III. Floodplains by Watershed

A. Willamette River

The lower Willamette River is defined as the segment of the river between Willamette Falls in Oregon City and its confluence with the Columbia River at Kelley Point Park in Portland. This segment, the majority of which falls within the City's Urban Services Boundary (USB) starting in Dunthorpe, is substantially distinct from the rest of the Willamette River Basin above it by virtue of the proximity and influence of the Columbia River. The Missoula Floods that flowed down the Columbia River and adjacent lands over 10,000 years ago scoured many of the morphological features that continue to define the structure of the lower Willamette River channel and surrounding areas. The daily and seasonal flows from the upper Columbia Basin define the hydrology of the lower Willamette, and tidal effects are transmitted from the coast. For the purposes of planning, BPS has divided the lower Willamette River in Portland into three reaches: South Reach, Central Reach, and North Reach. The South Reach stretches from the southern boundary of the USB at Dunthorpe to the Ross Island Bridge. The Central Reach, which includes the South Waterfront Subdistrict, begins to the north of the South Reach and extends from South Waterfront until around the Fremont Bridge. The North Reach is the remaining segment of the river from the Fremont Bridge to the confluence with the Columbia River at Kelley Point.

As the lower Willamette River enters the USB at Dunthorpe, the river is naturally incised into steep bedrock walls that confine the narrow channel, which results in a very narrow floodplain. Some of the deepest natural depths of the river (over 100 feet) exist in this portion of the South Reach, as well as some of the most continuous riparian tree canopy. As the river continues towards the Central Reach, landform constraints become less severe, and the channel widens and divides around Ross Island and associated smaller islands. Through the Central Reach and North Reach, the Willamette becomes increasingly influenced by the Columbia River, but its present form has been largely defined by a century of development, dredging, and industrial activities. However, as is shown by the historical flood events described above, the Willamette River can reclaim its historic floodplain and channels during flood events, with huge, costly, and lasting impacts on the city. The total acreage of land (excluding the area below ordinary high water) mapped in the Willamette River's existing floodplains are shown in Table 14.

TABLE 14: WILLAMETTE RIVER COMBINED FLOOD HAZARD AREA BY REACH (IN ACRES)

Willamette River Reach	# Tax lots	100-Year Floodplain	1996 Flood Inundation Area	1996 Full Flood Extent[8]	100-Year & 1996 Flood Inundation Area
North Reach	406	1,303	1,158	1,303	1,446
Central Reach	117	35	54	57	66
South Waterfront	39	55	4	78	56
South Reach	193	395	391	391	432
Willamette River Total	**755**	**1,789**	**1,606**	**1,829**	**2,000**

Today, the Willamette River in Portland provides for many uses, including shipping; industrial and commercial enterprises; residential uses; subsistence, commercial, and recreational fishing; other types of recreation; and fish and wildlife habitat. The river channel has been substantially altered and the river bottom is periodically dredged to improve navigation and allow large barges and ships to access Portland shipping terminals. The federal navigation channel extends from the mouth of the river upstream 11.5 miles to the Broadway Bridge. The width of the channel varies from 600 to 1,900 feet and the maintained depth is approximately 40 feet (the authorized channel depth is 43 feet), maintained by the Portland District U.S. Army Corps of Engineers.

i. Floodplain

The mostly static present form of the Willamette's floodway and floodplain differs substantially from its dynamic form prior to dams, significant development, and other alterations. Historically, the reduced landform constraints to the north of Sellwood allowed the formation of floodplains and off-channel habitats, with large off-channel lakes such as Guilds, Doane, and Ramsey Lakes (now covered by much of the industrial Northwest Portland). Historically, the river channel of the lower Willamette was a transitional zone between the highly constrained basalt trench from Willamette Falls to the South Reach to the wide and less constrained channel nearer to the confluence with the Columbia River. At the confluence, the Willamette River formed the southern portion of a vast floodplain system that included Smith & Bybee Lakes, Sauvie Island, and the Multnomah Channel, and Vancouver Lake and what is now Ridgefield Wildlife Refuge across the river, all of which provided high quality and extensive habitat for large numbers and types of biota at this ecological crossroads. This large low-lying floodplain complex

[8] Statistics for the actual 1996 Flood Extent are included for informational purposes, only. Portland does not apply floodplain regulations to this area.

was frequently reconfigured by flooding in the absence of the flood control systems in place today both locally and farther upstream.

Over the last 150 years, much of the floodplain, bottomland forests, and wetlands were drained or filled, and developed. Few large, connected and intact habitats remain in the floodplain in Portland. Below are images from the Willamette River Atlas (City of Portland, 2001) that depict the historic and more recent conditions of the Willamette River.

Along the river's length in Portland, riparian forests, mudflats, off-channel streams, lakes, and wetlands were connected to the river during seasonal high flows. In-channel islands, such as Sauvie, Swan and Ross islands, provided high quality fish and wildlife habitat that would change seasonally in response to flood events. The historical floodplain provided storage for floodwaters and sediment, nutrient exchange, as well as groundwater and wetland recharge. The floodplain also served as a source of organic matter and food supply (e.g., insects) to the Willamette River, and as a refuge for fish and wildlife during floods, providing slower flows and hiding spaces to avoid the high flows of the main channel. And although the portions of the remaining floodplain continue to provide some or all of these ecosystem functions, the overall condition of the river's floodplains have declined substantially over time.

Depictions of the extensive braiding of the Willamette River in 1888 compared with the much more channelized river in 2001.

Figure 12: Historic (circa 1888) vs recent (2001) floodplain conditions

Processes that have led to changes from historical to current floodplain conditions primarily involve the placement of fill and structures to support industrial, commercial, transportation and residential development of the floodplain. Placement of fill alters floodplain function by disturbing native vegetation, modifying absorption rates, and isolating the floodplain from the channel, thereby reducing the frequency of inundation from flooding events. The placement of structures in the floodplain – buildings, roads, pipes and utilities – cover the floodplain, diminish or eliminate its ability to provide many functions to the river, and introduce pollutants.

As a result of these processes, off-channel habitat in the lower Willamette River is one of the habitat types most greatly diminished in quantity and quality from historical condition. Floodplain fill, vegetation removal, bank and channel alterations, and urban development have destroyed floodplain, off-channel, and riverine habitats or greatly altered their structure and function. Large off-channel lakes such as Guilds Lake and Ramsey Lake were filled to provide land for downtown and port development, while Doane Lake was reduced in size and its connection to the river severed. At the same time, tributaries all along the lower river were piped underground to support development and disconnected from the mainstem channel. Most of the tributaries draining the West Hills into the Willamette have been disconnected by the presence of long culverted or piped sections. Figure 13, Figure 14, and Figure 15 show some of the off-channel habitat that has been lost to development over time, by river reach.

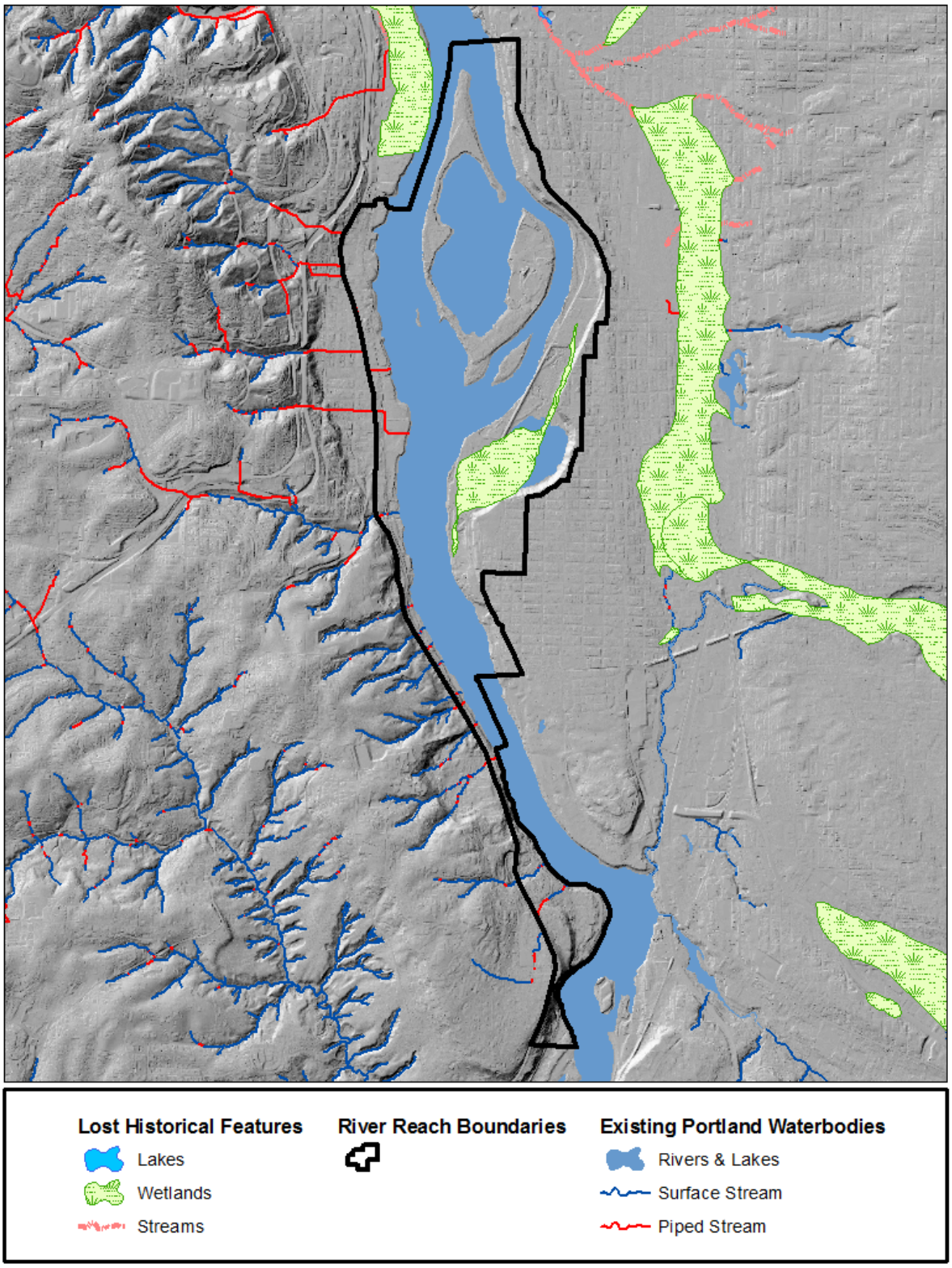


Figure 13: Historical off-channel lakes, wetlands, and streams lost to development in the South Reach (BES, 2016)

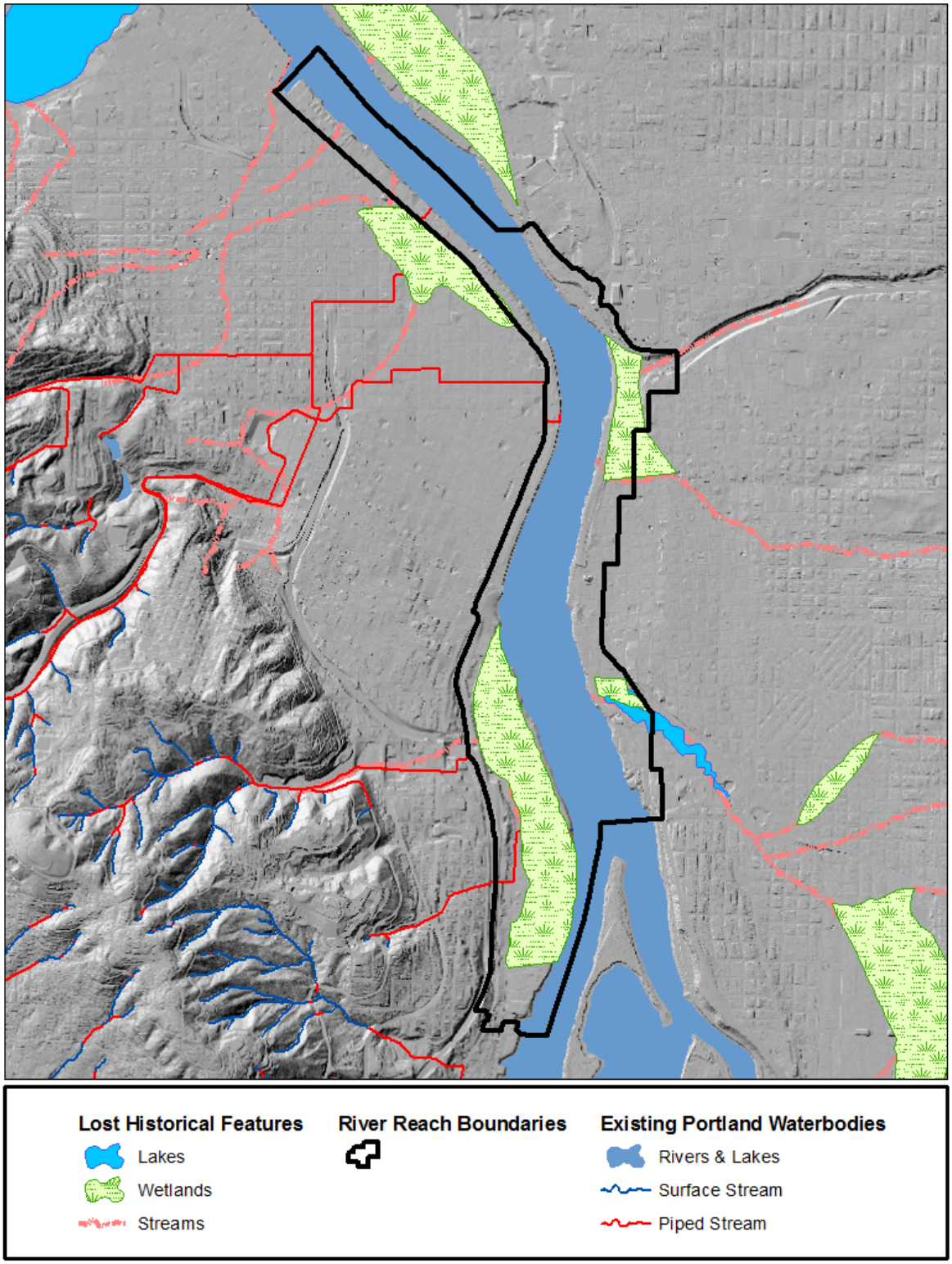


Figure 14: Historical off-channel lakes, wetlands, and streams lost to development in the Central Reach (BES, 2016)

