Appendix L I-205 Toll Project Geology and Soils Technical Memorandum

Geology and Soils Technical Memorandum

Date	February 2023
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From	WSP and HDR
CC	Mandy Putney (ODOT), Heather Wills (WSP), Nicole McDermott (WSP)
Subject	Geology and Soils Technical Memorandum

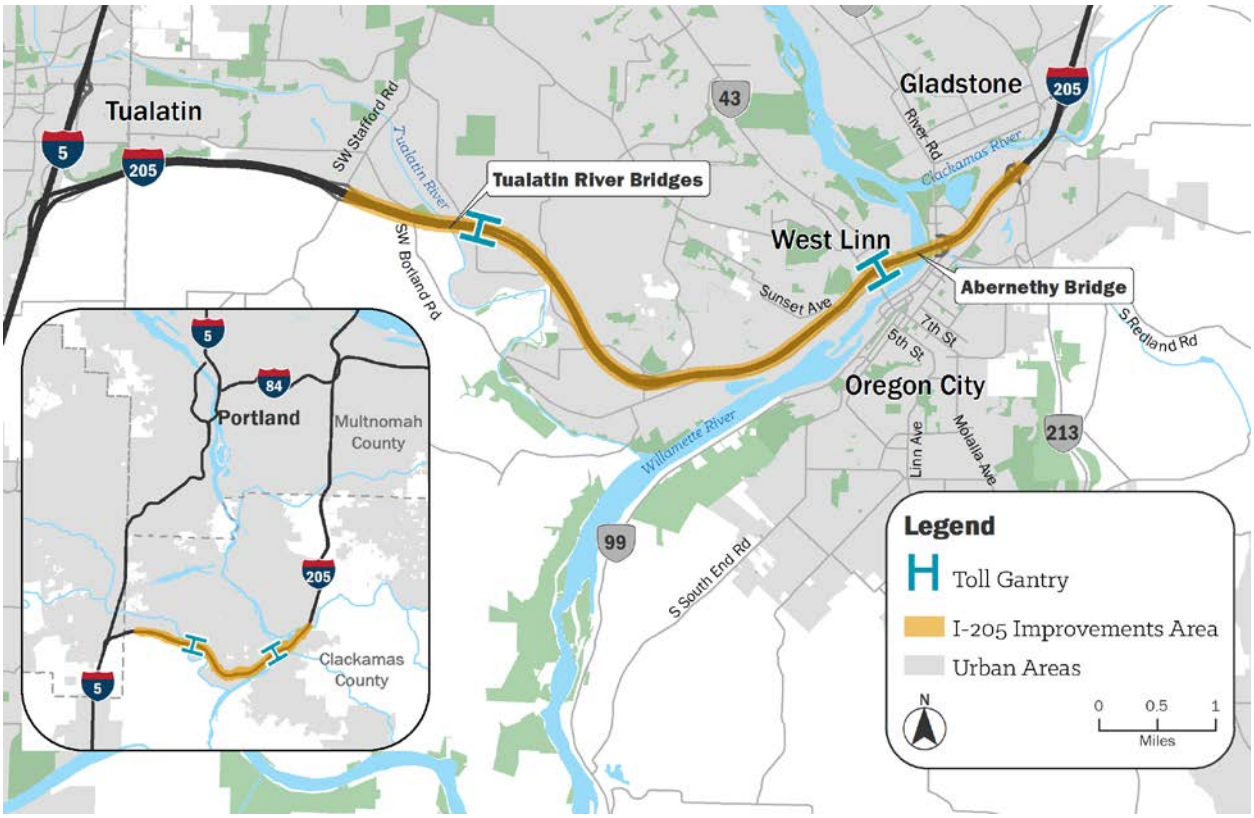
1 Introduction

This technical memorandum supports the I-205 Toll Project Environmental Assessment developed by the Oregon Department of Transportation (ODOT) in partnership with the Federal Highway Administration (FHWA). ODOT proposes to use variable-rate tolls[1] on the Interstate 205 (I-205) Abernethy Bridge and Tualatin River Bridges to raise revenue for construction of planned improvements to I-205 from Stafford Road to Oregon Route (OR) 213, including seismic upgrades and widening, and to manage congestion. The environmental assessment evaluates the effects of variable-rate tolls and the toll-funded I-205 improvements (together, the "Project") on the human and natural environment in accordance with the National Environmental Policy Act (NEPA). The Project area is illustrated in Figure 1-1.

