridge between Portland, Oregon and Vancouver, Washington; and from the mouth of the Willamette River to the Broadway Bridge, which is downriver from the proposed Bridge site. The Corps began work on a Dredge Material Management Plan for the existing 40-foot deep Lower Willamette River navigation channel in 2007-2008. In September 2008, the Corps suspended work on the Plan pending the outcome of the Portland Harbor Superfund investigation and cleanup. The Environmental Protection Agency is expected to select the final cleanup remedy in 2012. The Willamette's navigation channel was last maintained by the Corps in 1997.



Portland's Willamette River Atlas: A River Renaissance Resource

north segment

City of Portland, Bureau of Planning

25

Existing Uses

- Manufacturing
- Marine Cargo
- Industrial Services
- Utility
- Warehousing
- Mining
- Residential
- Commercial
- Mixed Use
- Institutions
- Parks and Open Space
- Vacant

Freight Network

- Regional Truck Route
- Major Truck Street
- Minor Truck Street
- Truck District
- Major Rail System
- Branch Rail Line

Other Features

- River-Dependent Use
- Existing Light Rail
- Future Light Rail
- Existing Streetcar
- Proposed Streetcar
- City Boundary

INFORMATION SOURCES:

Existing Use Inventory:
North of Steel Bridge:
Initially developed by Bureau of Planning from Port of Portland data (June 1998). Modified by Bureau of Planning through research (Jan. 2000).
South of Steel Bridge:
Original data from Multnomah County Assessment and Taxation (October 1995). Modified by Bureau of Planning through research (Jan. 2000).

Freight Network:
Truck Routes:
Developed by Portland Department of Transportation for Transportation Element of the City's Comprehensive Plan, Updated Dec. 2000.
Railroads:
Developed by Metro for the Regional Transportation Plan (Dec. 1999).

SEE ADDITIONAL INFORMATION ON PAGES 10 AND 27

MAX Light Rail Network:
Developed by Metro, Updated April 2001.

Portland Street Car:
Developed by Bureau of Planning from Portland Streetcar web site map (Oct. 2000).

City Boundary:
Digitized by Portland Department of Transportation. Updated by PDOT and Bureau of Planning, October 2000. Registered to ballot base maps.

All data compiled from source materials at different scales. For more detail, please refer to the source materials or City of Portland, Bureau of Planning.