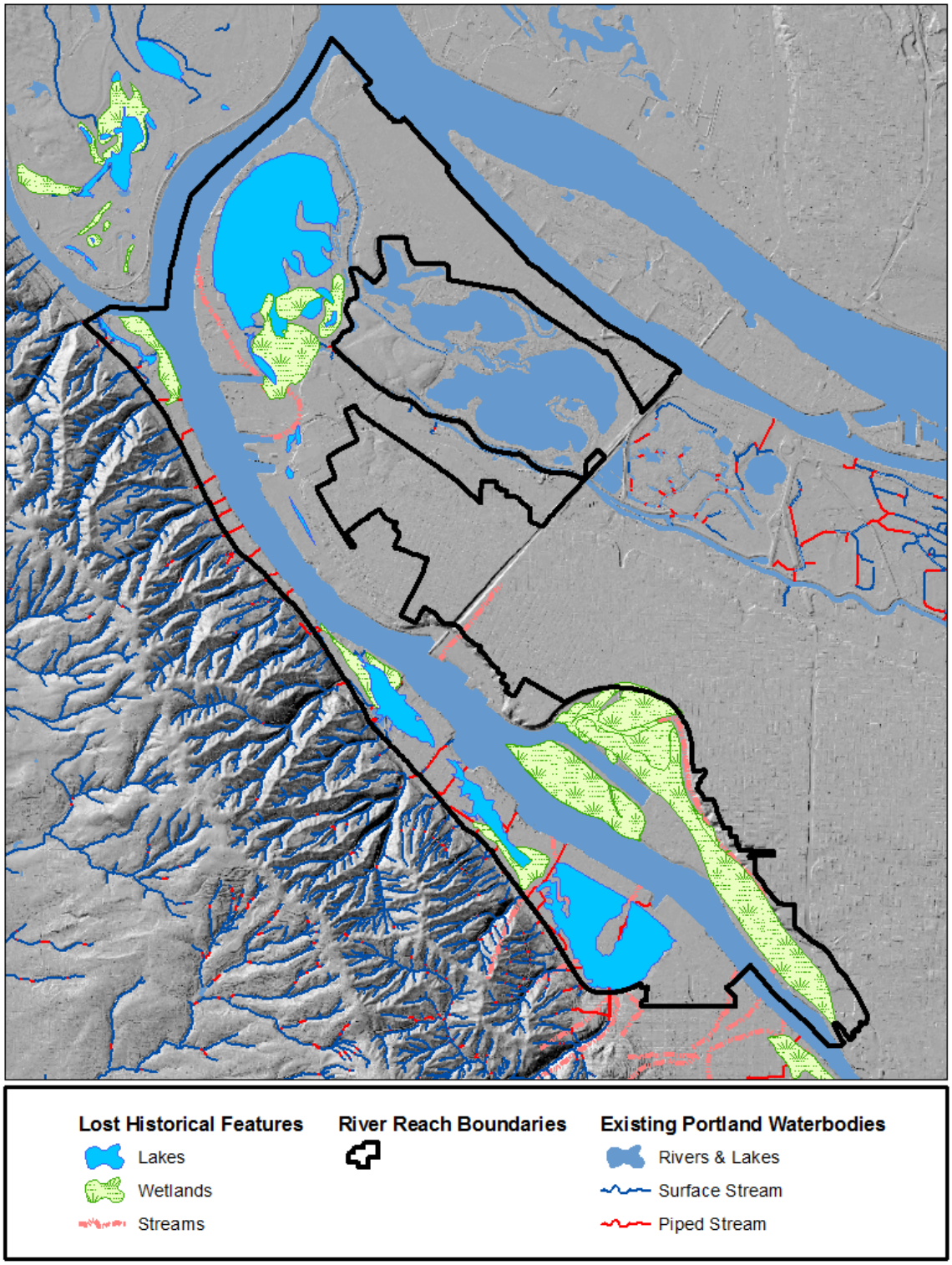


Figure 15: Historical off-channel lakes, wetlands, and streams lost to development in the North Reach (BES, 2016)

ii. Riparian Buffer Area

The River Plan/South Reach project mapped the riparian buffer area along the South Reach of the Willamette and applied additional requirements in this area as part of the River Overlay Zones chapter of the Zoning Code (33.475). These requirements are intended to preserve and enhance riparian vegetation, particularly native trees, as well as to require improvements to riparian habitat functions if certain types of development are proposed in this area. As is shown in Table 15, the Central Reach (excluding South Waterfront) has 42 acres of RBA and 26 existing buildings in the RBA. In contrast, the South Reach has 256 acres and 197 structures within by RBA. However, 178 acres of the mapped RBA is within the Open Space base zone. For all of the Willamette River, a total of 505 tax lots intersect the RBA and, of those, 99 tax lots are zoned Open Space.

TABLE 15: WILLAMETTE RIVER RIPARIAN BUFFER AREA

Reach	# Tax lots	Acres of RBA	Buildings in RBA
Central Reach	62	42	26
EX	20	18	11
RX	7	4	10
CX	6	3	4
OS	27	17	1
IG1	2	0.5	0
North Reach	250	589	121
IH	179	392	107
IG2	19	43	7
IG1	4	1	3
EG2	16	16	2
OS	28	107	1
CI1	2	13	1
CX	1	1	0
RF	1	16	0
South Reach	168	256	197
RF	2	20	68
R20	59	16	41
CM1	2	3	22
R5	29	2	21
CM2	13	16	18
RM4	6	8	10
OS	43	178	7
RM2	8	9	7
R10	2	0.2	2

Reach	# Tax lots	Acres of RBA	Buildings in RBA
EG2	3	4	1
South Waterfront	22	28	9
CX	24	34	9
OS	1	0.8	0
Grand Total	**505**	**923**	**353**

iii. Potential Impact of Development in Floodplains

Along the Willamette River in Portland, approximately 568 individual tax lots (1,283 acres) are partially or fully within a mapped floodplain (100-Year and Metro Title 3/1996). Of these tax lots, 140 are located completely (95 percent or more) within a floodplain and 428 are located partially within a floodplain (see Table 16, below).

TABLE 16: WILLAMETTE RIVER TAX LOTS WITHIN THE COMBINED FLOOD HAZARD AREA BY BASE ZONE

Reach	Zone	Fully Within (>95%)	Partially Within	Grand Total
Central Reach	EX	6	31	37
	IG1	14	15	29
	OS	7	20	27
	CX	3	12	15
	RX	1	8	9
Central Reach Total		31	86	117
North Reach	IH	90	225	315
	IG2	4	28	32
	OS	16	15	31
	EG2	0	20	20
	IG1	0	4	4
	CI1	0	2	2
	CX	0	1	1
	RF	0	1	1
North Reach Total		110	296	406
South Reach	R20	9	50	59
	OS	23	28	51
	R5	18	16	34
	CM2	6	19	25
	RM2	2	6	8
	RM4	1	5	6

Reach	Zone	Fully Within (>95%)	Partially Within	Grand Total
	EG2	0	3	3
	R10	0	2	2
	CM1	0	2	2
	RF	2	0	2
	RM1	0	1	1
South Reach Total		61	132	193
South Waterfront	CX	4	33	37
	OS	0	2	2
South Waterfront Total		4	35	39
Grand Total		**206**	**549**	**755**

A closer look at the tax lots partially within a floodplain allows an estimate of the potential for new development or redevelopment to impact floodplains. Using the maximum building coverage allowed by the base zone as a proxy, we analyzed whether tax lots the contained development area allowed by the base zone outside of the floodplain. The results of this analysis (summary results in Table 17, below) show that of the 755 properties that are located within the combined flood hazard area, 82 tax lots (10.8%) have sufficient area outside of the floodplain to develop to maximum building coverage. Development on the remaining 562 lots would either include some building in the floodplain or the building coverage would have to be less than the maximum allowed to avoid floodplain impacts. The percentage of the maximum building coverage that is within the floodplain on individual tax lots varies significantly.

TABLE 17: WILLAMETTE RIVER – TAX LOT AREA OUTSIDE OF THE FLOODPLAIN IS GREATER THAN OR EQUAL TO THE MAXIMUM ALLOWED BUILDING COVERAGE

Reach	No	Yes	Open Space	Grand Total
Central Reach	90	0	27	117
EX	37	0	0	37
IG1	29	0	0	29
OS	0	0	27	27
CX	15	0	0	15
RX	9	0	0	9
North Reach	360	15	31	406
IH	315	0	0	315
IG2	25	7	0	32
OS	0	0	31	31
EG2	13	7	0	20

Reach	No	Yes	Open Space	Grand Total
IG1	4	0	0	4
CI1	1	1	0	2
CX	1	0	0	1
RF	1	0	0	1
South Reach	75	67	51	193
R20	14	45	0	59
OS	0	0	51	51
R5	20	14	0	34
CM2	25	0	0	25
RM2	3	5	0	8
RM4	5	1	0	6
EG2	3	0	0	3
CM1	2	0	0	2
R10	0	2	0	2
RF	2	0	0	2
RM1	1	0	0	1
South Waterfront	37	0	2	39
CX	37	0	0	37
OS	0	0	2	2
Grand Total	**562**	**82**	**111**	**755**

iv. Additional Floodplain Characteristics

TABLE 18: WILLAMETTE RIVER ZONING (ACRES)

Willamette	Zone	Tax lots (#)	100-Year Floodplain	Metro Title 3/ 1996 Area	1996 Actual Flood Extent[9]	100-Year & 1996 Flood Inundation Area
Central Reach	EX	37	7	23	23	26
	OS	27	13	14	15	16
	IG1	29	9	11	11	12
	CX	15	4	4	5	7

[9] Statistics for the actual 1996 Flood Extent are included for informational purposes, only. Portland does not apply floodplain regulations to this area.

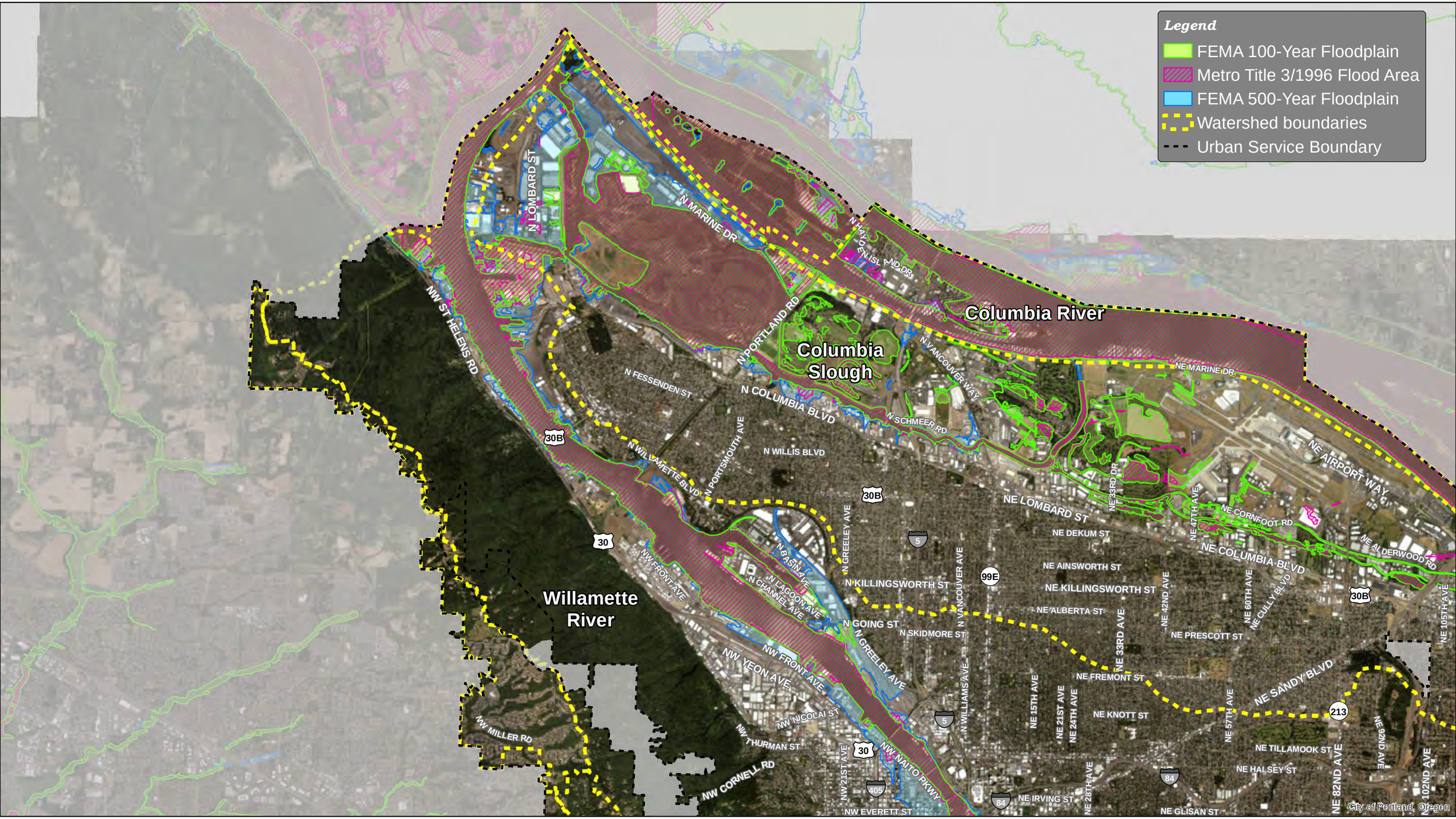
Willamette	Zone	Tax lots (#)	100-Year Floodplain	Metro Title 3/ 1996 Area	1996 Actual Flood Extent[9]	100-Year & 1996 Flood Inundation Area
	RX	9	2	4	4	5
Central Reach Total		117	35	54	57	66
North Reach	IH	315	905	803	936	1,022
	OS	31	216	202	213	220
	IG2	32	124	102	102	134
	EG2	20	25	13	13	30
	CI1	2	14	21	21	21
	RF	1	16	16	16	16
	CX	1	1	0.7	0.7	1
	IG1	4	1	0.6	0.6	1
North Reach Total		406	1,303	1,158	1,303	1,446
South Reach	OS	51	301	293	293	325
	RF	2	42	40	40	42
	R20	59	13	17	17	19
	CM2	25	15	15	15	18
	RM2	8	7	9	9	9
	RM4	6	8	7	7	8
	EG2	3	4	4	4	4
	CM1	2	3	3	3	3
	R5	34	2	2	2	3
	R10	2	0	0.2	0.2	0.2
	RM1	1	0	0.1	0.1	0.1
South Reach Total		193	395	391	391	432
South Waterfront	CX	37	55	3	78	55
	OS	2	0.8	0.7	0.9	0.9
South Waterfront Total		39	55	4	78	56
Grand Total		**755**	**1,789**	**1,606**	**1,829**	**2,000**

Table 19: Property Ownership (acres)

Willamette River	Tax lots (#)	100-Year Floodplain	Metro Title 3/ 1996 Area	1996 Actual Flood Extent[10]	100-Year & 1996 Flood Inundation Area
North Reach					
Private	124	486	461	461	545
Private-RR	15	19	3	3	20
Public	64	127	121	121	145
North Reach Total	203	632	586	586	711
Central Reach					
Private	58	18	34	34	40
Private-RR	5	1	0.2	0.2	1
Public	54	17	20	23	25
Central Reach Total	117	35	54	57	66
South Waterfront					
Private	28	36	2	59	37
Private-RR	11	19	2	20	19
South Waterfront Total	39	55	4	78	56
South Reach					
Private	131	186	171	171	202
Private-RR	62	209	220	220	230
South Reach Total	193	395	391	391	432
Grand Total	**755**	**1,789**	**1,606**	**1,829**	**2,000**

[10] Statistics for the actual 1996 Flood Extent are included for informational purposes, only. Portland does not apply floodplain regulations to this area.