This technical memorandum describes the existing conditions for geology and soils, discusses the impacts and benefits the Project would have on those conditions, and identifies measures to avoid, minimize, and/or mitigate adverse effects.

[1] Variable-rate tolls are fees charged to use a road or bridge that vary based on time of day and that can be used as a strategy to shift demand to less congested times of day.

Figure 1-1. I-205 Toll Project Area



2 Project Alternatives

ODOT evaluated two alternatives in the I-205 Toll Project Environmental Assessment and this technical memorandum:

- No Build Alternative
- Build Alternative

Figure 2-1 depicts the existing condition and the proposed lane configuration of I-205 through the Project area for the No Build Alternative and Build Alternative.

2.1 No Build Alternative

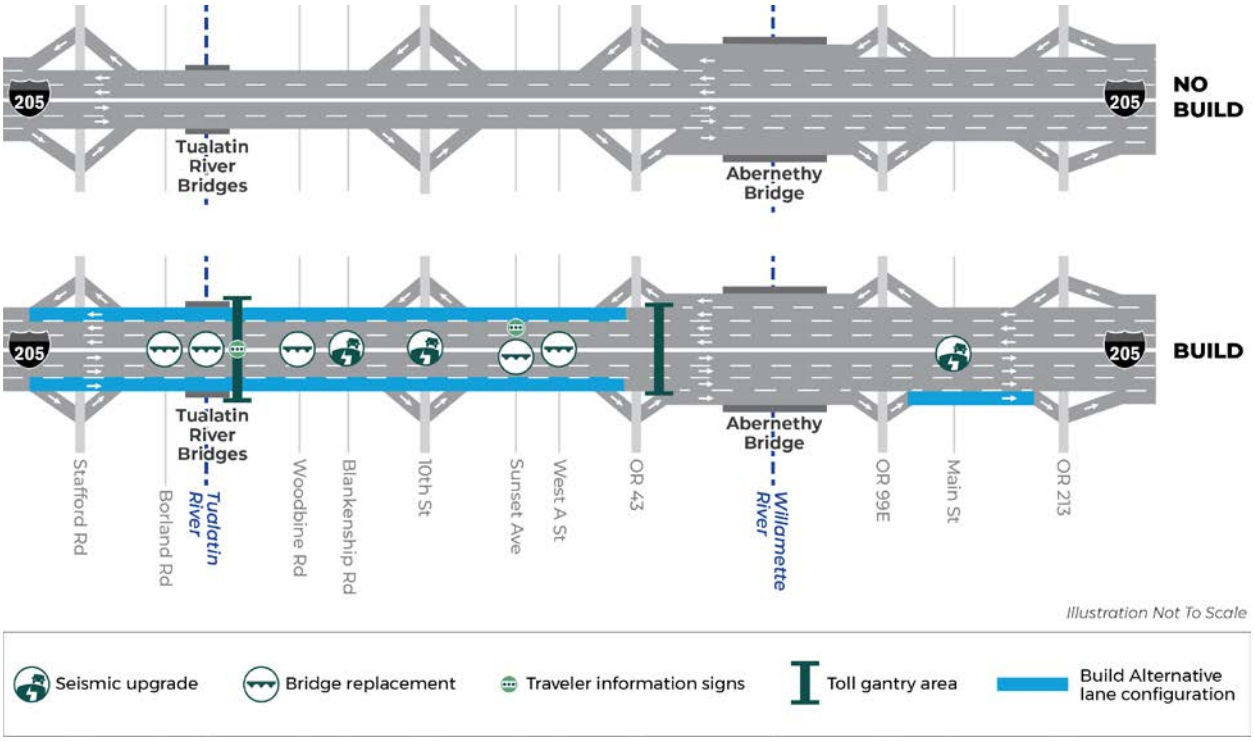
NEPA regulations require an evaluation of a No Build Alternative to provide a baseline to compare with the potential effects of a Build Alternative. The No Build Alternative consists of existing transportation infrastructure and any planned improvements that would occur regardless of the Project. The No Build Alternative includes the I-205: Phase 1A Project (reconstruction of the Abernethy Bridge with added auxiliary lanes and improvements to the adjacent interchanges at OR 43 and OR 99E) as a previously approved project that would be constructed by 2025. Under the No Build Alternative, tolling would not be

implemented and the toll-funded widening and seismic improvements on I-205 between Stafford Road and OR 213 would not be constructed.