Figure O-4: Existing Land and River Uses

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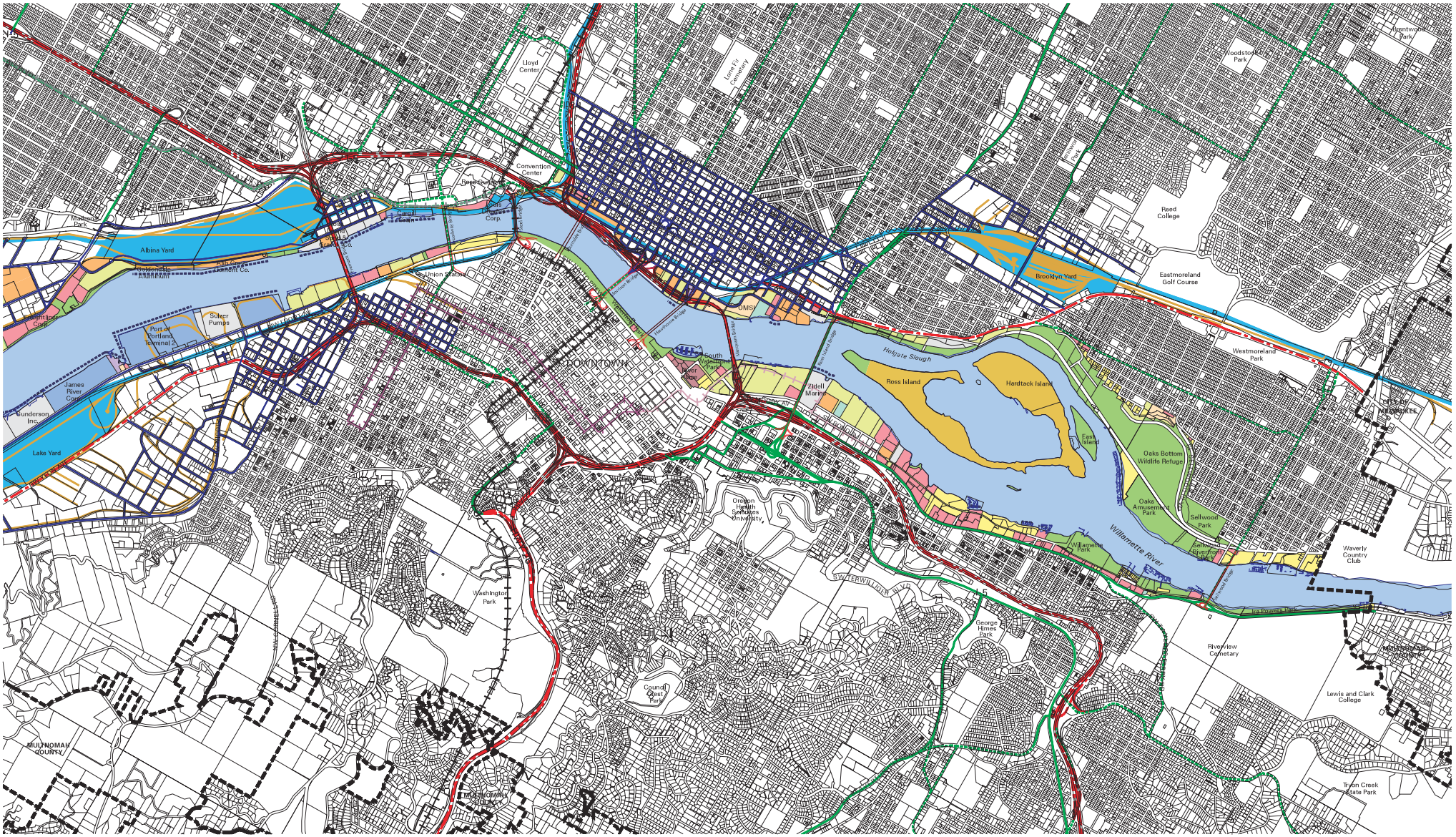
Scale: 1" = 2000'



Portland's Willamette River Atlas: A River Renaissance Resource

south segment

City of Portland, Bureau of Planning

Figure O-5: Existing Land and River Uses

O.4 NAVIGATIONAL ANALYSIS PROCESS

In developing the design concept for the proposed Bridge, TriMet initiated a review of current and future navigational needs, beginning with the SDEIS efforts in 2007 and 2008, and continuing through the preparation of this FEIS.

The Project proposal considered in this FEIS was developed through a NEPA process that began in 1993 for the South/North Corridor Project, resulting in the issuance of a 1998 DEIS. Since then, several other studies and supporting NEPA documents have helped shape the development of the current proposal for the Project and the proposed Bridge over the Willamette River. This includes the South Corridor Project SDEIS (2002), the Downtown Amendment to the South Corridor Project SDEIS (2003), and the South Corridor FEIS (2004).

Most recently, the Portland-Milwaukie Light Rail Project SDEIS (2008) focused on a set of light rail alternatives that serve the South Corridor between downtown Portland, the City of Milwaukie, and northern Clackamas County. In preparation for the SDEIS, Metro and TriMet conducted a Refinement Study beginning in 2006 that focused on bridge alignments and resulted in the addition of four potential bridge alignments. This analysis and process are documented in the *Portland-Milwaukie Light Rail Project Refinement Study* (Metro 2007). Subsequently, the Locally Preferred Alternative (LPA) helped define the location where transit service would be provided on both sides of the Willamette River, including the South Waterfront District and RiverPlace, and helped determine the crossing location of the new Bridge.

O.4.1 Selection of Willamette River Crossing Alignment Option

During the SDEIS process, the City of Portland convened the Willamette River Partnership, a committee of local property owners, river users, businesses, and agencies in the vicinity of the proposed Bridge crossings. The committee was charged with coordinating private development plans and investments with City of Portland utility, street, and park improvements, and the Project.

In July 2008, the Citizen Advisory Committee, the Portland-Milwaukie Steering Committee, and the Metro Council followed the recommendation of the Willamette River Partnership and adopted the refined Porter-Sherman alignment as the LPA, shown in Figure 2.3-2.

