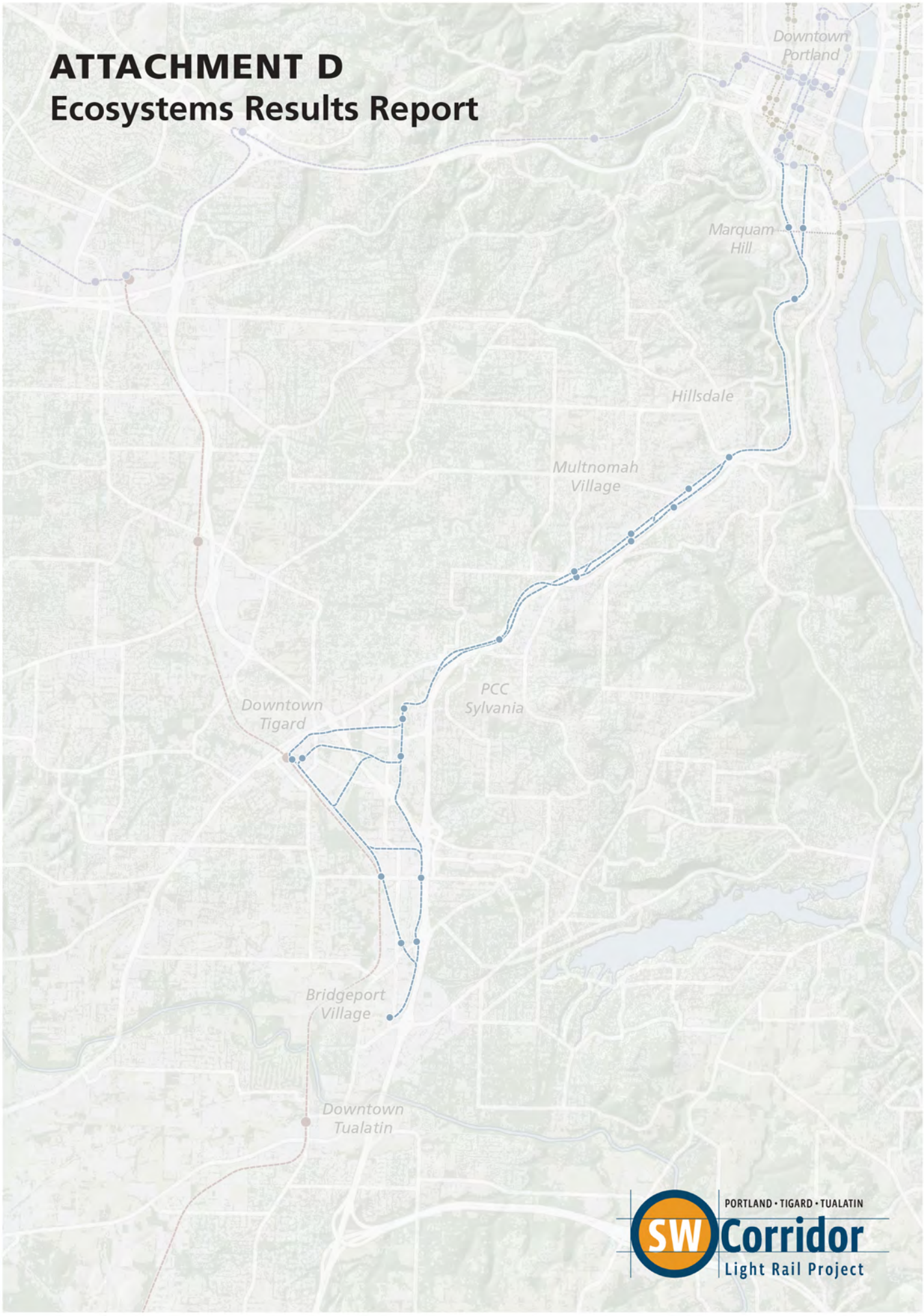
ATTACHMENT D
Ecosystems Results Report



PORTLAND • TIGARD • TUALATIN
SW Corridor
Light Rail Project

Southwest Corridor Light Rail Project
Ecosystems Results Report

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TABLE OF CONTENTS

1. Introduction 1
    1.1. Regulatory Environment 1
        1.1.1. Federal Regulations 2
        1.1.2. State Regulations 3
        1.1.3. Local Regulations 4
2. Study Area 5
3. Affected Environment 7
    3.1. Fish Species and Habitat 7
    3.2. Vegetation and Wildlife Species and Habitat 16
        3.2.1. Vegetation 16
        3.2.2. Wildlife Species and Habitat 25
    3.3. Wetlands 28
4. Long-Term Impacts 32
    4.1. Long-Term Impacts of the No-Build Alternative 32
    4.2. Long-Term Impacts of the Light Rail Alternatives 32
        4.2.1. Impacts Common to All Light Rail Alternatives 32
        4.2.2. Segment A: Inner Portland 34
        4.2.3. Segment B: Outer Portland 35
        4.2.4. Segment C: Tigard and Tualatin 37
        4.2.5. O&M Facilities Options 38
        4.2.6. Station Access Improvements 39
5. Construction Impacts 40
    5.1. No-Build Alternative 40
    5.2. Light Rail Alternatives 40
6. Indirect and Cumulative Impacts 41
    6.1. No-Build Alternative 41
        6.1.1. Indirect Impacts 41
        6.1.2. Cumulative Impacts 41
    6.2. Light Rail Alternatives 41
        6.2.1. Indirect Impacts 41
        6.2.2. Cumulative Impacts 42
7. Potential Mitigation Measures 43
8. References 44

1. INTRODUCTION

The ecosystems results report discusses the aquatic species and habitat, vegetation, wetlands, terrestrial and aquatic wildlife species and habitat, and other biological resources that may be affected by the Southwest Corridor Light Rail Project. The Southwest Corridor Light Rail Project would be subject to federal, state and local regulations concerning potential impacts to biological resources. Consequently, this ecosystems analysis provides information for the Draft and Final Environmental Impact Statements (Draft EIS and Final EIS). This analysis also assumes compliance with the conditions common to permits for large transportation projects. With regard to impact estimation, for example, the analysis assumes that Best Management Practices (BMPs) would be implemented, resulting in a degree of avoidance and minimization of impact.

Ecosystems exist at varying scales; smaller systems are contained within larger ones. Both natural and human factors can affect ecosystems, and ecosystem health can affect the quality of human life.

The results report supports discussions provided in Section 3.9 of the Southwest Corridor Light Rail Project Draft EIS. Detailed methods for evaluating the existing conditions and potential impacts to ecosystem resources are discussed Appendix A of this report. Minor deviations from these methods to account for on-the-ground conditions are noted in the text below.

1.1. Regulatory Environment

Construction of the Southwest Corridor Light Rail Project would be subject to federal, state and local regulations concerning impacts to biological resources, including the National Environmental Policy Act (NEPA). One goal of conducting this ecosystems analysis is to prepare NEPA documentation that can support the environmental review of other agencies' permit decisions for the project following the Record of Decision (ROD) of the Federal Transit Administration (FTA) on the Final EIS. The principal regulations, ordinances and permit actions that could apply to implementation of the selected alternative are summarized in Table 1.1-1. Many of the processes identified below would be addressed in detail during the design and permitting phase, which would occur after the identification of a preferred alternative.

Table 1.1-1. Summary of Potential Natural Resource Permit Requirements

Regulation/Permit	Responsible Agency	Documentation or Processes Required	Regulated Resources
Federal			
National Environmental Policy Act (NEPA)	Federal Transit Administration (FTA)	NEPA EIS addressing natural resource conditions, impacts and mitigation	Human and natural environment, and related social and economic effects
Clean Water Act (CWA) Section 404 Individual Permit	U.S. Army Corps of Engineers (USACE)	Alternatives analysis; wetland delineation study; wetland functional assessment and impact analysis; mitigation plan	Waters of the U.S., including wetlands
Federal Endangered Species Act (ESA) and Magnuson-Stevens Fishery Conservation Management Act	National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS)	Biological Assessment addressing project impacts to listed species, species proposed for listing and candidate species	Vegetation, wildlife, fisheries

Table 1.1-1. Summary of Potential Natural Resource Permit Requirements

Regulation/Permit	Responsible Agency	Documentation or Processes Required	Regulated Resources
Fish and Wildlife Coordination Act	USFWS, NMFS and Oregon Department of Fish and Wildlife (ODFW)	Agency consultation; identify impacts to fish and wildlife resources; recommend mitigation	Vegetation, wildlife, fisheries
Federal Migratory Bird Treaty Act	USFWS	Identify impacts to migratory birds; avoid destruction of active nests or eggs, and killing of individuals	Wildlife
Bald Eagle and Golden Eagle Protection Act	USFWS	Identify bald eagle nesting habitats; agency consultation	Wildlife
State			
Oregon Removal – Fill Permit	Oregon Department of State Lands (DSL)	Alternatives analysis; wetland delineation study; wetland functional assessment and impact analysis; mitigation plan	Waters of the state, including wetlands
Oregon State ESA	ODFW and Oregon Department of Agriculture (ODA)	Identify project impact to state-listed and candidate species not currently listed under federal ESA	Vegetation, wildlife, fisheries
CWA Section 401 Water Quality Certification	Oregon Department of Environmental Quality (DEQ)	Assess project compliance with state water quality standards; implement mitigation measures	Rivers, streams, other bodies of water
Fish Passage Act	ODFW	Agency consultation; identify crossed streams with native migratory fish; implement passage at identified streams	Native migratory fish
Local			
Environmental Overlay Zone	City of Portland	Identify adverse impacts; mitigation plan; impact evaluation/ alternatives analysis	Rivers, streams, wetlands and floodplains, vegetation, wildlife and fisheries
Title 11: Trees	City of Portland	Identify and mitigate trees to be removed	Trees
Stormwater Management Plan	City of Portland	Manage impervious surface runoff and discharge points	Rivers, streams, wetlands
City of Tigard Sensitive Lands	City of Tigard	Identify adverse impacts; mitigation plan	Vegetation, wildlife, fisheries
Title 8: Urban Forestry	City of Tigard	Identify and mitigate trees to be removed	Trees
City of Tualatin Natural Resource Overlay Zone	City of Tualatin	Protect natural resources and areas of public value	Vegetation, wildlife, fisheries
Clean Water Services Sensitive Areas	Clean Water Services	Sensitive areas pre-screening, delineation report; natural resource assessment report	Sensitive natural areas and vegetated corridors
Surface Water Management Agency of Clackamas County	Water Environment Services	Protect natural resources and areas of public value; stormwater treatment plans	Sensitive natural areas and buffers

1.1.1. Federal Regulations

In addition to NEPA, the primary federal natural resource regulatory approvals that would be required include the Endangered Species Act (ESA) Section 7 process and the Clean Water Act (CWA) Section 404 permit. The federal ESA Section 7 process must be initiated when a federal action, such as funding or permitting, that could affect a species listed or proposed for listing under the federal ESA is

undertaken. Section 7 of the ESA requires consultation by the lead federal agency with the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). Additionally, an analysis of effects on Essential Fish Habitat under the Magnuson-Stevens Fishery Conservation Management Act would be required. Consultation under the federal ESA and the Magnuson-Stevens Fishery Conservation Management Act would be initiated once a preferred alternative is selected. A Biological Assessment (BA) is anticipated for the Final EIS.

Section 404 of the CWA regulates the discharge of dredged or fill materials into "waters of the U.S." (waters), which includes rivers, streams, wetlands and some ditches. Applicants for Section 404 permits must demonstrate that all wetland and water impacts have been avoided to the extent practicable and that unavoidable impacts are offset through compensatory mitigation. An alternatives analysis would be required if the project's impacts trigger an Individual Permit rather than a Nationwide Permit. That analysis would be completed after the NEPA process is completed, but the alternatives analysis in the EIS should address the CWA issues to the extent practicable.

In Oregon, permit applications for impacts to wetlands require a combination of federal and state agency approvals. A Joint Permit Application is jointly filed with the U.S. Army Corps of Engineers (USACE) (Section 404 permit) and the Oregon Department of State Lands (DSL) (Oregon Removal-Fill permit). Before a Section 404 permit can be approved, the USACE needs to receive reviews and approvals through the following combination of federal and state agency approvals:

- ESA review by USFWS and NMFS
- coordination with state and federal fish and wildlife agencies
- CWA 401 Water Quality Certification from the Oregon Department of Environmental Quality (DEQ)
- Section 106 Compliance from the State Historic Preservation Office (SHPO).

1.1.2. State Regulations

In Oregon, the principal state regulations for biological resources are the CWA Section 401 Water Quality Certification, the Oregon Removal-Fill Law, Oregon Fish Passage Law and the Oregon ESA (see Table 1.1-1).

A Section 404 permit application for wetland and waters impacts triggers review for a Section 401 Water Quality Certification through DEQ. Approval of a post-construction stormwater management plan to address impacts from stormwater to waters and aquatic receptors is necessary before the issuance of a Water Quality Certification.

The Oregon Removal-Fill Law requires a permit for any removal or fill activities within Essential Salmonid Habitat (ESH) or of 50 cubic yards or more in any other water of the state (including wetlands). As mentioned, this permit application would be filed jointly with USACE through the federal CWA Section 404 permitting process. DSL review of the joint application would also include consultation with the Oregon Department of Fish and Wildlife (ODFW), DEQ, the Department of Land Conservation and Development (DLCD), Washington County, the City of Portland, the City of Tigard and the City of Tualatin.

The Oregon Fish Passage Law requires that passage for fish be maintained or restored in streams with current or historical presence of native migratory fish. ODFW reviews fish passage designs.

The Oregon ESA gives the Oregon Department of Agriculture (ODA) and ODFW responsibility and jurisdiction over state-listed threatened and endangered species. Federal ESA Section 7 consultation with USFWS and NMFS includes consultation with ODFW for fishery issues and with ODA for federally listed plant species. Lists of the state-listed and federally listed threatened, endangered and sensitive species potentially occurring within the project corridor are presented in Section 3 of this report. These lists will be refined during the design and permitting phases, and could include mainstem Willamette River and Columbia River fish species potentially affected by stormwater runoff.

1.1.3. Local Regulations

Under Oregon land use regulations, local and state jurisdictions are required to compile inventories of wetland and other natural areas and protect the highest-ranking inventoried sites. Within the project corridor, this protection is provided by local regulations as discussed below.

The local jurisdictions' environmental zones, sensitive lands overlay zones, and other locally identified regulated areas and resources are generally intended to provide protection for natural resource values that provide benefit to the public. Such areas include sites that meet the standards of Statewide Planning Goal 5 for open space, scenic or natural values. In general, the overlay zones are intended to allow development in situations where adverse impacts from the development can be avoided or mitigated. The regulations of these ordinances provide guidelines for, among other things, identifying, protecting and mitigating impacts, and managing important natural resources. Each jurisdiction has its own process for assessment and approval of development projects in the vicinity of sensitive ecosystem resources. The processes generally include an assessment of existing conditions, analysis of potential impacts from a project, and documentation of actions taken to avoid, minimize or compensate for impacts to the resources.

Permit approvals from local jurisdictions would include those related to the following areas:

- City of Portland Environmental Overlay Zone
- City of Tigard Sensitive Land Overlay Zone
- City of Tualatin Natural Resources Overlay Zone
- Clean Water Services Sensitive Areas and Vegetated Corridors.

In addition, each jurisdiction has its own urban forestry or tree code, as well as local requirements for stormwater management and treatment.

2. STUDY AREA

The boundary of the study area for direct effects is rather complex, because it is based on project elements, and it extends 50 feet from the edge of construction for the light rail alternatives, station improvements and operation and maintenance (O&M) facilities. The study area does not include the station access improvements, because they are not necessarily associated with a particular alignment alternative and have relatively small footprints. The study area for the ecosystems resources covers rivers, streams, wetlands, floodplains and riparian corridor functions.

Table 2.1-1 below summarizes the areas in acres for the construction footprints and the 50-foot buffers around them. The overall study area size for the light rail footprints and the buffers ranges from approximately 98 to 186 acres. The Marquam Hill connection options range between 4 and 6 acres. The O&M facilities range between approximately 12 and 22 acres in size.

