# Memo

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| Date: | Wednesday, April 14, 2021 |
| Project: | Oregon City-West Linn Pedestrian and Bicycle Bridge Concept Plan |
| To: | Sandra Hikari |
| From: | Marc Butorac, PE, PTOE, PMP (Kittelson and Associates, Inc.)<br>Mikal Mitchell, PE (HDR)<br>Nick Gross (Kittelson and Associates, Inc.) |
| Subject: | **Preliminary Bridge Concept Plans** |

## Purpose

This memorandum summarizes and evaluates the five most promising bridge alignments identified as part of *TM #2: Identify Crossing Alignments* based on planning-level cost, design, and construction feasibility, and risk of U.S. Coast Guard compatibility regarding the navigational channel vertical and horizontal clearance needs.

## Alignments Overview

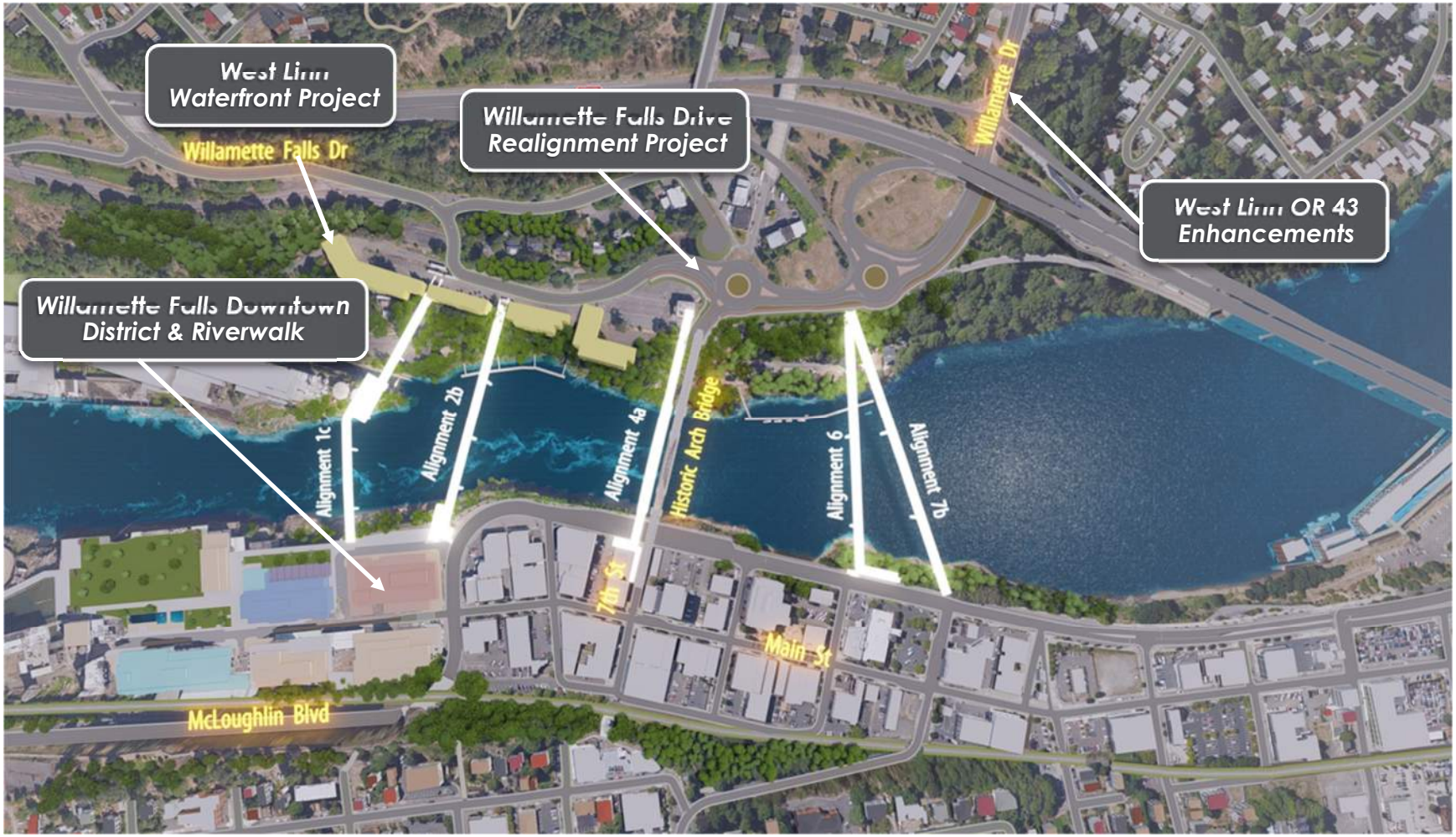
Fifteen potential alignments were identified for a bridge dedicated to people walking, biking, and rolling across the Willamette River between Willamette Falls and the I-205 Abernethy Bridge.

Alignment suggestions were taken from and discussions were held with the Project Advisory Committee (PAC), Project Leadership Team (PLT), Project Management Team (PMT). In addition, input was received as part of Partner Agency Technical Workshop #1, stakeholder interviews, focus group work sessions, discussions with interested government parties, and a feasibility screening conducted in *TM #2: Identify Crossing Alignments*. With this collective input, the following five most promising alignments were advanced by the PMT for additional consideration:

- Alignment 1c: 4th Street to Mill Street
- Alignment 2b: 5th Street to Mill Street
- Alignment 4a: Main Street to Mill Street
- Alignment 6: 9th Street to Willamette Drive
- Alignment 7b: 10th Street to OR 43

Figure 1 illustrates the five most promising alignments, as well as the planned improvements in the project area, including the Willamette Falls Downtown District & Riverwalk, West Linn Waterfront Project, Willamette Falls Drive Realignment Project, and West Linn OR 43 Enhancements.

**Figure 1. Summary of Alignments**



# Potential Bridge Types

In understanding the feasibility and costs of each bridge alignment, the potential bridge types need to be examined to determine their respective utility to providing a crossing and the number of potential support structures that may be needed in the river to create a total bridge length of approximately 750 to 1000 feet (the range of distances from bridgehead to bridgehead for the five most promising alignments). This section explorers the tradeoffs and ability of various bridge types to fulfill the proposed alignments and provides the context for in-river support piers and relative construction cost magnitudes.

## Long-Span Bridge

A long-span (arch, suspension, cable-supported) bridge type could reach main span lengths of approximately 650 feet. This span length would still require supports near the edge of the river but would allow more flexibility in the location of those supports for navigational clearance requirements and constructability enhancements. The elimination of the need to construct foundations nearer the middle of the river would be the primary constructability advantage of this structure type. The depth of the channel (ranging from approximately 50 to 100+ feet deep) between the Historic Arch Bridge and Willamette Falls (Alignments 1c, 2b, and 4a) will make foundation construction near the middle of the river extremely challenging. The depth of the channel downstream of the Arch Bridge does not appear to be as deep, and foundation construction near the middle of the river may be more reasonable. The need for temporary works in the river to construct the superstructure will be highly dependent on the type of long-span structure and the construction methods chosen.

**Figure 2. Example of a Long-Span Pedestrian Bridge**

http://www.trailtimes.ca/wp-content/uploads/2018/05/11709680_web1_M180503-TDT-skywalk--1-.jpg

A long-span bridge structure is generally more costly due to the unique construction details required and the limited pool of contractors with experience in these types of structures. In this case, the use of a long-span structure to eliminate foundations in deep water may help to offset the typical cost differential. Cable-supported structures and suspension structures allow for the superstructure to be placed with the supporting cable system, which can reduce installation and construction access costs.

There are some special considerations regarding maintenance of a long-span bridge structure. Weathering steel is not typically used on these bridge types for aesthetic reasons; therefore, if steel elements are used, they would require maintenance painting or more durable specialized coatings. Cable-supported structures require special inspection of the cables and anchorages on a regular interval. Maintenance access should be considered as part of the design of the structure, perhaps considering underdeck inspection vehicles as part of the design criteria.

## Girder Bridge

A girder (steel I-girder, steel box girder, or concrete box girder) bridge type would have a maximum practical span length of 400 feet, requiring foundations nearer the middle of the river. To balance spans and minimize structure depth, the maximum span length in the main portion of the river would be approximately 200 to 300 feet, depending on river vessel navigation requirements. As noted in the section above, for some alignments, construction of foundations nearer the center of the river may be quite challenging due to the depth of the river channel. Prefabricated girder types such as steel or precast concrete would have a reduced amount of temporary works needed in the river compared to cast-in-place girder types.

**Figure 3. Example of a Girder Pedestrian Bridge**

A girder bridge type is generally lower in cost due to the simpler construction details and familiarity of the contractor with the construction methods under appropriate site conditions. In this case, due to the depth of the river channel, the cost of constructing foundations in the river may increase construction complexity and directly impact the associated substructure costs.

Maintenance of a girder bridge would be similar to that of other typical highway bridges in an agency's inventory. The use of concrete is typically considered to produce the least maintenance cost in a structure during its life span, but the use of weathering steel can also minimize paint maintenance. Careful detailing of a weathering steel girder structure would be necessary to limit staining of the concrete substructure elements.