O.4.2 Identification of the Bridge Alignment

The Metro Council identified the following key reasons behind its selection of the LPA and Bridge alignment. The LPA and Bridge alignment would:

- Serve almost 3,000 more residents and more than 4,000 additional employees;

  Add 1,200 to 1,400 light rail trips a day between downtown Portland and Milwaukie or Oak Grove;

- Reduce total transit travel time to South Waterfront by five minutes;
- Have fewer noise impacts and impact one less park than the previous alignment;
- Be most likely to serve as a catalyst for development in the area;
- Provide substantial travel time benefits for buses, with over 13,000 riders gaining benefits;
- Avoid the greater impacts to eastside industrial business compared to other options;
- Be compatible with the OHSU and OMSI master plans;
- Be more compatible with the South Waterfront Willamette River Greenway plans for natural habitat area between SW Porter Street and the Marquam Bridge; and
- Offer a short walk connection to the Portland Aerial Tram, which provides access to more than 10,000 jobs on Marquam Hill.

O.4.3 Willamette River Bridge Type Selection Process

After adoption of the 2008 LPA and the selection of the bridge alignment, TriMet focused on several issues related to the bridge height and type. Given the multi-use purpose of the Bridge, its location, and its importance to the Project, TriMet asked a committee of design, engineering, transportation, business, and community leaders to study all bridge types, and recommend types appropriate for the context and the budget. The following types were considered: trusses, arches, cable supported, movable, and girder.

The Willamette River Bridge Advisory Committee (WRBAC) agreed on the selection criteria to be used for the Bridge. These criteria considered, among others, cost, risk, navigation, fundamental performance, architecture, urban context, greenways, sustainability, operations, and environmental opportunities. Environmental opportunities include, for example, which bridge types are best at treating stormwater, supporting wildlife and fish habitat, and incorporating alternative energy.

The cable-stayed Bridge type was selected over other types because:

- It is efficient at spanning long distances, which allowed the number of piers in the water to be reduced, and increased both vertical and horizontal navigational clearances;
- Fewer in-water piers would reduce the long-term environmental impact of the structure;
- The cantilevered construction process used would reduce environmental impact during construction; and
- It can be designed with thinner decks than other Bridge types, allowing a more transparent structure on the city skyline and a greater vertical navigation clearance.

In determining the necessary and appropriate clearances for the proposed Bridge and where the piers should be placed, TriMet conducted detailed computer simulation modeling, 3-D visual simulations, field investigations, and statistical analyses. TriMet also engaged navigational safety experts and experienced river pilots with knowledge of tug and barge operations between the Ross Island and Marquam Bridges.

In February 2009, after seven working group meetings (technical staff from partner jurisdictions), two public workshops and public forums and ten WRBAC committee meetings, the WRBAC recommended that the Project conduct further analysis of cable-stayed bridge types. In May 2009, the committee recommended that the Project proceed with designing a four-pier cable-stayed Bridge type. Additional information about the Bridge study process is available in *Portland-Milwaukie Light Rail Project Willamette River Bridge Type Selection Process Report* (TriMet 2009).

O.5 NAVIGATIONAL EFFECTS

O.5.1 Horizontal Clearance

The proposed Bridge is designed so that the in-water piers will be nearly 780 feet apart with 694 feet of waterway between their support pier structures. This design will satisfy the horizontal clearance needs for River users in the Project area, including users coming from the Holgate Slough and main stem Willamette River south of the Ross Island Bridge.

O.5.2 Vertical Clearance

Vertical clearance is the primary concern of river users. As noted above, among the bridges in the vicinity of the proposed crossing, the lift span of the Hawthorne Bridge has the highest clearance at 159 feet, when the deck is raised. The Ross Island and Marquam Bridges (which would be immediately adjacent to the proposed Bridge) have maximum vertical clearances of 120 feet. The lowest vertical clearance is the Sellwood Bridge, upstream of the proposed Bridge, which has a clearance of 75 feet.