Table 2.1-1. Footprint and Buffer Areas by Light Rail Alternative, Marquam Hill Connection Option and O&M Facilities Option

Alternative/Option	Footprint Area (acres)	Buffer Area (acres)	Total Area (acres)[1]
Segment A: Inner Portland			
A1: Barbur	54.92	43.10	98.02
A2-BH: Naito Bridgehead	64.91	48.10	113.01
A2-LA: Naito Limited Access	59.69	40.64	100.33
Segment B: Outer Portland[1]			
B1: Barbur	100.63	74.88	175.51
B2: I-5 Barbur TC-60th	90.41	78.80	169.21
B3: I-5 26th-60th	87.12	90.74	177.87
B4: I-5 Custer-60th	85.84	100.56	186.41
Segment C: Tigard and Tualatin			
C1: Ash-I-5	60.23	74.34	134.57
C2: Ash-Railroad	54.88	67.22	122.10
C3: Clinton-I-5	54.87	66.55	121.42
C4: Clinton-Railroad	49.52	59.43	108.95
C5: Ash-I-5 Branched	59.98	71.96	131.94
C6: Wall-I-5 Branched	61.05	69.76	130.81
Marquam Hill Connection Options			
1A: Elevator/Bridge and Path	1.42	2.83	4.26
1B: Elevator/Bridge and Recessed Path	1.66	2.92	4.58
1C: Elevator/Bridge and Tunnel	2.60	3.43	6.02
2: Full Tunnel	2.40	3.41	5.81
O&M Facilities Options			
Hunziker Full	17.36	4.93	22.29
Hunziker Partial A	7.72	4.06	11.78
Branched 72nd	14.72	3.81	18.54
Through 72nd	12.94	4.02	16.97

Note:

[1]Due to rounding, some totals might not correspond with the sum of the separate values.

An expanded analysis area is used to address indirect, downstream impacts to fish related to stormwater quality and hydrologic modifications. These fish include those listed under the federal ESA and the Magnuson-Stevens Fishery Conservation and Management Act. During ESA consultation, an analysis area known as an "action area" will extend to the ocean because of these indirect effects on these species.

The inventory for wildlife species was proposed to extend 0.25 mile from the edge of construction for general habitats and impacts, but ground-truthing did not extend that distance. Ground-truthing, when necessary, was conducted both where imprecise spatial data suggested further investigation was necessary and where access was available.

3. AFFECTED ENVIRONMENT

Much of the study area is along existing transportation corridors with adjacent urbanized land uses. These land uses include commercial and residential buildings, schools, roads, sidewalks, railways and other infrastructure. The remainder of the study area consists of forested lands and undeveloped areas adjacent to the northern portion of SW Barbur Boulevard and within road and railway rights of way. Specific habitats and ecosystem resources that exist in the study area are described below.

3.1. Fish Species and Habitat

The study area is within the following four subwatersheds (also called the 12-digit Hydrologic Unit Code [HUC12] areas), which are located in two subbasins:

- Balch Creek-Willamette River subwatershed – HUC 170900120202 (Lower Willamette subbasin)
- Oswego Creek-Willamette River subwatershed – HUC 170900120104 (Lower Willamette subbasin)
- Fanno Creek subwatershed – HUC 170900100502 (Tualatin Creek subbasin)
- Saum Creek-Tualatin River subwatershed – HUC 170900100504 (Tualatin Creek subbasin).

The light rail alternatives cross a total of 25 streams within Segments A, B and C (Red Rock Creek crosses more than one time). Based on mapping, the majority of these streams currently flow under the light rail alternatives within pipes or culverts, while the others flow on the surface. Each of the alternatives in Segment A and Segment B cross the same watercourses within the same reaches, so there is no difference between the alternatives for the stream resources in these segments. The Segment C alignments also cross the same watercourses, but do so at different reaches of the watercourses.

The watercourses are mapped in two datasets available from Metro's Regional Land Information Service (RLIS) and the Pacific Northwest Hydrography Framework Group (PNWHFG, 2005) (PNWHFG, 2005; Metro, 2017). Of these watercourses, only a few are named in RLIS (Stephens Creek, Tryon Creek, and Red Rock Creek)Several others have local names, but those names are not in the databases. Red Rock Creek is the largest stream that flows mainly on the surface in the study area. When names were not available, the latitude-longitude identification number (LLID), which is a unique 13-digit code, is used to identify streams.. A total of 10 watercourses occur within Segment A, 10 watercourses within Segment B, and 6 watercourses within Segment C. Streams that run through pipes or culverts have been previously impacted and are largely paved over within the study area (see Figures 3.1-1, 3.1-2 and 3.1-3).

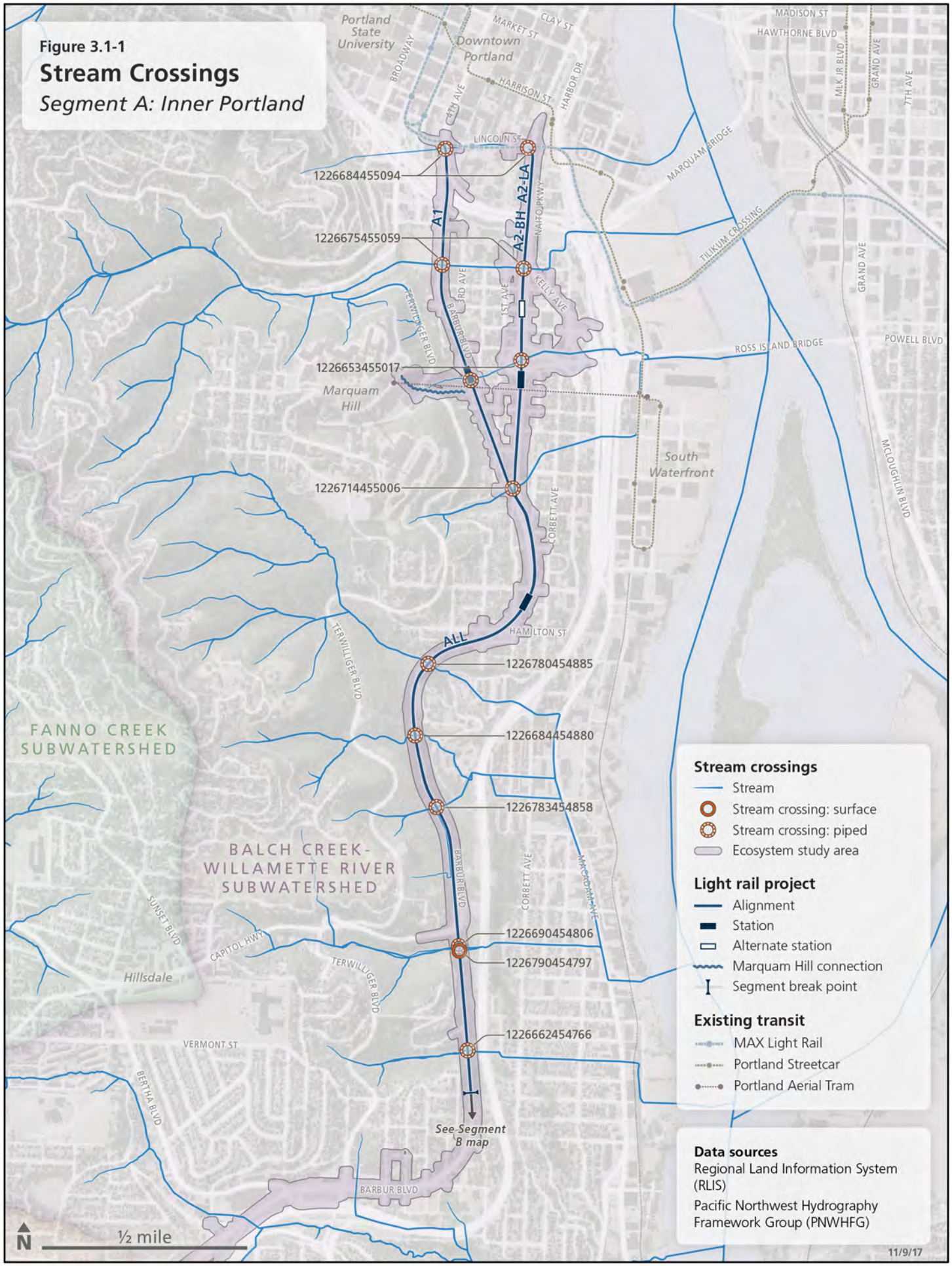


Figure 3.1-1
Stream Crossings
Segment A: Inner Portland
Portland State University
Downtown Portland
Marquam Hill
South Waterfront
FANNO CREEK SUBWATERSHED
BALCH CREEK-WILLAMETTE RIVER SUBWATERSHED
Hillsdale
BROADWAY
MARKET ST
CLAY ST
HARRISON ST
HARBOR DR
4TH AVE
LINCOLN ST
MADISON ST
HAWTHORNE BLVD
MLK JR BLVD
GRAND AVE
7TH AVE
MARQUAM BRIDGE
NAITO PKWY
TILIKUM CROSSING
ROSS ISLAND BRIDGE
POWELL BLVD
MCLOUGHLIN BLVD
KELLY AVE
1ST AVE
3RD AVE
BARBUR BLVD
TERWILLIGER BLVD
CORBETT AVE
HAMILTON ST
MACADAM AVE
SUNSET BLVD
CAPITOL HWY
VERMONT ST
BERTHA BLVD
A1
A2-BH-A2-LA
ALL
1226684455094
1226675455059
1226653455017
1226714455006
1226780454885
1226684454880
1226783454858
1226690454806
1226790454797
1226662454766
See Segment B map
Stream crossings
Stream
Stream crossing: surface
Stream crossing: piped
Ecosystem study area
Light rail project
Alignment
Station
Alternate station
Marquam Hill connection
Segment break point
Existing transit
MAX Light Rail
Portland Streetcar
Portland Aerial Tram
Data sources
Regional Land Information System (RLIS)
Pacific Northwest Hydrography Framework Group (PNWHFG)
N
½ mile
11/9/17

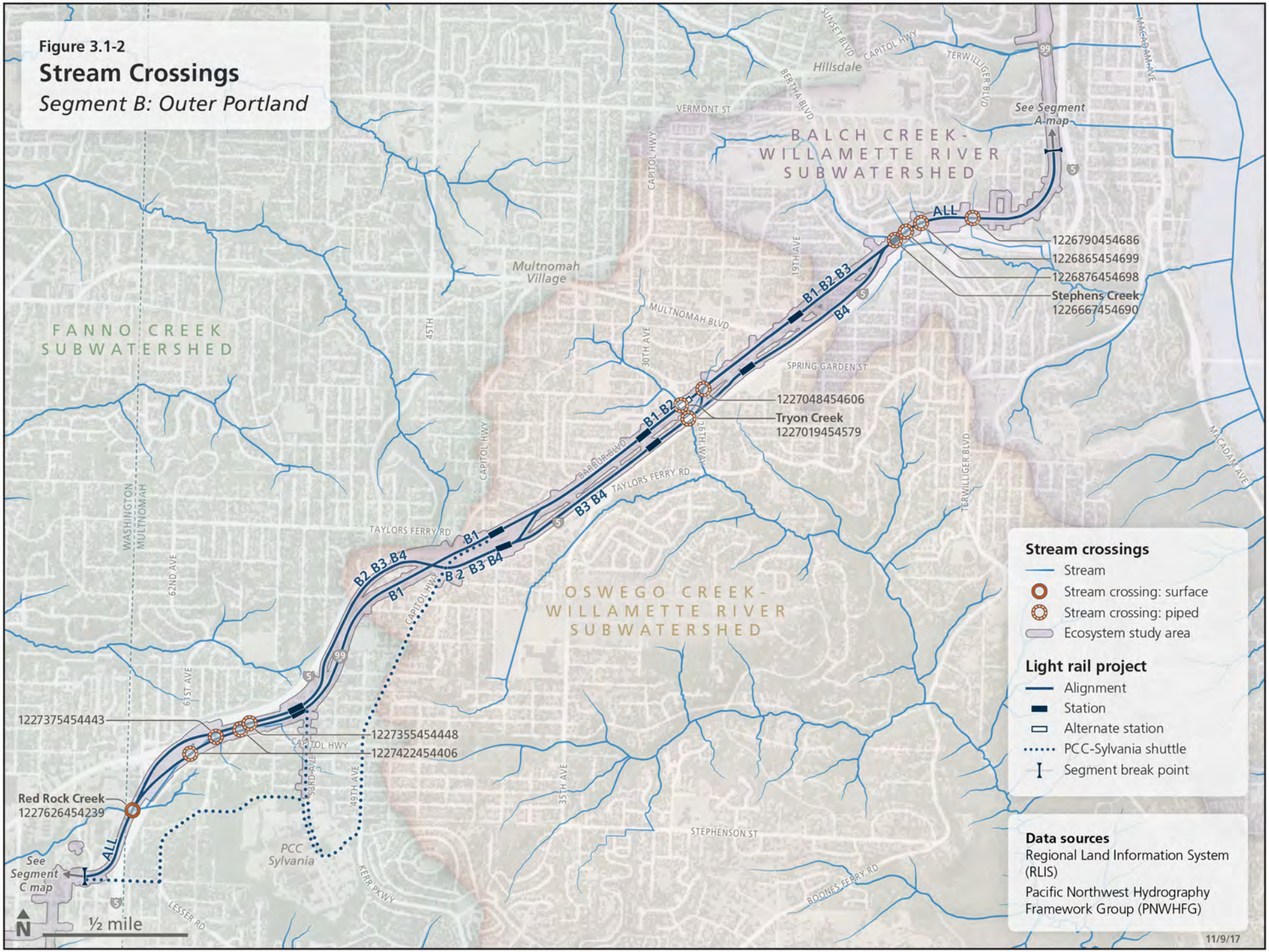


Figure 3.1-2
Stream Crossings
Segment B: Outer Portland
FANNO CREEK SUBWATERSHED
BALCH CREEK-WILLAMETTE RIVER SUBWATERSHED
OSWEGO CREEK-WILLAMETTE RIVER SUBWATERSHED
Hillsdale
Multnomah Village
PCC Sylvania
See Segment A map
See Segment C map
ALL
B1 B2 B3 B4
B1 B2
B2 B3 B4
B1
B3 B4
B4
1226790454686
1226865454699
1226876454698
Stephens Creek
1226667454690
1227048454606
Tryon Creek
1227019454579
1227375454443
1227355454448
1227422454406
Red Rock Creek
1227626454239
VERMONT ST
SUNSET BLVD
CAPITOL HWY
BERTHA BLVD
TERWILLIGER BLVD
MACADAM AVE
19TH AVE
MULTNOMAH BLVD
30TH AVE
SPRING GARDEN ST
45TH
BARBUR BLVD
TAYLORS FERRY RD
WASHINGTON
MULTNOMAH
62ND AVE
61ST AVE
53RD AVE
49TH AVE
35TH AVE
STEPHENSON ST
BOONES FERRY RD
KERR PKWY
LESSER RD
99
5
N
½ mile
Stream crossings
Stream
Stream crossing: surface
Stream crossing: piped
Ecosystem study area
Light rail project
Alignment
Station
Alternate station
PCC-Sylvania shuttle
Segment break point
Data sources
Regional Land Information System (RLIS)
Pacific Northwest Hydrography Framework Group (PNWHFG)
11/9/17