FEMA Biological Opinion (BiOp) - Existing Conditions: Aerial Imagery (2020) - Willamette River Watershed - North



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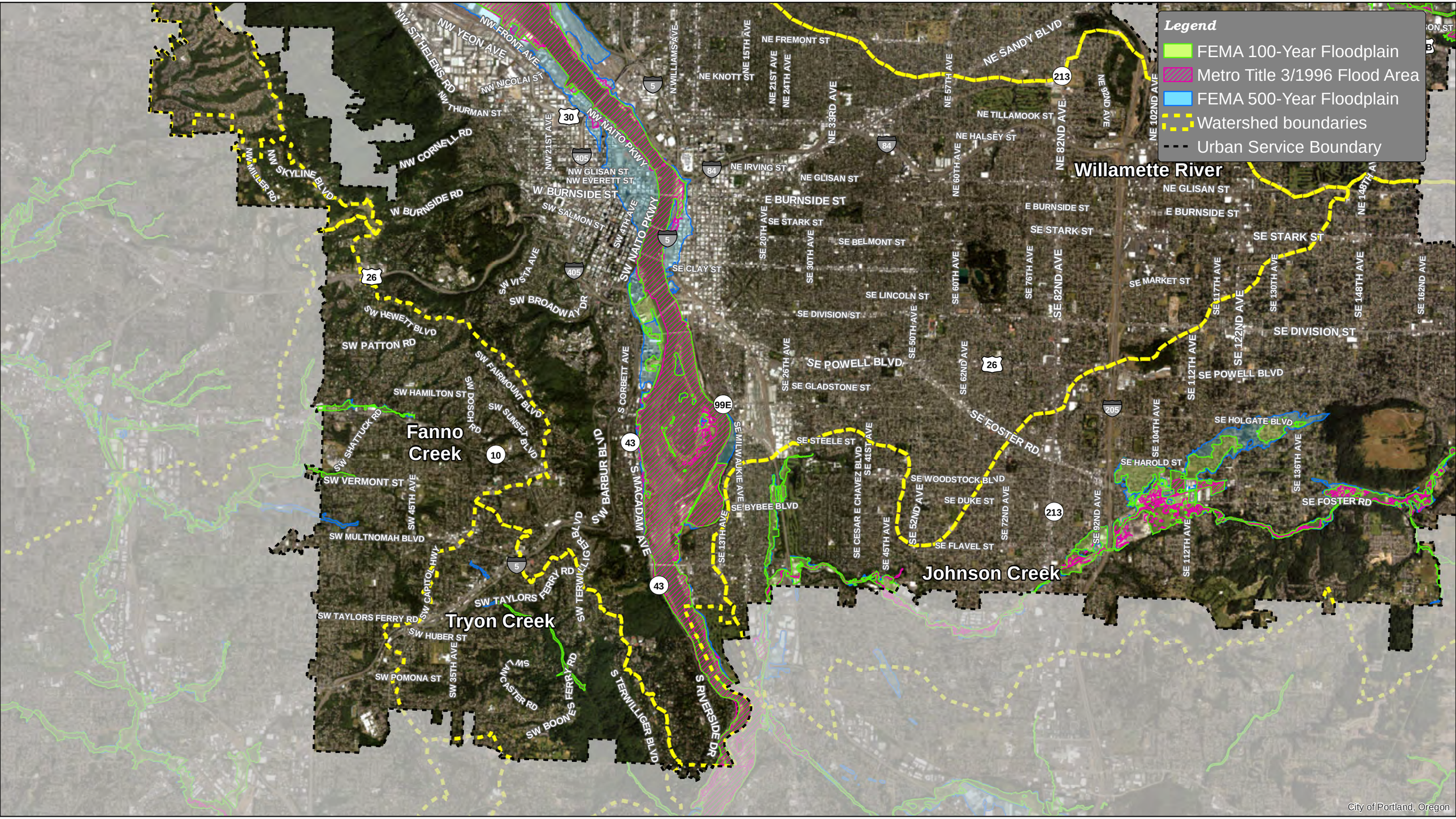
FEMA Biological Opinion (BiOp) - Existing Conditions:

Aerial Imagery (2020) - Willamette River Watershed - South



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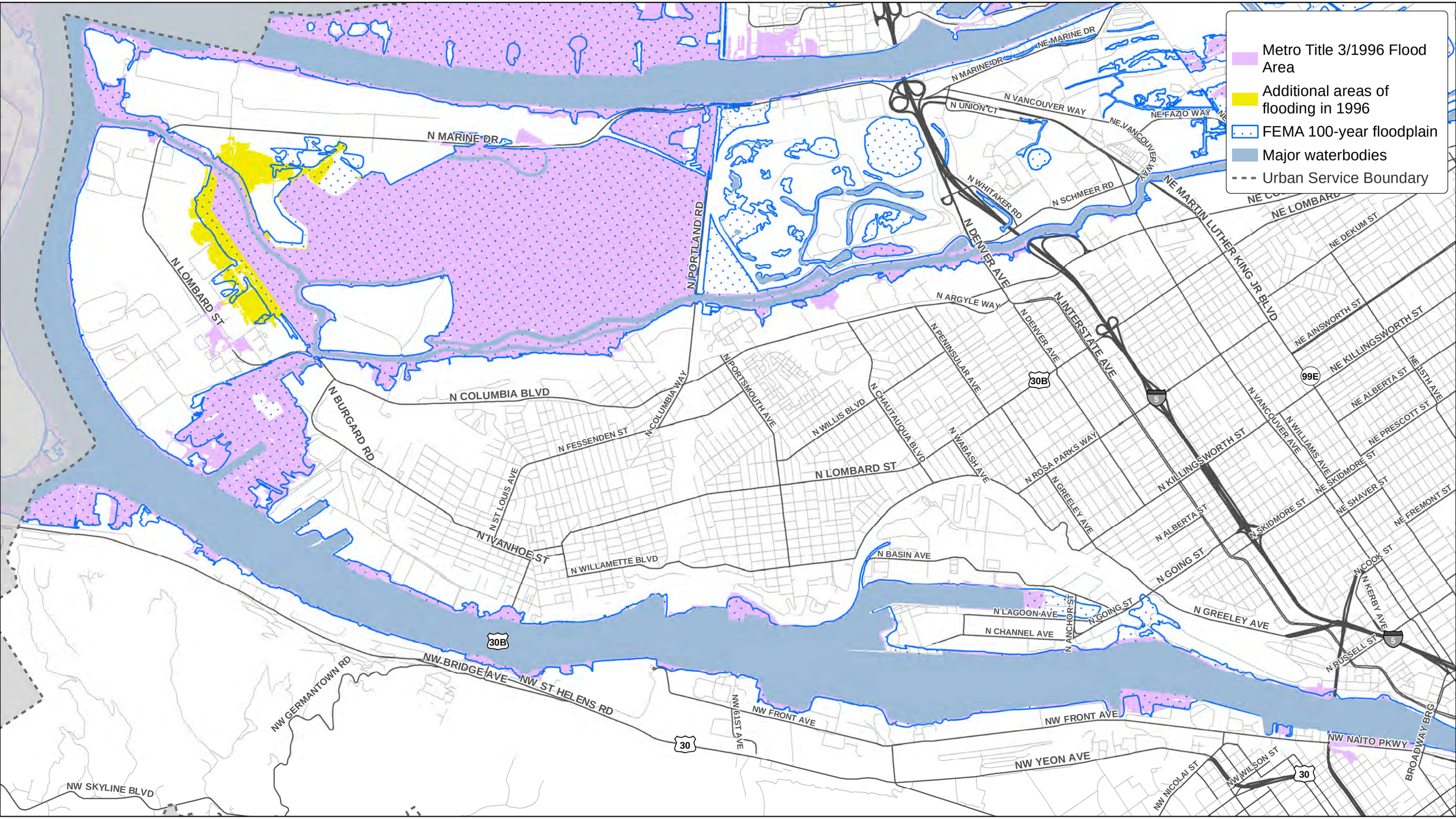
FEMA Biological Opinion (BiOp) - Comparison:

1996 Flood Inundation Areas - Willamette River Watershed - North



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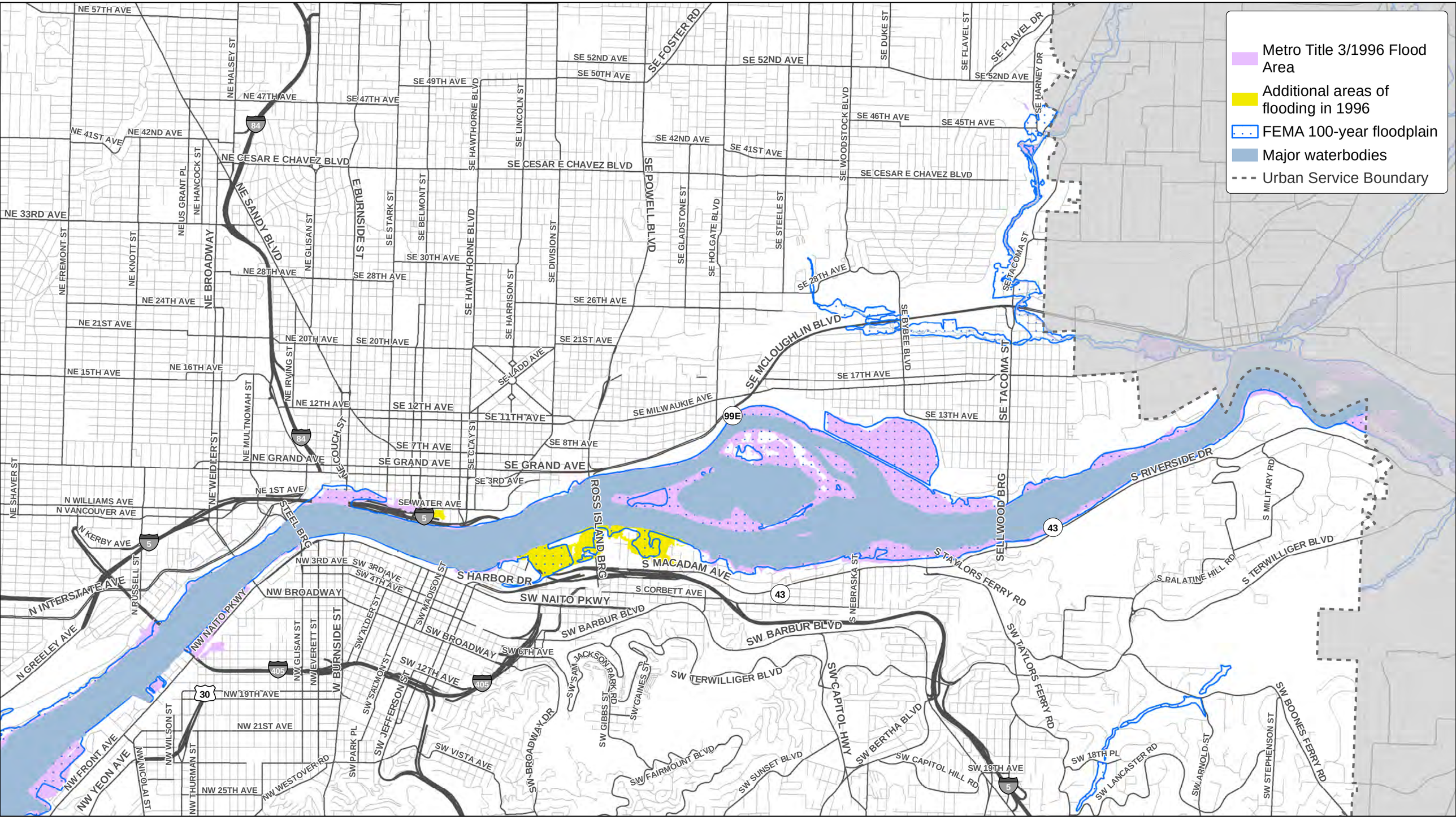
FEMA Biological Opinion (BiOp) - Comparison:

1996 Flood Inundation Areas - Willamette River Watershed - South



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FEMA Biological Opinion (BiOp) - Existing Conditions:

Zoning (2021) - Willamette River Watershed - North

(Zoning Designations within Current Extent)

Zoning

- Open Space (OS)
- Residential Farming (RF)
- Single Dwelling Residential 20,000 (R20)
- Single Dwelling Residential 10,000 (R10)
- Single Dwelling Residential 7,000 (R7)
- Single Dwelling Residential 5,000 (R5)
- Single Dwelling Residential 2,500 (R2.5)
- Residential Manufactured Dwelling Park (RMP)
- Residential Multi-Dwelling 1 (RM1)
- Residential Multi-Dwelling 2 (RM2)
- Residential Multi-Dwelling 3 (RM3)
- Residential Multi-Dwelling 4 (RM4)
- Central Residential (RX)
- Institutional Residential (IR)
- Campus Institutional 1 (CI1)
- Campus Institutional 2 (CI2)
- Commercial Residential (CR)
- Commercial Mixed Use 1 (CM1)
- Commercial Mixed Use 2 (CM2)
- Commercial Mixed Use 3 (CM3)
- Commercial Employment (CE)
- Central Commercial (CX)
- General Employment 1 (EG1)
- General Employment 2 (EG2)
- Central Employment (EX)
- General Industrial 1 (IG1)
- General Industrial 2 (IG2)
- Heavy Industrial (IH)
- County Zoning

- FEMA 100-year floodplain
- Metro Title 3/1996 Flood
- FEMA 500-year floodplain
- Watershed boundaries
- Urban Service Boundary

Columbia Slough

Willamette River

N MARINE DR
N LOMBARD ST
N PORTLAND
N DENVER AVE
N ARGYLE WAY
N PENINSULAR AVE
N INTERSTATE AVE
N LUTHER KING JR BLVD
NE DEKUM S
NE AINSWORTH ST
NE KILLINGSWORTH ST
NE ALBERTA ST
NE 15TH AVE
N COLUMBIA BLVD
N BURGARD RD
N COLUMBIA WAY
N PORTSMOUTH AVE
N FESSENDEN ST
N WILLIS BLVD
N CHAUTAUQUA BLVD
N WABASH AVE
N ROSA PARKS WAY
N GREELEY AVE
N KILLINGSWORTH ST
N VANCOUVER AVE
N WILLIAMS AVE
NE SKIDMORE ST
NE SHAVER ST
NE FREMONT ST
NE PRESCOTT ST
N ST LOUIS AVE
N IVANHOE ST
N WILLAMETTE BLVD
N ALBERTA ST
N SKIDMORE ST
N GOING ST
N BASIN AVE
N LAGOON AVE
N CHANNEL AVE
N ANCHOR ST
N GREELEY AVE
N COOK ST
N KERBY AVE
N RUSSELL ST
NW GERMANTOWN RD
NW BRIDGE AVE
NW ST HELENS RD
NW 61ST AVE
NW FRONT AVE
NW NAITO PKWY
BROADWAY BRG
NW YEON AVE
NW WILSON ST
NW NICOLAI ST
NW SKYLINE BLVD
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30
99E
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FEMA Biological Opinion (BiOp) - Existing Conditions:

Zoning (2021) - Willamette River Watershed - South

(Zoning Designations within Current Extent)

Zoning

- Open Space (OS)
- Residential Farming (RF)
- Single Dwelling Residential 20,000 (R20)
- Single Dwelling Residential 10,000 (R10)
- Single Dwelling Residential 7,000 (R7)
- Single Dwelling Residential 5,000 (R5)
- Single Dwelling Residential 2,500 (R2.5)
- Residential Manufactured Dwelling Park (RMP)
- Residential Multi-Dwelling 1 (RM1)
- Residential Multi-Dwelling 2 (RM2)
- Residential Multi-Dwelling 3 (RM3)
- Residential Multi-Dwelling 4 (RM4)
- Central Residential (RX)
- Institutional Residential (IR)
- Campus Institutional 1 (CI1)
- Campus Institutional 2 (CI2)
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- Commercial Mixed Use 2 (CM2)
- Commercial Mixed Use 3 (CM3)
- Commercial Employment (CE)
- Central Commercial (CX)
- General Employment 1 (EG1)
- General Employment 2 (EG2)
- Central Employment (EX)
- General Industrial 1 (IG1)
- General Industrial 2 (IG2)
- Heavy Industrial (IH)
- County Zoning

- FEMA 100-year floodplain
- Metro Title 3/1996 Flood
- FEMA 500-year floodplain
- Watershed boundaries
- Urban Service Boundary