The bridge types assumed for the SDEIS analysis would provide either a 72-foot vertical clearance (cable-stayed through truss) or a 65-foot vertical clearance (concrete segmental). The SDEIS noted that initial results indicated that a clearance of approximately 75 feet may be required to accommodate river users. To further analyze this element, TriMet considered many alternatives for vertical clearance of the proposed Bridge (ranging from 65 to 120 feet) and examined over 30 years of river data. TriMet found that water levels in the most recent 30 years are statistically different than water levels from more than 30 years ago. This is because data from the most recent 30 years includes the effect on river levels resulting from operation of the existing dams on the Columbia and Willamette Rivers and their tributaries.

As noted above, the initial user survey in early 2008 (First Study) showed that a 75 foot clearance would allow most, but not all, river users to transit the proposed Bridge at most river levels anticipated (see Table O-1). Some river users expressed concern regarding this height in the 2008 user's survey and in comments on the SDEIS. TriMet then did a Second Study that

focused on eight river users who had been identified as being partially impacted by a 75 foot vertical clearance. These users were:

- Portland Spirit: 44 foot Portland Spirit; and 58 foot Columbia Gorge
- Oregon Maritime Museum (OMM): 67 foot tall Sternwheeler Steamer Portland
- Shaver Transportation: four tugs, clearance of 22 to 55 feet
- Promise Charters: 51 ft ketch rigged sailboat Promise
- L.A. Linker, Sailboat Prospect: 65 foot masted sailboat Prospect
- Lindblad Explorations: 53 foot Sea Lion and 55 foot Sea Bird
- SDS Lumber, Captain Gary Collins 55 foot tall Dauby
- Combined Forest & Marine Services, Clark Caffall
- Bernard's Moorage (Bernard's Moorage did not respond to contacts for follow up discussions or reviews of the Bridge proposal)

Each of these river users indicated that the 75 foot vertical clearance was acceptable, except for OMM and Portland Spirit. OMM requested a vertical clearance of 84 feet. Portland Spirit requested 85 foot vertical clearance with ADA-compliant ramps and landings.

TriMet's Second Study found that a 77.52 foot vertical clearance for approximately 150 feet would allow for the passage of nearly 99 percent of the anticipated Bridge traffic. Any restrictions in passage would be primarily in the winter, during high water events, and could be minimized or reduced through existing river management systems, including dams and control devices on the Columbia River and Willamette River. This estimate of the current and future passage rates reflects an additional 3.4-foot allowance for safety and river level fluctuations, including the potential future effects on river levels as a result of global climate change. The *Climate Change Technical Memorandum (Parametrix 2010)* recommendation of 3.9 feet included 0.5 feet for the influence of tides on the Willamette River stage. The data set used to analyze percent passage used the high gauge reading for each day, which includes the influence of tides. Therefore, the percent passage analysis used 3.4 feet for safety and river level fluctuations (3.9 feet less 0.5 feet).

The Second Study also looked at the same 30 years of river data. For two of the tallest potentially affected vessels, TriMet calculated the number of days that would be affected by a 77.52 foot vertical clearance plus a 3.4-foot safety allowance. TriMet extended this calculation to the Portland Spirit, which has expressed a future desire to operate through use of a wind powered turbine. While not required to consider this potential future use (since at this time it is nothing more than a speculative future possibility), if actualized, this future scenario would require an additional vertical clearance, for a total of 64 feet. The second tallest boat was the Sailboat Prospect, which requires a clearance of 65 feet. TriMet did not examine the Sailboat Prospect's

use because the owners requested only that the Bridge have a clearance to match the Sellwood Bridge.

Table 2 below lists the approximate percentages and days that the vessels owned by the eight river users identified above would likely not be able to pass under the proposed Bridge. The number of days affected was also examined for the "months of interest" or most important months for each vessel. For example, the months of interest for the Sternwheeler Steamer Portland are April through November.

Table O-2
Days that would be effected by a 77.52 foot vertical clearance

Vessel	Percent passage	Number of Unusable Days in 30 years [1]	Approximate Average Number of Days per Year Without Passage	Percent Passage during Months of Interest	Approximate Average Number of Days per Year Without Passage [2]
Columbia Gorge[3]	99.9	9	0.3	99.8	0.3
Columbia Gorge	99.4	61	2.0	98.8	1.7
Portland Spirit without Wind Turbines (current configuration)[3]	100	0	0	Same, year round service	Same, year round service
Portland Spirit with Wind Turbines[3]	97.9	220	7.3	Same, year round service	Same, year round service
Portland Spirit with Wind Turbines	90.6	992	33.1	Same, year round service	Same, year round service
Sternwheeler Steamer Portland[3]	91.8	863	28.7	94.0	14
Sternwheeler Steamer Portland	63.5	3,857	128.5	70.5	69.5

1. Out of 30 years (10,663 days) of river data.

2. The month of interest for the Columbia Gorge is November through March. There were 4,414 days of data for this period. .