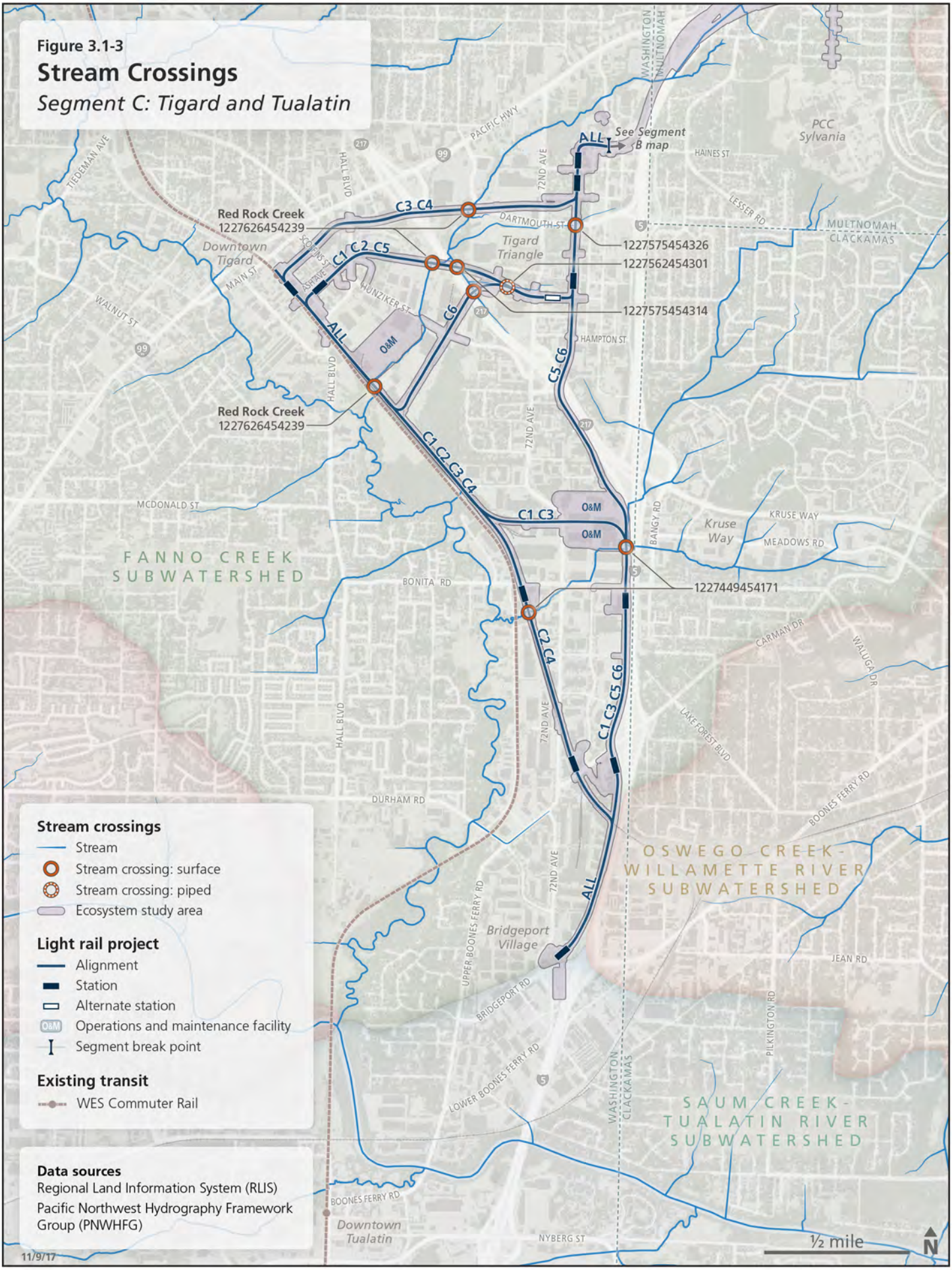


Figure 3.1-3
Stream Crossings
Segment C: Tigard and Tualatin
See Segment B map
Red Rock Creek
1227626454239
Red Rock Creek
1227626454239
1227575454326
1227562454301
1227575454314
1227449454171
C3 C4
C1 C2 C5
C6
ALL
O&M
C5 C6
C1 C2 C3 C4
C1 C3
C2 C4
C1 C3 C5 C6
Downtown Tigard
Tigard Triangle
Kruse Way
Bridgeport Village
Downtown Tualatin
PCC Sylvania
FANNO CREEK SUBWATERSHED
OSWEGO CREEK-WILLAMETTE RIVER SUBWATERSHED
SAUM CREEK-TUALATIN RIVER SUBWATERSHED
PACIFIC HWY
HALL BLVD
72ND AVE
DARTMOUTH ST
HAINES ST
LESSER RD
MULTNOMAH CLACKAMAS
WASHINGTON MULTNOMAH
MAIN ST
SCHOLLS FERRY RD
ASHTAVE
HUNZIKER ST
WALNUT ST
HAMPTON ST
MCDONALD ST
BONITA RD
BANGY RD
KRUSE WAY
MEADOWS RD
CARMAN DR
WALUGA DR
LAKE FOREST BLVD
BOONES FERRY RD
DURHAM RD
UPPER BOONES FERRY RD
BRIDGEPORT RD
JEAN RD
PILKINGTON RD
LOWER BOONES FERRY RD
WASHINGTON CLACKAMAS
NYBERG ST
TIEDEMAN AVE
Stream crossings
Stream
Stream crossing: surface
Stream crossing: piped
Ecosystem study area
Light rail project
Alignment
Station
Alternate station
Operations and maintenance facility
Segment break point
Existing transit
WES Commuter Rail
Data sources
Regional Land Information System (RLIS)
Pacific Northwest Hydrography Framework Group (PNWHFG)
11/9/17
½ mile
N

Table 3.1-1 provides a summary of the streams present within the study area, the source of the name/LLID and location (i.e., RLIS or PNWHFG), whether the mapped stream passes under the alternatives on the surface or is pipedand its location within subwatersheds (HUC12) and project segments. Because the RLIS stream data are more detailed and were updated more recently, RLIS was used as the primary source of information on mapped streams while PNWHFG was used only as a supplemental source. PNWHFG included three streams that were not in the RLIS database.

Most of the streams are small and flow through pipes under the proposed light rail alternative alignment footprints and buffers. The few surface waters include Red Rock Creek and Carter Creek, as well as a small number of their tributaries. None have a free and open connection to streams that are known to support fish, such as Fanno Creek and the Willamette River.

Table 3.1-1. Mapped Streams within the Ecosystems Study Area

Name/LLID	Source[1]	Status	Subwatershed (HUC12)
Segment A: Inner Portland			
1226684455094	PNWHFG	Piped	Balch Creek-Willamette River
1226675455059	RLIS	Piped	Balch Creek-Willamette River
1226653455017	RLIS	Piped	Balch Creek-Willamette River
1226714455006	RLIS	Piped	Balch Creek-Willamette River
1226780454885	RLIS	Piped	Balch Creek-Willamette River
1226684454880	RLIS	Piped	Balch Creek-Willamette River
1226783454858	RLIS	Piped	Balch Creek-Willamette River
1226690454806/ 1226790454797	RLIS	Surface to pipe	Balch Creek-Willamette River
1226662454766	RLIS	Piped	Balch Creek-Willamette River
Segment B: Outer Portland			
1226790454686	RLIS	Piped	Balch Creek-Willamette River
1226865454699	PNWHFG	Piped	Balch Creek-Willamette River
1226876454698	PNWHFG	Piped	Balch Creek-Willamette River
Stephens Creek 1226667454690	RLIS	Piped	Balch Creek-Willamette River
1227048454606	RLIS	Piped	Oswego Creek-Willamette River
Tryon Creek 1227019454579	RLIS	Piped	Oswego Creek-Willamette River
1227355454448	RLIS	Piped	Fanno Creek
1227422454406	RLIS	Piped	Fanno Creek
1227375454443	RLIS	Piped	Fanno Creek
Red Rock Creek 1227626454239	RLIS	Piped and surface at various intervals	Fanno Creek
Segment C: Tigard and Tualatin			
Red Rock Creek 1227626454239	RLIS	Surface	Fanno Creek
1227575454326	RLIS	Surface	Fanno Creek
1227562454301	RLIS	Piped	Fanno Creek
1227575454314	RLIS	Surface	Fanno Creek
1227449454171	RLIS	Surface	Fanno Creek

[1] RLIS was used as the primary source of mapped stream data. PNWHFG data were used only if there was no corresponding stream in the RLIS data.

Several databases were queried for potential species presence in the study area, including the Oregon Biodiversity Information Center (ORBIC) database, publicly available data from the USFWS Information, Planning, and Consultation System (IPaC), USFWS county lists, and ODFW's Centralized Oregon Mapping Products and Analysis Support System (COMPASS). The database searches revealed the presence within the expanded analysis area, but not within the direct effect study area, of eight species of fish listed under the federal or state ESA, or as federal species of concern or state sensitive. Of these, five are salmon and steelhead, and are represented by seven evolutionarily significant units (ESUs) or distinct population segments (DPSs) (see Table 3.1-2). Because of the potential effects of stormwater runoff from the study area, additional species that would be addressed in the federal ESA consultation process include those ESUs/DPSs that utilize the lower Columbia River for migration and rearing, including those originating in the Snake River, Upper Columbia River and Middle Columbia River subbasins.

Table 3.1-2. Fish Species Recorded as Potentially Present in the Vicinity of the Project

Scientific Name Common Name	Federal Status			State Status				ORBIC[6]	IPaC[7]	County[1]			COMPASS[8]
	Listed Threatened	Species of Concern[2]	Critical Habitat[3]	Listed Endangered	Sensitive	Sensitive Critical[4]	Sensitive Vulnerable[5]			Multnomah	Clackamas	Washington	
Acipenser medirostris													
Green sturgeon	N/A	●	N/A	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A
Entosphenus tridentata													
Pacific lamprey	N/A	●	N/A	N/A	N/A	N/A	●	●	N/A	N/A	N/A	N/A	N/A
Oncorhynchus clarki													
Coastal cutthroat trout Lower Columbia River ESU*	N/A	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	●
Oncorhynchus keta													
Chum salmon Columbia River ESU	●	N/A	●	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Oncorhynchus kisutch													
Coho salmon Lower Columbia River ESU	●	N/A	●	●	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	●
Oncorhynchus mykiss													
Steelhead Lower Columbia River DPS**	●	N/A	●	N/A	N/A	●	N/A	●	N/A	N/A	N/A	N/A	●
Steelhead Upper Willamette River DPS	●	N/A	●	N/A	N/A	N/A	●	●	N/A	N/A	N/A	N/A	N/A
Oncorhynchus tshawytscha													
Chinook salmon Lower Columbia River ESU	●	N/A	●	N/A	N/A	●	N/A	●	N/A	N/A	N/A	N/A	●
Chinook salmon Upper Willamette River ESU	●	N/A	●	N/A	N/A	●	N/A	●	N/A	N/A	N/A	N/A	N/A
Salvelinus confluentus													
Bull trout	●				●					●	●		

Sources and Notes:

[1] USFWS Species by County, available at: https://www.fws.gov/endangered/ (2017).

[2] Species of Concern. (Taxa that were previously Category 1 (C1) or Category 2 (C2) candidates for which further information is needed to warrant listing as threatened or endangered.)

[3] Critical Habitat has been designated for this species.

[4] Taxa for which listing is pending.

[5] Taxa for which listing can be avoided through continued protection and monitoring.

[6] ORBIC, 2017.

[7] USFWS Information for Planning and Consultation (IPaC), 2017.

[8] ODFW Centralized Oregon Mapping Products and Analysis Support System (COMPASS), 2017.

*ESU = Evolutionarily Significant Unit

**DPS = Distinct Population Segment

Federal Status – U.S. Fish and Wildlife Service and National Marine Fisheries Service

State Status – Oregon Department of Fish and Wildlife

The species listed in Table 3.1-1 occur in the expanded analysis area of the Fanno Creek, Willamette River and Columbia River drainages, downstream of the study area. Fish are not present within the more limited project study area itself. ODFW (2009) conducted fish presence surveys in several streams in the vicinity of the proposed alignments. Within Segment A, ODFW found 17 species total in the lowest reach of Stephens Creek (LLID 1226667454690). The Stephens Creek reach that was sampled was downstream of a culvert under Highway 43 (SW Macadam Avenue), which presents a passage barrier of unknown status for fish. An additional 2,500-foot culvert is in place from approximately 400 feet downstream of the stream's crossing under Interstate 5 (I-5) to where it daylights (returns to the surface) near SW Bertha Boulevard.

Within Segment B, the light rail alignments cross the upper reaches of Tryon Creek (LLID 1226557454227 in the RLIS dataset). The stream under the alignments is piped through a 54-inch-wide, 590-foot-long culvert. The stream appears to flow at the surface for the remainder of its course (with the exception of several culverts) before flowing through Tryon Creek State Park and discharging to the Willamette River approximately 3.6 miles downstream of the alignments. Several fish species are known to occur in the lower reaches of Tryon Creek, but not within the study area. Coho salmon and steelhead are recorded as being present up to Tryon Creek's crossing of SW Maplecrest Drive, approximately 4,500 lineal feet southeast of the alignments (ODFW, 2009). Farther south along the Segment B alternative alignments, ODFW found no fish in Woods Creek (LLID 1227615454726), which is adjacent to the light rail alignment near SW Capitol Highway (ODFW, 2009).

No studies have been published regarding fish presence within the study area in Segment C. Given the number and lengths of culverts between the alignment alternatives and Fanno Creek (the closest fish-bearing stream), the presence of fish near the alignment is unlikely.

Although no streams within the study area are known to support fish, further investigation would need to occur to ensure compliance with Oregon Fish Passage Law; any new or revised structures over streams with current or historical presence of native migratory fish need to be designed to meet fish passage criteria.

Impacts to floodplains can affect aquatic habitats and fish through changes in vegetation, off-channel refuge and hydrology (see Figure 3.1-4). Table 3.1-3 shows the area of mapped 100-year floodplains intersecting the study area by alternative. No mapped 100-year floodplains are within Segments A and B of the study area. Within Segment C, mapped 100-year floodplains occurring within construction footprints and buffers range between 2.1 and 4.5 acres for the light rail alternatives. For the O&M

facilities within Segment C, mapped floodplains occur only at the Hunziker options; between 5.2 and 10.2 acres of mapped floodplains are present at the Hunziker options. Additional detail regarding floodplains is in the Draft EIS Section 3.10, Water Resources.

Table 3.1-3. 100-Year Floodplains Mapped within Footprint and Buffer Areas, by Alternative and O&M Facilities Option, in Segment C

Alternative/Option	Footprint Area (acres)	Buffer Area (acres)	Total Area (acres)[1]
Segment C: Tigard and Tualatin			
C1: Ash-I-5	1.73	2.77	4.51
C2: Ash-Railroad	1.73	2.77	4.51
C3: Clinton-I-5	0.63	1.49	2.13
C4: Clinton-Railroad	0.63	1.49	2.13
C5: Ash-I-5 Branched[2]	1.73	2.70	4.43
C6: Wall-I-5 Branched	0.68	1.76	2.44
O&M Facility Options			
Hunziker Full	7.93	2.32	10.24
Hunziker Partial	3.23	1.98	5.20
Branched 72nd	0.00	0.00	0.00
Through 72nd	0.00	0.00	0.00

[1] Due to rounding, some totals might not correspond with the sum of the separate values.

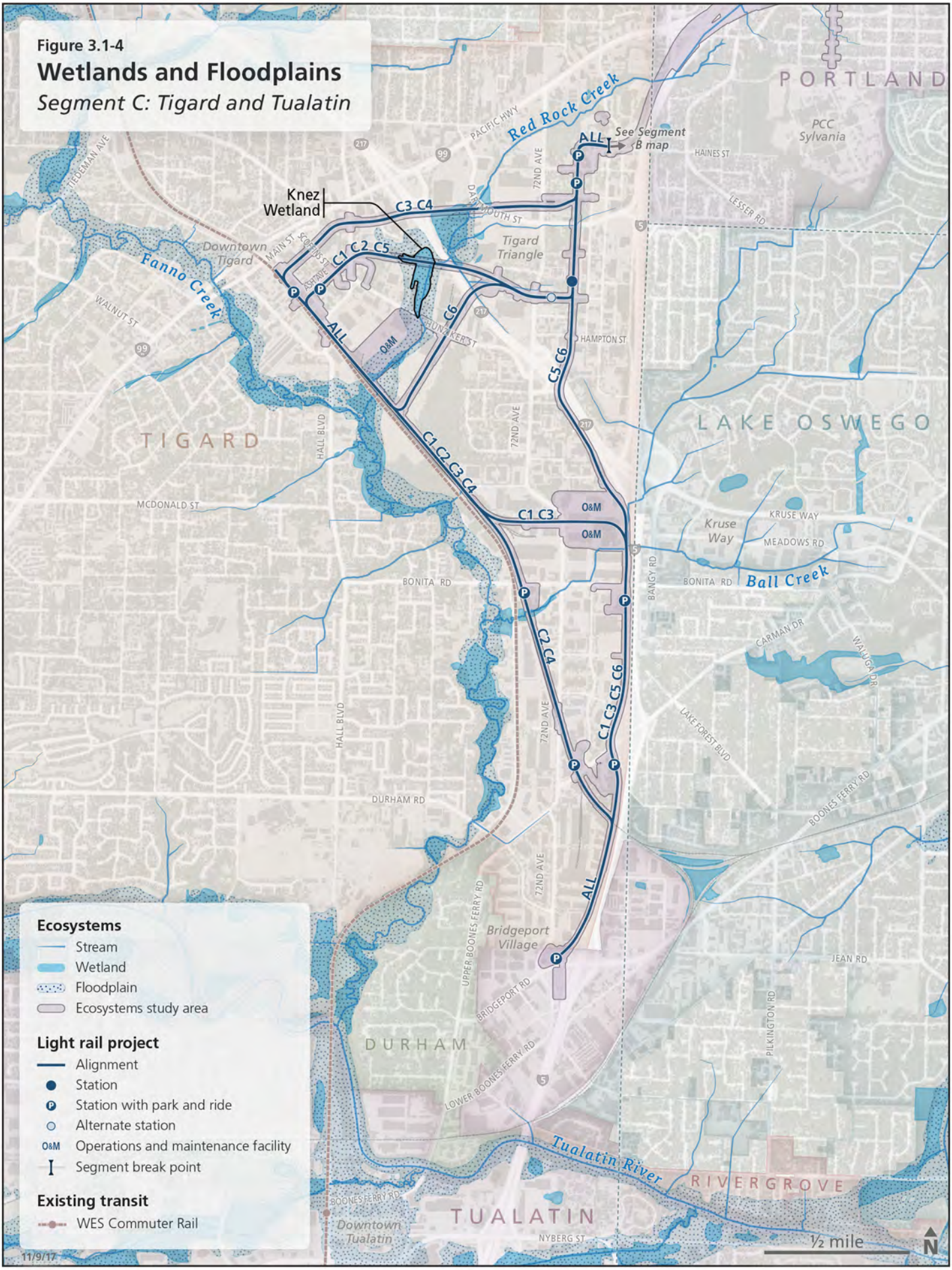


Figure 3.1-4
Wetlands and Floodplains
Segment C: Tigard and Tualatin
PORTLAND
Red Rock Creek
PACIFIC HWY
See Segment B map
ALL
PCC Sylvania
HAINES ST
72ND AVE
LESSER RD
Knez Wetland
C3 C4
SOUTH ST
Tigard Triangle
Downtown Tigard
MAIN ST
SCOUTLAS ST
ASH AVE
C1 C2 C5
Fanno Creek
WALNUT ST
99
217
5
C6
HUNZIKER ST
O&M
HAMPTON ST
C5 C6
TIGARD
HALL BLVD
LAKE OSWEGO
C1 C2 C3 C4
MCDONALD ST
C1 C3
O&M
KRUSE WAY
Kruse Way
MEADOWS RD
BONITA RD
Ball Creek
BANGY RD
CARMAN DR
WALLGA DR
C2 C4
C1 C3 C5 C6
LAKE FOREST BLVD
DURHAM RD
BOONES FERRY RD
Bridgeport Village
UPPER BOONES FERRY RD
BRIDGEPORT RD
JEAN RD
PILKINGTON RD
DURHAM
LOWER BOONES FERRY RD
Tualatin River
RIVERGROVE
TUALATIN
Downtown Tualatin
NYBERG ST
½ mile
N
Ecosystems
Stream
Wetland
Floodplain
Ecosystems study area
Light rail project
Alignment
Station
Station with park and ride
Alternate station
O&M Operations and maintenance facility
Segment break point
Existing transit
WES Commuter Rail
11/9/17