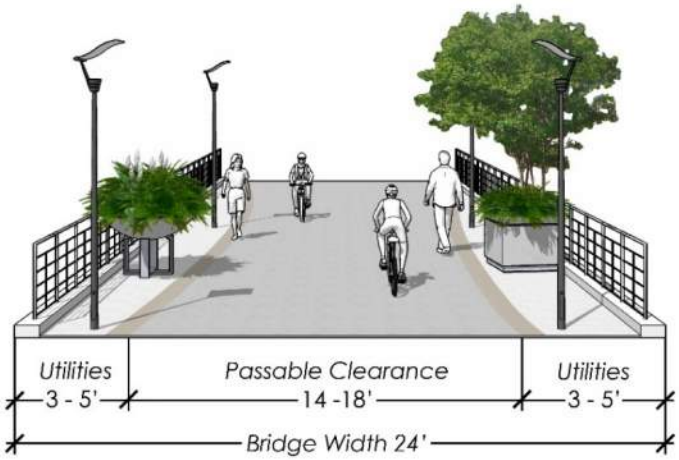
## Conceptual Bridge Design Considerations

To aid in the comparison of alignment alternatives, several conceptual bridge design considerations, assumptions, and constraints are summarized by topic in the following sections. The topics summarized include bridge cross-section, horizontal and vertical bridge alignment, landing area size, river vessel navigation clearances, vehicular clearances, emergency vehicle accommodation, hydraulic freeboard, and initial geological considerations. An initial concept alignment and profile along with identified clearance constraints is shown for each alternative in Attachment A to support the general feasibility assessment.

### Cross-Section

The recommended cross-section width to appropriately accommodate people walking, biking, and rolling of all ages and abilities is 24 feet. The 24-foot width allows for the installation of utilities, including lighting; the opportunity for landscaping and placemaking features including benches; and sufficient clearance for two-way walking, biking, and rolling travel, as well as emergency vehicle access. Figure 4 illustrates a conceptual alignment cross-section assumption for this study. At locations where ramping is required, to limit the area required, the assumed ramping cross-section width is 14 feet. The ramping may also include separate stairwells for access.

**Figure 4. Conceptual Alignment Cross-Section**



## Horizontal and Vertical Bridge Approaches and Alignments

This section describes the horizonal and vertical bridge approach needs for each of the five most promising alignments. Table 1 provides a summary of the horizontal and vertical alignment considerations.

### Alignment 1c

The horizontal length between bridgeheads of the two legs of Alignment 1c combined is approximately 943 feet. The elevation differential between the ends of the alignment is approximately 80 feet. In order to maintain a 5%[1] grade on the structure, additional alignment length will be required on the order of 660 feet. To achieve this additional alignment length, a ramping structure on Moores Island has been conceptualized. It would consist of switchback or spiral ramps along with stairs and potentially an elevator system to create the approximately 33 feet of vertical profile increase needed. Depending on the outcome of coordination with the Coast Guard and bridge type selection in future phases, vertical profiles may need to be raised to achieve necessary clearances or hydraulic freeboard, which would increase the ramping required at one or both bridgeheads. It should be noted that the elevation of the end of the bridge on the West Linn side is assumed at this time to be approximately 10 feet higher than existing ground in order to accommodate future planned development in the area.

### Alignment 2b

The horizontal length between the two bridgeheads for Alignment 2b is approximately 758 feet. The elevation differential between existing (or assumed finish) ground elevations at the ends of the alignment is approximately 70 feet. To maintain a 5% grade on the structure, additional alignment length will be required on the order of 620 feet. To achieve this additional alignment length, a ramping structure at the Oregon City bridgehead has been conceptualized. It would consist of switchback or spiral ramps along with stairs and potentially an elevator system to create the approximately 31 feet of vertical profile increase needed. It should be noted that the elevation of the end of the bridge on the West Linn side is assumed at this time to be approximately 12 feet higher than existing ground to accommodate future planned development in the area.

### Alignment 4a

The horizontal length between the two bridgeheads for Alignment 4a is approximately 951 feet. The elevation differential between the ends of the alignment is approximately 47 feet. This produces an approximate 5% grade on the structure. This alignment parallels the existing Historic Arch Bridge. In Oregon City, between OR 99E (McLoughlin Blvd.) and Main Street, the clearance between the existing bridge and adjacent buildings appears to be less than 24 feet and, in some cases, 12 feet or less. To carry the full bridge width to a landing at Main Street, demolition of these buildings would be required. An alternative solution for consideration would be to incorporate ramping parallel to OR 99E in the available space between OR 99E and the existing buildings.

[1] The use of a 5% grade is based on Americans with Disabilities Act (ADA) guidance.

### Alignment 6

The horizontal length between the two bridgeheads for Alignment 6 is approximately 875 feet. The elevation differential between the ends of the alignment is approximately 54 feet. In order to maintain a 5% grade on the structure, additional alignment length will be required on the order of 200 feet. To achieve this additional alignment length, a ramping structure at the Oregon City bridgehead has been conceptualized. It is assumed to consist of a ramp that parallels the river and OR 99E along with stairs to create the approximately 10 feet of vertical profile increase needed. If a girder-type bridge is selected in future phases, vertical profiles may need to be raised to achieve necessary clearances, which would increase the ramping required at one or both bridgeheads.

### Alignment 7b

The horizontal length between the two bridgeheads for Alignment 7b is approximately 995 feet. The elevation differential between the ends of the alignment is approximately 50 feet. This produces an approximate 5% grade on the structure. If a girder-type bridge is selected in future phases, vertical profiles may need to be raised to achieve necessary clearances, which would increase the ramping required at one or both bridgeheads.

**Table 1: Horizontal and vertical bridge approaches and alignments**

| Alignment | Horizontal and vertical alignment considerations |
|---|---|
| Alignment 1c: 4th Street to Mill Street | • Approximately 1600 feet total bridge length + ramping length at 5% grade.<br>• Approximately 660 feet of ramping required on Moores Island to achieve a 33-foot elevation differential. |
| Alignment 2b: 5th Street to Mill Street | • Approximately 1380 feet total bridge length + ramping length at 5% grade.<br>• Approximately 620 feet of ramping required at Oregon City bridgehead to achieve a 31-foot elevation differential. |
| Alignment 4a: Main Street to Mill Street | • Approximately 950 feet total bridge length + ramping length at 5% grade.<br>• If the necessary buildings are demolished in Oregon City, no ramping required.<br>• As an alternative to building demolition, approximately 230 feet of ramping south of and adjacent to OR 99E may be considered. |
| Alignment 6: 9th Street to Willamette Drive | • Approximately 1080 feet total bridge length + ramping length at 5% grade.<br>• Approximately 200 feet of ramping required at Oregon City bridgehead to achieve a 10-foot elevation differential. |
| Alignment 7b: 10th Street to OR 43 | • Approximately 1000 feet total bridge length at 5% grade.<br>• No ramping required. |

## Landing Area Size

Where the bridge profile touches down at approximately existing ground (or future ground) on each side of the river, a limited area would be required for the bridgeheads. The area needed would likely be dictated by the structure type selected and the area needed for construction. Table 2 provides a summary of landing area size considerations.

Where ramping structures are used, the area required will be larger based on the length of the ramp needed. This area will ultimately depend on the layout of the ramp structure.

**Table 2: Landing area size**

| Alignment | Landing area size considerations |
|---|---|
| Alignment 1c: 4th Street to Mill Street | • Oregon City and West Linn bridgeheads are dictated by structure type and area needed for construction.<br>• Moores Island could require approximately 16,000 square feet for ramping structure and requires demolition of some structures.<br>• Construction access for the Oregon City bridgehead would be dependent upon the relative timing of planned improvements in the Willamette Falls Downtown District & Riverwalk area. |
| Alignment 2b: 5th Street to Mill Street | • West Linn bridgehead is dictated by structure type and area needed for construction.<br>• Oregon City bridgehead could require approximately 16,000 square feet for ramping structure.<br>• Construction access for the Oregon City bridgehead would be dependent upon the relative timing of planned improvements in the Willamette Falls Downtown District & Riverwalk area. |
| Alignment 4a: Main Street to Mill Street | • Oregon City and West Linn bridgeheads are dictated by structure type and area needed for construction.<br>• Requires demolition of two large buildings in downtown Oregon City or development of perpendicular ramping from the bridge along OR 99E. |
| Alignment 6: 9th Street to Willamette Drive | • West Linn bridgehead is dictated by structure type and area needed for construction.<br>• Oregon City bridgehead could require approximately 5,000 square feet for ramping structure.<br>• Oregon City bridgehead would likely require modification and/or improvements to the half-viaduct structure supporting McLoughlin Blvd.<br>• Construction of the Oregon City bridgehead would likely be accessed primarily from the river in order to limit impacts to OR 99E. |
| Alignment 7b: 10th Street to OR 43 | • Oregon City and West Linn bridgeheads are dictated by structure type and area needed for construction.<br>• Oregon City bridgehead would likely require modification and/or improvements to the retaining wall and pedestrian walkway on the river side of McLoughlin Blvd.<br>• Construction of the Oregon City bridgehead would likely be accessed primarily from the river in order to limit impacts to OR 99E. |

## River Vessel Navigational Clearances

The Historic Arch Bridge provides a 181-foot horizontal clearance and a 74-foot vertical clearance to Columbia River Datum[2] (CRD). For alignments upstream of the Oregon City Arch Bridge (Alignments 1c, 2b, and 4a), these are the assumed required clearances for the main river navigation channel.

[2] The Columbia River Datum (CRD) is defined by the National Oceanic and Atmospheric Administration (NOAA) as the Mean Lower Low Water During Lowest River Stages.

Alignment 1c is unique in that it crosses the portion of the Willamette River beyond the entrance to the locks and leads directly to the Willamette Falls. As a result, commercial vessel traffic would not seem likely to use this portion of the river. For the portion of the structure crossing the locks channel, we have assumed a horizontal clearance equal to the width of the locks is required and a vertical clearance of 74 feet above CRD is required. These assumed clearances appear to present minimal risk to Coast Guard permitting.