The months of interest for the Sternwheeler Steamer Portland are April – November (8 months). There were 7,143 days of river data for these months.

3. Without including 3.4 feet for climate change and safety.

The Columbia Gorge is owned by Cascade Locks and services the Columbia River from April through October. From November through March, the Columbia Gorge Vessel is leased to the Portland Spirit and services the Willamette River. As shown above, the Columbia Gorge may not be able to pass under the proposed Bridge approximately 0.3 to 1.7 days during its Willamette River service period or "months of interest." The Sternwheeler Steamer Portland may not be able to pass under the Bridge 14 to 69.5 days during its "months of interest." If the owners of the Portland Spirit installed wind turbines on its vessel, it would not be able to pass under the Bridge

approximately 7.3 to 33 days per year. However, these vessels would also not be able to pass under the Sellwood Bridge.

In August 2010, as the FEIS was being completed, TriMet was contacted by an additional river user, the owner of a charter sail company, Sail Scovare Yachts & Expeditions, Inc., located near the Sellwood bridge. Both in a meeting and in a subsequent email to TriMet, the owner identified concerns regarding the project's vertical navigation restrictions and potential passage rates for one of his three charter vessels. The affected vessel, which has a vertical clearance of 65.8 feet, began to operate in 2010. The owner is not among the parties that provided written comments during the public comment period for the 2008 SDEIS. In addition to the notices, meetings and public advertisements conducted for the SDEIS, TriMet's river user outreach and survey process included notices at marinas along the Willamette River, and this party was not among the river users responding to the surveys. Sail Scovare's promotional materials and website state the company has been operating since 2003, and it offers a range of excursion offerings, ranging from hourly to weekly or longer sailings, and sailing routes along the Willamette, the Columbia, as well as to the Puget Sound and the San Juan Islands. The company also offers custom excursions to Hawaii and other destinations. The owner reported a high demand for his cruises between his base north of the Sellwood bridge and downtown Portland, particularly in the summer months, and stated that the proposed bridge height would affect his ability to offer charter cruises.

In an August 2010 meeting with the owner, TriMet provided additional information about the project, including the bridge's current specifications and construction plan, the background on the project's bridge selection process, the permits required for bridge construction, and related opportunities for further public comment through the U.S. Coast Guard's permit review process.

The emergence of a river user with a newly identified large sailing vessel that could be affected by navigation restrictions does not alter the overall conclusions of TriMet regarding the project's effects on the reasonable needs of navigation. Based on information from the owner and his stated vertical clearance needs for the vessel and "months of interest" that include summer as well as winter holiday period sailings, the effects would be similar to other charter operations. The potential percent passage rates for Sail Scovare's largest vessel, if it operates excursions requiring navigation beneath the new Willamette River Bridge, would be similar to those estimated for other tall vessels, ranging from 90 percent and above. These estimates are based on the conservative application of historic data and river level fluctuation factors, which incorporate the highest daily river level readings for past years, and also reflect passage rates during the highest effect months of winter. The owner, whose statements indicate he initiated the purchase and operation of the vessel after the project had proposed its original bridge height in the 2008 SDEIS and after the LPA bridge height was identified, would also have available a variety of options to minimize the impact of navigation restrictions on his charter operations. This includes obtaining predicted river levels that are available daily to Willamette River users, altering the site he uses to begin or end excursions when anticipated river levels could affect his clearance, modifying his vessel, using other vessels within his fleet, or altering his cruise routes.