3.2. Vegetation and Wildlife Species and Habitat

3.2.1. Vegetation

Within Segments A and B, the habitat mapping shown in Figures 3.2-1 and 3.2-2 is derived from the Bureau of Planning & Sustainability vegetation mapping project, which began in 2004. It emerged from a new Geographic Information Systems (GIS) model intended to produce a relatively fine-scale inventory of landscape features that contribute to riparian and upland natural resource values and functions. The mapping project methods are described in the summary document prepared by the City of Portland (2011).

As shown in Table 3.2-1, the City of Portland maps the greatest amount of acreage of forest within Segment A, both in the construction footprint and the associated buffers. This forest habitat occurs on slopes adjacent to SW Barbur Boulevard at the southern half of the segment. The northernmost portion of Segment A consists of heavily developed and urbanized areas with relatively little vegetation present.

Within the Segment A light rail alternative alignment footprints there are approximately 13.5 to 14.0 acres of forest, 3.4 to 3.8 acres of woodland, 0.9 to 1.2 acres of shrublands, and 0.9 to 1.8 acres of herbaceous cover. Relatively similar areas of each vegetation class are present in the construction buffers. The total amount of mapped vegetation classes within the Segment A alignment alternatives footprints and buffers ranges from 37.4 to 39.6 acres.

Within the Segment B light rail alternative alignment footprints there are approximately 2.7 to 4.3 acres of forest, 5.1 to 8.5 acres of woodland, 0.1 to 0.3 acre of shrublands, and 3.4 to 4.5 acres of herbaceous cover, depending on the alternative. Relatively similar areas of each vegetation class are present in the construction buffers. The total amount of mapped vegetation classes within the Segment B alignment alternatives footprints and buffers ranges from 26.0 to 31.1 acres.

Given the scale of the effort, the City of Portland (2011) vegetation layer provides relatively precise habitat mapping, which was used to calculate impacts. Although small inaccuracies were noted in the field (such as new developments where habitat was previously mapped), they were generally minor. For example, tree canopies overhanging roads, and even developed areas without tree canopy cover, are frequently included in the mapping when viewed closely. Since these inaccuracies tended to overestimate rather than underestimate impacts, the mapping information was used because the field observations do not cover the majority of the project and are not as comprehensive (although more detailed surveys will be conducted after a Preferred Alternative is selected).

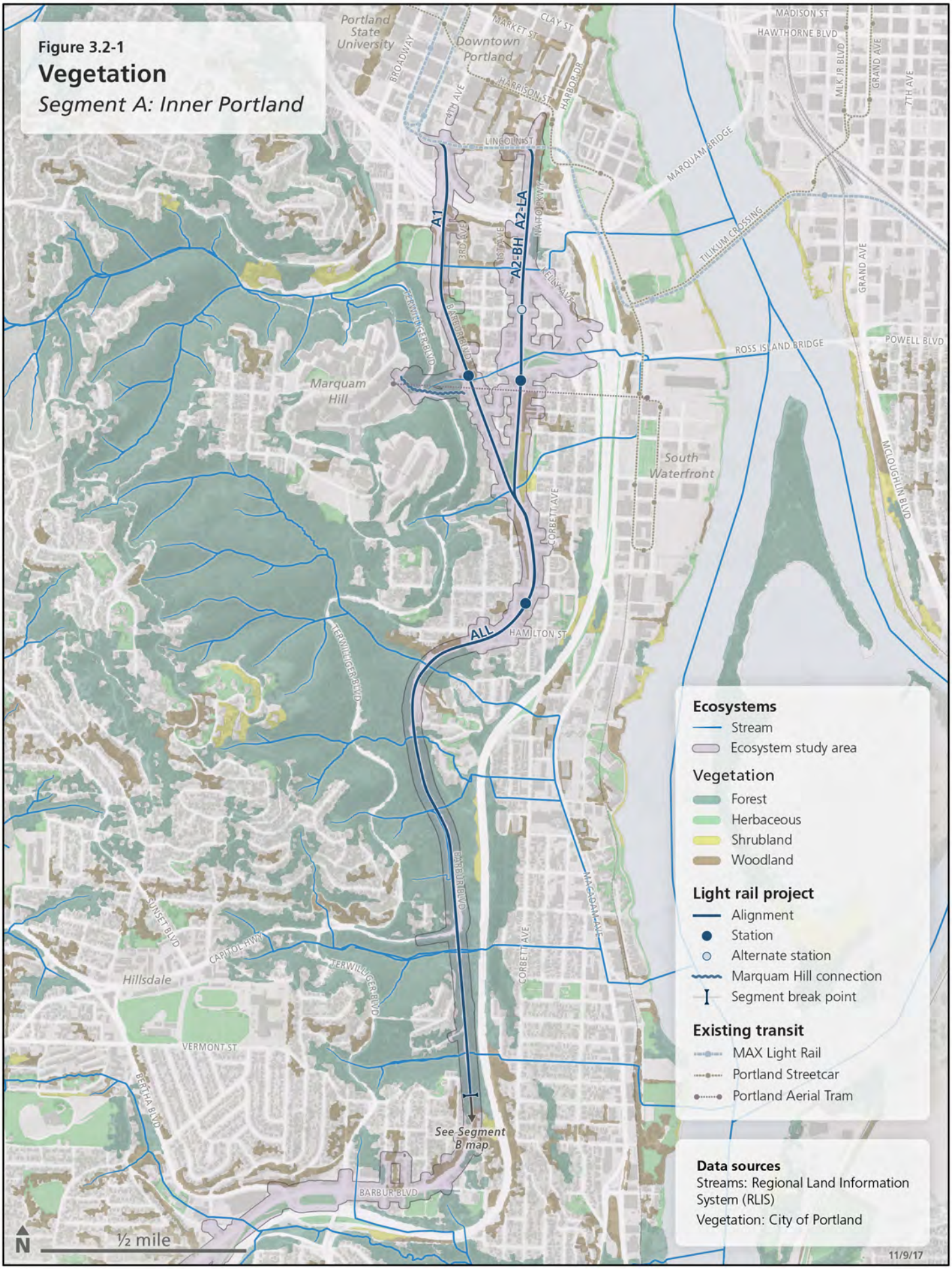


Figure 3.2-1
Vegetation
Segment A: Inner Portland
Portland State University
Downtown Portland
Marquam Hill
Hillsdale
South Waterfront
BROADWAY
MARKET ST
CLAY ST
HARRISON ST
HARBOR DR
LINCOLN ST
MADISON ST
HAWTHORNE BLVD
MLK JR BLVD
GRAND AVE
7TH AVE
MARQUAM BRIDGE
TILIKUM CROSSING
ROSS ISLAND BRIDGE
POWELL BLVD
MCLOUGHLIN BLVD
A1
A2-BH
A2-LA
ALL
BARBUR BLVD
CORBETT AVE
TERWILLIGER BLVD
SUNSET BLVD
CAPITOL HWY
VERMONT ST
BERTHA BLVD
MACADAM AVE
See Segment B map
Ecosystems
Stream
Ecosystem study area
Vegetation
Forest
Herbaceous
Shrubland
Woodland
Light rail project
Alignment
Station
Alternate station
Marquam Hill connection
Segment break point
Existing transit
MAX Light Rail
Portland Streetcar
Portland Aerial Tram
Data sources
Streams: Regional Land Information System (RLIS)
Vegetation: City of Portland
N
½ mile
11/9/17

Figure 3.2-2

Vegetation

Segment B: Outer Portland

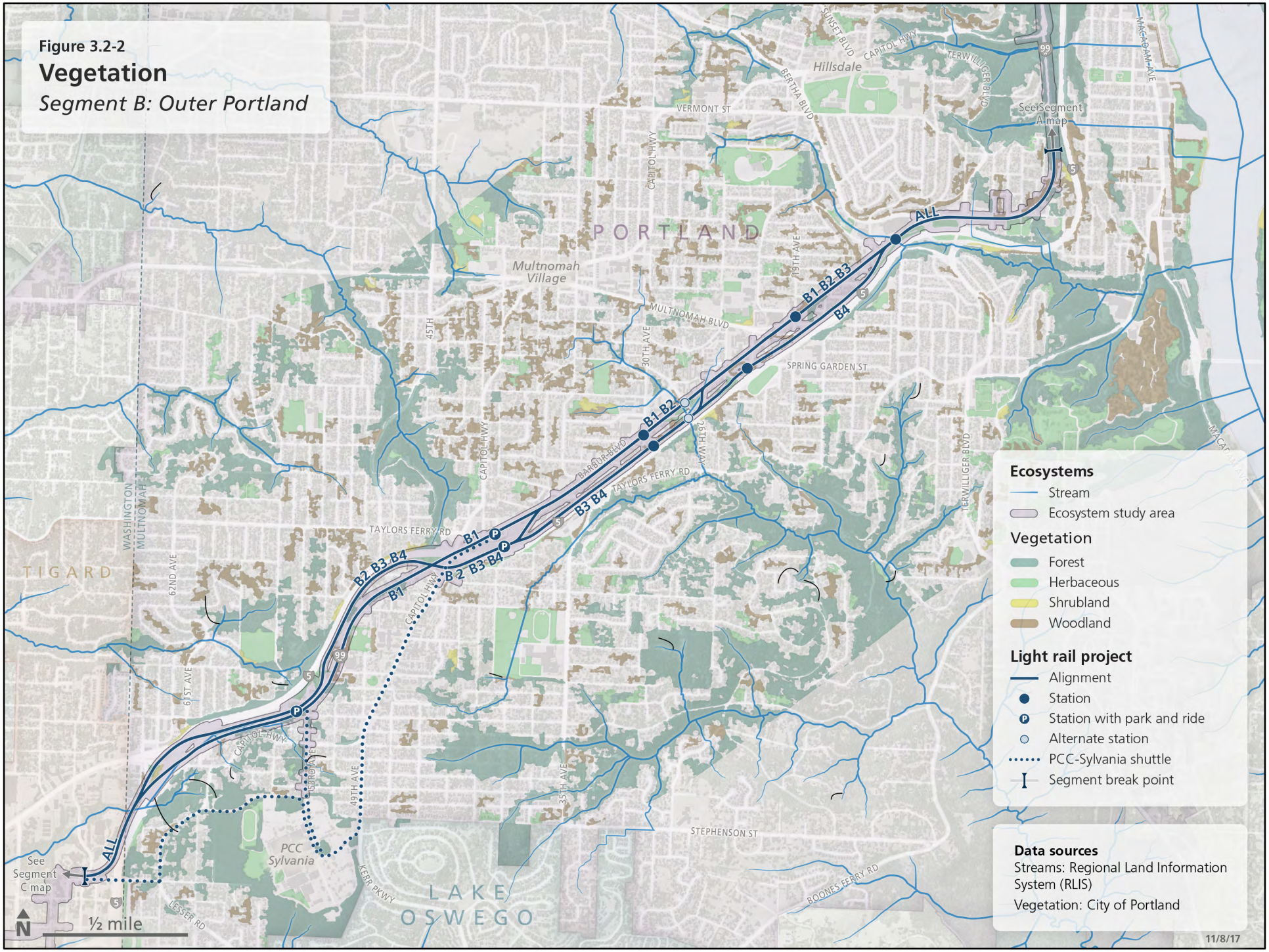


Table 3.2-1. Area in Acres of Vegetation Classes Identified by City of Portland (2011) Present within Segments A and B

Alternative/ Option	Forest (Footprint / Buffer)	Herbaceous (Footprint / Buffer)	Shrubland (Footprint / Buffer)	Woodland (Footprint / Buffer)	All Classes (Footprint / Buffer Totals)	Grand Total
Segment A: Inner Portland						
A1: Barbur	13.53 / 13.95	0.92 / 0.44	0.89 / 0.50	3.83 / 3.32	19.17 / 18.21	37.39
A2-BH: Naito Bridgehead	13.79 / 14.34	1.82 / 0.85	0.92 / 0.46	3.38 / 4.05	19.90 / 19.70	39.60
A2-LA: Naito Limited Access	13.96 / 14.26	1.91 / 0.79	1.16 / 0.40	3.47 / 3.20	20.50 / 18.64	39.15
Segment B: Outer Portland						
B1: Barbur	4.30 / 4.97	3.45 / 4.26	0.06 / 0.81	5.13 / 3.44	12.93 / 13.47	26.04
B2: I-5 Barbur TC-60th	2.86 / 4.66	3.87 / 4.53	0.00 / 0.32	6.82 / 3.76	13.54 / 13.28	26.82
B3: I-5 26th-60th	2.86 / 4.66	3.93 / 4.82	0.00 / 0.32	8.18 / 4.25	14.96 / 14.05	29.01
B4: I-5 Custer-60th	2.69 / 4.97	4.53 / 4.96	0.00 / 0.32	8.45 / 5.18	15.67 / 15.43	31.10
Marquam Hill Connection Options						
1A: Elevator/Bridge and Path	0.78 / 1.36	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.78 / 1.36	2.41
1B: Elevator /Bridge and Recessed Path	1.00 / 1.50	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	1.00 / 1.50	2.50
1C: Elevator/Bridge and Tunnel	1.69 / 1.64	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	1.69 / 1.64	3.33
2: Full Tunnel	1.74 / 1.66	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	1.74 / 1.66	3.40

While the vegetation classes provide an indication of the potential wildlife habitat types present in Segments A and B, the local development regulations require compliance with the standards governing Environmental Zones (E-zones). Within Segment A, areas of mapped E-zones are similar between all the alternatives (see Table 3.2-2 and Figure 3.2-3). Total acreage of E-zone conservation areas within the construction footprint for all three alternatives is 18.7 acres. E-zone conservation areas within construction buffers for the three alternatives range from approximately 11.6 to 11. 8 acres. Similarly, E-zone protection areas within the construction footprint total 1.2 acres, and within the buffer total 1.2 acres. Most of these E-zone areas are associated with the forested area along SW Barbur Boulevard.

Within Segment B, areas of mapped E-zones are similar between the four alternatives (see Table 3.2-2 and Figure 3.2-4). Total acreage of E-zone conservation areas within the construction footprint for all four alternatives is 0.3 acre, and within construction buffers for the four alternatives is approximately 1.1 acres. Similarly, total acreage of E-zone protection areas within the construction footprint is 0.0 acre, and within the buffer ranges from 1.3 to 1.4 acres. Like Segment A, most of these areas are associated with the forested area along SW Barbur Boulevard.