For the section of the structure crossing the main portion of the river, the assumed vertical profile provides approximately 50 feet of vertical clearance above CRD for shallow superstructure types. Girder-type bridges will provide less vertical clearance. While this seems reasonable for the expected vessel use in this area, it cannot be confirmed and vetted with the Coast Guard until a Navigation Impact Report is completed for this specific portion of the river. As such, the risk of permittability by the Coast Guard for the bridge on this alignment and vertical profile is higher than other alternatives.

The I-205 Abernethy Bridge provides a 265-foot horizontal clearance and a 76-foot vertical clearance to CRD. For alignments between the Abernethy Bridge and the Oregon City Arch Bridge (Alignments 6 and 7b), these are the assumed required clearances for the main river navigation channel.

**Table 3: River vessel navigation clearances**

| Alignment | River vessel navigation clearance considerations |
|---|---|
| Alignment 1c: 4th Street to Mill Street | • Required clearances over the main channel are not easily assumed and present permitting risk. Long-span bridge types provide approximately 50 feet of vertical clearance while girder-type bridges will provide less.<br>• Assumed required clearances over locks are easily achieved by long-span or girder-type bridges. |
| Alignment 2b: 5th Street to Mill Street | • Required horizontal and vertical clearances can be achieved on the assumed profile with a long-span or girder-type bridge. |
| Alignment 4a: Main Street to Mill Street | • Required horizontal and vertical clearances can be achieved on the assumed profile with a long-span type bridge.<br>• A girder-type bridge would require an increase in vertical profile and ramping at one or both bridgeheads. |
| Alignment 6: 9th Street to Willamette Drive | • Required horizontal and vertical clearances can be achieved on the assumed profile with a long-span type bridge.<br>• A girder-type bridge would require an increase in vertical profile and increased ramping at one or both bridgeheads. |
| Alignment 7b: 10th Street to OR 43 | • Required horizontal and vertical clearances can be achieved on the assumed profile with a long-span type bridge.<br>• A girder-type bridge would require an increase in vertical profile and ramping at one or both bridgeheads. |

## Vehicular Clearances

Based on the Oregon Department of Transportation Bridge Design Manual, 17 feet of vertical clearance is required for National Highway System (NHS) routes and 16 feet of vertical clearance is required for non-NHS routes. According to the American Association of State Highway and Transportation Officials LRFD Bridge Design Specifications, these vertical

clearances should be increased by 1 foot for pedestrian overpasses. Table 4 provides a summary of vertical clearance considerations.

For Alignment 2b, there appears to be an access road that leads down to the locks that would pass below the bridge just as it reaches the West Linn bridgehead. It is assumed that a vertical clearance of 17 feet would be needed for this undercrossing. This should be confirmed during the preliminary design of the structure if this alignment is selected. A vertical profile adjustment of this access road appears necessary in order to use the assumed vertical profile of the pedestrian crossing.

For Alignment 4a, OR 99E passes beneath this alignment on the Oregon City side of the river. OR 99E is shown in mapping to be an NHS route. The Oregon City Arch Bridge provides a limited vertical clearance on the order of 14 feet, 1 inch. It is expected that this vertical clearance could be met or exceeded, but achieving an 18-foot vertical clearance or higher may be challenging.

**Table 4: Vehicular clearances**

| Alignment | Vehicular clearance considerations |
|---|---|
| Alignment 1c: 4th Street to Mill Street | • No required vehicular clearances below this alignment. |
| Alignment 2b: 5th Street to Mill Street | • Access road to locks does not appear to have required clearances. A pedestrian bridge profile increase and increase in ramping or lowering of the access road vertical profile would be required. |
| Alignment 4a: Main Street to Mill Street | • Required clearances for Territorial Drive can be achieved on the assumed profile with a long-span or girder-type bridge.<br>• Matching the vertical clearance of the Historic Arch Bridge can be achieved on the assumed profile with a long-span or girder-type bridge.<br>• To achieve a vertical clearance of 18 feet over McLoughlin Blvd., the profile would need to be increased and ramping would be required. |
| Alignment 6: 9th Street to Willamette Drive | • Required clearances for Territorial Drive can be achieved on the assumed profile with a long-span or girder-type bridge. |
| Alignment 7b: 10th Street to OR 43 | • Required clearances for Territorial Drive can be achieved on the assumed profile with a long-span or girder-type bridge. |

## Emergency Vehicle Accommodation

It is assumed that the use of alignments requiring significant ramping to achieve a 5% grade will preclude the accommodation of emergency vehicles due to the sharp curves that will likely be introduced into the ramping layout. Alignments with small amounts of ramping required may be able to accommodate emergency vehicles if it is considered in the layout and design of the ramping. Alignments that do not require ramping appear to best accommodate emergency vehicles.

**Table 5: Emergency vehicle accommodation**

| Alignment | Emergency vehicle accommodation considerations |
|---|---|
| Alignment 1c: 4th Street to Mill Street | • Does not accommodate emergency vehicles due to ramping structure on Moores Island. |
| Alignment 2b: 5th Street to Mill Street | • Does not accommodate emergency vehicles due to ramping structure at Oregon City bridgehead. |
| Alignment 4a: Main Street to Mill Street | • If the necessary buildings are demolished and the full bridge width is carried to Main St., it appears this alignment could accommodate emergency vehicle use.<br>• If ramping perpendicular to the bridge along OR 99E is implemented, this alignment would not accommodate emergency vehicle use. |
| Alignment 6: 9th Street to Willamette Drive | • May be able to accommodate emergency vehicle use if the ramping at the Oregon City bridgehead is designed for accommodations. |
| Alignment 7b: 10th Street to OR 43 | • Appears to accommodate emergency vehicle use. |

## Hydraulic Freeboard

Based on recent hydraulic analysis for the I-205 Abernethy Bridge, the 100-year flood elevation appears to be approximately 49 feet. A summary of related considerations is shown in Table 6.

**Table 6: Hydraulic freeboard**

| Alignment | Hydraulic freeboard considerations |
|---|---|
| Alignment 1c: 4th Street to Mill Street | • The lowest point of the main span structure appears to provide approximately 2 feet of freeboard for long-span bridge types.<br>• The assumed vertical profile may need to be increased for girder-type bridges to achieve the necessary hydraulic freeboard. |
| Alignment 2b: 5th Street to Mill Street | • Hydraulic freeboard requirements are achieved for long-span and girder-type bridges on the assumed vertical profile. |
| Alignment 4a: Main Street to Mill Street | • Hydraulic freeboard requirements are achieved for long-span and girder-type bridges on the assumed vertical profile. |
| Alignment 6: 9th Street to Willamette Drive | • Hydraulic freeboard requirements are achieved for long-span and girder-type bridges on the assumed vertical profile. |
| Alignment 7b: 10th Street to OR 43 | • Hydraulic freeboard requirements are achieved for long-span and girder-type bridges on the assumed vertical profile. |

## Initial Geological Considerations

HazVu, an online statewide geohazards viewer provided by the Oregon Department of Geology and Mineral Industries (DOGAMI), identifies the banks of the Willamette River at this alignment as having a moderate to high landslide hazard potential. The river channel is identified as having a high liquefaction hazard potential. The land on the Oregon City side of the river is identified as having a low liquefaction hazard potential. There is no liquefaction hazard potential identified on the West Linn side of the river. Based on this high-level hazards assessment, it is expected that any foundations on the West Linn side of the river may have to consider demands due to potential global instabilities of the slope they are founded on. Any foundations in the river or near the riverbanks will have to consider potential liquefaction effects, including lateral spreading due to liquefaction.

**Table 7: Initial geological considerations**

| Alignment | Initial geological consideration differentiators |
|---|---|
| Alignment 1c: 4th Street to Mill Street | • On the West Linn side of the river, the moderate to high landslide hazard potential extends up to Willamette Falls Drive. |
| Alignment 2b: 5th Street to Mill Street | • On the West Linn side of the river, the moderate to high landslide hazard potential extends up to Mill St. Notably, there is an area around Mill St. that does not show an identified landslide hazard. |
| Alignment 4a: Main Street to Mill Street | • On the West Linn side of the river, the moderate to high landslide hazard potential extends up to Mill St. Notably, there is an area around Mill St. that does not show an identified landslide hazard. |
| Alignment 6: 9th Street to Willamette Drive | • On the West Linn side of the river, the moderate to high landslide hazard potential extends up to OR 43. |
| Alignment 7b: 10th Street to OR 43 | • On the West Linn side of the river, the moderate to high landslide hazard potential extends up to OR 43. |

## Planning-Level Bridge Construction Costs

The planning-level bridge construction costs presented herein are based on a per square foot unit cost approach. The costs per square foot are order of magnitude approximations based on experience and judgement from prior projects. A range is provided to encompass multiple bridge types, from girder to long-span. As noted in the bridge type discussion, girder-type bridges in this location will be higher cost than typical highway bridges due to the site conditions including a deep river channel. Additionally, depending on the allowable level of impacts to traffic on OR 99E and the timing of construction of improvements in the Willamette Falls Downtown District & Riverwalk area, a significant amount of construction access from the river will likely be required regardless of bridge type or alignment and must be considered. The unit costs also include contingency to address unknowns at this level of project development. The following unit costs ranges are used to estimate the planning-level construction cost:

- Bridge: $1,000 - $1,500 per square foot
- Ramps: $400 - $600 per square foot
- Stairs/elevator tower: $2,000,000 each

These unit costs do NOT include construction costs for any other improvements associated with the project, design engineering, construction engineering, right-of-way and utility, and other similar costs.

The following planning-level bridge construction costs (Table 8) are based on a 24-foot-wide bridge structure and 14-foot-wide ramps where used. It should be noted that in future phases, the main bridge structure width could be reduced to save cost and still provide a 14- to 18-foot-wide passable clearance with reduced width available for landscaping and placemaking features.