2.2 Build Alternative

Under the Build Alternative, drivers of vehicles on I-205 would be assessed a toll for crossing the Abernethy Bridge (between OR 43 and OR 99E) and for crossing the Tualatin River Bridges (between Stafford Road and 10th Street). The Build Alternative includes construction of a third through lane in each direction of I-205 between the Stafford Road interchange and the OR 43 interchange, a northbound auxiliary lane between OR 99E and OR 213, toll gantries and supporting infrastructure, as well as replacement of or seismic upgrades to multiple bridges along I-205 (shown schematically in Figure 2-1).

Figure 2-1. Schematic Diagrams of No Build and Build Alternatives



The following sections provide a more detailed description of the Build Alternative.

2.2.1 Bridge Tolls: Abernethy and Tualatin River Bridges

Under the Build Alternative, ODOT could begin tolling as early as December 2024, before the completion of construction of Project improvements to I-205. Two areas have been identified for placement of the toll gantries and supporting infrastructure. The toll gantries and supporting infrastructure would be located entirely within the existing I-205 right-of-way. Tolling would consist of an all-electronic system that would automatically collect tolls from vehicles traveling on the highway. Toll gantries would consist of vertical columns on the outside of the travel lanes and a horizontal structure that spans the travel lanes; electronic tolling equipment would be attached to the horizontal structure.

2.2.2 Improvements to I-205

Under the Build Alternative, a 7-mile portion of I-205 would be widened between Stafford Road and OR 213, with added through lanes between Stafford Road and OR 43, and a northbound auxiliary lane from OR 99E to OR 213. Eight bridges between Stafford Road and OR 213 would be replaced or reconstructed to withstand a major seismic event. New drainage facilities would be installed in both directions of I-205.

Bridge Reconstructions and Replacements

The following bridges would be reconstructed with foundation improvements and substructure upgrades for seismic resiliency but would not be replaced:

- Northbound I-205 bridge over Blankenship Road – Mile Post (MP) 5.84
- Southbound I-205 bridge over Blankenship Road – MP 5.90
- Northbound I-205 bridge over 10th Street (West Linn) – MP 6.40
- Southbound I-205 bridge over 10th Street (West Linn) – MP 6.42
- I-205 bridge over Main Street (Oregon City) – MP 9.51

The following bridges would be replaced to meet seismic design standards and to facilitate the widening of I-205:

- Northbound I-205 bridge over SW Borland Road – MP 3.82
- Southbound I-205 bridge over SW Borland Road – MP 3.81
- Northbound I-205 bridge over the Tualatin River – MP 4.1
- Southbound I-205 bridge over the Tualatin River – MP 4.08
- Northbound I-205 bridge over Woodbine Road – MP 5.14
- Southbound I-205 bridge over Woodbine Road – MP 5.19
- Sunset Avenue (West Linn) bridge over I-205 – MP 8.28
- West A Street (West Linn) bridge over I-205 – MP 8.64

The I-205 bridges over 10th Street and Blankenship Road would be widened and raised to meet the proposed new highway grade. The I-205 bridges over the Tualatin River and SW Borland Road would be replaced on a new alignment between the existing northbound and southbound directions to accommodate construction. The I-205 bridges over Woodbine Road would be replaced on the existing alignment and raised to meet the proposed new highway grade. The Broadway Street Bridge over I-205 would be removed to enhance the function of the OR 43 interchange.