Table 3.2-2. Area in Acres of City of Portland Environmental Zones within Construction Footprint and Buffers

Alternative/Option	Conservation E-Zone (Footprint / Buffer)	Protection E-Zone (Footprint / Buffer	Sum of Footprint and Buffer (Conservation)	Sum of Footprint and Buffer (Protection)	Grand Total
Segment A: Inner Portland					
A1: Barbur	18.72 / 11.79	1.01 / 1.23	30.51	2.24	32.75
A2-BH: Naito Bridgehead	18.72 / 11.70	1.01 / 1.23	30.42	2.24	32.66
A2-LA: Naito Limited Access	18.72 / 11.59	1.01 / 1.23	30.30	2.24	32.54
Segment B: Outer Portland					
B1: Barbur	0.28 / 1.1	0.00 / 0.17	1.38	0.17	1.55
B2: I-5 Barbur TC-60th	0.28 / 1.05	0.00 / 0.10	1.33	0.10	1.43
B3: I-5 26th-60th	0.28 / 1.05	0.00 / 0.10	1.33	0.10	1.43
B4: I-5 Custer-60th	0.28 / 1.05	0.00 / 0.10	1.33	0.10	1.43
Marquam Hill Connection Options					
1A: Elevator/Bridge and Path	0.93 / 1.73	0.00 / 0.08	2.66	0.08	2.74
1B: Elevator/Bridge and Recessed Path	1.15 / 1.85	0.01 / 0.18	3.00	0.19	3.18
1C: Elevator/Bridge and Tunnel	1.51 / 1.78	0.49 / 0.34	3.29	0.84	4.13
2: Full Tunnel	1.49 / 1.64	0.52 / 0.33	3.13	0.85	3.98

1

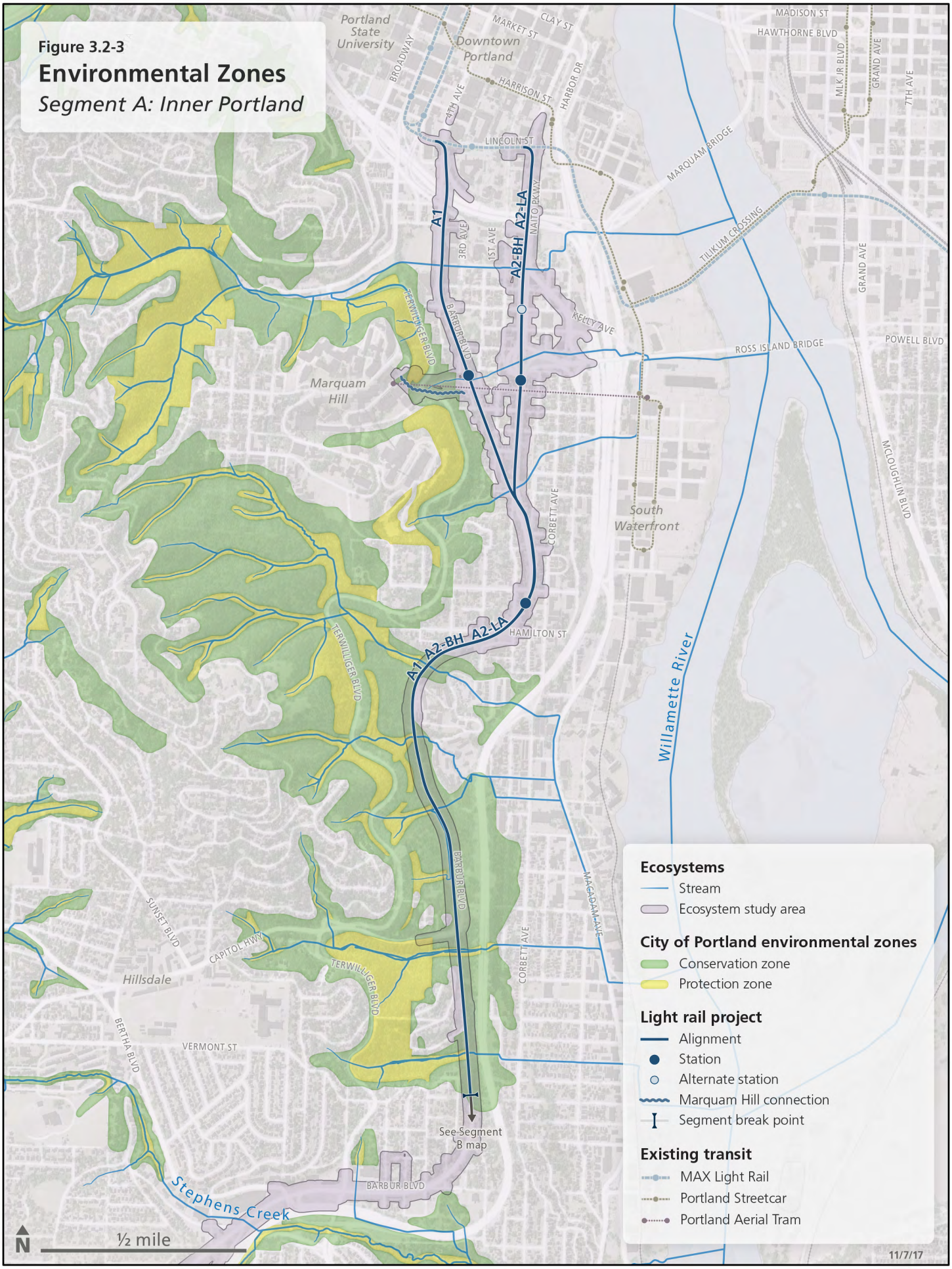
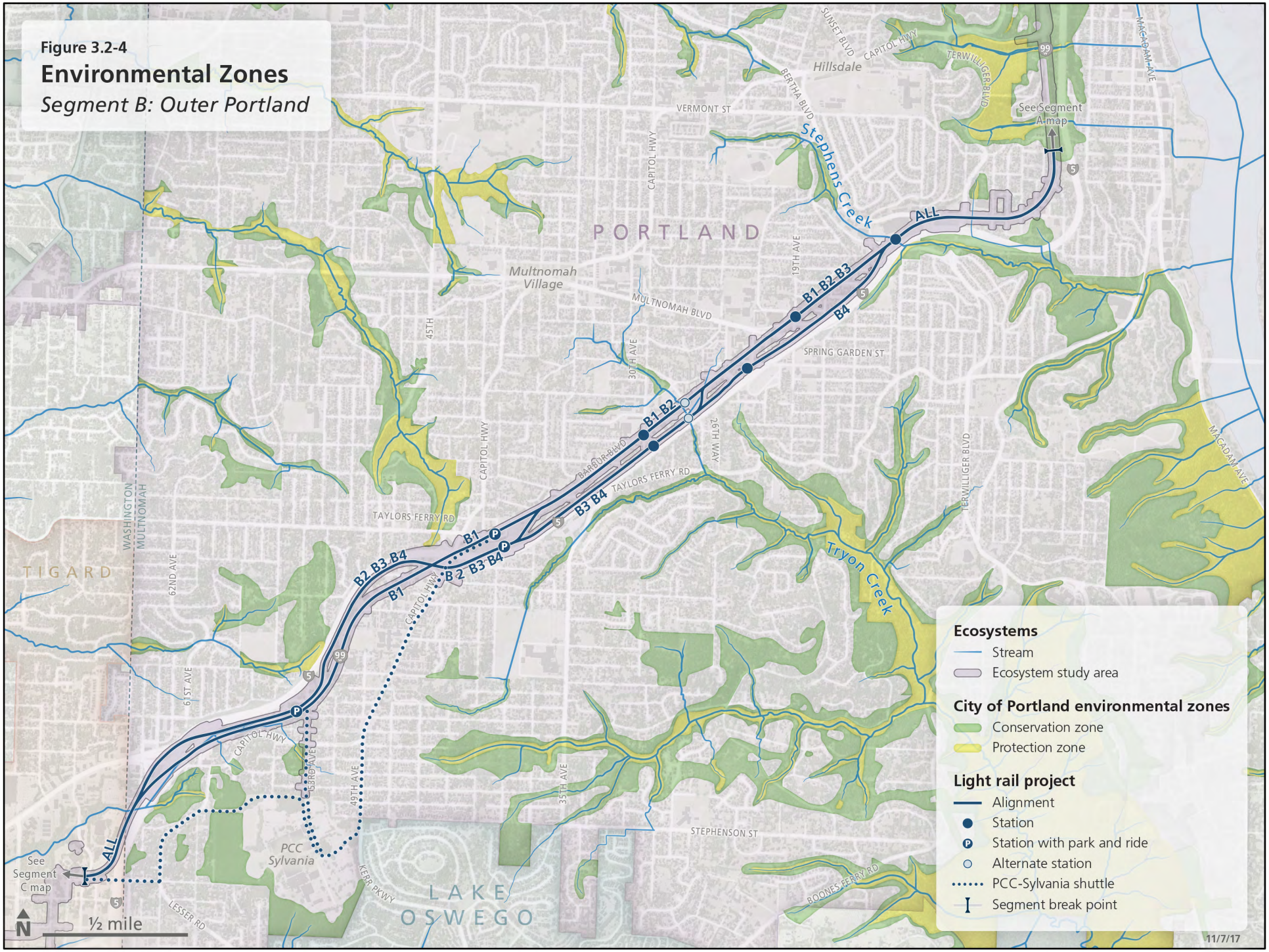


Figure 3.2-3
Environmental Zones
Segment A: Inner Portland
Portland State University
Downtown Portland
BROADWAY
MARKET ST
CLAY ST
HARRISON ST
HARBOR DR
4TH AVE
LINCOLN ST
MADISON ST
HAWTHORNE BLVD
MLK JR BLVD
GRAND AVE
7TH AVE
MARQUAM BRIDGE
TILIKUM CROSSING
A1
3RD AVE
1ST AVE
A2-BH
A2-LA
NAITO PKWY
KELLY AVE
BARBUR BLVD
TERWILLIGER BLVD
Marquam Hill
ROSS ISLAND BRIDGE
POWELL BLVD
CORBETT AVE
South Waterfront
MCLOUGHLIN BLVD
HAMILTON ST
A1 A2-BH A2-LA
Willamette River
MACADAM AVE
SUNSET BLVD
CAPITOL HWY
Hillsdale
BERTHA BLVD
VERMONT ST
See Segment B map
Stephens Creek
N
½ mile
Ecosystems
Stream
Ecosystem study area
City of Portland environmental zones
Conservation zone
Protection zone
Light rail project
Alignment
Station
Alternate station
Marquam Hill connection
Segment break point
Existing transit
MAX Light Rail
Portland Streetcar
Portland Aerial Tram
11/7/17

Figure 3.2-4

Environmental Zones

Segment B: Outer Portland



Within Segment C, the majority of the study area consists of developed land cover. Developed land cover includes commercial and residential buildings, schools, roads, sidewalks, railways and other infrastructure. The remainder of the study area consists of several undeveloped areas primarily within road and railway rights of way; the riparian corridor of Red Rock Creek, Fanno Creek and others, including several wetlands; park areas adjacent to creeks; and undeveloped lots.

Vegetated corridors mapped by the City of Tigard to meet Clean Water Services (CWS) standards are intended to provide consultants, planners, and resource managers information on the location of vegetated corridors as defined and regulated by Chapter 3 of the CWS Design and Construction Standards (CWS, 2017). These corridors are located mainly around surface waters, as shown on Figure 3.2-5. Within Segment C, the mapped vegetated corridors are similar between all of the alternatives. Mapped vegetated corridors within the construction footprints for the six alternatives range from 3.3 to 4.1 acres (see Table 3.2-3). Mapped vegetated corridors within construction buffers for the six Segment C alternatives range from 4.0 to 5.4 acres. Most of these corridors are associated with the forested areas along Red Rock Creek and Fanno Creek.

Table 3.2-3. City of Tigard-Mapped Vegetated Corridors

Alternative/Option	Footprint / Buffer (Acres)	Total of Footprint and Buffer
Segment C: Tigard and Tualatin		
C1: Ash-I-5	3.96 / 5.41	9.37
C2: Ash-Railroad	4.13 / 5.62	9.74
C3: Clinton-I-5	3.52 / 4.88	8.41
C4: Clinton-Railroad	3.69 / 5.09	8.78
C5: Ash-I-5 Branched	3.78 / 4.66	8.44
C6: Wall-I-5 Branched	3.27 / 4.03	7.30
O&M Facilities Options		
Hunziker Full	1.84 / 2.20	4.04
Hunziker Partial A	1.35 / 1.83	3.19
Hunziker Partial B	1.84 / 2.20	4.04
Branched 72nd	0.00 / 0.00	0.00
Through 72nd	0.70 / 1.16	1.87

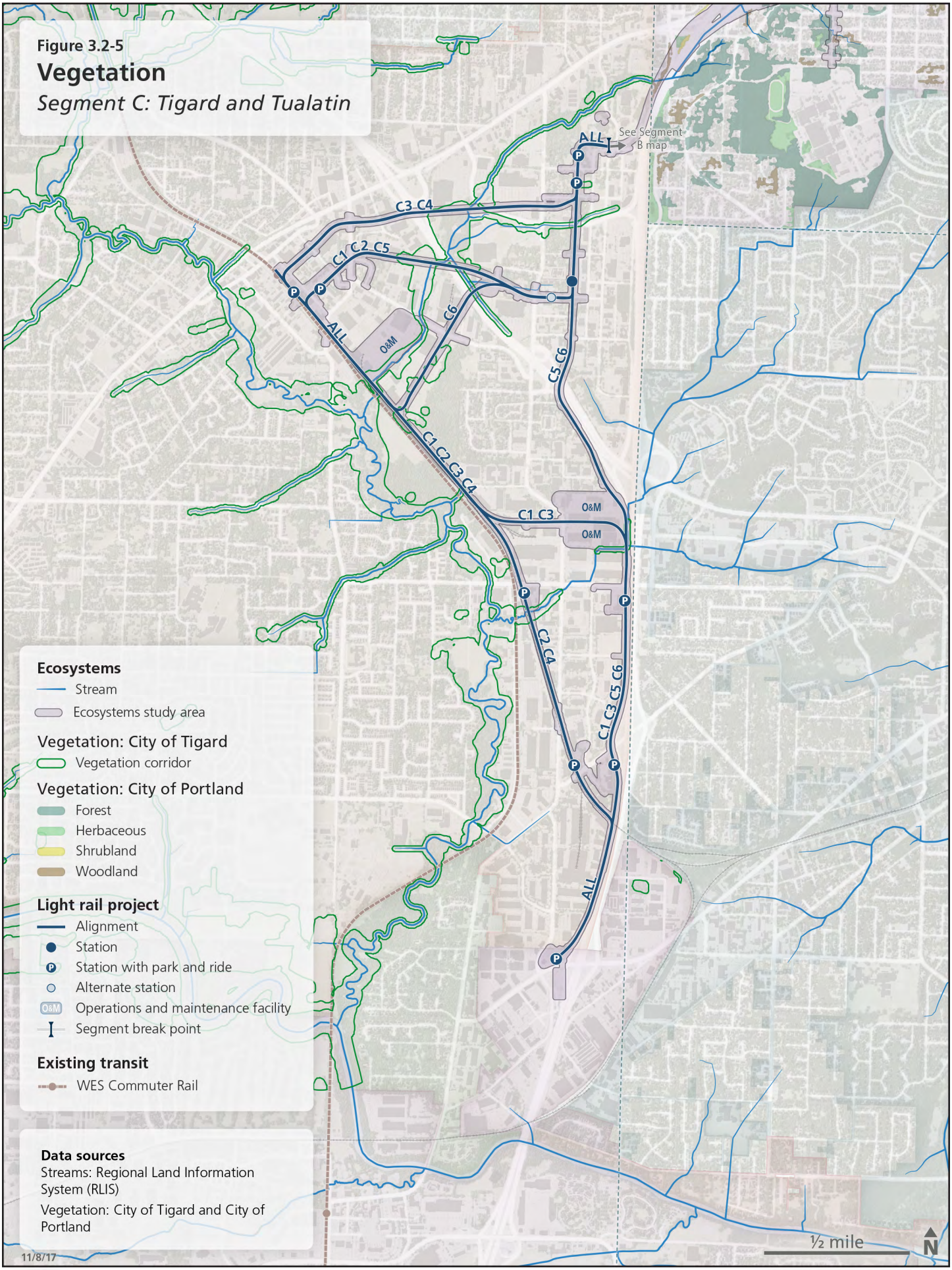


Figure 3.2-5
Vegetation
Segment C: Tigard and Tualatin
See Segment B map
ALL
C3 C4
C1 C2 C5
C6
O&M
C5 C6
C1 C2 C3 C4
C1 C3
C2 C4
C1 C3 C5 C6
Ecosystems
Stream
Ecosystems study area
Vegetation: City of Tigard
Vegetation corridor
Vegetation: City of Portland
Forest
Herbaceous
Shrubland
Woodland
Light rail project
Alignment
Station
Station with park and ride
Alternate station
Operations and maintenance facility
Segment break point
Existing transit
WES Commuter Rail
Data sources
Streams: Regional Land Information System (RLIS)
Vegetation: City of Tigard and City of Portland
11/8/17
½ mile
N

3.2.2. Wildlife Species and Habitat

Wildlife species within the study area for this analysis include mollusks, insects, amphibians, reptiles, birds and mammals. Plant species include grasses, forbs, shrubs and trees.