**Table 8: Planning-level bridge construction costs**

| Alignment | Planning-level bridge construction costs |
|---|---|
| Alignment 1c: 4th Street to Mill Street | • $27M - $40M |
| Alignment 2b: 5th Street to Mill Street | • $22M - $32M |
| Alignment 4a: Main Street to Mill Street | • $23M - $35M |
| Alignment 6: 9th Street to Willamette Drive | • $25M - $36M |
| Alignment 7b: 10th Street to OR 43 | • $25M - $37M |

## Viewshed Considerations

A 3D model of the project study area has been developed to illustrate visual perspectives from each alignment with an emphasis on viewsheds to Willamette Falls and the Historic Arch Bridge. Each alignment was qualitatively assessed based on the perspective images exported from the 3D model, proximity to Willamette Falls and the Historic Arch Bridge, and potential visual impacts. Table 9 summarizes the considerations and initial assessment of the viewsheds for each alignment.

**Table 9: Viewshed considerations**

| Alignment | Viewshed considerations | Looking downtown from alignment | Looking upstream from alignment |
|---|---|---|---|
| Alignment 1c: 4th Street to Mill Street | • Alignment 1c provides high-quality viewsheds of Willamette Falls and fair-quality viewsheds of the Historic Arch Bridge based on proximity and orientation the proposed alignment.<br>• Alignment 1c is located approximately 2,700 feet from Willamette Falls and 1,100 feet from the Historic Arch Bridge.<br>• Alignment 1c presents minor viewshed obstruction of Willamette Falls from the Historic Arch Bridge. |  |  |
| Alignment 2b: 5th Street to Mill Street | • Alignment 2b provides high-quality viewsheds of the Willamette Falls and high-quality viewsheds of the Historic Arch Bridge based on proximity and orientation the proposed alignment.<br>• Alignment 2b is located approximately 3,300 feet from Willamette Falls and 550 feet from the Historic Arch Bridge.<br>• Alignment 2b obscures the view of Willamette Falls from the Historic Arch Bridge and partially obscures the upstream views of the Historic Arch Bridge. |  |  |
| Alignment 4a: Main Street to Mill Street | • Alignment 4a provides fair-quality viewsheds of Willamette Falls and low-quality viewsheds of the Historic Arch Bridge based on proximity and orientation the proposed alignment.<br>• Alignment 4a is located approximately 3,700 feet from Willamette Falls and 20 feet from the Historic Arch Bridge.<br>• Due to the proximity of Alignment 4a to the Historic Arch Bridge, the viewing of the historically significant structure will be limited based on perspective.<br>• Alignment 4a fully obscures upstream views of the Historic Arch Bridge from all vantage points. |  |  |
| Alignment 6: 9th Street to Willamette Drive | • Alignment 6 provides low-quality viewsheds of Willamette Falls and high-quality viewsheds of the Historic Arch Bridge based on proximity and orientation the proposed alignment.<br>• Alignment 6 is located approximately 4,400 feet from Willamette Falls and 550 feet from the Historic Arch Bridge.<br>• The Historic Arch Bridge is anticipated to block the view of Willamette Falls from the perspective of Alignment 6.<br>• Alignment 6 has minor obscuring impact from downstream vantage points of the Historic Arch Bridge. |  |  |
| Alignment 7b: 10th Street to OR 43 | • Alignment 7b provides low-quality viewsheds of Willamette Falls and high-quality viewsheds of the Historic Arch Bridge based on its proximity to these culturally and historically significant resources from the proposed alignment.<br>• Alignment 4a is located approximately 4,700 feet from Willamette Falls and 900 feet from the Historic Arch Bridge.<br>• The Historic Arch Bridge is anticipated to block the view of Willamette Falls from the perspective of Alignment 7b.<br>• Alignment 7b has minor obscuring impact from downstream vantage points of the Historic Arch Bridge. |  |  |

The online virtual reality viewshed perspective website and fly-through video are located at: Willamette Bicycle and Pedestrian River Crossing (arcgis.com).
Attachment B provides higher resolution visual perspective imaginary from each alignment looking up (toward Willamette Falls) and downstream (toward I-205 Abernethy Bridge).

# Planning

The planning section of this memorandum summarizes the alignment considerations related to connectivity, placemaking opportunities, and economic development.

## Connectivity

Connectivity to the existing and planned transportation improvements as well as the envisioned redevelopment within the project study area was qualitatively assessed to evaluate potential integration and network connectivity for reach alignment. *TM #4: Active Transportation Analysis* provides a detailed summary of the existing and planned facilities for people walking, biking, and rolling within the project study area. Table 10 summarizes the connectivity considerations.

**Table 10: Connectivity**

| Alignment | Connectivity considerations |
|---|---|
| Alignment 1c: 4th Street to Mill Street | • Alignment 1c has a strong and centrally located connection into the planned Willamette Falls Downtown District & Riverwalk area in Oregon City, including the opportunity for integration into the riverwalk concept – a shared-use path with viewing overlooks located along the shoreline of the Willamette River.<br>• In West Linn, the bridgehead landing is located at the southern edge of a planned West Linn Waterfront Project (residential development), presenting the opportunities for increasing residential access.<br>• Further opportunities exist in West Linn for integration into the surrounding planned walking, biking, and rolling networks, including the planned Willamette Falls Drive Realignment Project in conjunction with redevelopment of the Old City Historic District and widening of I-205. |
| Alignment 2b: 5th Street to Mill Street | • In Oregon City, Alignment 2b connects into the northern extent of the Willamette Falls Downtown District & Riverwalk area adjacent to OR 99E.<br>• Due to the moderate level of traffic stress (LTS) experience for people walking, biking, and rolling along OR 99E, the characteristics of the immediate bridgehead connection are moderate compared to Alignment 1c.<br>• In West Linn, Alignment 2b has a strong and centrally located connection into the planned Old City Hall District redevelopment area and the realignment of Willamette Falls Drive.<br>• These connections present opportunities for immediate residential and broader walking, biking, and rolling network integration. |
| Alignment 4a: Main Street to Mill Street | • In Oregon City, Alignment 4a connects into the core historic downtown area, presenting strong opportunities for connectivity to existing facilities and destinations.<br>• Main Street in Oregon City has low-moderate LTS ratings for people walking, biking, and rolling, further increasing the connectivity opportunities for all ages and abilities.<br>• In West Linn City, Alignment 4a has opportunities for strong, well-integrated, and direct connections to planned improvements associated with the future realignment of Willamette Falls Drive and OR 43 enhancements. |

**Table 10: Connectivity**

| Alignment | Connectivity considerations |
|---|---|
| Alignment 6: 9th Street to Willamette Drive | • In Oregon City, the opportunity for connectivity into the adjacent active transportation networks is moderate, primarily due to the challenges associated with crossing OR 99E to access destinations in the historic downtown area.<br>• Opportunities exist on the Oregon City side to extend the existing shared-use path along the Willamette River southwest to connect to the bridgehead landing of Alignment 6.<br>• In West Linn, Alignment 6 connects into the planned improvements associated with the Willamette Falls Drive Realignment Project, presenting a strong opportunity for connectivity into the planned facilities for people walking, biking, and rolling. |
| Alignment 7b: 10th Street to OR 43 | • In Oregon City, the opportunity for connectivity into the adjacent active transportation networks is strong.<br>• The Oregon City bridgehead landing is located in proximity of the signalized OR 99E/10th Street intersection, providing a protected phase for people walking, biking, and rolling to cross OR 99E.<br>• 10th Street in Oregon City is the primary connection via Singer Hill to access destinations in the McLoughlin neighborhood located on top of the Oregon City bluff.<br>• Alignment 7b is the closest alignment to the existing shared-use path along the shoreline Oregon City with opportunities for connectivity.<br>• In West Linn, Alignment 7b connects into the planned improvements associated with the realignment of Willamette Falls Drive and OR 43 enhancements, presenting a strong opportunity for connectivity into the planned facilities for people walking, biking, and rolling. |

## Placemaking Opportunities

Placemaking opportunities at bridgehead locations were qualitatively assessed based on a person's ability to utilize the physical space in a way that is attractive, comfortable, and facilitates a sense of place. Examples of placemaking opportunities include the ability of an alignment to increase access to existing spaces that are currently underutilized. Table 11 summarizes the placemaking opportunities and considerations for each potential alignment.

**Table 11: Placemaking Opportunities**

| Alignment | Placemaking opportunities |
|---|---|
| Alignment 1c: 4th Street to Mill Street | • Alignment 1c presents a strong and unique opportunity to connect people to Moores Island, a connection that is currently limited.<br>• Potential redevelopment opportunities, including access to potential future recreation and open space on Moores Island.<br>• Alignment 1c is the only potential alignment that provides the opportunity to access Moores Island.<br>• At the bridgehead landings in West Linn and Oregon City, strong placemaking opportunities exist due to the planned redevelopments of the Old City Hall District and Heron Mill site and adjacent planned low-stress facilities.[3] |

[3] *TM#4: Active Transportation Analysis* provides a detailed description and analysis of LTS within the project study area.