2.2.3 Construction

Construction of the Build Alternative is expected to last approximately 4 years, beginning in late 2023 with construction of toll gantries and toll-related infrastructure and continuing from 2024 through 2027 with construction of I-205 widening and seismic improvements. Most toll-related construction would be conducted alongside I-205 within the existing right-of-way. For highway widening, it is anticipated that construction would be sequenced to widen one direction of I-205 at a time, enabling traffic to be moved to a temporary alignment while the remaining widening work is completed. Construction activities would include adding temporary crossover lanes to enable access to the temporary traffic configurations during

roadway widening. Staging areas for construction equipment and supplies for the Build Alternative would be located primarily in the median of I-205 in ODOT right-of-way.

3 Regulatory Framework

The following federal, state, and local laws, regulations, plans, policies, and guidance documents informed the assessment of geology and soils:

- Federal
  - National Environmental Policy Act of 1969
  - Federal Highway Administration NEPA-implementing regulations, Environmental Impact and Related Procedures (23 Code of Federal Regulation [C.F.R.] Part 771)
  - Council on Environmental Quality Regulations (40 C.F.R. Parts 1500–1508)
- State
  - Oregon's Statewide Planning Goals and Guidelines (Oregon Administrative Rule 660-015-0000)
  - Oregon Highway Plan, 1999
  - ODOT Geotechnical Design Manual, 2018
  - ODOT Environmental Impact Statement Annotated Template, 2010
  - Oregon Standards Specifications for Construction, 2021
- Regional and Local
  - Clackamas County Zoning and Development Ordinance
  - City of West Linn Comprehensive Plan, Community Development Code, and applicable neighborhood plans
  - Oregon City Comprehensive Plan and Municipal Code

4 Methodology

4.1 General Approach

The Project Team evaluated the affected environment (existing conditions), potential effects under the No Build Alternative and Build Alternative, and mitigation measures for geology and soils.

4.2 Area of Potential Impact

The geographic Area of Potential Impact (API) for geology and soils is the area that extends 100 feet from the edge of existing I-205 right-of-way between the Stafford Road and OR 213 interchanges, as shown in Figure 5-1.

4.3 Describing the Affected Environment

The Project Team conducted a desktop assessment to document the existing geologic conditions within the API. The following geotechnical data reports written for the I-205 Improvements Project were also reviewed:

- *Geotechnical Engineering Report: Abernethy Bridge* (Shannon & Wilson 2020a)
- *Geotechnical Engineering Report: Main Street Bridge* (Shannon & Wilson 2020b)
- *Geotechnical Report: Rock Cut* (Shannon & Wilson 2020c)
- *Geotechnical Report: Sunset Avenue Bridge* (Shannon & Wilson 2020d)
- *Geotechnical Report: West A Street Bridge* (Shannon & Wilson 2020e)
- *Geotechnical Report: Hwy 64 over 10th Street* (Foundation Engineering 2020a)
- *Geotechnical Report: Hwy 64 over Blankenship Road* (Foundation Engineering 2020b)
- *Geotechnical Report: Hwy 64 over SW Borland Road* (Foundation Engineering 2020c)
- *Geotechnical Report: Hwy 64 over SW Woodbine Road* (Foundation Engineering 2020d)
- *Geotechnical Report: Tualatin River Bridge* (Shannon & Wilson 2020f)
- *Geotechnical Data Report: Phase 1* (Shannon & Wilson 2020g)

When conducting the prior analysis for the 2018 Documented Categorical Exclusion, the Project Team reviewed the following data sources for pertinent geologic, hydrogeologic, seismic, and soil property information: existing maps and technical reports published by the U.S. Geological Survey, Oregon Department of Geology and Mineral Industries, local and state agencies with past or current projects in the Project vicinity, and the Natural Resources Conservation Service. The U.S. Geological Survey; Oregon Department of Geology and Mineral Industries; Oregon Department of Environmental Quality (DEQ); and local county, city and regional agencies were contacted as needed to collect this data.

No testing of soils or geologic conditions was conducted as part of the preparation of the Project; however, field investigations were completed for the preparation of the previous reports written during the preliminary stages of the I-205 Improvements Project. Investigations to evaluate the existing foundations and options for widening and replacement were completed for each of the bridge locations, the rock cut area, retaining wall areas, and sign structure areas in the geology and soils API (Shannon & Wilson 2020a, b, c, d, e, f, and g; Foundation Engineering 2020a, b, c, and d).