Database searches for non-fish (terrestrial) species listed under federal or state processes as threatened, endangered or sensitive revealed the presence of 8 species of plants, 19 species of birds, 5 mammals, 2 reptiles, 1 amphibian, 1 insect and 1 mollusk (see Table 3.2-4). As in the fish database queries, not all of the species identified in the databases are likely to occur within the study area.

Table 3.2-4. Listed/Sensitive Terrestrial Species by Dataset

	Federal Status					State Status								County[3]			
Common Name *(Scientific Name)*	Listed Endangered	Listed Threatened	Candidate[5]	Species of Concern[6]	Critical Habitat[7]	Listed Endangered	Listed Threatened	Candidate	Sensitive	Sensitive Critical[8]	Sensitive Vulnerable[9]	ORBIC[1]	IPaC[2]	Multnomah	Clackamas	Washington	COMPASS[4]
Plants																	
Golden paintbrush *(Castilleja levisecta)*	N/A	●	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●	●	●	N/A
White rock larkspur *(Delphinium leucophaeum)*	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●
Water howellia *(Howellia aquatilis)*	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A
Bradshaw's lomatium (desert-parsley) *(Lomatium bradshawii)*	●	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A
Kincaid's lupine *(Lupinus sulphureus* ssp. *Kincaidii)*	N/A	●	N/A	N/A	●	N/A	●	N/A	N/A	N/A	N/A	N/A	●	●	N/A	●	N/A
Whitebark pine *(Pinus albicaulis)*	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	N/A
Nelson's checkermallow *(Sidalcea nelsoniana)*	N/A	●	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	●	●	●	●	N/A
Oregon sullivantia *(Sullivantia oregana)*	N/A	N/A	N/A	●	N/A	N/A	N/A	●	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A
Birds																	
Marbled murrelet (*Brachyramphus marmoratus)*	N/A	●	N/A	N/A	●	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	●	●	●	N/A
Common nighthawk *(Chordeiles minor)*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●
Olive-sided flycatcher *(Contopus cooperi)*	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●

Table 3.2-4. Listed/Sensitive Terrestrial Species by Dataset

Common Name *(Scientific Name)*	Federal Status					State Status								County[3]			
	Listed Endangered	Listed Threatened	Candidate[5]	Species of Concern[6]	Critical Habitat[7]	Listed Endangered	Listed Threatened	Candidate	Sensitive	Sensitive Critical[8]	Sensitive Vulnerable[9]	ORBIC[1]	IPaC[2]	Multnomah	Clackamas	Washington	COMPASS[4]
Pileated woodpecker *(Dryocopus pileatus)*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●
Willow flycatcher *(Empidonax traillii)*	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●
Harlequin duck *(Histrionicus histrionicus)*	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●
Lewis's woodpecker *(Melanerpes lewis)*	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●
American white pelican *(Pelecanus erythrorhynchos)*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●
Red-necked grebe *(Podiceps grisegena)*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●
Oregon vesper sparrow *(Pooecetes gramineus affinis)*	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●
Chipping sparrow *(Spizella passerina)*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●
Yellow-billed cuckoo *(Coccyzus americanus)*	N/A	●	N/A	N/A	●	N/A	N/A	N/A	N/A	●	N/A	N/A	●	●	●	●	N/A
Streaked horned lark *(Eremophila alpestris strigata)*	N/A	●	N/A	N/A	●	N/A	N/A	N/A	N/A	●	N/A	N/A	●	●	●	●	N/A
American peregrine falcon *(Falco peregrinus anatum)*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●	●	N/A	N/A	N/A	N/A	●
Bald eagle *(Haliaeetus leucocephalus)*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●	●	N/A	N/A	N/A	N/A	N/A
Purple martin *(Progne subis)*	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A	N/A	N/A	●
Northern spotted owl *(Strix occidentalis caurina)*	N/A	●	N/A	N/A	●	N/A	●	N/A	N/A	N/A	N/A	N/A	●	●	●	●	●
Mammals																	
Pallid bat *(Antrozous pallidus)*	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●
Townsend's big-eared bat	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A	N/A	N/A	●

Table 3.2-4. Listed/Sensitive Terrestrial Species by Dataset

Common Name *(Scientific Name)*	Federal Status					State Status								County[3]			
	Listed Endangered	Listed Threatened	Candidate[5]	Species of Concern[6]	Critical Habitat[7]	Listed Endangered	Listed Threatened	Candidate	Sensitive	Sensitive Critical[8]	Sensitive Vulnerable[9]	ORBIC[1]	IPaC[2]	Multnomah	Clackamas	Washington	COMPASS[4]
(Corynorhynus townsendii)																	
Red tree vole (*Arborimus longicaudus)*	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	●	N/A	●	N/A
North American wolverine *(Gulo gulo luscus)*	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	●	●	N/A	N/A
Columbian white-tailed deer (*Odocoileus virginianus leucurus)*	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A
Reptiles																	
Western pond turtle *(Actinemys marmorata)*	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A	N/A	N/A	●
Painted turtle *(Chrysemys picta)*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	●	N/A	N/A	N/A	N/A	●
Amphibians																	
Oregon slender salamander *(Batrachoseps wrighti)*	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	●	●	N/A	N/A	N/A	N/A	N/A
Insects																	
Fender's blue butterfly *(Icaricia icarioides fenderi)*	●	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	●	N/A
Invertebrates																	
California floater (mussel) (*Anodonta californiensis)*	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A	N/A	N/A	●	N/A	N/A	N/A	N/A	N/A

Sources and Notes:

[1] Oregon Biodiversity Information Center (ORBIC), 2017.

[2] USFWS Information for Planning and Consultation (IPaC), 2017.

[3] USFWS Species by County, available at: https://www.fws.gov/endangered/ (2017).

[4] ODFW Centralized Oregon Mapping Products and Analysis Support System (COMPASS), 2017.

[5] Taxa for which the U.S. Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.

[6] Taxa that were previously Category 1 (C1) or Category 2 (C2) candidates for which further information is needed to warrant listing as threatened or endangered.

[7] Critical Habitat has been designated for this species.

[8] Taxa for which listing is pending.

[9] Taxa for which listing can be avoided through continued protection and monitoring.

Federal Status – U.S. Fish and Wildlife Service and National Marine Fisheries Service
State Status – Oregon Department of Fish and Wildlife and Oregon Department of Agriculture

The presence of wildlife or plant species listed as threatened or endangered under the federal ESA within Segments A and B is not likely. A few state-sensitive bird and mammal species, including pileated woodpecker and Townsend's big-eared bat, likely inhabit the forested areas along SW Barbur Boulevard. The presence of wildlife species listed as threatened or endangered under the federal ESA within Segment C is not likely; however, the plant species Nelson's checkermallow could occur in the Knez Wetland (see the discussion under the Wetlands section below). State-sensitive bird, mammal and reptile species, including purple martin, Townsend's big-eared bat and western pond turtle, likely inhabit the vegetated and wetland areas along Red Rock Creek.

In addition to the threatened, endangered and sensitive species, over 100 other species are likely to occur within the vicinity of the project (Csuti et al., 1997). At least 20 species of amphibians and reptiles potentially occur within the study area and surrounding habitat areas, including native and non-native species. Among these species are the northwestern salamander (*Ambystoma gracile*), northern red-legged frog (*Rana aurora*), western painted turtle (*Chrysemys picta*), northwestern pond turtle (*Actinemys marmorata*), and northern alligator lizard (*Elgaria coerulea*). Bird species are the largest group of vertebrates that occur in urban areas. Notable bird species in the area include the great blue heron (*Ardea herodias*), red-tailed hawk (*Buteo jamaicensis*), bald eagle (*Haliaeetus leucocephalus*) and osprey (*Pandion haliaetus*). Mammals that occur in the vicinity of the project include Virginia opossum (*Didelphis virginiana*), black-tailed deer (*Odocoileus hemionus*), eastern cottontail (*Sylvilagus floridanus*), raccoon (*Procyon lotor*), coyote (*Canis latrans*), several bat species (*Myotis* spp. and *Corynorhinus* spp.), fox squirrel (*Sciurus niger*), native mice (*Peromyscus* spp.) and vole (*Microtus* spp.) species, house mouse (*Mus musculus*) and Norway rat (*Rattus norvegicus*). Muskrat (*Ondatra zibethicus*), non-native nutria (*Myocastor coypus*), beaver (*Castor canadensis*), and river otter (*Lontra canadensis*) occur in the Tualatin River and its tributaries, including Fanno Creek and Red Rock Creek (Csuti et al., 1997).

3.3. Wetlands

The presence of wetlands within the study area have been assessed using the best available data, which includes three distinct, but often overlapping datasets: National Wetlands Inventory (NWI), RLIS, and City of Tigard Local Wetlands Inventory (LWI). See Figure 3.1-4 for mapped wetlands in Segment C. Both the NWI and RLIS datasets cover all segments, but RLIS maps more acreage of wetlands for the area covered. The LWI for the City of Tigard was completed in 1997 (COT, 1997), and portions of it appear to be included in the RLIS data.

Of these layers, the RLIS (Metro, 2017) data was considered the most comprehensive, because the "layer is based on the 1998 National Wetlands Inventory, finished and in-progress local wetland inventories conducted by local jurisdictions, and information/documentation collected during the development of Metro's Title 13 Nature in Neighborhoods program." However, while RLIS data claims to include the NWI, it does not include ponds or riverine type wetlands. Furthermore, it was not possible to obtain the wetland type (e.g., emergent, scrub-shrub, forested, ponds and riverine) from the RLIS data. Therefore, to be as comprehensive as possible with the existing data, this section discusses the extent of wetlands from all three sources—NWI, RLIS and City of Tigard LWI.

Field visits were conducted on three days, May 17 and June 5 and 6, 2017, to improve the accuracy of the mapping. The resulting mapping accuracy is useful for the Draft EIS impact analysis, but not accurate enough to be used for permitting purposes. A formal wetland delineation will be required in areas where impacts might occur. The purpose of the site visits, therefore, was to confirm that the majority of wetlands is fairly accurately mapped in RLIS, and that this data represents a conservatively high estimate of potential wetland presence within the study area. Small wetlands discovered in the field (and not included in RLIS) were mapped, and boundaries of wetlands that were noticeably different from mapped wetlands (such as those adjacent to Costco in Tigard) were mapped using a combination of Global Positioning System (GPS) data and field observations marked on aerial photos.

In an effort to capture the area of riverine wetlands, the area of NWI wetlands by alternative alignment is presented in Table 3.3-1. Segments A and B contain few mapped wetland resources, ranging from 0.1 to 0.2 acre for each alternative. Segment C contains 0.4 to 1.8 acres for each alternative.

Table 3.3-1. Approximate Area of Wetland Types Identified in National Wetlands Inventory (USFWS, 2017) by Alternative

Alternative/ Option	Freshwater Emergent Wetland (Footprint/ Buffer) (acres)	Freshwater Forested/Shrub Wetland (Footprint/ Buffer) (acres)	Freshwater Pond (Footprint/ Buffer) (acres)	Riverine (Footprint/ Buffer) (acres)	Grand Total (Footprint/ Buffer) (acres)	Total by Alignment (acres)
Segment A: Inner Portland						
A1: Barbur	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.10 / 0.13	0.10 / 0.13	0.23
A2-BH: Naito Bridgehead	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.10 / 0.13	0.10 / 0.13	0.23
A2-LA: Naito Limited Access	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.10 / 0.13	0.10 / 0.13	0.23
Segment B: Outer Portland						
B1: Barbur	0.00 / 0.00	0.04 / 0.05	0.00 / 0.00	0.01 / 0.03	0.05 / 0.08	0.13
B2: I-5 Barbur TC-60th	0.00 / 0.00	0.04 / 0.05	0.00 / 0.00	0.01 / 0.03	0.05 / 0.08	0.12
B3: I-5 26th-60th	0.00 / 0.00	0.04 / 0.05	0.00 / 0.00	0.01 / 0.03	0.05 / 0.08	0.13
B4: I-5 Custer-60th	0.00 / 0.00	0.04 / 0.05	0.00 / 0.00	0.01 / 0.03	0.05 / 0.08	0.13
Segment C: Tigard and Tualatin						
C1: Ash-I-5	0.11 / 0.11	0.00 / 0.03	0.70 / 0.58	0.13 / 0.08	0.94 / 0.81	1.75
C2: Ash-Railroad	0.09 / 0.07	0.04 / 0.13	0.70 / 0.58	0.13 / 0.07	0.96 / 0.86	1.81
C3: Clinton-I-5	0.11 / 0.11	0.21 / 0.49	0.00 / 0.01	0.00 / 0.01	0.31 / 0.62	0.94
C4: Clinton-Railroad	0.09 / 0.07	0.25 / 0.59	0.00 / 0.01	0.00 / 0.00	0.34 / 0.67	1.01
C5: Ash-I-5 Branched	0.11 / 0.12	0.00 / 0.03	0.70 / 0.58	0.13 / 0.09	0.94 / 0.82	1.76
C6: Wall-I-5 Branched	0.11 / 0.12	0.04 / 0.06	0.00 / 0.01	0.00 / 0.02	0.15 / 0.21	0.36
O&M Facility Options						
Hunziker Full	0.04 / 0.08	0.00 / 0.40	0.29 / 0.23	0.00 / 0.01	0.32 / 0.72	1.04
Hunziker Partial	0.04 / 0.08	0.02 / 0.20	0.19 / 0.36	0.00 / 0.01	0.25 / 0.66	0.90
Branched 72nd	0.07 / 0.17	0.00 / 0.00	0.00 / 0.00	0.00 / 0.11	0.07 / 0.28	0.35
Through 72nd	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	0.00

The RLIS dataset showed no wetlands within Segments A and B. Table 3.3-2 shows the areas of RLIS-mapped wetlands within Segment C, which ranges from 0.3 to 3.0 acres.

Table 3.3-2. Approximate Area of Mapped RLIS-identified Wetlands

Alternative/Option	Footprint Area (acres)	Buffer Area (acres)	Total Area (acres)
Segment C: Tigard and Tualatin			
C1: Ash-I-5	1.27	1.43	2.70
C2: Ash-RR	1.33	1.64	2.97
C3: Clinton-I-5	1.13	1.63	2.76
C4: Clinton-RR	1.19	1.81	3.00
C5: Ash-I-5 Branched[2]	1.27	1.17	2.45
C6: Wall-I-5 Branched	0.09	0.16	0.25
O&M Facility Options			
Hunziker Full	0.67	0.60	1.27
Hunziker Partial	0.62	0.60	1.22
Branched 72nd	0.00	0.00	0.00
Through 72nd	0.00	0.00	0.00

Table 3.3-3 below summarizes the mapped wetlands identified in the City of Tigard LWI as significant (Fishman Environmental Services, 1997) and additional wetlands identified in City of Tigard data as jurisdictional (COT, 2017).