Columbia Slough

Willamette River

Tryon Creek

Fanno Creek

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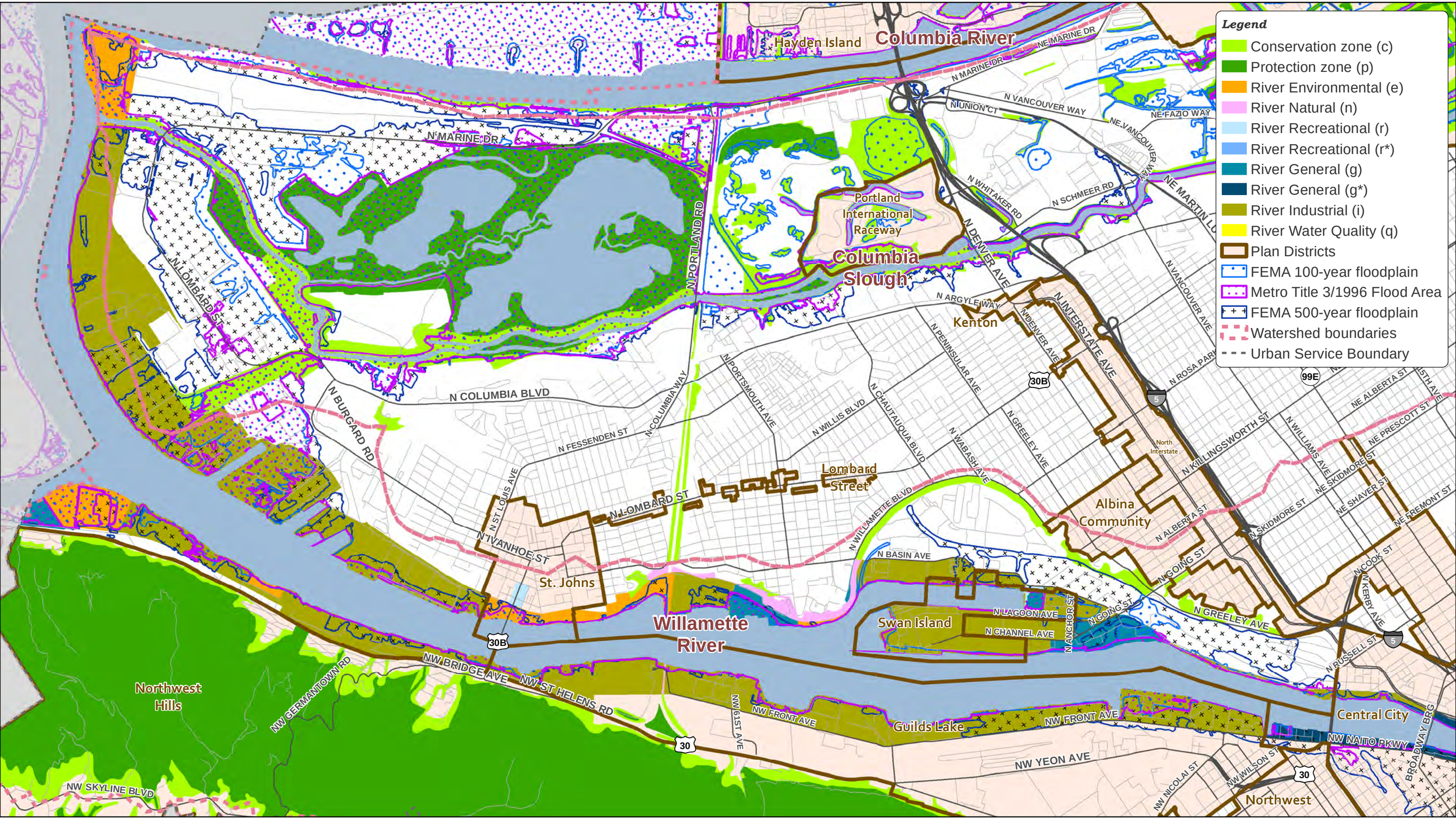
FEMA Biological Opinion (BiOp) - Existing Conditions:

Overlay Zones - Willamette River Watershed - North



Legend

- Conservation zone (c)
- Protection zone (p)
- River Environmental (e)
- River Natural (n)
- River Recreational (r)
- River Recreational (r*)
- River General (g)
- River General (g*)
- River Industrial (i)
- River Water Quality (q)
- Plan Districts
- FEMA 100-year floodplain
- Metro Title 3/1996 Flood Area
- FEMA 500-year floodplain
- Watershed boundaries
- Urban Service Boundary

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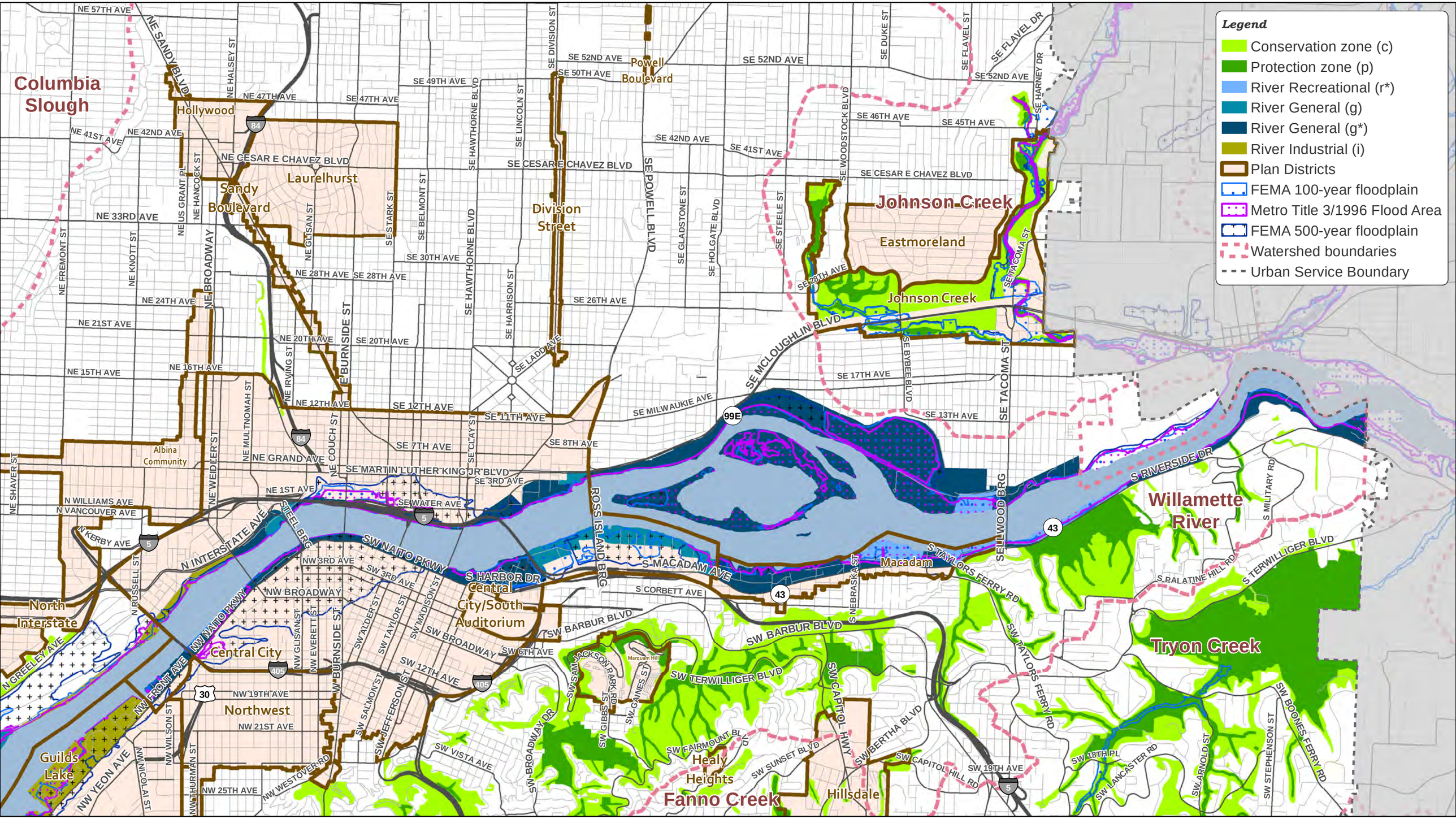
FEMA Biological Opinion (BiOp) - Existing Conditions:

Overlay Zones - Willamette River Watershed - South



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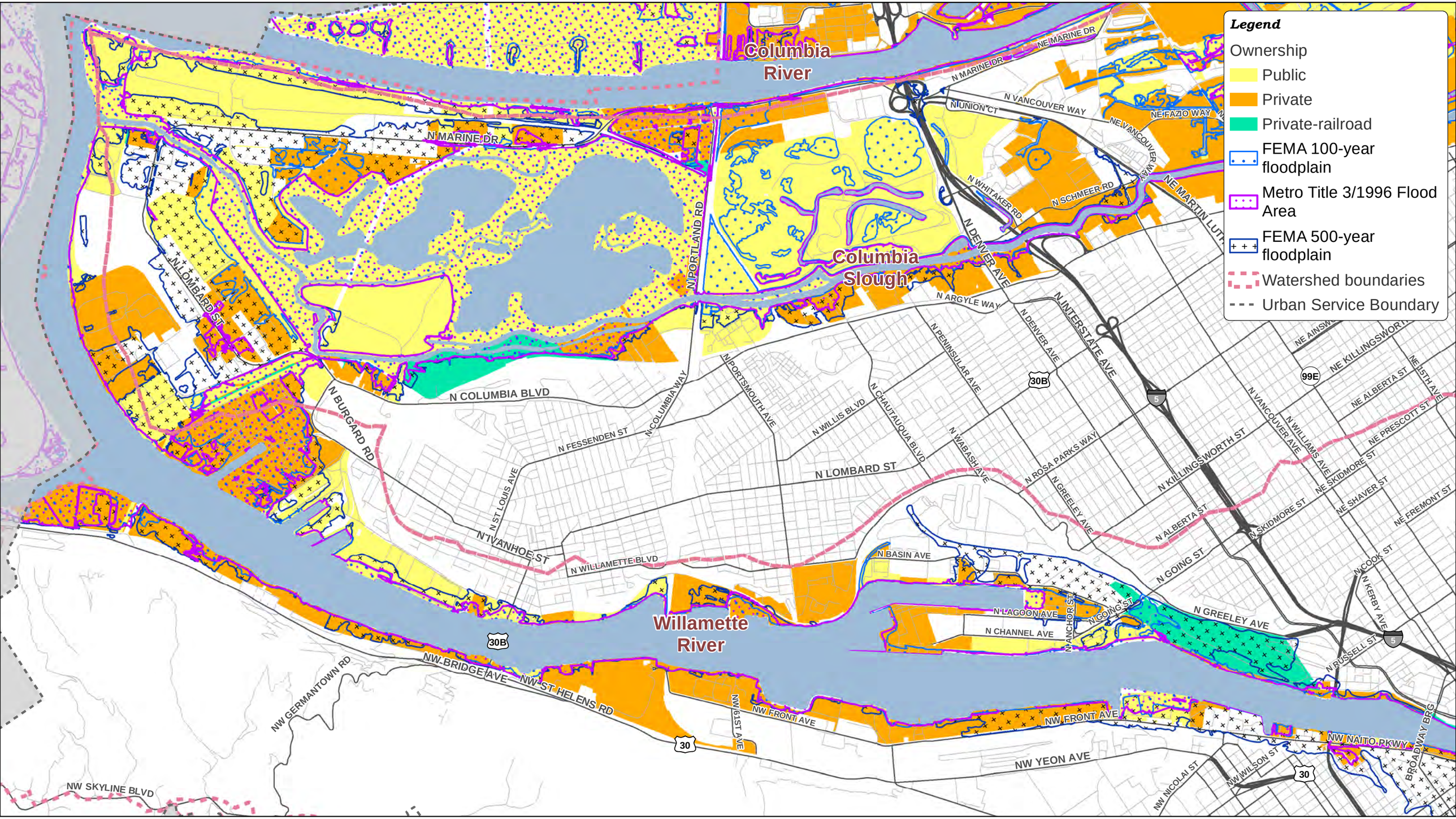
FEMA Biological Opinion (BiOp) - Existing Conditions

Property Ownership - Willamette River Watershed - North



Legend

- Ownership
- Public
- Private
- Private-railroad
- FEMA 100-year floodplain
- Metro Title 3/1996 Flood Area
- FEMA 500-year floodplain
- Watershed boundaries
- Urban Service Boundary

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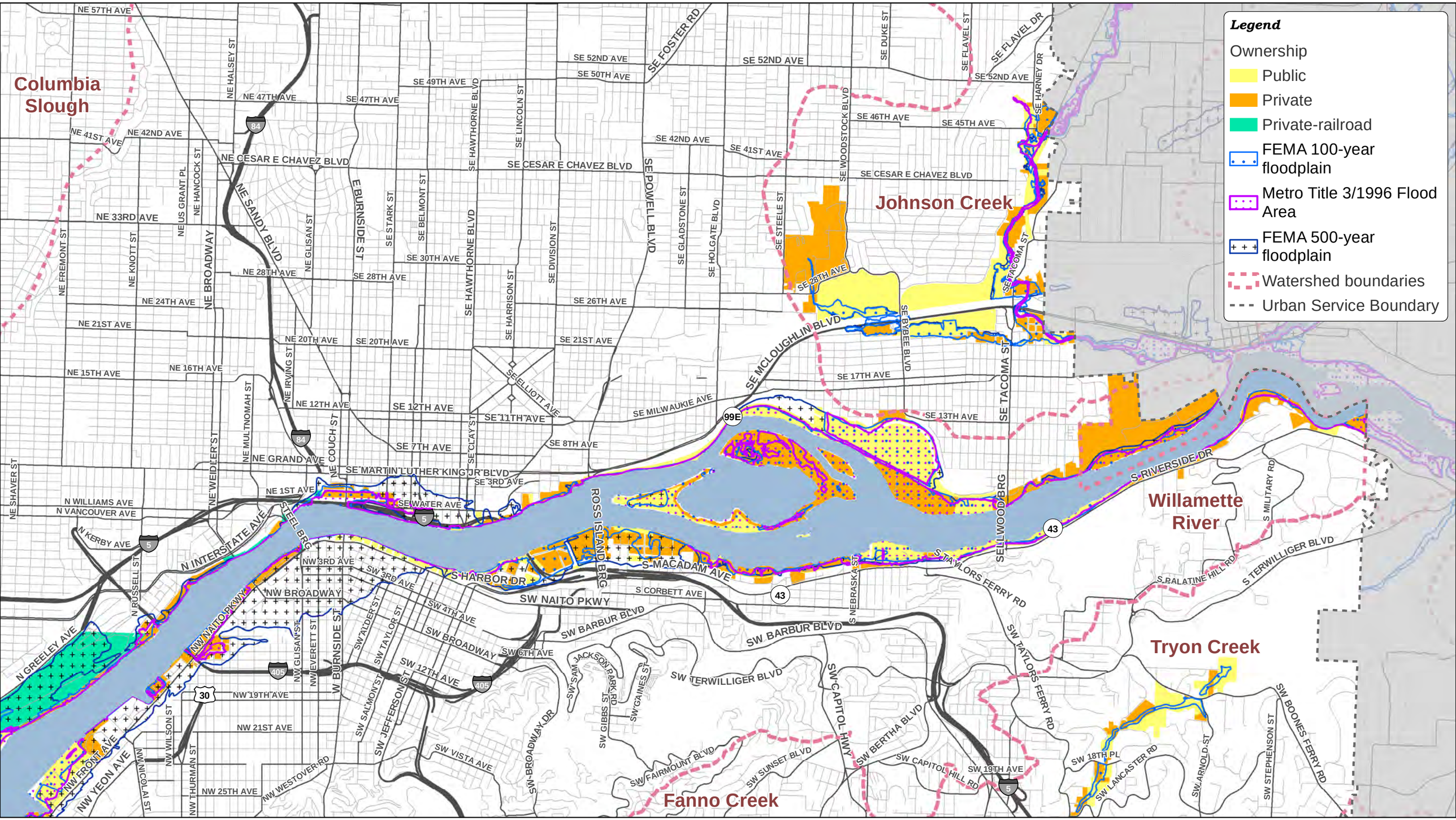
FEMA Biological Opinion (BiOp) - Existing Conditions