**Table 11: Placemaking Opportunities**

| Alignment | Placemaking opportunities |
|---|---|
| Alignment 2b: 5th Street to Mill Street | • In Oregon City, Alignment 2b's placemaking ability is moderate due to the proximity of OR 99E and the limited physical space at the bridgehead landing area.<br>• The required ramping presents less attractive bridgehead environments for bridge user access.<br>• In West Linn, Alignment 2b presents strong placemaking opportunities due to the ability to integrate the bridgehead landing area with the planned Old City Hall District redevelopment and realignment of Willamette Falls Drive.<br>• The bridgehead in West Linn will connect at-grade, requiring no ramping. |
| Alignment 4a: Main Street to Mill Street | • In Oregon City, Alignment 4a presents poor placemaking opportunities primarily due to the limited and constrained bridgehead landing area located at the Main Street/7th Street intersection.<br>• In West Linn, Alignment 4a presents strong placemaking opportunities due to availability of space, opportunity to activate vacant land uses, including West Linn Old City Hall, and integration with the planned Old City Hall District redevelopment and realignment of Willamette Falls Drive.<br>• The West Linn bridgehead will connect at-grade, requiring no ramping. |
| Alignment 6: 9th Street to Willamette Drive | • In Oregon City, Alignment 6 placemaking ability is poor due to the proximity of OR 99E and the limited physical space at the bridgehead landing area.<br>• The required ramping and potential elevator present less attractive Oregon City bridgehead environments for bridge user access.<br>• In West Linn, Alignment 6 presents moderate placemaking opportunities due to the potential ability to increase the open space located on the east side of OR 43 as part of the planned future realignment of Willamette Falls Drive.<br>• The bridgehead in West Linn will connect at-grade, requiring no ramping. |
| Alignment 7b: 10th Street to OR 43 | • In Oregon City, Alignment 7b placemaking ability is poor due to the proximity of OR 99E and the limited physical space at the bridgehead landing area.<br>• In West Linn, Alignment 7b presents moderate placemaking opportunities due to the potential ability to increase the open space located on the east side of OR 43 as part of the future realignment of Willamette Falls Drive.<br>• The West Linn bridgehead will connect at-grade, requiring no ramping. |

## Economic Development Opportunities

Economic development opportunities were qualitatively assessed based on an alignment's ability to integrate, add potential value, and further benefit the planned transportation improvements and envisioned redevelopment within the project study area. Table 12 summarizes the economic development opportunities and considerations for each alignment.

**Table 12: Economic Development Opportunities**

| Alignment | Economic development opportunities |
|---|---|
| Alignment 1c: 4th Street to Mill Street | • Strong economic development opportunities exist based on Alignment 1c's ability to integrate into the identified planned developments, including the Willamette Falls Downtown District & Riverwalk area in Oregon City and the Old City Hall District redevelopment in West Linn.<br>• In Oregon City, opportunity to direct regional active transportation trips through downtown.<br>• The attractiveness to the alignment based on potential viewsheds to Willamette Falls and the Historic Arch Bridge further increases the opportunity to capitalize on economic development opportunities at the bridgehead landing areas. |
| Alignment 2b: 5th Street to Mill Street | • Moderate economic development opportunities exist based on the constrained integration of the bridgehead landing area and proximity to OR 99E in Oregon City.<br>• In West Linn, strong economic development opportunities are present due to the centrally located bridgehead landing relative to the planned Old City Hall District redevelopment and proximity to the future realignment of Willamette Falls Drive. |
| Alignment 4a: Main Street to Mill Street | • In Oregon City, economic development opportunities are moderate due to the limited space and the inability to redevelop historically designated structures.<br>• Alignment 4a has the opportunity to increase access to existing businesses for people walking, biking, and rolling, benefiting the local business in Oregon City.<br>• In West Linn, moderate economic development opportunities are present due to the proximity of the bridgehead landing relative to the planned Old City Hall District redevelopment and future realignment of Willamette Falls Drive. |
| Alignment 6: 9th Street to Willamette Drive | • In Oregon City, economic development opportunities are moderate due to the limited space and the inability to redevelop historically designated structures.<br>• In West Linn, economic development opportunities are fair to poor due to constrained space and proximity to planned residential development. |
| Alignment 7b: 10th Street to OR 43 | • In Oregon City, economic development opportunities are moderate to strong due to the ability to integrate the bridgehead into the signalized intersection of OR 99W/10th Street, increasing the ease of access to local business.<br>• In Oregon City, 0th Street via Singer Hill provides a direct route for people biking to the upper bluff of Oregon City, further enhancing economic opportunities.<br>• In West Linn, economic development opportunities are poor due to constrained space and proximity to planned residential development.<br>• In West Linn, economic development opportunities are fair to poor due to constrained space and proximity to planned residential development. |

## Evaluation Criteria Conclusions

Several of the alignment attributes and constraints discussed in prior sections are included in *TM #1: Evaluation Criteria for Crossing Alignments*. An overall summary of the conclusions that can be drawn when comparing alignments with respect to those evaluation criteria is provided in Table 13.

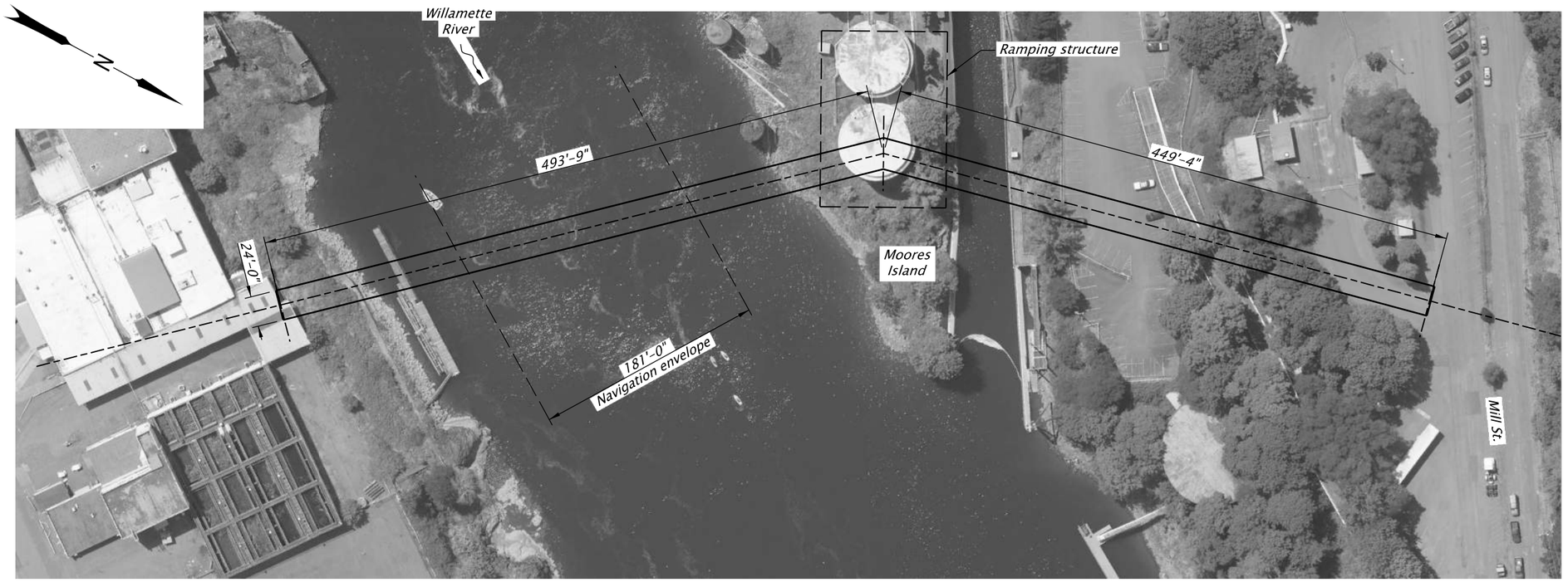
**Table 13: Alignment Evaluation Criteria Summary**

| Performance measure | Alignment summary |
|---|---|
| Horizontal and vertical bridge approaches and alignments | • Alignments 4a, 6, and 7b have the shortest bridge plus ramping lengths at approximately 1,000 feet.<br>• Alignment 1c has the longest bridge plus ramping length at approximately 1600 feet.<br>• If the necessary buildings are demolished in Oregon City, Alignment 4a does not appear to require ramping.<br>• Alignment 7b does not appear to require ramping. |
| Clearance to flood elevation | • All alignments appear able to feasibly provide clearance to the estimated 100-year flood elevation. |
| River vessel navigational impact | • Alternative 1c has the most risk associated with future Coast Guard permitting based on the lower bridge alignment across the main channel with no ramping at the Oregon City bridgehead. Oregon City bridgehead ramping would provide the ability to alleviate potential Coast Guard permitting risks.<br>• All other alternatives appear to be able to feasibly achieve the assumed navigational clearances using long-span bridge types.<br>• The use of a girder-type bridge may require an increase in the vertical profile and additional ramping at one or both bridgeheads to achieve assumed navigational clearances. |
| Accommodation of emergency vehicles | • Alignments 1c and 2b do not appear to allow for the accommodation of emergency vehicles.<br>• Alignment 7b appears to provide the best opportunity to accommodate emergency vehicles. |
| Properties of sufficient size to serve bridge landing | • Alignment 4a requires either demolition of either large buildings in downtown Oregon City or perpendicular ramping along OR 99E.<br>• Alignment 1c requires the demolition of privately owned holding tanks on Moores Island<br>• Alignment 2b requires a large ramping structure, but there appears to be property available to accommodate it.<br>• Alignments 6 and 7b likely require modification of structures supporting McLoughlin Blvd. and pedestrian areas adjacent to the river. |
| Planning-level cost | • All alignments appear to have reasonably comparable planning level costs for bridge construction. |

## Next Steps

The analysis described in this memorandum has been reviewed by the PAC and PMT and updated to produce the final *TM #3A: Preliminary Bridge Concept Plan.* The findings presented in this memorandum, *TM #3B: Benefits and Impact Analysis, and TM #4: Active Transportation Analysis* will be used in *TM #5: Executive Summary and Recommendations* to evaluate and identify a preliminary preferred crossing alignment to be reviewed with the PAC, PLT, and the public to form the basis of recommendations for the preferred crossing alignment.