Table 3.3-3. Approximate Area of Mapped Wetlands for Segment C: Tigard and Tualatin

Alternative/ Option	Wetland Status/Type			Footprint and Buffer Total		
	Jurisdictional (acres)	Significant (acres)	Total by Type and Alignment (acres)	Jurisdictional Total (acres)	Significant (acres)	Total (acres)
Segment C: Tigard and Tualatin						
C1: Ash-I-5	0.00	1.31	1.31	0.14	2.76	2.90
C1: Ash-I-5 Buffer	0.14	1.45	1.59			
C2: Ash-Railroad	0.00	1.36	1.37	0.14	3.00	3.14
C2: Ash-Railroad Buffer	0.14	1.63	1.77			
C3: Clinton-I-5	0.40	1.16	1.56	0.85	2.71	3.56
C3: Clinton-I-5 Buffer	0.45	1.55	2.00			
C4: Clinton-Railroad	0.40	1.21	1.61	0.85	2.95	3.80
C4: Clinton-Railroad Buffer	0.45	1.74	2.18			
C5: Ash-I-5 Branched	0.00	1.31	1.31	0.10	2.48	2.57
C5: Ash-I-5 Branched Buffer	0.09	1.17	1.26			
C6: Wall-I-5 Branched	0.15	0.22	0.38	0.70	0.38	1.08
C6: Wall-I-5 Branched Buffer	0.54	0.16	0.70			
O&M Facility Options						
Hunziker Full	0.00	0.68	0.68	0.00	1.39	1.39

Hunziker Full Buffer	0.00	0.71	0.71			
Hunziker Partial A	0.00	0.68	0.68	0.00	1.39	1.39
Hunziker Partial A Buffer	0.00	0.71	0.71			
Through 72nd	0.00	0.00	0.00	0.00	0.00	0.00
Through 72nd Buffer	0.00	0.00	0.00			
Branched 72nd	0.00	0.00	0.00	0.00	0.00	0.00
Branched 72nd Buffer	0.00	0.00	0.00			

Segment C contains by far the greatest amount of wetland resources. These wetland resources are associated with streams such as Red Rock Creek, Ball Creek and Fanno Creek in generally flat areas near Tigard. The portions of these wetlands near the project are generally surrounded and confined by development.

Historically, the area associated with Red Rock Creek was part of a larger wetland. The historical "Red Rock Creek Wetland" was probably more than 25 acres in size and contained a mix of forested, shrub, emergent and open water wetland types. The construction of Oregon Highway 217 (OR-217) severed the wetland into two portions, a 6.7-acre wetland/pond complex on the southwest side of the highway which contains the Knez Wetland and a 15-acre wetland area on the northeast side of the highway, referred to here as the "Costco Wetlands." The two wetlands are still hydrologically connected by Red Rock Creek, which passes under the highway in a culvert. Both wetlands are mapped by the NWI and RLIS as wetland, but the boundaries have been adjusted somewhat based on site visits and aerial photos.

The Knez Wetland, a 1.87-acre site, contains a relatively high-quality, remnant Willamette Valley wet prairie plant community. According to the wetland site's management plan, The Wetlands Conservancy (TWC) supported protection of the wetland in comments submitted to regulatory agencies during the Knez Building Materials, Inc. wetlands permitting process in 1991. Upon approval of the permit in 1992, Knez Building Materials, Inc. donated the property to the City of Tigard in 1992. TWC assisted the city in site management, and in 1994 the property was donated to TWC by the city (TWC, 2006).

Parametrix and David Evans and Associates, Inc. project team representatives met with a representative of TWC (Megan Garvey) on May 17, 2017. She described TWC's efforts to establish listed plant species in the remnant prairie portion of the property. She stated that Nelson's checker-mallow was planted several years ago but the fluctuating water levels (as a result of beaver dams as well as water inputs from outside the site) have made it difficult to control weeds and maintain the populations, and it is currently unknown whether the species persists at the site. She also mentioned that placement of a water control device known as a "beaver deceiver" could make water levels more predictable and improve conditions for the adjacent landowners, whose parking lots occasionally flood during high water.

Red Rock Creek flows south along the eastern edge of the Knez Wetland site and then continues south through a narrow strip of land that ends at SW Hunziker Street. The wetland extends onto adjacent properties to the north, west and east of TWC's parcel and contains additional wetland prairie, a hydrologically connected 1.3-acre stormwater detention pond and a short unnamed tributary of Red Rock Creek that enters the site from the northwest. The total area of the wetland/pond complex is approximately 6.7 acres, with about 4.4 acres in wetland prairie.

4. LONG-TERM IMPACTS

4.1. Long-Term Impacts of the No-Build Alternative

The No-Build Alternative would not include any of the proposed changes to the corridor's transportation system. Impacts would be limited to activities and conditions that already exist.

The potential ecosystem impacts from the No-Build Alternative are relatively few. Untreated stormwater runoff would continue to flow from unimproved impervious surfaces that the light rail alternatives would upgrade; stormwater would continue to flow untreated to project vicinity streams in many locations.

4.2. Long-Term Impacts of the Light Rail Alternatives

The light rail alignment alternatives in Segments A and B are largely in developed areas, and they share similar alignments in locations where they are adjacent to ecosystem resources. The discussions of impacts in Segments A and B include impacts that apply to all of the alignment alternatives in those segments. In Segment C, different alignments have different localized effects, and the impacts are discussed by alternative and facility where they differ from one another.

The station access improvements generally involve localized improvements such as new sidewalks and bike lanes and crossings that are primarily adjacent to roadways. Impacts from the station access improvements to contiguous, high-quality ecosystem resources are expected to be relatively few. Upgraded facilities that would be part of these improvements would likely include stormwater runoff treatment and management, which would benefit ecosystems.

4.2.1. Impacts Common to All Light Rail Alternatives

Direct long-term impacts could occur where the project crosses streams, removes vegetation or fills wetlands. The project includes the guideway, station footprints, roadway improvements, stormwater facilities and other ancillary features.

Riparian habitat could experience permanent impacts where guideways span areas of riparian vegetation. Construction of elevated guideways above vegetation would reduce the amount of water the vegetation receives from precipitation. In some areas, vegetation cleared from beneath elevated guideways might not grow back. Because elevated guideway structures would be relatively narrow, shading impacts on riparian vegetation would be limited in most areas, although some impacts would result from shading and water interception. Herbaceous plants and shrubs are generally able to grow beneath narrow guideways that are at least 15 feet above the ground (Sound Transit, 2011). Based on the nature and location of construction buffer impacts, as well as the current condition of the corridor itself, no substantial degradation of riparian functions (e.g., fish and wildlife habitat, food chain support or water temperature maintenance) or processes would likely result from project-related clearing under any of the alternatives.

Long-term impacts to streams could be caused by increases in the amount of impervious surface in the study area, which can increase stormwater runoff rates, volumes and pollutant loads. These impacts, in turn, can lead to higher peak flows and degrade water quality in streams. New impervious areas would include new tracks and guideways, stations, O&M facilities and roads. To minimize the potential

impacts of increased impervious surface, stormwater detention and treatment facilities would be constructed as part of the project. The amount of area treated would be sufficient to offset any increase in impervious surface area under any of the alternatives. Based on the implementation of these detention and treatment facilities and BMPs, peak flows would not be expected to increase in any of the streams in the study area as a result of the project; moreover, base flows would be expected to remain similar to current conditions. Stormwater from all project-related impervious surface would receive appropriate flow control where required. In addition, pollutant-generating impervious surfaces associated with the project would receive water quality treatment where applicable.

The effects on vegetation and wildlife habitat from project construction would vary, depending on the land cover type within the project clearing limits. The effects on the developed cover type, for example, would be minimal. Little or no vegetation is present in areas that are already developed; therefore, the replacement of existing developed cover with guideways or other facilities would constitute a minimal change in the characteristics of such areas or their ability to support wildlife.

Project construction could cause changes in habitat quality within the forest, woodland, shrubland and herbaceous cover types within Segments A and B, and in vegetated corridors within Segment C. In these cover types, replacement of existing vegetation with project features would represent a loss of structural and biotic diversity associated with the variety of plant and wildlife species previously present in the cleared areas. In areas with herbaceous and shrub vegetation, the potential for adverse effects would vary with site-specific conditions. For example, areas dominated by dense growth of invasive species (e.g., Himalayan blackberry [*Rubus armeniacus*]) typically do not support diverse and abundant communities of vegetation and wildlife. Conversely, areas with more native species would be expected to support a greater number and variety of species.

Construction of project features would have a greater likelihood of reducing the habitat quality of forest and woodland areas than other cover types. Clearing of trees, snags and understory vegetation would cause the loss of nesting and foraging sites for many species of birds, as well as a reduction in the availability of hiding cover for small mammals. The introduction of cleared areas through patches of contiguous forest cover would result in the fragmentation of the forested habitat. By increasing the amount of edge habitat (where sensitive wildlife species are less protected from weather extremes and are more susceptible to predation from species that are adapted to open habitats), fragmentation compounds the effects of habitat loss by reducing the quality of the remaining habitat.

Invasive plants rapidly colonize disturbed sites such as construction areas. They prevent native species from becoming re-established following ground disturbance, spread into undisturbed areas where they can affect habitat value on additional lands, and generally provide relatively poor wildlife habitat or forage. Several of the BMPs that would be implemented during project construction are intended to avoid, reduce and control new infestations of noxious weeds. Consistent and successful application of these measures would reduce potential habitat disturbance and improve existing habitats that are already disturbed.

Despite the implementation of BMPs, it is likely that some especially invasive weeds could become established in some areas disturbed during construction. However, the project could also improve conditions where existing weeds such as Himalayan blackberry, reed canarygrass (*Phalaris arundinacea*), or Japanese knotweed (*Fallopia japonica*) dominate vegetated areas within the study area. Because of project construction, such areas would either be replaced with project features or

disturbed and replanted with native species, increasing the potential for re-establishment of native vegetation.

Wetland impacts could be associated with fill for guideways and other project elements. Direct impacts would likely decrease the functions and values of the impacted wetlands, interrupt existing hydrological regimes, and remove wetland vegetation.

Further discussion of these potential impacts, by segment and ecosystem element, are discussed below.

4.2.2. Segment A: Inner Portland

The Segment A light rail alternatives traverse several piped streams and the forested area along SW Barbur Boulevard. As a result, the impacts from the alternatives within Segment A are mostly associated with tree removal.

Aquatic Species and Habitat

Direct impacts to fish are not anticipated within Segment A, because no fish-bearing streams are located within this segment. Direct impacts to streams would likely be insignificant, because most of the 10 streams currently traverse the alignment alternatives through pipes or culverts that have not been proposed for replacement. Indirect impacts could occur as a result of changes to hydrology and riparian buffers. No impacts to mapped 100-year floodplains would occur within Segment A.

Vegetation and Wildlife Species and Habitat

As shown in Table 3.2-1, the City of Portland (2011) maps the greatest amount of acreage of forest of the segments in Segment A, both in the construction footprint and the associated buffers. This forest habitat occurs on slopes adjacent to SW Barbur Boulevard in the southern half of the segment. The northern half consists of heavily developed and urbanized areas with little vegetation present. Within Segment A, the impacts to the four mapped vegetation classes are similar, with approximately 13.5 to 14.0 acres of forest within the construction footprints, 3.4 to 3.8 acres of woodland, 0.9 to 1.2 acres of shrublands, and 0.9 to 1.8 acres of herbaceous cover. Similar areas of each vegetation class are present in the construction buffers. The total amount of mapped vegetation classes within the Segment A light rail alternatives ranges from 37.4 to 39.6 acres.

Within Segment A, impacts to mapped E-zones are similar between all the alternatives (see Table 3.2-2). Total acreage of impacts from the construction footprint to the City of Portland's conservation E-zones for the three alternatives is 18.7 acres. Impacts to conservation E-zones within buffers for the three light rail alternatives range from 11.6 to 11.8 acres. Similarly, the acreage of impacts to protection E-zones is 1.2 acres within the construction footprint and 1.2 acres within the buffer. Most of these impacts are associated with the forested area along SW Barbur Boulevard.

For the four Marquam Hill connection options, impacts to vegetation would encompass between 0.8 and 1.7 acres within the construction footprints and 1.4 and 1.7 acres within the footprint buffers. The forest vegetation class would be the only class to be impacted by these options. Similarly, impacts to E-zones would total between 2.7 and 3.1 acres of conservation E-zone and 0.1 and 0.9 acre of protection E-zone.

The presence of threatened or endangered wildlife or plant species within Segment A is not likely. Sensitive bird and mammal species, however, including pileated woodpecker and Townsend's big-eared bat, likely inhabit the forested areas along SW Barbur Boulevard. Removal of trees would have a negative impact on these species, but the impact would be minimal in the context of the remaining habitat in the area.

Overall, impacts to vegetation and wildlife species with all the Segment A light rail alternatives and Marquam Hill connection options would be noticeable but minimal.

Wetlands

Within Segment A, RLIS data shows no wetlands, but according to NWI data, small riverine wetlands are present. Data reviews and limited site visits support the accuracy of this presence, and it is due to the developed nature of much of the alternative and the steep slopes that lie outside of developed areas. Riverine wetlands are found along small unnamed tributaries that lead from forested slopes west of the alternative, which are then piped under SW Barbur Boulevard, I-5 and development in Southwest Portland. These streams are listed in Table 3.1-1. About 0.2 acre of impacts to mapped NWI wetland areas could occur with any of the light rail alternatives. In addition, impacts to unmapped, small riverine wetlands are possible, which could slightly increase total wetland impacts. A comprehensive delineation of wetlands would be completed during the design and permitting phase of the project.

Currently no palustrine or emergent wetlands are mapped within the Marquam Hill connection options. Impacts to smaller, undiscovered wetlands are possible, but they would be limited.

Overall, the level of potential impacts to wetlands in Segment A is considered minor.

Threatened and Endangered Species

No threatened or endangered species, or other sensitive species, are likely present within Segment A. Impacts to ESA-listed fish from stormwater runoff are possible but are not confined to this segment. However, increased stormwater treatment could provide a net benefit in the long term. Sensitive bird and mammal species, including pileated woodpecker and Townsend's big-eared bat, likely inhabit the forested areas along SW Barbur Boulevard. Removal of trees would have a negative impact on these species, but the impact would be minimal in the context of the remaining habitat in the area.

4.2.3. Segment B: Outer Portland

The Segment B alternatives traverse several piped streams and the forested area along SW Barbur Boulevard, as well as mostly developed areas. As such, the impacts from the alternatives within Segment B are associated with tree removal in the northern and southern extents of the segment.

Aquatic Species and Habitat

Direct impacts to fish are not anticipated within this segment, because no fish-bearing streams are located within this segment. Direct impacts to streams would likely be insignificant, because most of the 11 streams currently traverse the alternative alignments through pipes or culverts that have not been proposed for replacement as part of the project. Indirect impacts could occur as a result of changes to hydrology and riparian buffers. No impacts to mapped 100-year floodplains would occur within Segment B.

Vegetation and Wildlife Species and Habitat

Vegetation acreage impacted in Alternative B is approximately three-quarters that of Alternative A, with a higher proportion of herbaceous cover and a lower proportion of woodland and forested cover (see Table 3.2-1). The central portion of the segment consists of heavily developed and urbanized areas with little vegetation present. Within Segment B, the impacts to the four mapped vegetation classes are similar, with approximately 2.7 to 4.3 acres of forest within the construction footprints, 5.1 to 8.5 acres of woodland, 0.1 to 0.3 acres of shrublands, and 3.4 to 4.5 acres of herbaceous cover. Similar areas of each vegetation class are present in the construction buffers. The total amount of mapped vegetation classes within the Segment A alignment alternatives ranges from 26.0 to 31.1 acres.

Within Segment B, impacts to mapped E-zones are similar between all of the alternatives. Impacts to conservation E-zones within the construction footprint of the three alternative alignments are approximately 0.3 acre. Impacts to conservation E-zones within buffers for the three alternatives are approximately 1.1 acres. Similarly, impacts to protection E-zones are negligible (0.0 acre) within the construction footprint and 1.3 to 1.4 acres within the buffer. Most of these impacts are associated with the forested area along SW Barbur Boulevard in the northern portion of Segment B.

The presence of threatened or endangered wildlife or plant species within Segment B is not likely. Sensitive bird and mammal species, however, including pileated woodpecker and Townsend's big-eared bat, likely inhabit the forested areas along SW Barbur Boulevard. Removal of trees would have a negative impact on these sensitive species, but the impact would be minimal in the context of the remaining habitat in the area.

Overall, impacts to vegetation and wildlife species within Segment B would be minimal.

Wetlands

Similar to Segment A, wetland resources impacted in Segment B are limited to small areas consisting of forested/shrub and riverine wetlands found along streams. A small wetland, unmapped in RLIS but mapped by NWI, was found at SW 35th Avenue and SW Barbur Boulevard. Although it appears to be a shrub wetland based on characteristics observed during the field visit, it is identified by NWI as riverine. Impacts to this wetland would be approximately 0.01 acre within the construction footprint and 0.03 acre within the construction buffer for all four Segment B light rail alternatives. Additional impacts to a mapped forested/shrub wetland would occur along the upper portion of the stream called Red Rock Creek as it intersects I-5 near SW Barbur Boulevard. Potential impacts to this wetland would be less than 0.1 acre within the construction footprint and less than 0.1 acre within the construction buffer.

Overall, the level of potential impacts to wetlands in Segment B is considered minor, with the impact to wetlands of each light rail alternative totaling approximately less than 0.1 acre within construction footprints and less than 0.1 acre within construction buffers.