When the design is advanced, it may be necessary to conduct a field survey to confirm soil conditions in the locations of any proposed ground-disturbing activities.

4.4 Effect Assessment Methods

The impacts analysis evaluates short-term (construction) direct effects, long-term direct effects, and cumulative effects on geology and soils from the No Build Alternative and Build Alternative, as described in the following sections. No indirect effects on geology and soils were identified from the No Build Alternative and Build Alternative.

4.4.1 Direct Effects Assessment Methods

The analysis of direct short-term and long-term geology and soils effects resulting from the Project considered potential seismic hazards, such as liquefaction and lateral spreading, and soil hazards, such as soft or weak soils, and how Project construction could be affected by those conditions or cause effects on geology and soils.

Most potential short-term effects related to geology and soils would result from temporary ground disturbance during construction activities.

The seismic hazards review evaluated the prevalence and severity of mapped hazards in and immediately adjacent to the API. This evaluation was based on current standards of practice, design codes, and levels of risk developed specifically for this Project. Direct long-term effects were assessed by evaluating the relative earthquake hazard of the API.

The soil hazards review evaluated how affected soils in the API may behave when subject to construction activities as well as the potential built Project. The direct long-term effects were assessed by evaluating what soils underlie the proposed Project and identifying the characteristic adverse behaviors of those soils.

4.4.2 Cumulative Effects Assessment Methods

The *I-205 Toll Project Cumulative Impacts Technical Report* includes an analysis of the Project's potential to contribute to cumulative effects on geology and soils. Therefore, cumulative effects are not discussed in this technical memorandum.

4.5 Mitigation Approach

The Project would avoid and/or mitigate most anticipated impacts. Mitigation measures, if required, were developed using applicable agency-based regulations and guidance for those agencies with jurisdiction.

5 Affected Environment

The geology and soils API lies within the Portland and Tualatin basins, which were formed more than 6 million years ago during the Missoula Floods. The Portland Basin was created by complex folding and faulting of the basement rock. The most prevalent basement rock of the Portland Basin is a sequence of lava flows of the Columbia River Basalt Group (CRBG), which flowed into the area between about 17 million and 6 million years ago (Beeson et al. 1991).