# Attachment A. Bridge Concept Plans

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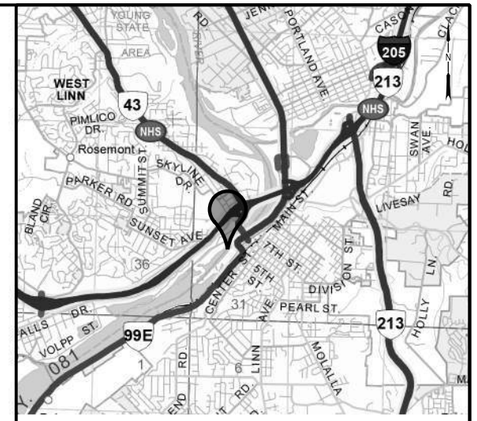
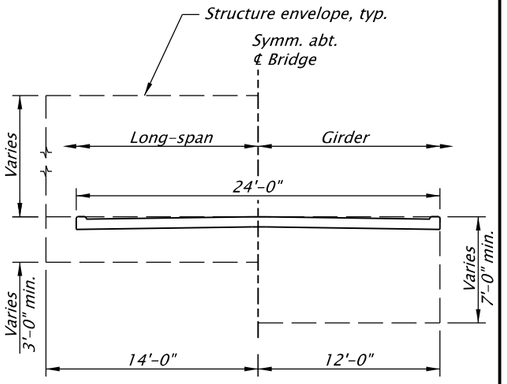



## LOCATION MAP
SEC. 31, T2S, R2E, WM
LAT. 45.35722, LONG. -122.61306

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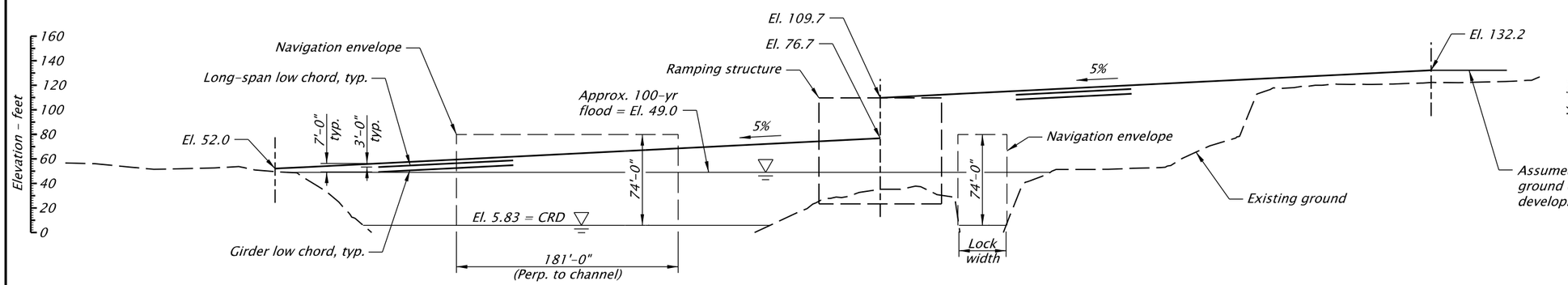


## ELEVATION
Scale: 1"=100'

*Note:*
*An initial concept alignment and profile is shown to assess general feasibility with respect to identified clearance constraints. Refinement of alignment and profile are possible in future phases. Preliminary bridge design features such as span length and bent location are not shown because they are dependent on bridge type selection which is beyond the scope of this study.*

**SCALE WARNING**
IF THIS SCALE LINE DOES NOT MEASURE ONE INCH, THEN DRAWING IS NOT TO SCALE

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| STRUCTURE NO. | |
| BDS DWG NO. | |
| CALC. BOOK | |
| HWY: 000 | |
| M.P.: 000.00-000.00 | |
| COUNTY | Clackamas |
| DATE | 03/21 |

**CONCEPT PLANS SUBJECT TO CHANGE**

HDR ENGINEERING, INC
1050 SW 6TH AVENUE, SUITE 1800
PORTLAND, OR 97204-1134
503.423.3700

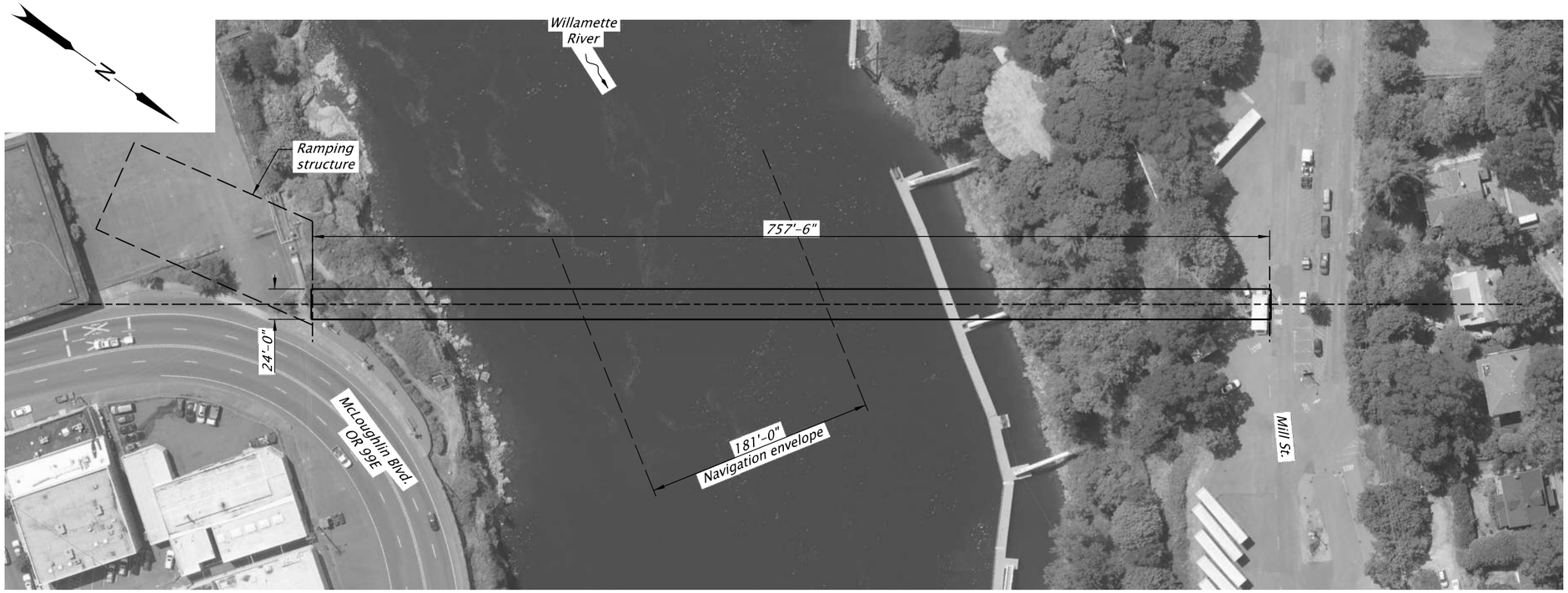
STRUCTURE NAME
**OREGON CITY-WEST LINN PEDESTRIAN AND BICYCLE BRIDGE CONCEPT PLAN**
HIGHWAY
CLACKAMAS COUNTY

Designer: M. Mitchell | Reviewer: J. Bingle
Drafter: H. Gonsior | Checker: -

**PLAN, ELEVATION & SECTION OPTION 1c**

SHEET NO. 1

FINAL ELECTRONIC DOCUMENT AVAILABLE UPON REQUEST




## PLAN
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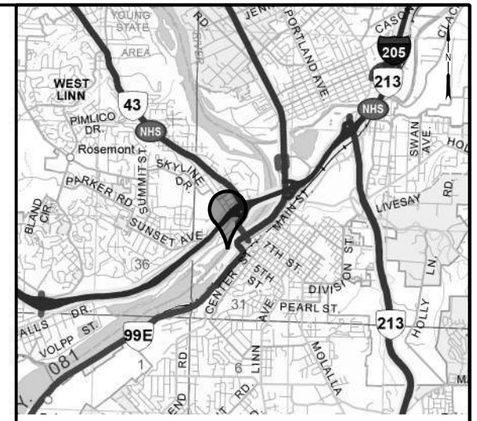


## LOCATION MAP
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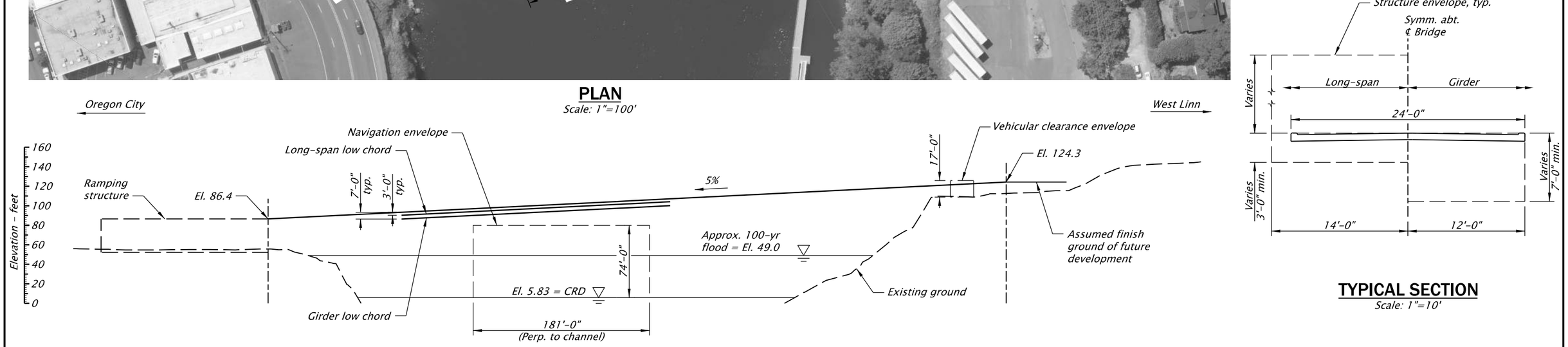


## ELEVATION
Scale: 1"=100'




## TYPICAL SECTION
Scale: 1"=10'

*Note:*
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| M.P.: 000.00-000.00 | |
| COUNTY | Clackamas |
| DATE | 03/21 |