Threatened and Endangered Species

No threatened or endangered species, or sensitive species, are likely present within this segment. Impacts to ESA-listed fish from stormwater runoff are possible, but they would not be confined to this segment or specific alternatives. Additional discussion of stormwater runoff for all the alternatives is

discussed above. However, increased stormwater treatment could provide a net benefit in the long term. Sensitive bird and mammal species, including pileated woodpecker and Townsend's big-eared bat, likely inhabit the forested areas along SW Barbur Boulevard. Removal of trees would have a negative impact on these species, but the impact would be minimal in the context of the remaining habitat in the area.

4.2.4. Segment C: Tigard and Tualatin

Within Segment C, the majority of the study area consists of developed land cover. Developed land cover includes commercial and residential buildings, schools, roads, sidewalks, railways and other infrastructure. The remainder of the study area consists of several undeveloped areas primarily within road and railway rights of way; the riparian corridor of Red Rock Creek, Fanno Creek; and other streams; and park areas adjacent to creeks. The Segment C light rail alternatives traverse several piped and open streams and wetlands near OR-217, as well as mostly developed areas. As such, most of the impacts from the alternatives within Segment C are associated with wetland impacts.

Aquatic Species and Habitat

Direct impacts to fish are not anticipated for the Segment C light rail alternatives, because there are no fish-bearing streams. Direct impacts to streams could be possible, because the most of the six streams that currently traverse the alignment alternatives do so on the surface. Within Segment C, impacts to mapped 100-year floodplains within construction footprints and buffers range between 2.1 and 4.5 acres for the light rail alternatives.

Vegetation and Wildlife Species and Habitat

Because much of Segment C is urbanized and developed, it contains less area of mapped vegetation than the Segments A and B. Within Segment C, impacts to mapped City of Tigard vegetated corridors are similar between all six of the alternatives. Impacts to corridors within the construction footprint for the six alternative alignments range from 3.3 to 4.1 acres. Impacts to vegetated corridors within construction buffers for the six alternatives range from 4.0 to 5.4 acres. Most of these impacts are associated with the forested areas along Red Rock Creek and Fanno Creek.

The presence of threatened or endangered wildlife species within Segment C is not likely; however, Nelson's checkermallow could occur in the Knez Wetland. Impact to this plant species is discussed in further detail in the section "Threatened and Endangered Species" below. Sensitive bird, mammal and reptile species, including purple martin, Townsend's big-eared bat and western pond turtle, likely inhabit the vegetated and wetland areas along Red Rock Creek. Removal of trees and modification of wetland and pond areas would have a negative impact on these species, but the impact would be minimal in the context of the remaining habitat in the area.

Overall, impacts to vegetation and wildlife species within Segment C would be minimal.

Wetlands

Direct impacts to wetlands in Segment C, from the light rail alternatives and associated buffers, are shown in Table 3.3-1. The City of Tigard's LWI mapping results are used here, because they indicate the most conservative (highest) level of impacts. Based on this mapping, between 0.4 acre and 1.8 acres of impacts to jurisdictional and significant wetlands could occur within the construction footprints of the

Segment C light rail alternatives. Between 0.7 acre and 2.2 acres of impacts to jurisdictional and significant wetlands could occur with the construction footprint buffers. Impacts to the relatively large wetland complexes north of OR-217 (the Costco Wetlands) and the Knez Wetland would likely require substantial coordination with regulatory agencies and mitigation partners before permits could be received for unavoidable impacts to either of these wetlands.

Threatened and Endangered Species

No threatened or endangered fish or wildlife species are likely present within this segment, except for one federally listed plant, the Nelson's checkermallow, which was planted within the Knez Wetland complex as part of a past restoration effort. Its current presence is unknown, but anecdotal information suggests that the initial plantings did not survive (M. Garvey, pers. comm., 2017). Therefore, impacts from Alternative C1: Ash to I-5 would need to be assessed more closely in this area. In addition, potential habitat for Nelson's checkermallow is likely present within the wetland complex north of OR-217 (the Costco Wetlands), and further investigation for plant presence would need to be conducted.

Impacts to ESA-listed fish from stormwater runoff is possible, but such potential impacts are not confined to this segment. Additional discussion of stormwater runoff for all the alternatives is included above.

4.2.5. O&M Facilities Options

At the Branched 72nd Facility or the Through 72nd Facility, an unnamed tributary to Carter Creek is present between the facilities and I-5. Red Rock Creek flows to the east of the Hunziker facilities (Hunziker Full Facility and both of the Hunziker partial facilities). Both the 72nd and Hunziker sites appear to have a fringe of non-native, invasive vegetation, such as Himalayan blackberry, present between the stream and the proposed footprint. During development, this vegetation would likely be impacted. The streams associated with the O&M facilities are not recorded as containing fish, but indirect impacts to these streams could occur through construction and operation of the facilities.

Of the O&M facilities options, mapped floodplains occur only at the Hunziker options. Between 5.2 and 10.2 acres of mapped floodplains are present at the Hunziker options. No mapped floodplains are present at the proposed 72nd Avenue options.

In general, the proposed O&M facilities are located in areas of existing development; therefore, vegetation at the O&M facilities is mapped entirely as Grass/Open Area, with no forested vegetation present.

Direct impacts to wetlands could occur as a result of the construction of the Hunziker O&M facilities options, because there are mapped RLIS, NWI, and LWI wetlands present on the eastern edge of the parcels, although in general the O&M facilities have been proposed in areas of existing development. While no wetlands have been mapped at the Branched 72nd Facility or the Through 72nd Facility, an unnamed tributary to Carter Creek is present between the facilities locations and I-5.

4.2.6. Station Access Improvements

Improvements for bike and pedestrian access to stations have been proposed for areas outside of the light rail alternatives alignments. These projects generally include improved or new sidewalks, bike lanes and road crossings. Where these improvements occur, potential impacts to vegetation, wildlife, roadside ditches and roadside wetlands could occur. Given that their locations are mainly adjacent to roadways, impacts to contiguous, high-quality ecosystem resources are expected to be relatively low. During design and permitting of the Southwest Corridor Light Rail Project, additional identification of these resources would occur, negative impacts would be minimized to the extent practicable, and compensatory mitigation would be implemented for unavoidable impacts. Upgraded facilities could include stormwater runoff treatment and management, which would benefit ecosystems.

5. CONSTRUCTION IMPACTS

Construction impacts discussed in this section are generally short-term and temporary.

5.1. No-Build Alternative

As stated above, existing conditions characterize the No-Build Alternative, which would not include any of the project's proposed changes to the transportation system in the corridor. Consequently, the No-Build Alternative would not include construction over the length of the corridor and, therefore, would avoid, or have fewer short-term impacts to, ecosystem resources.

5.2. Light Rail Alternatives

Although detailed construction areas are not defined at this early phase in the project design, the potential construction limits have been estimated for this analysis. The contractor could identify additional staging areas later, if needed. Direct construction impacts will be identified during the Final EIS and permitting phases.

Temporary disturbance to vegetation would occur during construction as a result of direct removal of vegetation and potential soil compaction. Dust from construction also has the potential to adversely impact surrounding vegetation through settlement of dust on leaf surfaces, thereby reducing photosynthetic efficiency. Temporary impacts to vegetation would be minimized by limiting construction staging and access corridors to the minimum size practicable and siting such areas in already disturbed areas where possible. Temporarily disturbed areas would be revegetated with native plant species, where feasible, and restored to pre-project conditions or better. Silt fencing and other erosion control methods would be utilized to minimize the potential short-term impacts to adjacent vegetation. A return to pre-construction conditions would depend in part on the re-establishment of vegetation, however, and would not occur immediately. Herbaceous vegetation and some fast-growing shrubs would require two to five years to return to pre-project conditions. Areas of mature forest would require several decades.

Short-term impacts could include visual and auditory disturbance, and removal of vegetation during construction. Any birds protected by the Migratory Bird Treaty Act that are nesting in areas cleared or graded during construction could be adversely affected. These impacts could be avoided by several methods, including scheduling the clearing activity for the non-nesting season, conducting surveys to determine occupancy before construction or excluding birds from nesting on structures.

In addition, noise, lights and other disturbance from construction could negatively affect breeding, foraging, and dispersal of both common and protected terrestrial wildlife that might avoid loud machinery, and migratory birds that might no longer rest or feed near the construction areas. Lights used for night work could disturb nocturnal animals such as owls or bats, or disrupt night-migrating birds.

6. INDIRECT AND CUMULATIVE IMPACTS

6.1. No-Build Alternative

6.1.1. Indirect Impacts

Existing conditions characterize the No-Build Alternative, which would not include any of the proposed changes to the corridor's transportation system and, therefore, would have no direct impacts to wetlands, waterways, fisheries, wildlife, plants, and threatened, endangered or sensitive species. Because much of the area's transportation facilities and adjacent developments were built before current stormwater management treatment practices were in place, stormwater runoff from impervious surfaces would continue to flow untreated or undertreated to project vicinity streams until redevelopment occurs.

6.1.2. Cumulative Impacts

Cumulative impacts of the No-Build Alternative could occur as a result of any or all of the past, present and reasonably foreseeable projects. Over time, these factors have reduced the extent and diversity of the region's ecosystems. The No-Build Alternative could exacerbate the decline of ecosystem health by not retarding personal automobile usage in the region and by not encouraging growth in a manner that is consistent with regional density goals.

6.2. Light Rail Alternatives

6.2.1. Indirect Impacts

Changes in Stormwater Treatment

As in much of the region, many of the existing facilities within the study area either do not have any stormwater runoff treatment facilities or have facilities that are not up to standards. With construction of light rail, stormwater management facilities would be implemented to meet local requirements of the City of Portland, the City of Tigard or Clean Water Services, and these new or upgraded facilities would indirectly benefit ecosystems.

Waterways and Floodplains

Potential impacts to floodplains could affect aquatic habitats and fish. There are no mapped 100-year floodplains within Segments A and B of the ecosystems study area, but there are within Segment C. Additional details on floodplains are discussed in Section 3.10, Water Resources, of the Draft EIS.

Wildlife Crossings

With the construction of retaining walls along SW Barbur Boulevard, terrestrial animal crossings would likely be hindered. Anecdotal evidence suggests that a small herd of deer, and occasionally elk, inhabit the forested area between SW Hamilton Street and SW Terwilliger Boulevard. Individual deer occasionally cross SW Barbur Boulevard; however, barriers to crossings in areas where collisions could occur, such as the retaining walls that would be a part of the light rail alternatives, would be a benefit. Crossing of SW Barbur Boulevard would still be possible through the Newberry Street and Vermont Street viaducts.

Terrestrial Disturbance

Both noise and human activity have been demonstrated to displace wildlife from occupied habitats, interfere with the ability of birds to hear territorial songs, interfere with mating and alarm calls of amphibians and small mammals and interfere with raptor foraging activities. The ecosystems study area is within or immediately adjacent to developed areas for nearly its entire length. Wildlife that use habitats adjacent to the light rail alternatives alignments are generally accustomed to some level of human activity and noise. Impacts would be related to changes in noise levels and the types of human activities. Based on the limited amount of area that would be affected under any of the light rail alternatives, such effects would not be expected to cause changes in the regional populations of any wildlife species.

6.2.2. Cumulative Impacts

Future planned projects in the ecosystems study area are more local in scale than the Southwest Corridor Light Rail Project, and are generally in areas that are already developed. Future projects would generally have limited potential to adversely affect ecosystem resources, because any projects or land use actions would be subject to regulatory review and permitting, which would trigger measures to avoid, minimize or mitigate impacts on ecosystem resources. Such processes would also result in compensatory mitigation for any unavoidable impacts to streams or stream buffers, and wetlands or wetland buffers.

7. POTENTIAL MITIGATION MEASURES

In accordance with state and federal regulations and Executive Order 11990, the project would avoid and minimize impacts to ecosystem resources, including wetlands, waters and vegetation, to the extent practicable during the construction of the project.

During construction, BMPs would be used to avoid impacts to wetlands and waters from erosion, spills, damage to vegetation or disruption of hydrology. Standard specifications and special provisions would direct contractors to avoid and minimize impacts. In addition, standard terms and conditions of approvals from regulatory agencies will be incorporated into the preliminary designs analyzed in this document. The project team would work collaboratively with local, state, and federal permitting agencies to seek compensatory mitigation objectives and site selection after a preferred alternative is selected.

Compensatory mitigation for these direct impacts is regulated by federal, state and local jurisdictions as described in Section 1.2 of this report, and would typically require restoring or enhancing degraded wetland areas or establishing new wetlands nearby to compensate for functions lost or degraded by those impacts.

Within Segments A and B, potential compensatory mitigation for wetland impacts could include on-site or off-site enhancement or restoration of existing wetlands, or creation of new wetlands. The selection of these sites would depend on the area needed for mitigation, current and future ownership of potential mitigation sites, and site characteristics. Likely mitigation sites depend on the area needed for mitigation, current and future ownership of potential mitigation sites, and site characteristics. Mitigation sites would be selected based on soil types and topographic position that would increase the likelihood of successful restoration or establishment of wetland conditions.

Within Segment C, where wetland impacts could occur, compensatory mitigation would likely consist of purchasing credits through an approved mitigation bank or in-lieu-fee program. In addition, impacts to the existing Knez Wetland could be mitigated through enhancement or restoration of the existing wetland complex or purchase of adjacent parcels for the benefit of protecting the existing wetland complex. It could also be possible to improve habitat for plant species listed as threatened under the federal ESA through improvements to hydrology and vegetation.

8. REFERENCES

City of Portland. 2011. City of Portland Bureau of Planning & Sustainability Natural Resource Inventory Update, Vegetation Mapping Project. November 28, 2011. Available online at: https://www.portlandoregon.gov/bps/article/106047.

COT (City of Tigard). 1997. City of Tigard Local Wetlands Inventory, Wetlands Assessment. Prepared for the City of Tigard by Fishman Environmental Services. December 1994, approved by the Oregon Division of State Lands. September 1997.

COT. 2017. Tigard Maps webmapping platform. Available at: https://www.tigardmaps.com/mox6/publicinteractive.cfm. Last accessed: July 11, 2017.

Csuti, B. A., A. J. Kimerling, T. A. O'Neil, M. M. Shaughnessy, E. P. Gaines, and M. M. P. Huso. 1997. Atlas of Oregon Wildlife: Distribution, Habitat, and Natural History. Oregon State University Press. Corvallis, OR.

CWS (Clean Water Services). 2017. Chapter 3 – Sensitive Areas and Vegetated Corridors Design and Construction Standards – R&O 17-05. Available at: https://www.cleanwaterservices.org/permits-development/design-construction-standards/. Accessed July 19, 2017.

Fishman Environmental Services. 1997. City of Tigard Local Wetlands Inventory, Wetlands Assessment. Prepared for City of Tigard. December 1994. Portland, Oregon.

Metro. 2017. Metro Regional Land Information Service (RLIS) mapping website. Available at: http://rlisdiscovery.oregonmetro.gov/?action=viewDetail&layerID=462. Accessed June 5, 2017.

ODFW (Oregon Department of Fish and Wildlife). 2009. Abundance and Distribution of Fish Species in City of Portland Streams, Completion Report 2009, Project Period: 1 March 2008 to 30 June 2009. Prepared by Erick S. Van Dyke and Adam J. Storch. Prepared for City of Portland, Bureau of Environmental Services. December 2009. Clackamas, Oregon.

ODFW. 2017. Centralized Oregon Mapping Products and Analysis Support System (COMPASS). Available at: http://compass.dfw.state.or.us/. Accessed June, 20, 2017.

ORBIC (Oregon Biodiversity Information Center). 2017. Data system search for rare, threatened and endangered plants and animals in the vicinity of 12 mile area between Portland and Oregon. May 18, 2017.

PNWHFG (Pacific Northwest Hydrography Framework Group). 2005. Oregon Hydrography Water Courses data layer. Available at: http://spatialdata.oregonexplorer.info/geoportal/details;id=c4119ef0b66d4219b080d91c495525e9. Accessed June 2, 2017.

Sound Transit. 2011. East Link Light Rail Project, Seattle, Washington: Final Environmental Impact Statement. Appendix H3, Ecosystems Technical Report. Prepared by CH2M HILL. Seattle, WA.

TWC (The Wetlands Conservancy). 2006. Knez Wetland Management Plan. August 2004, Last updated June 2006.

USFWS (United States Fish and Wildlife Service). 2017. Information, Planning, and Conservation (IPaC) Data Query. Available at: https://ecos.fws.gov/ipac/. Accessed on February 9, 2017.

Personal Communications

Garvey, Megan, The Wetlands Conservancy, discussion with Bill Hall (Parametrix), Phil Rickus (David Evans & Associates), and Ethan Rosenthal (David Evans & Associates). May 17, 2017.