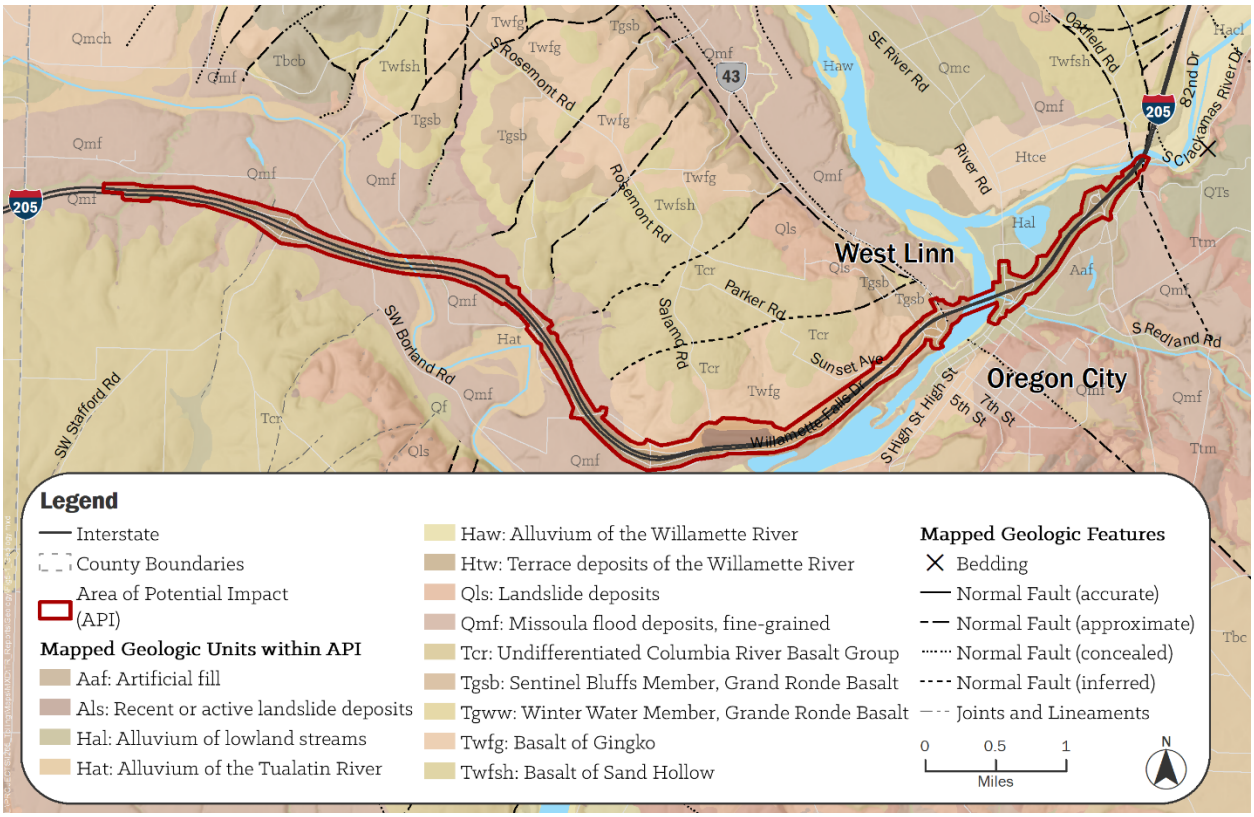
The Tualatin Basin is a large northwest-southeast trending structural depression that extends from the confluence of the Tualatin River and the Willamette River (southeast) to the Portland Hills (north) and the Coast Range (west). Similar to the Portland Basin, the Tualatin Basin was formed by complex folding and faulting of the underlying basement rock that includes CRBG flows in the API.

The Columbia, Willamette, and Clackamas Rivers converge within the Portland Basin and, with their tributaries, have contributed to extensive alluvial and sedimentary rock that overlies basalt. Within the API, I-205 is partially located in a channel scabland eroded by the Missoula Floods (Burt et al. 2009). The

exposed geologic units along I-205 rock cuts are composed of CRBG lava flows. Figure 5-1 shows the mapped geologic units within the API, which consist of fill, fine-grained Missoula Floods deposits, and sentinel bluffs Grande Ronde basalt.

Oregon is located within the Cascadia Subduction Zone (CSZ), a fault line that is a source of substantial earthquakes. The CSZ produces earthquakes greater than magnitude 8 about every 500 years (Atwater and Hemphill-Haley 1997); the last earthquake of this magnitude occurred in 1700 (Satake et al. 1996; Atwater and Hemphill-Haley 1997). CSZ seismic hazards include ground shaking, liquefaction and its associated effects, ground surface fault rupture, and tsunami. A CSZ event could result in damage to or failure of the existing bridges along I-205.

Figure 5-1. Mapped Geologic Units within the Geology and Soils Area of Potential Impact



Source: United States Department of Agriculture Natural Resources Conservation Service

6 Environmental Consequences

6.1 No Build Alternative

Under the No Build Alternative, no activities would occur that could affect geology or soils within the API. Without the seismic upgrades and replacements of the I-205 bridges, a CSZ earthquake would likely result in damage to the bridges and surrounding infrastructure, making this section of I-205 impassable

and hindering regional emergency response immediately following the earthquake. Inadequate transportation access would prolong overall recovery from the earthquake.