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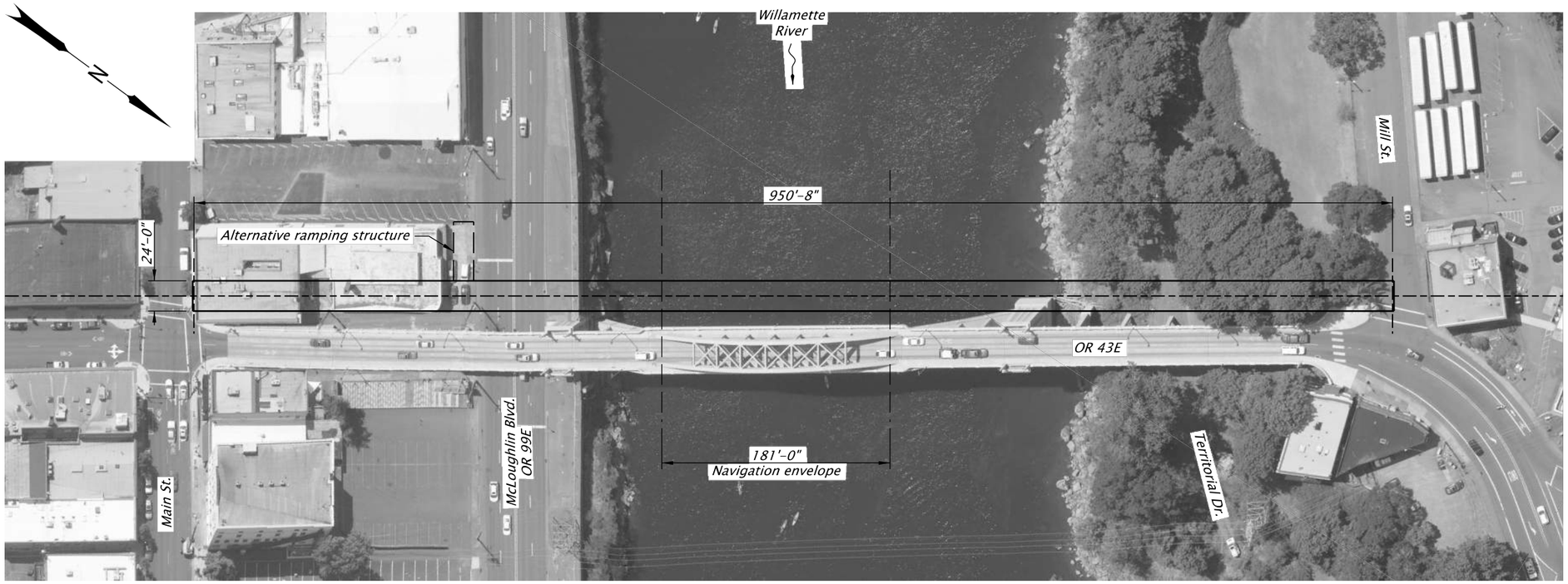
Designer: M. Mitchell | Reviewer: J. Bingle
Drafter: H. Gonsior | Checker: -

**PLAN, ELEVATION & SECTION OPTION 2b** | SHEET NO. 2

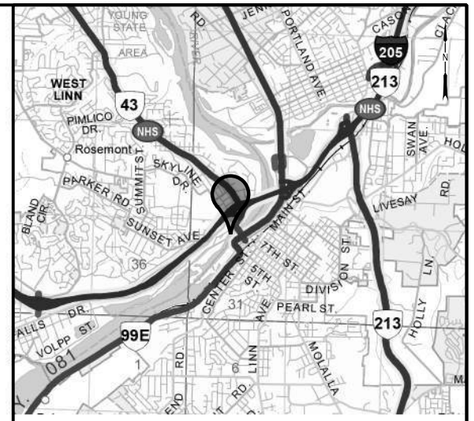
FINAL ELECTRONIC DOCUMENT AVAILABLE UPON REQUEST



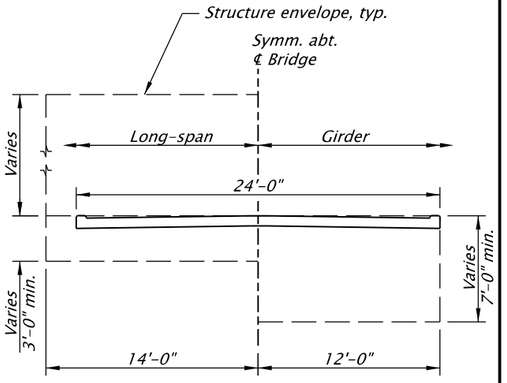

Oregon City

West Linn

## PLAN
Scale: 1"=100'




## LOCATION MAP
SEC. 31 & 32, T2S, R2E, WM
LAT. 45.35889, LONG. -122.60972

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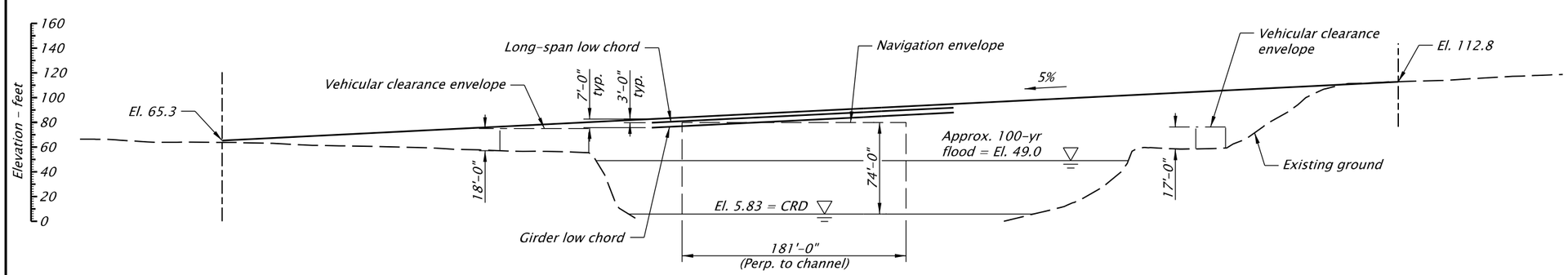


## ELEVATION
Scale: 1"=100'

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| M.P.: 000.00-000.00 | |
| COUNTY | Clackamas |
| DATE | 03/21 |

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STRUCTURE NAME
**OREGON CITY-WEST LINN PEDESTRIAN AND BICYCLE BRIDGE CONCEPT PLAN**
HIGHWAY
CLACKAMAS COUNTY

Designer: M. Mitchell | Reviewer: J. Bingle
Drafter: H. Gonsior | Checker: -

**PLAN, ELEVATION & SECTION OPTION 4a**

SHEET NO. 3

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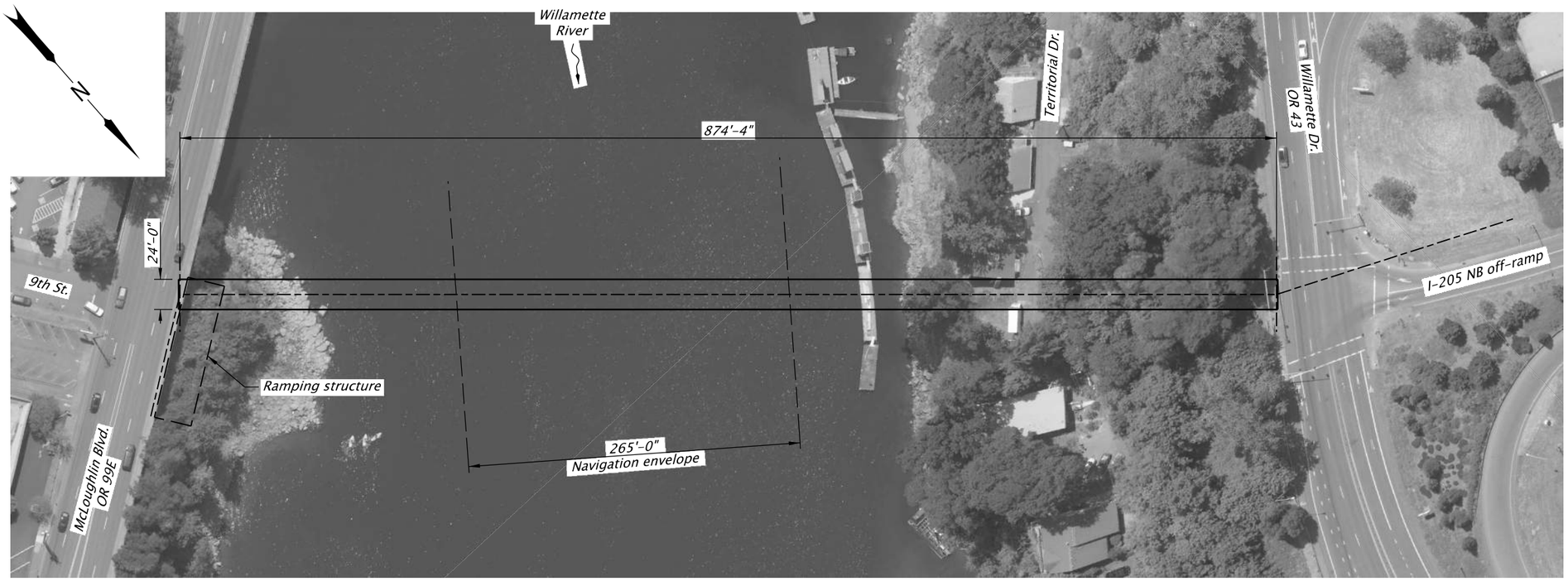