Property Ownership - Willamette River Watershed - South



Legend

- Ownership
- Public
- Private
- Private-railroad
- FEMA 100-year floodplain
- Metro Title 3/1996 Flood Area
- FEMA 500-year floodplain
- Watershed boundaries
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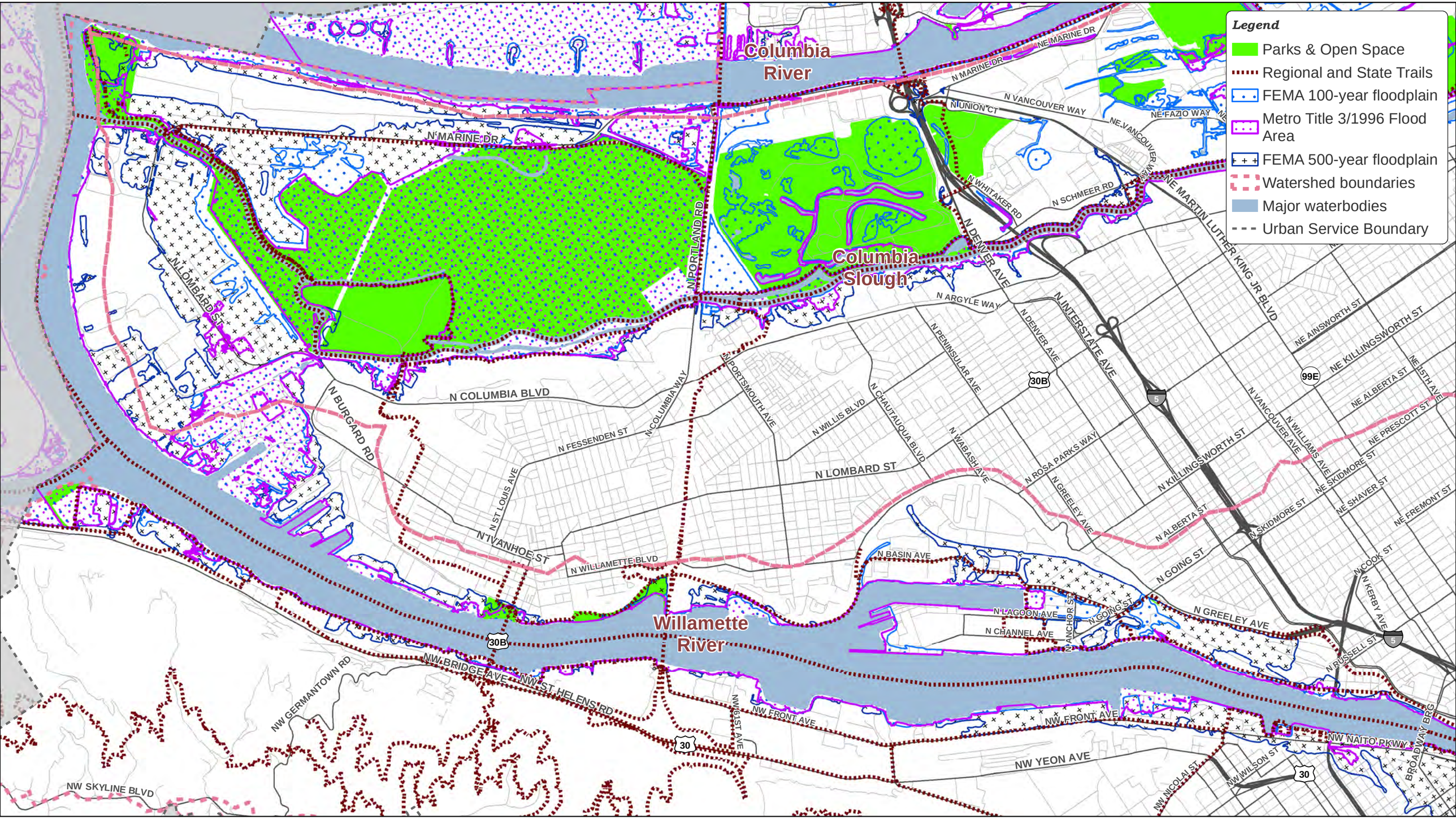
FEMA Biological Opinion (BiOp) - Existing Conditions:

Parks/Open Space & Major Trails - Willamette River Watershed - North



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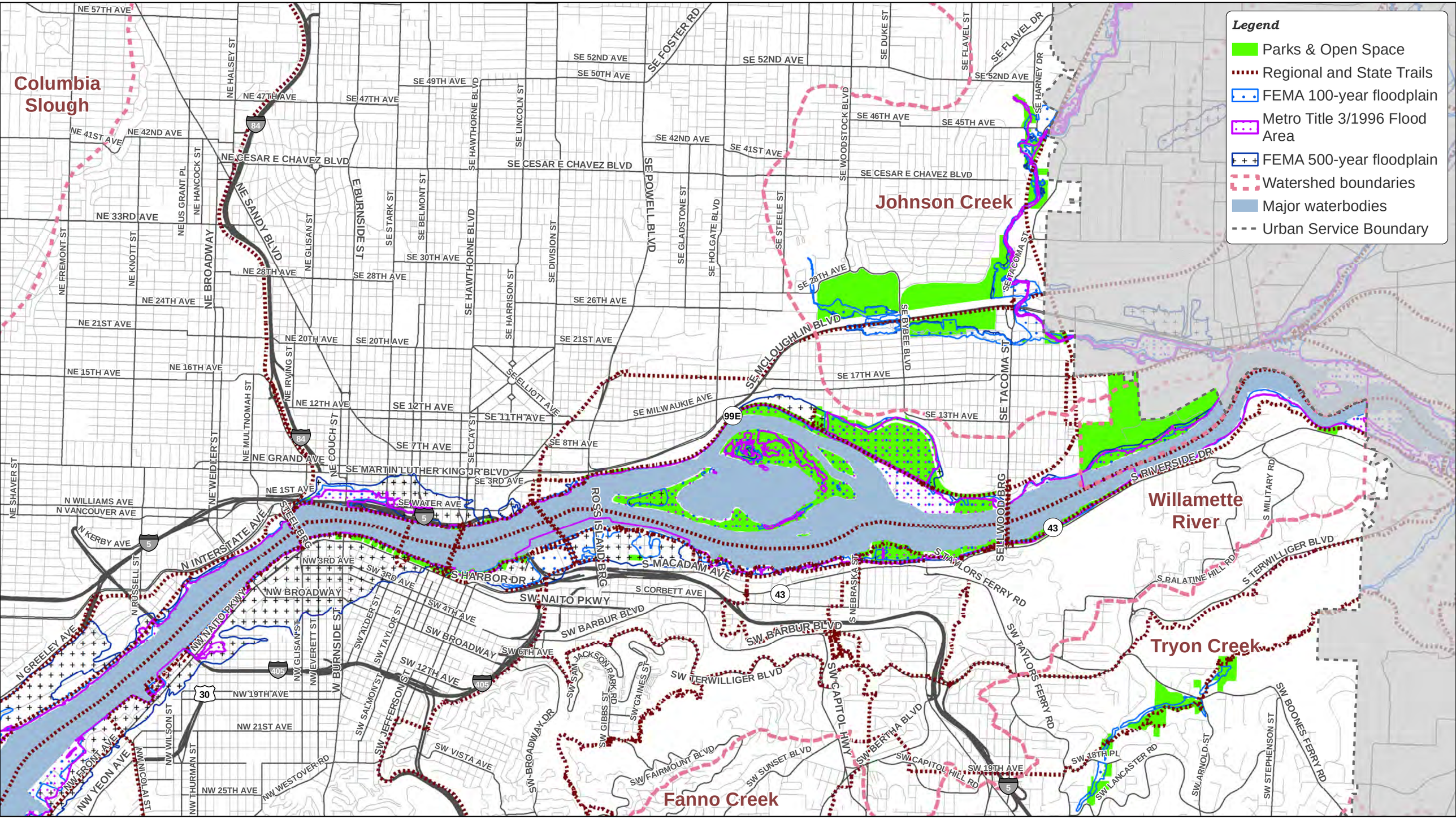
FEMA Biological Opinion (BiOp) - Existing Conditions:

Parks/Open Space & Major Trails - Willamette River Watershed - South



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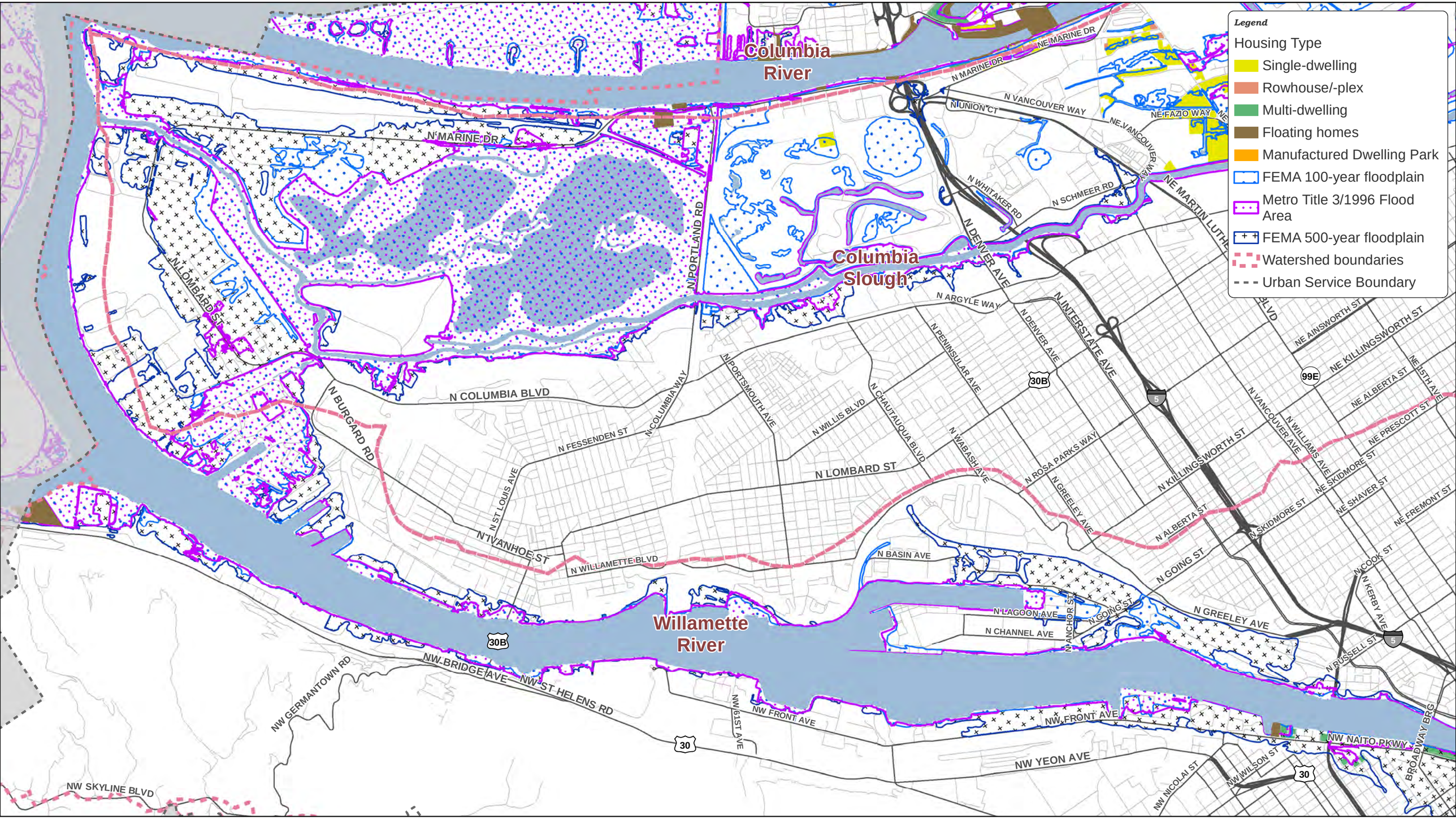
FEMA Biological Opinion (BiOp) - Existing Conditions:

Housing Type - Willamette River Watershed - North



Legend

Housing Type

- Single-dwelling
- Rowhouse/-plex
- Multi-dwelling
- Floating homes
- Manufactured Dwelling Park
- FEMA 100-year floodplain
- Metro Title 3/1996 Flood Area
- FEMA 500-year floodplain
- Watershed boundaries
- Urban Service Boundary

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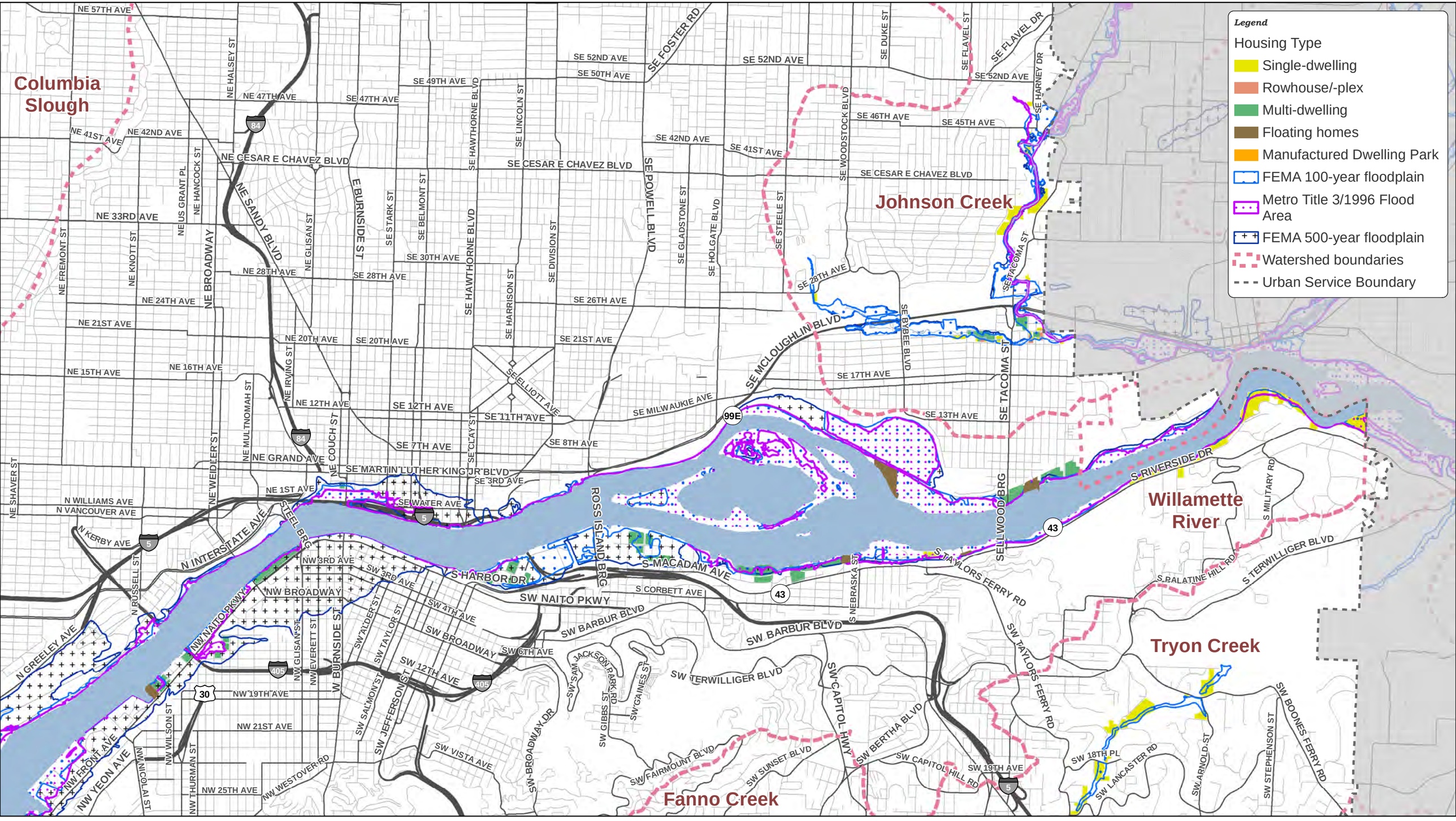
FEMA Biological Opinion (BiOp) - Existing Conditions:

Housing Type - Willamette River Watershed - South



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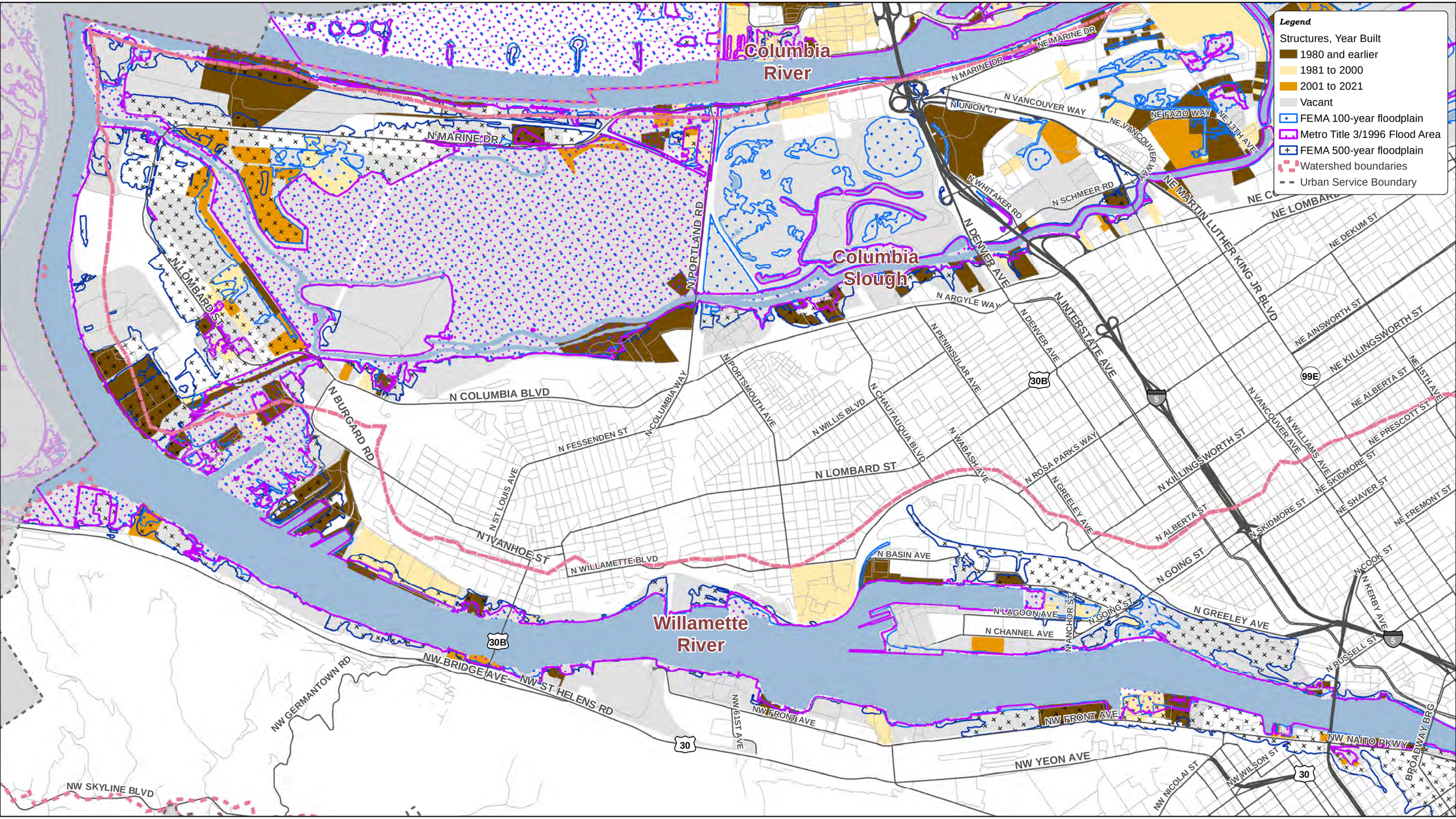
FEMA Biological Opinion (BiOp) - Existing Conditions: Structures, Year Built - Willamette River Watershed - North



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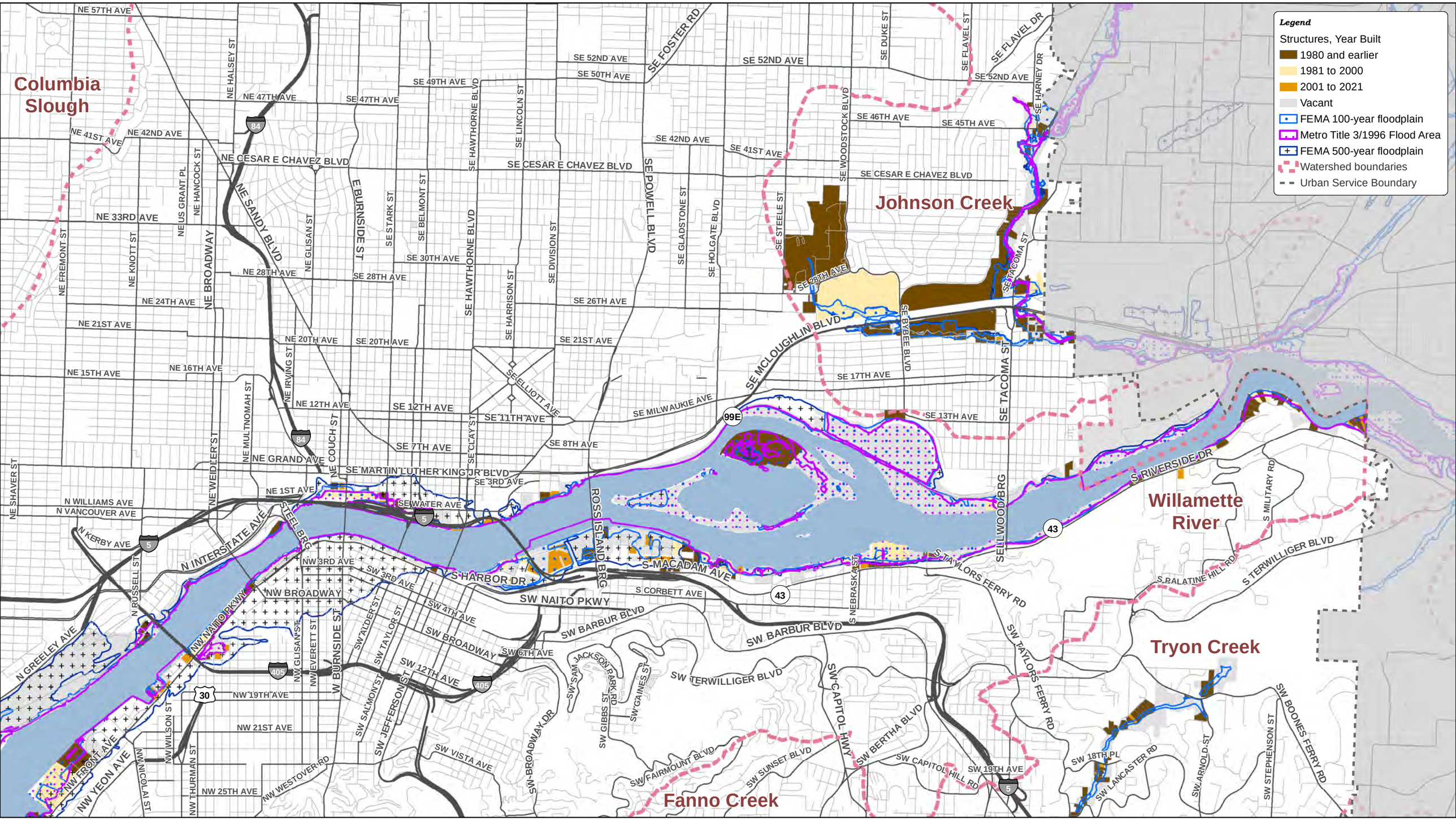
FEMA Biological Opinion (BiOp) - Existing Conditions:

Structures, Year Built - Willamette River Watershed - South



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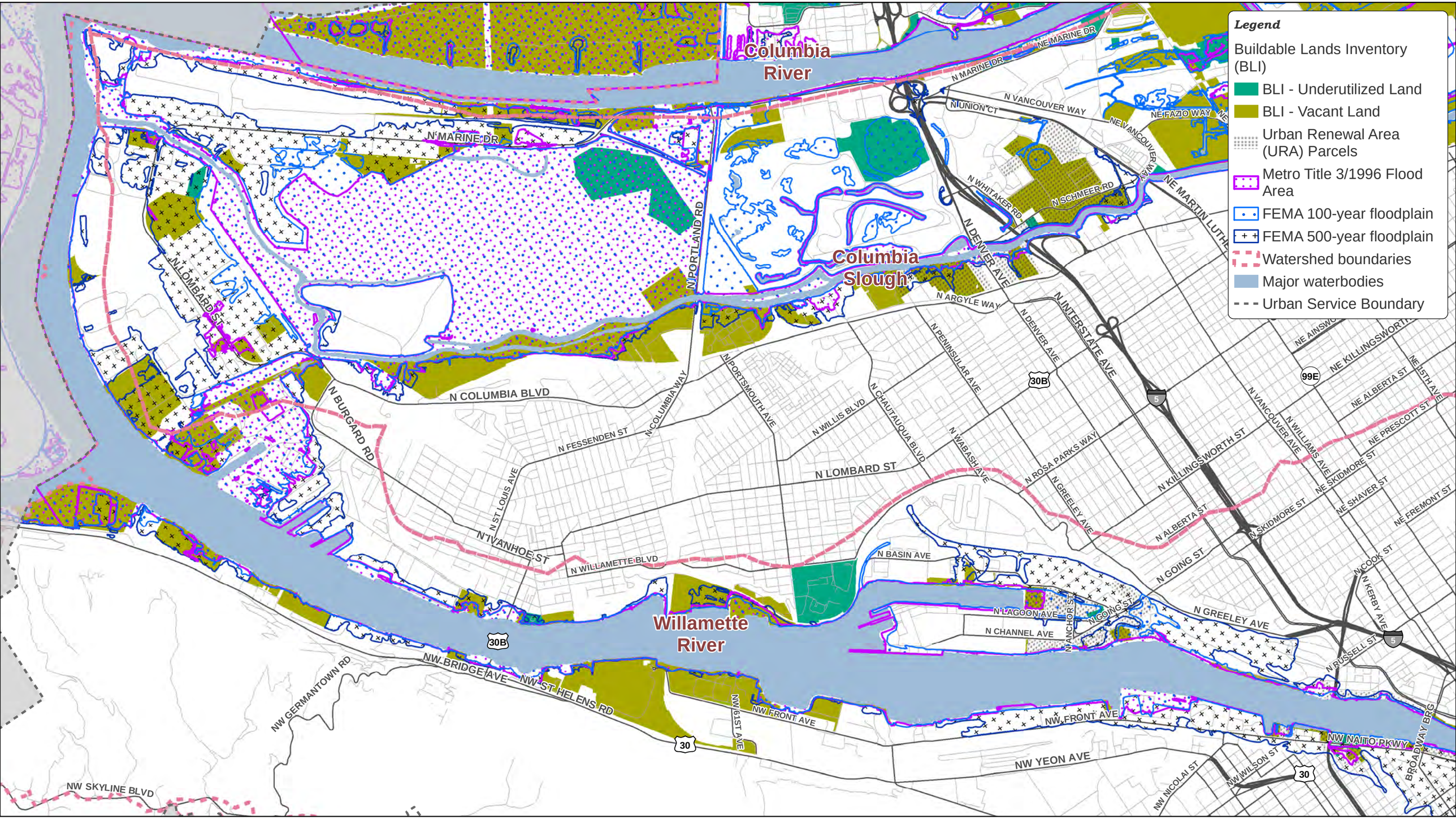
FEMA Biological Opinion (BiOp) - Existing Conditions:

BLI Lands & URAs - Willamette River Watershed - North



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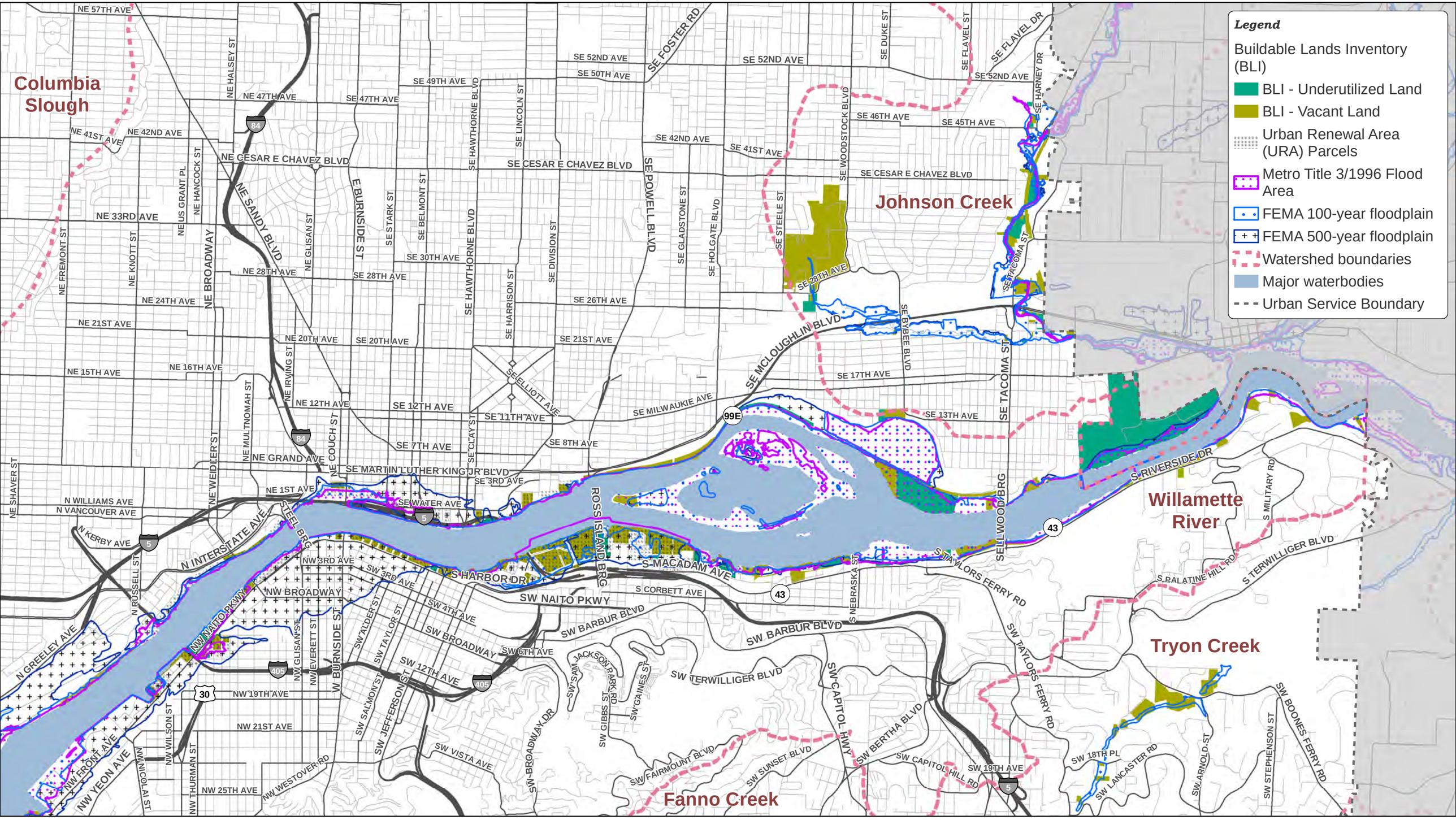
FEMA Biological Opinion (BiOp) - Existing Conditions:

BLI Lands & URAs - Willamette River Watershed - South



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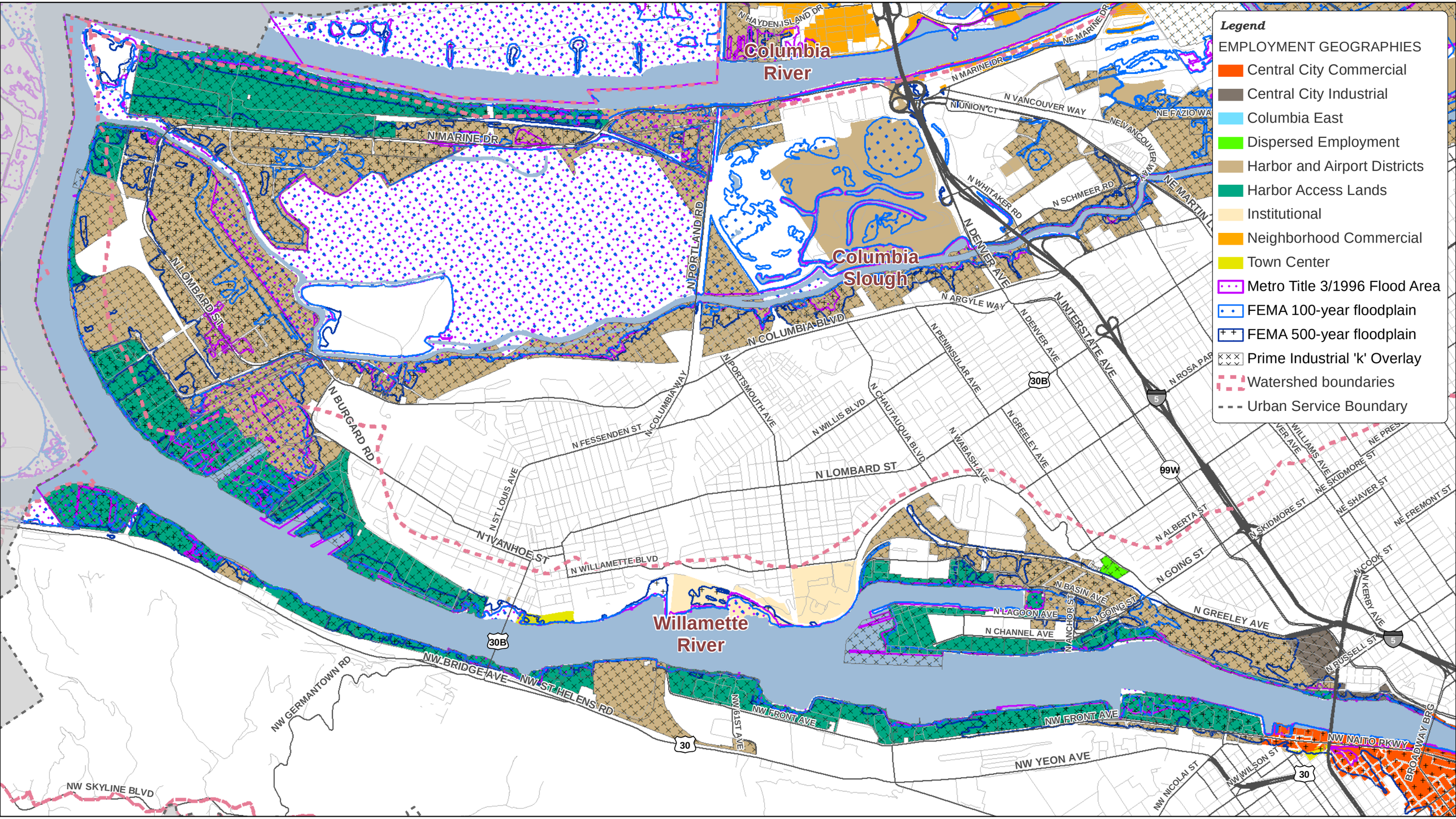
FEMA Biological Opinion (BiOp) - Existing Conditions: Employment Geographies - Willamette River Watershed - North



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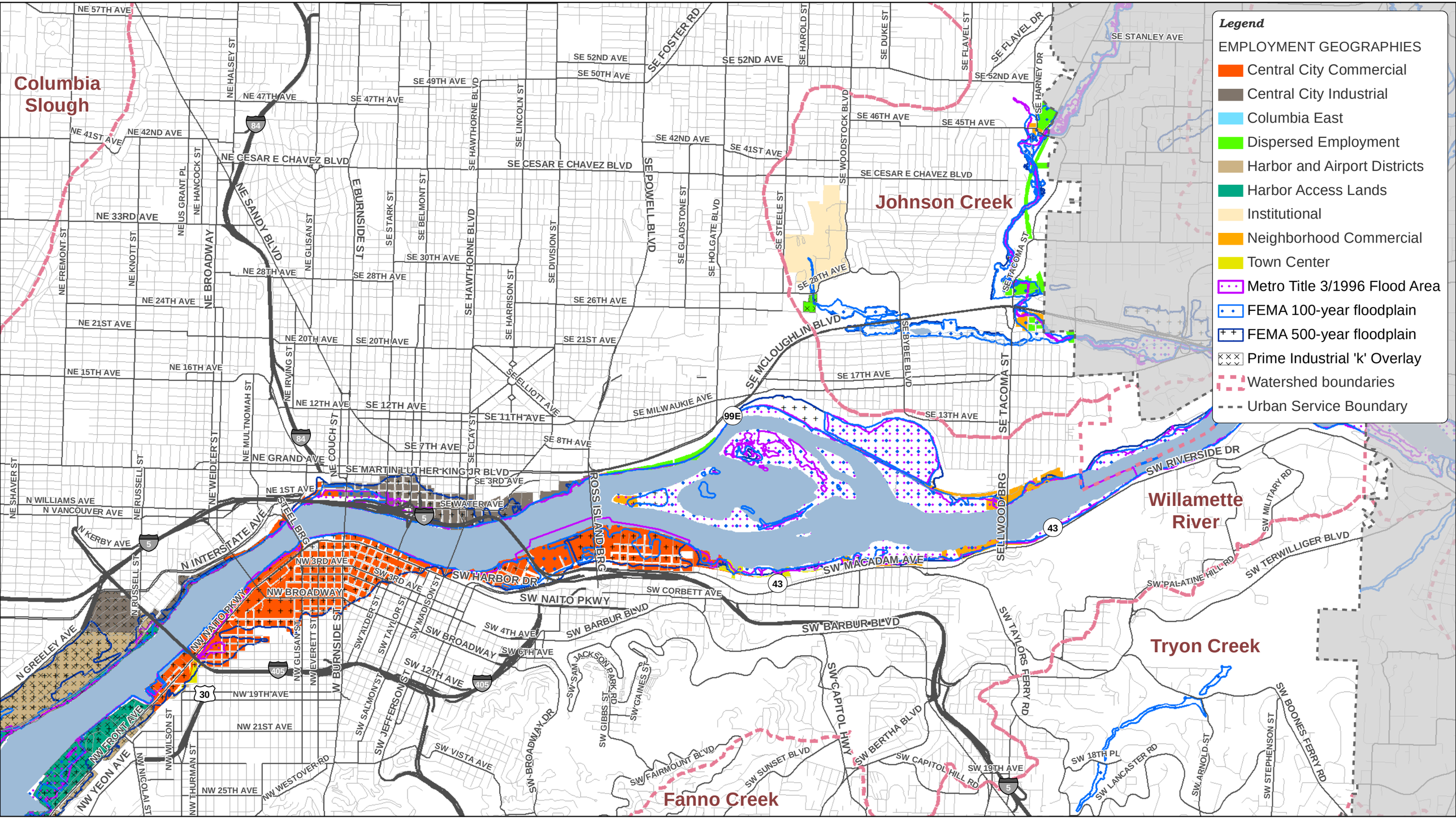
FEMA Biological Opinion (BiOp) - Existing Conditions: Employment Geographies - Willamette River Watershed - South



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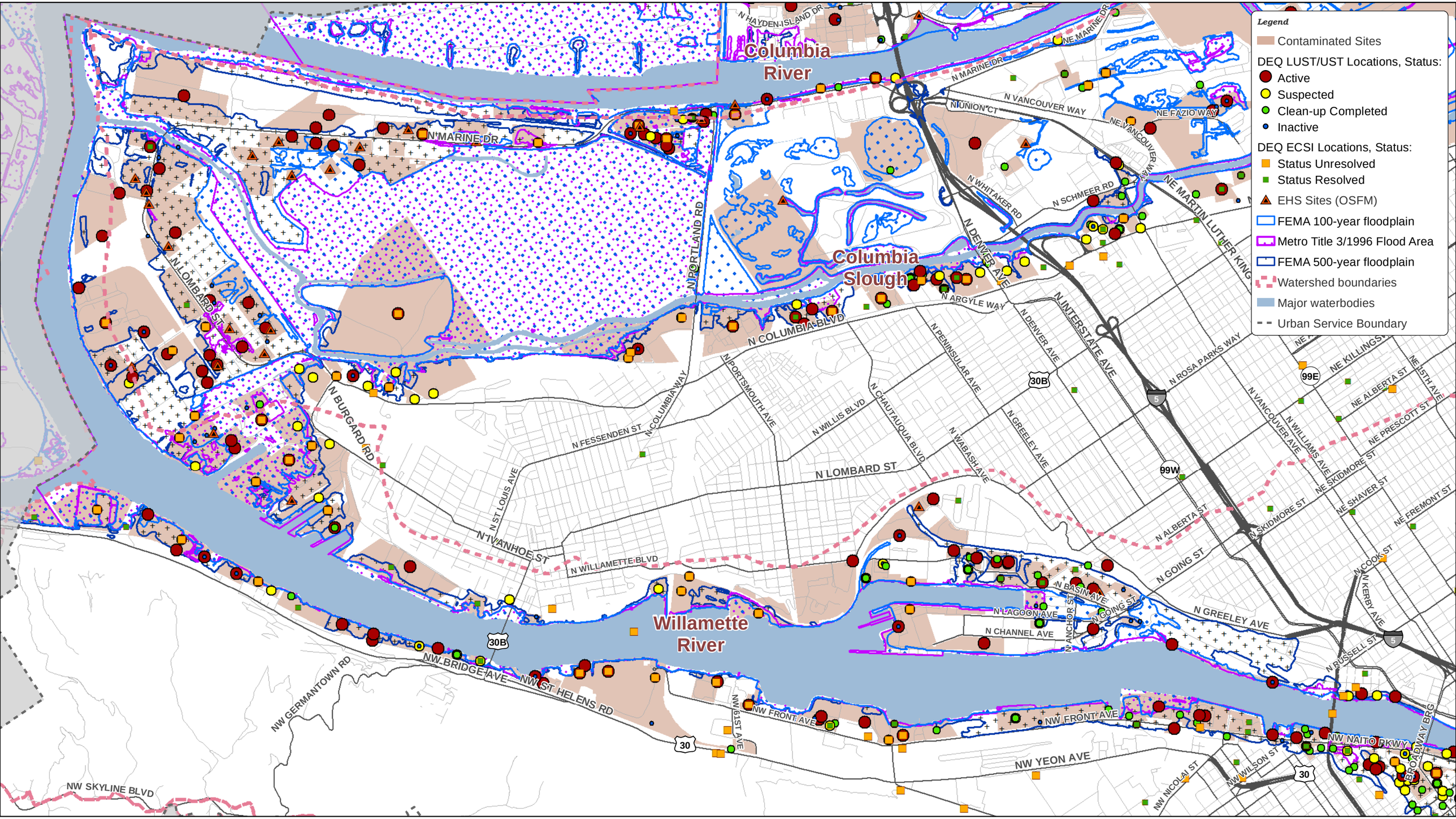
FEMA Biological Opinion (BiOp) - Existing Conditions:

Hazardous Substance Contamination Sites - Willamette River Watershed - North



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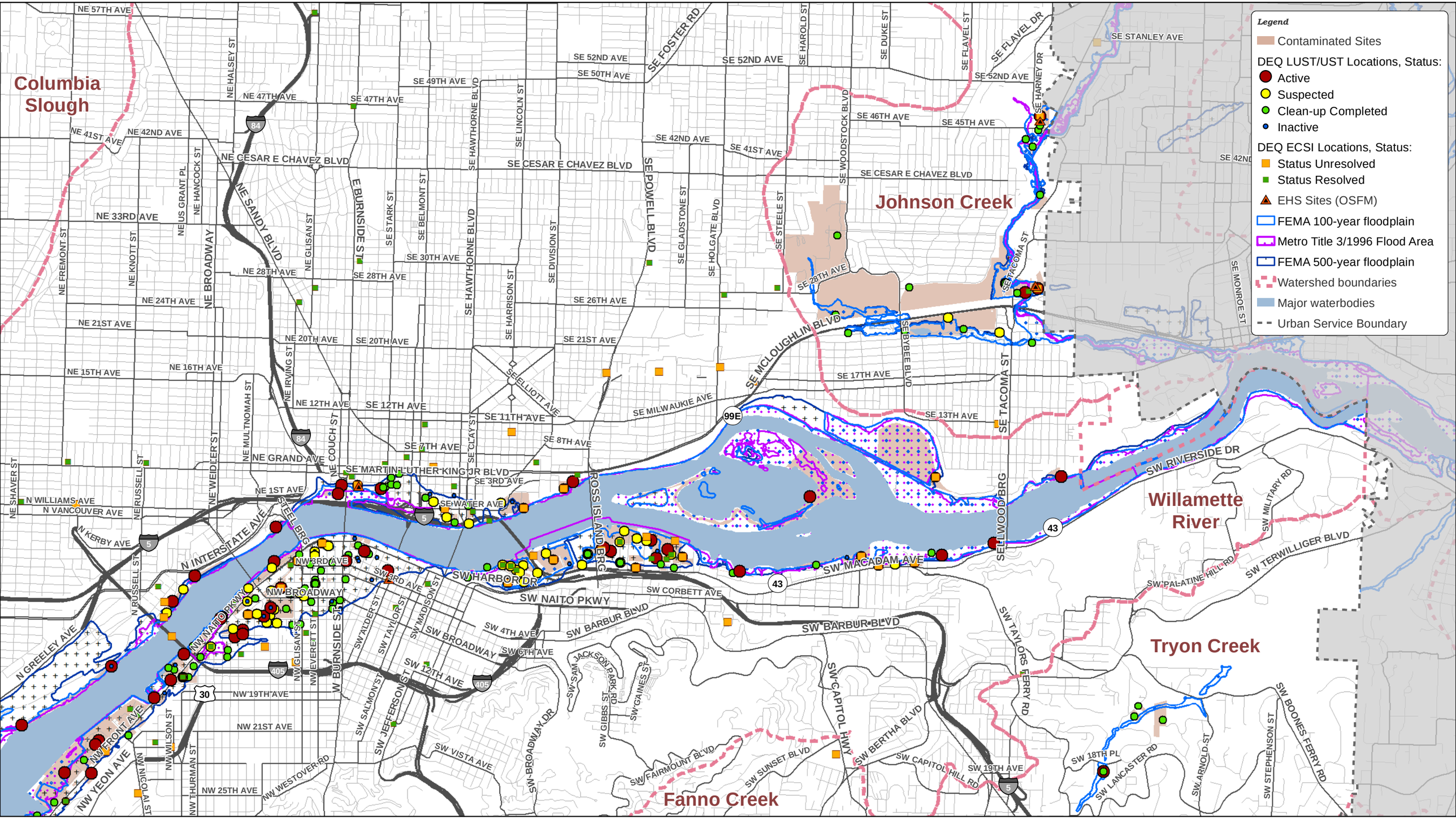
FEMA Biological Opinion (BiOp) - Existing Conditions:

Hazardous Substance Contamination Sites - Willamette River Watershed - South



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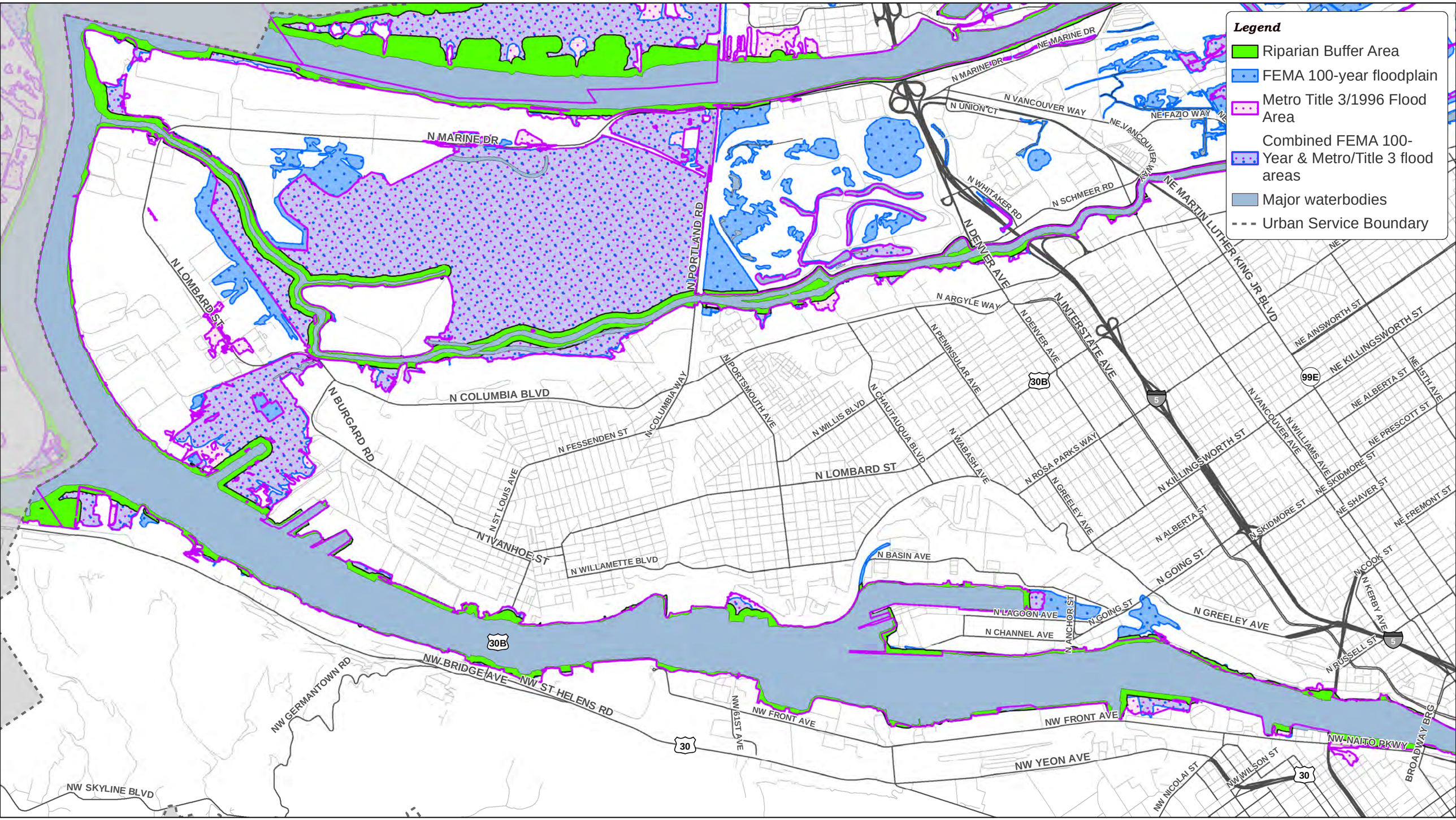
FEMA Biological Opinion (BiOp) - Existing Conditions:

Riparian Buffer Area - Willamette River Watershed - North



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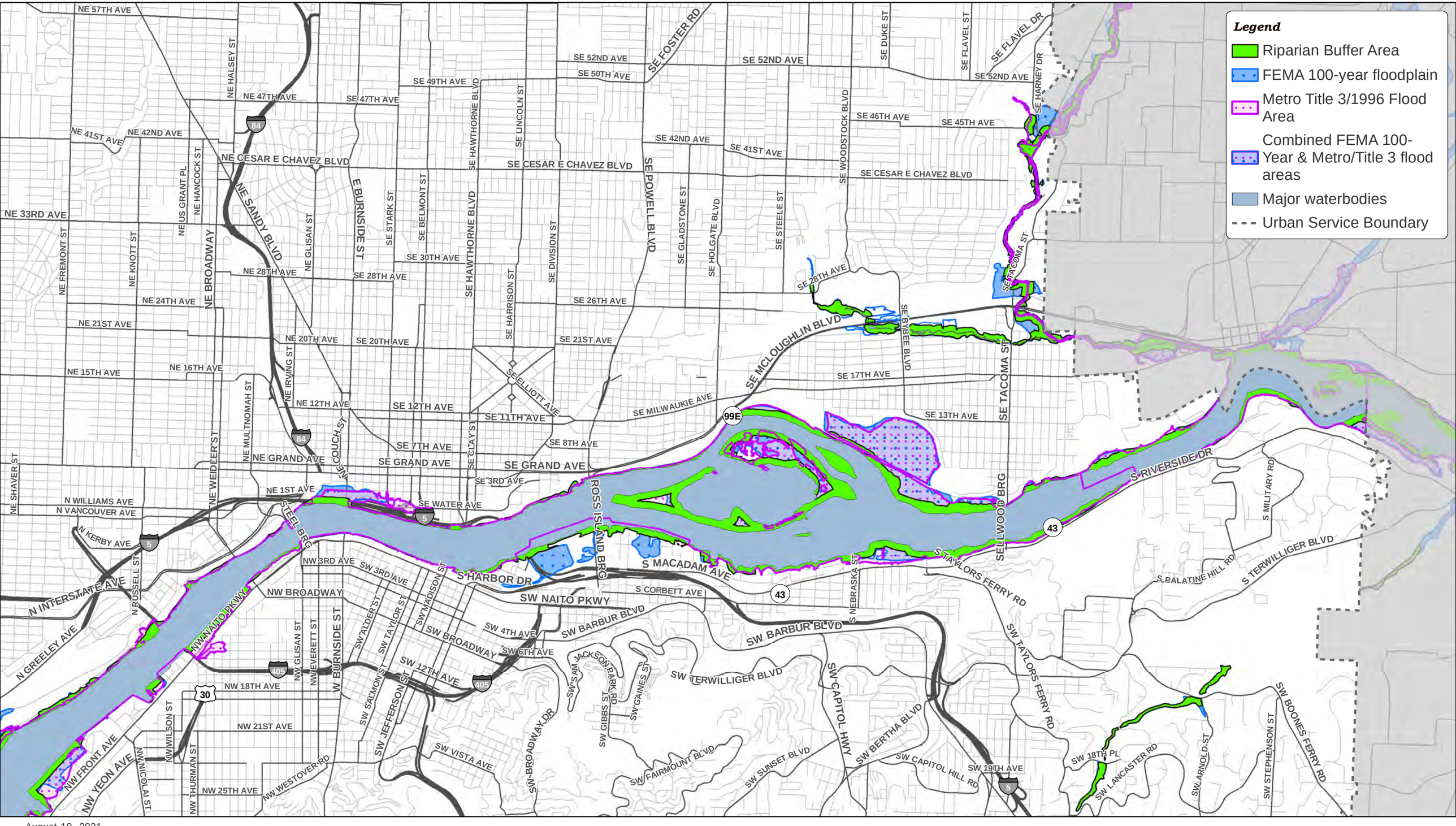
FEMA Biological Opinion (BiOp) - Existing Conditions:

Riparian Buffer Area - Willamette River Watershed - South



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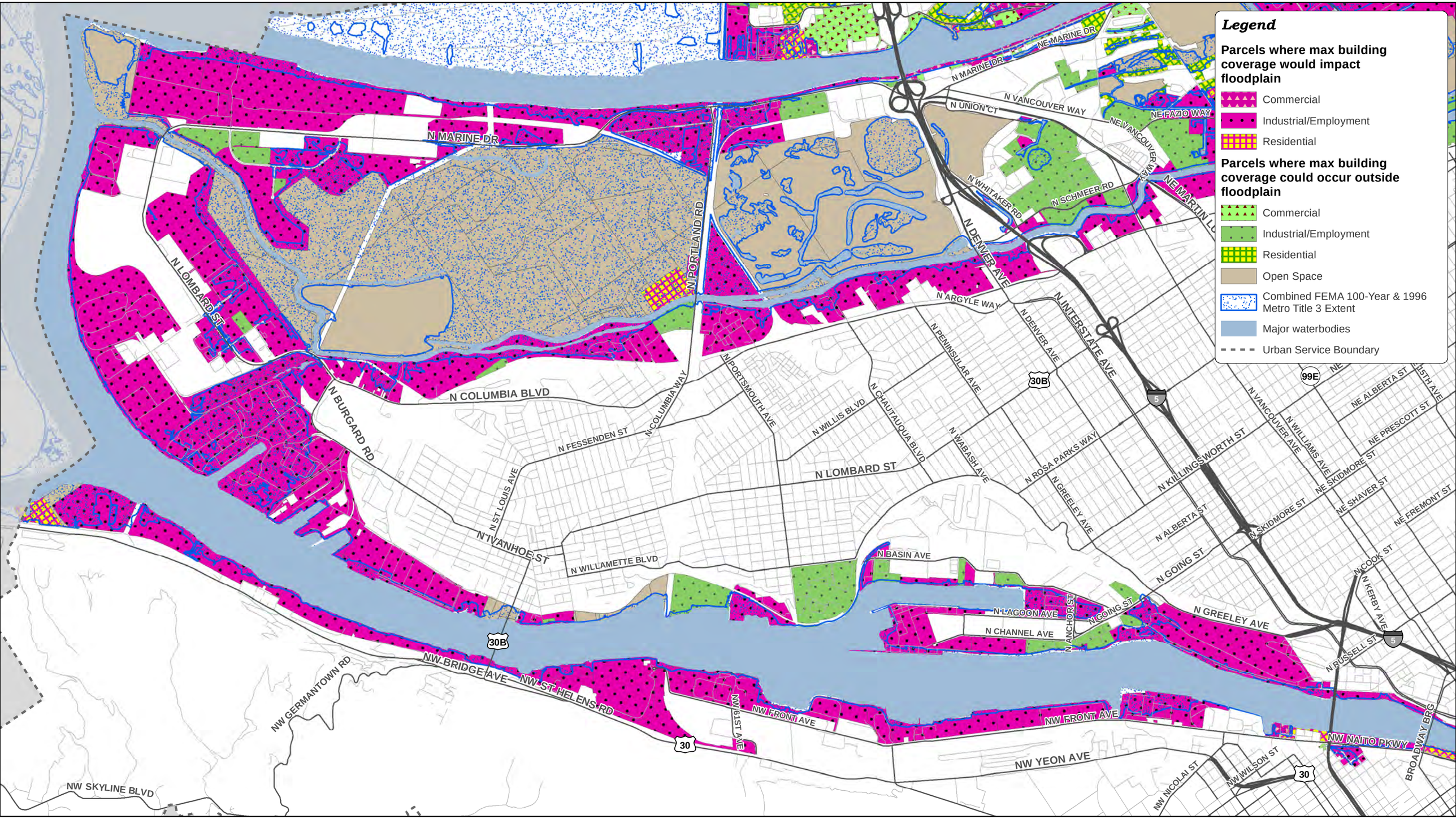
FEMA Biological Opinion (BiOp) - Existing Conditions: Development Potential - Willamette River Watershed - North



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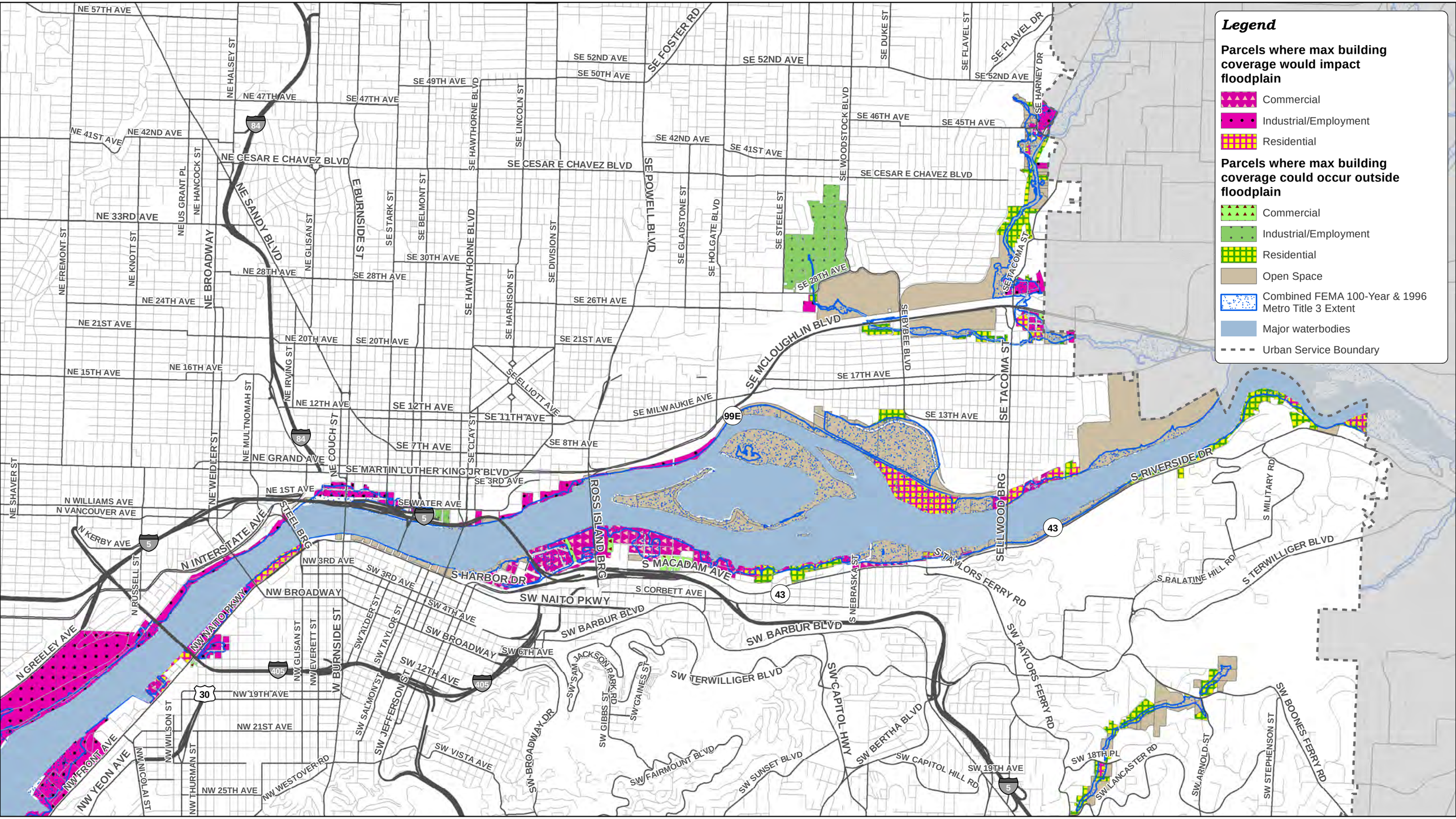
FEMA Biological Opinion (BiOp) - Existing Conditions: Development Potential - Willamette River Watershed - South



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