6.2 Build Alternative

6.2.1 Short-Term Effects

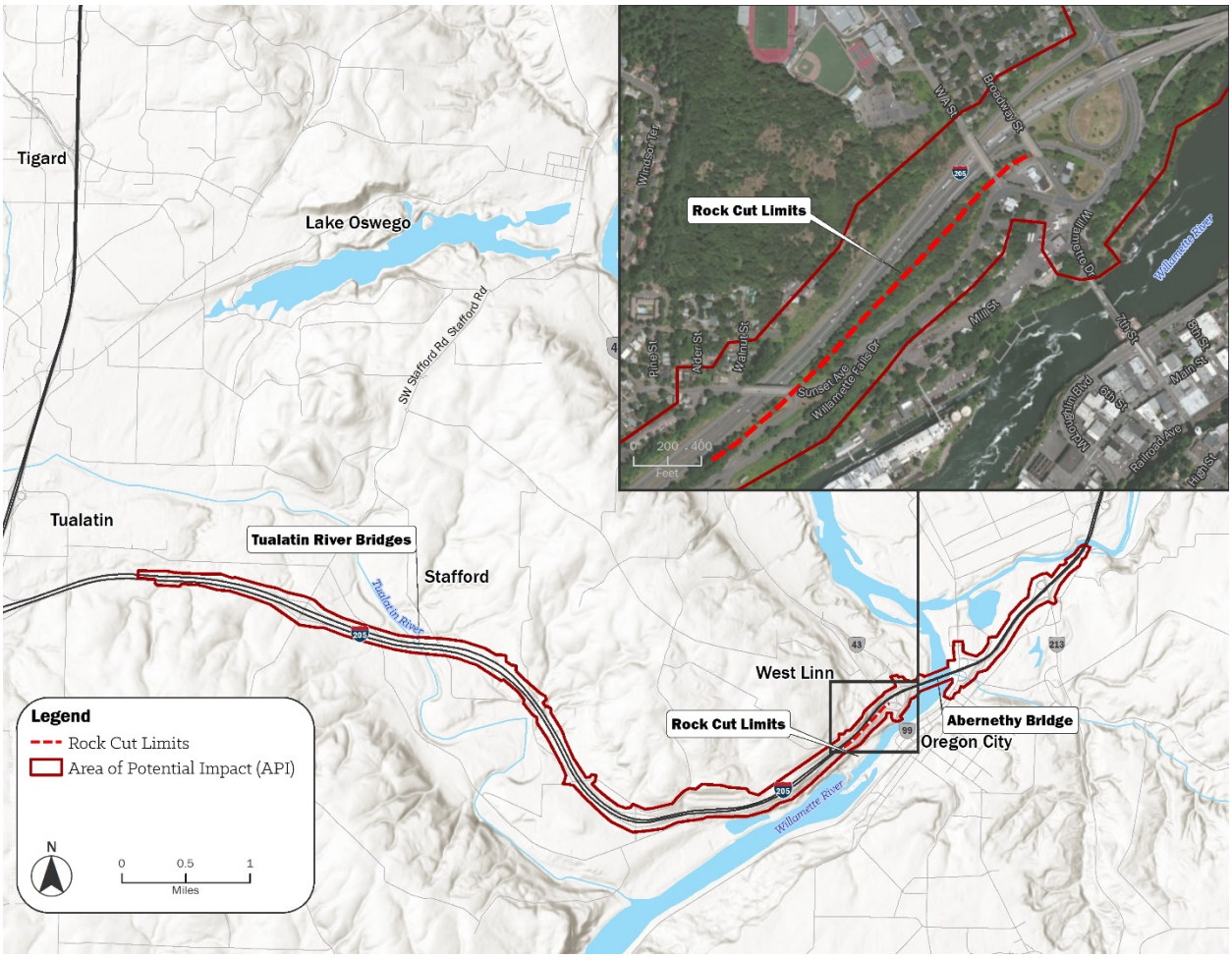
During construction, excavation of soils would be required at various bridge foundations, along the roadway, and at the tolling gantry areas. Excavated soils that are stored on site and other areas of soil disturbance could experience erosion from wind or stormwater. Soils would be compacted by machinery and storage of materials. An erosion and sediment control plan that would identify best management practices (BMPs), such as installing erosion controls, temporary seeding, and delineating disturbance limits, would be implemented during construction to minimize or prevent erosion of soils.