O.5.3 Construction and Permanent Effects on Landside Access

The Project's proposed bridge alignment and type were designed to minimize impacts to Central Eastside Industrial District land uses, which includes properties with water-dependent uses and river navigation activities. Previous alternatives, including the Meade-Caruthers and Porter-Caruthers alignments in the SDEIS, required a direct acquisition of a property owned and used by the Portland Spirit for river cruise and charter ship operations; the SDEIS identified compensation and relocation measures that could be taken if acquisition of all or part of the property was required. While the LPA to Park Avenue does not require construction of light rail facilities on the property, the Bridge construction activities and the placement of the permanent capped piers for the east Bridge tower are close to the Portland Spirit's mooring and loading dock. Accordingly, TriMet has identified impacts to Portland Spirit's operations due to the location of the temporary construction bridge, associated construction activities on and near the temporary bridge, and the piers. These features would restrict the ability of some of the Portland Spirit vessels to access or maneuver to and from its dock. The construction facilities and activities affect more area and pose more restrictions to operations than the permanent bridge, but the permanent Bridge facility would also restrict the accessibility and maneuvering of some of the Portland Spirit vessels to and from the existing dock. This is considered to be a local landside access impact, and otherwise does not change the horizontal or vertical navigation characteristics or passage rates reported for the Portland Spirit vessels or other vessels navigating up and down the Willamette River after the project is constructed.

To address these vessel docking concerns, TriMet has been coordinating closely with Portland Spirit representatives from early conceptual planning though the preliminary engineering conducted for the FEIS. Further coordination will continue during final design to identify potential operating modifications, design measures, or mitigation strategies to allow the Portland Spirit to effectively maintain its operations in its current location. However, if some or all of Portland Spirit operations cannot be maintained at the existing Portland Spirit site during construction or permanently, the project will mitigate the impacts by providing compensation for the loss of property or property rights, which would include compensation for temporary or permanent relocation of the business. TriMet will also provide relocation assistance and other technical or advisory support to help the business owner obtain a suitable site for its relocated operations. As discussed in more detail in Section 3.1, Acquisitions and Displacements, TriMet will comply with the requirements of 49 CFR Part 24 Uniform Relocation Assistance and Real Property Acquisition Act of 1970, as amended. Relocation options could include temporary operations during construction in locations where vessel moorage and loading are already permitted, or permanent relocation. The business owner could also elect to apply property or relocation compensation to develop an appropriate site for Portland Spirit's operations, subject to applicable local, state, and federal regulations. As discussed in more detail in Section 3.2, Land Use and Economy, TriMet's construction period mitigation for businesses affected during construction also includes outreach, assistance, and public information designed to assist impacted businesses in maintaining their customer base during construction; examples include promotional programs and other marketing or advertising programs to encourage patronage during construction.

O.5.4 Consideration of Other Potential Bridge Types or the Use of a Lift Bridge

Comments from several of the navigation users have also suggested the use of a lift bridge. Generally, lift bridges are required only when there would be a substantial navigational impact resulting from a lower fixed bridge height. TriMet did consider a lift bridge option and concluded that the significant cost for a lift bridge was outweighed by the rarity of times the Bridge would need to be lifted. In other words, significant financial resources would be required to construct the Bridge for it to be lifted a handful of times in any given year.

TriMet's cost estimates for developing a bridge with a lift bridge mechanism were found to substantially exceed the project's overall financial capacity, rendering the Project unable to fulfill its purpose and need. A moveable span would result in a Bridge costing nearly $205 million, requiring an additional $120 million in cost for the Project, or a 143% increase in the $84 million (in 2008 dollars) budgeted for the Bridge.

In addition, a lift bridge option would require significant alterations to the Bridge design, which would likely affect water elements and related environmental consequences. The environmental review documented in the FEIS indicates that the combination of Endangered Species habitat, contaminated sediments, and the potential for scour around any in-water structures supports a conclusion that the existing Bridge proposal reduces impacts compared to a bridge with larger or more numerous in-water structures. What's more, the raising of the Bridge, as occurs at the existing Steel Bridge, would negatively affect transit operations. Additionally, the piers to support a movable span would need to be closer together and located in the center of the river and would likely reduce horizontal navigation clearances.

Other types of bridge mechanisms that could provide variable clearances, such as a swing bridge, were also examined and found unviable due to the need for additional in-water structures that would be required in the center of the waterway.