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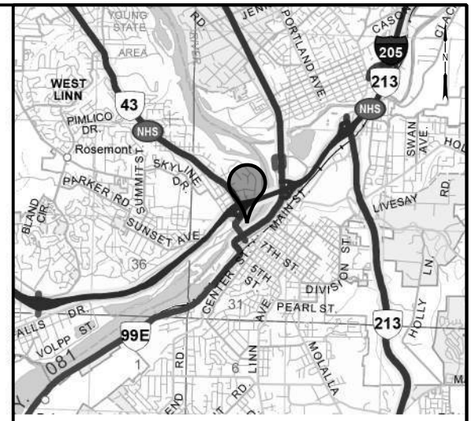


## LOCATION MAP
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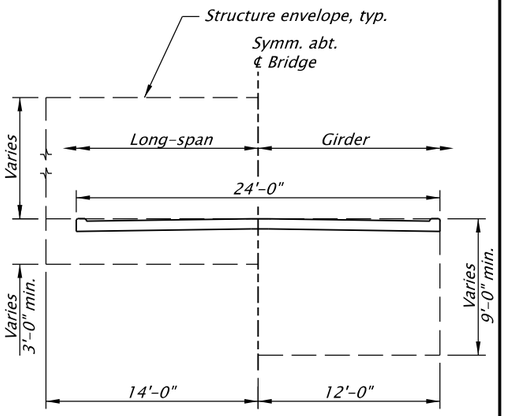


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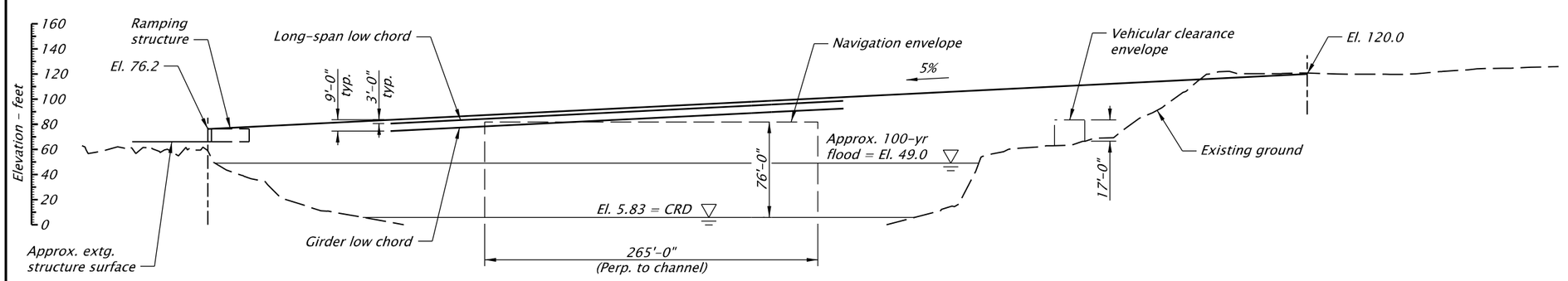


## ELEVATION
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HIGHWAY
CLACKAMAS COUNTY

Designer: M. Mitchell | Reviewer: J. Bingle
Drafter: H. Gonsior | Checker: -

**PLAN, ELEVATION & SECTION OPTION 6** | SHEET NO. 4

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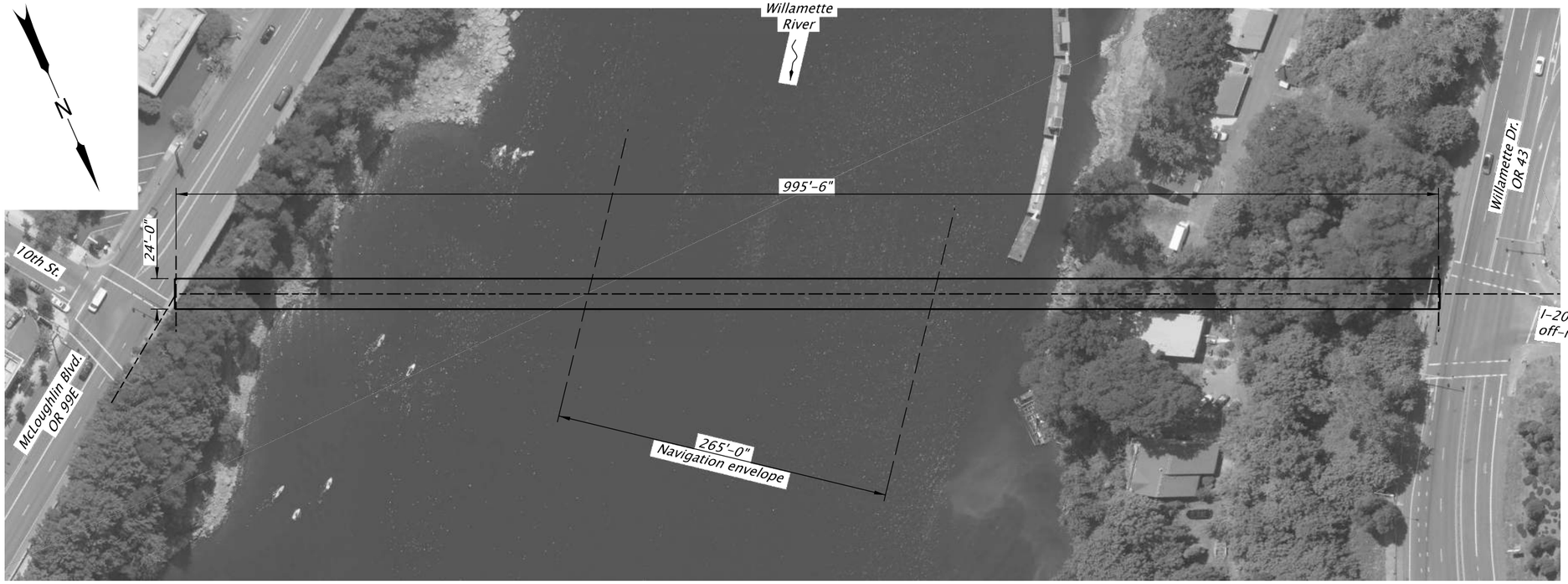


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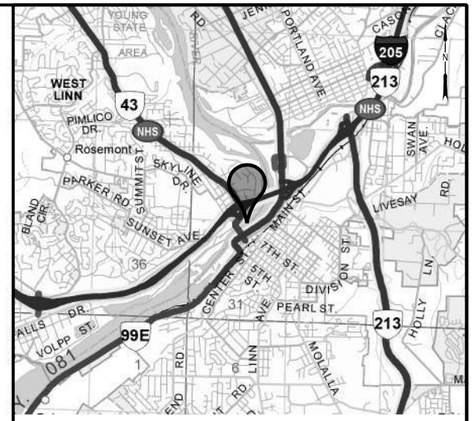


## LOCATION MAP
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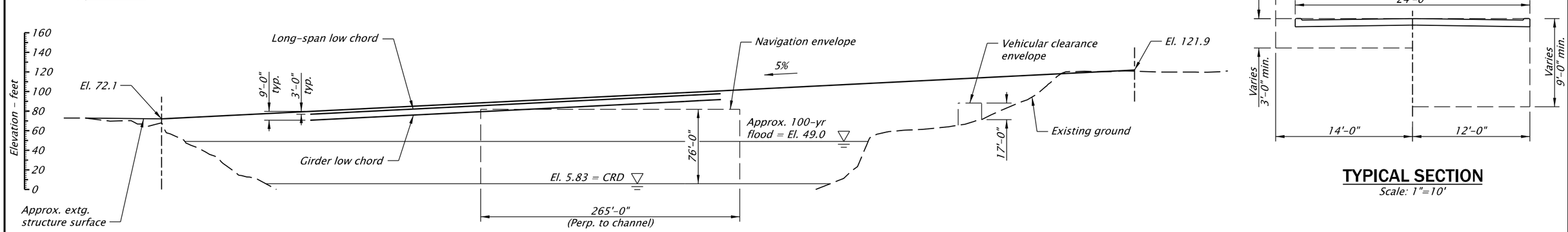


## ELEVATION
Scale: 1"=100'




## TYPICAL SECTION
Scale: 1"=10'

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| COUNTY | Clackamas |
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OREGON DEPARTMENT OF TRANSPORTATION

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CLACKAMAS COUNTY

Designer: M. Mitchell | Reviewer: J. Bingle
Drafter: H. Gonsior | Checker: -

**PLAN, ELEVATION & SECTION OPTION 7b**

SHEET NO. 5

FINAL ELECTRONIC DOCUMENT AVAILABLE UPON REQUEST

# Attachment B. Viewshed Images

# Alignment 1c - Looking downstream

# Alignment 1c - Looking upstream

# Alignment 2b - Looking downstream

# Alignment 2b - Looking upstream

*Alignment 4a - Looking downstream*


Alignment 4a - Looking upstream


Alignment 6 - Looking downstream

# Alignment 6 - Looking upstream


Alignment 7b - Looking downstream


Alignment 7b - Looking upstream