In-water work would be required in the Tualatin River. Drilled shafts anticipated at the Tualatin River Bridges would be constructed using fully cased excavations due to the potentially expansive clay soil types at the river. Other areas of excavation performed within the Tualatin River would likely be contained within a cofferdam during construction. Both activities could mobilize sediment during construction. The placement of new piers within the Tualatin River could also modify localized scour and result in temporary sediment migration and turbidity. BMPs such as turbidity monitoring and the use of turbidity curtains or cofferdams would be implemented to minimize these effects.

A rock cut would be required along a portion of the existing rock cut adjacent to I-205 northbound, from the Broadway Bridge (I-205 MP 8.69) to southwest of the Sunset Avenue Bridge (I-205 MP 8.38). Blasting would be required to move the rock cut face 35 to 40 feet south of the existing rock face for a total length of approximately 2,565 feet (as shown in Figure 6-1). Blasting of rock creates ground vibrations that could potentially damage nearby structures such as houses and render a nearby cell tower temporarily inoperable if not properly planned. A blasting plan for the rock cut would be implemented to limit the timing, sequence, and force of each blast and minimize the possibility of damage or harm to nearby structures. Monitoring of ground vibrations would be conducted to ensure maximum vibrations are not exceeded. The construction contractor would use rock fall barriers to control rock migration.

All excavation, pile driving, shaft installation, and other foundational work associated with construction of the improvements would adhere to the *Oregon Standard Specifications for Construction* (ODOT 2021).

Figure 6-1. Rock Cut Limits



6.2.2 Long-Term Effects

Under the Build Alternative, bridges along I-205 in the API would be retrofitted or replaced and designed to withstand a CSZ earthquake. The expanded rock cut along I-205 northbound (on the south side of the highway) would modify the slope angles of the rock face, increasing its stability. It would also provide a catchment area sufficient for retention of 90% of all rockfall and 99% retention of free-falling rocks, thereby improving safety along northbound I-205 (Shannon & Wilson 2020c).

6.3 Summary of Effects

Table 6-1 provides a comparison of anticipated effects on geology and soils by alternative.

Table 6-1. Summary of Geology and Soils Effects by Alternative

Effects	No Build Alternative	Build Alternative
Short-Term	▪ None	▪ Potential soil compaction and erosion during construction ▪ Disturbance of soils during excavation ▪ Potential sediment migration and turbidity during in-water work
Long-Term	▪ Potential bridge failures along I-205 after a Cascadia Subduction Zone earthquake	▪ Improved bridges and foundations along I-205 that reduce the potential of bridge failure after a Cascadia Subduction Zone earthquake ▪ Improved stability of rock cut; improved safety from rock falls

7 Avoidance, Minimization, and/or Mitigation Commitments

Construction contractors would be required to develop and implement an erosion and sediment control plan with BMPs to reduce the potential for soil erosion. No additional mitigation for construction is required. There would be no long-term impacts on geology and soils under the Build Alternative, and the Build Alternative would result in long-term benefits for seismic resilience and rock stability; therefore, no avoidance, minimization, and/or mitigation measures are proposed.

8 References

Atwater, B.F., and Hemphill-Haley, E. 1997. *Recurrence intervals for great earthquakes of the past 3500 years at Northeastern Willapa Bay, Washington*: U.S. Geological Survey Professional Paper 1576.

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Burt, W., Conlon, T., Tolan, T.L., Wells, R.E., and Melady, J. (Burt et al.). 2009. "Hydrogeology of the Columbia River Basalt Group in the Northern Willamette Valley, Oregon: Volcanoes to vineyards: geologic field trips through the dynamic landscape of the Pacific Northwest." O'Connor, J.E., Dorsey, R.J., and Madin, I.P., (eds.), *Geological Society of America Field Guide*, Vol. 15, p. 697-736.

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Foundation Engineering Inc. 2020c. *Geotechnical Report, I-205: Stafford Road to OR99E Corridor Road Widening & Seismic Retrofit. Hwy 64 over Borland Road*. August 2020.

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Shannon & Wilson. 2020e. *Geotechnical Report, I-205: Stafford Road to OR 99E Widening. West A Street Bridge*. July 2020.

Shannon & Wilson. 2020f. *Geotechnical Report, I-205: Stafford Road to OR 99E Widening. Tualatin River Bridge*. August 2020.

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