O.5.5 Landside and Operational Considerations of a Higher Bridge

Americans with Disabilities Act

TriMet is required to comply with the Americans with Disabilities Act in the construction and operation of its facilities. The USDOT and the Department of Justice require that when a new public transportation facility, such as a bridge, has a pedestrian walkway, that pedestrian walkway must be ADA compliant.

Pedestrian accessibility is a fundamental consideration of this Project because the Bridge will become a key link to the regional trails system. An 85-foot Bridge clearance, as requested by Portland Spirit, would result in a 23 percent increase in slope to the Bridge. This increased slope would cause technical and operational difficulties. Ramps and landings would need to be installed on the pedestrian pathway to maintain accessibility for individuals with disabilities. Yet, the bicycle pathway would need to be maintained at a constant slope for ease of ride, which would necessitate a defined separation between the pedestrian and bicycle paths. This defined separation would reduce the net available pathway and make the pathway too narrow for

maintenance or emergency vehicles. Emergency vehicles would have to use the center transit area, which causes disruption to the transit service.

Other Operational Considerations for a Higher Bridge Clearance

A vertical clearance of 85 feet would require an increased slope to the light rail trackway, as much as 5.85 percent. A slope this steep would negatively impact operations, service reliability, and significantly increase cost and time devoted to vehicle maintenance. The average speed of a bus or light rail vehicle would be reduced due to the increased slope, which affects service reliability.

O.5.6 Columbia River and Willamette River Dams

The mainstem Willamette River contains 11 federally owned dams, all operated by the Corps. There are also 11 Federal dams on the Columbia River. No federally owned dam on the Columbia or Willamette River is beyond its design life and none is slated for removal.

The Condit dam is owned by PacifiCorp and is on the White Salmon River, a tributary to the Columbia. The Condit dam has been proposed for removal as early as October 2010, but the environmental reviews are still underway and no decision has been made. The environmental documents for that proposal indicate that removal will have a negligible effect on Columbia River flows compared to today.

Even if a Federal dam on either the Columbia or Willamette were to be removed, TriMet does not expect any appreciable change in the Willamette River elevation. This is because the Corps, which has oversight on the dams and river systems, can adjust the river flows to accommodate for, among others, flood control.

O.5.7 Climate Change Considerations

TriMet considered the effects that global climate change may have on the water surface level of the Willamette River (Parametrix 2010). In general, the level of the Willamette River at the Project site is affected by the flow rate of the Willamette River, the stage of the Columbia River, and tidal elevation. As noted above, the flows on these river systems are heavily managed. Best available science suggests that there are uncertainties inherent in global climate change models and underlying variables, and how those variables intersect to change weather patterns, temperatures, and precipitation. To address these uncertainties, conservative values were used for this evaluation.

The review of best available science on the potential changes in Willamette River levels due to climate change forces yielded the following conclusion. During winter months (generally November to April):

- The potential increase in Willamette River water level may range from 1.8 to 2.5 feet;

- The effects of increased sea level may affect the Willamette River by 0.1 to 1.0 foot, with less increase at higher river stages, such as when flooding is expected to occur; and

- The potential effect of change in the Columbia River elevation could not be quantified.

Based on the data, a conservative estimate of increase in the Willamette River level due to global climate change is 3.9 feet by 2099. The frequency of these increased water levels is not predictable based on best available science. In addition, it is likely that summer flow would be lower than currently measured.

TriMet also conducted an analysis of the potential change in vessel passage rates using the higher river levels that could result because of climate change. The analysis (which included a variance for safety considerations) found that passage rates would remain very similar to those predicted for the Project without climate change factored in.

O.6 SUMMARY

The new Bridge is being designed to maintain reasonable current and future navigational use of the River. The Bridge would provide 77.52 feet vertical clearance as measured from the Columbia River Datum (CRD) for approximately 150 feet in the middle of the center span of the Bridge. It would provide 694 feet horizontal clearance between piers.

Of the existing river users, only two vessels would be affected by a height of 77.52 feet (which includes an additional 3.4 feet to account for climate change and safety). However, the majority of river users would be able to safely pass under this Bridge 99 percent of days.

TriMet has determined that based on detailed engineering and constructability considerations, land-side urban fit, visual and aesthetic appeal, and cost, this vertical clearance best accommodates the reasonable needs of river users and landside and transit users.