

Floodplain Resilience Project Draft Existing Conditions Report

November 2021



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**PLANNING &
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I. Introduction

The Portland Bureau of Planning and Sustainability is undertaking the Floodplain Resilience Project to update regulations that apply to the City's floodplains. The intention of this project is to ensure that Portland's floodplains continue to be diverse and thriving ecological systems that are resilient to climate change and natural fluctuations in river levels and flows, and that continue to serve a diverse set of economic and social functions, while serving as homesites, recreational locations, and workplaces for thousands of residents.

Situated at the confluence of two major North American rivers, Portland is, in part, defined by the iconic waterfront areas and floodplains that have served as hubs of commerce, industry and recreation for generations. The areas that constitute Portland's floodplains are projected to continue to be major centers of job growth and new housing that will continue to meet the needs of Portland's growing population for decades to come. The floodplain also provides habitat that is of vital importance to threatened and endangered runs of salmon and steelhead that live and spawn in the extended Columbia and Willamette River watersheds.

This document provides a historical, ecological and geographic perspective of Portland's floodplains. It is intended to describe the communities, people, land uses and environments that are located in the floodplains and to give a better picture of who may be impacted by and who will benefit from new floodplain regulations. Also included is an appendix that summarizes the federal, state, regional and local regulations that currently apply to Portland's floodplains.

A. Floodplains and Floods

i. Key Functions of Floodplains

Floodplains are the dynamic and diverse areas adjacent to rivers and streams that are inundated during floods but may not be underwater during normal conditions. They are often low-lying areas adjacent to a stream or river channel and can vary in width from small to extensive and expansive, depending on the landform constraints and gradients. Historically, floodplains in the Portland region were complex and had a natural ability to absorb and diminish floods. Streams and rivers were often a braided series of small side channels that changed and rearranged seasonally. Salmon spawned and used these side channels as refugia. Beaver ponds were abundant and created wetlands for a diversity of fish, reptiles, amphibians, and waterfowl. In addition, wetlands fed by groundwater and springs provided rich soil nutrients and cool, clean water to the streams and rivers.

Unfortunately, Portland has lost many of the wetlands and floodplains that existed prior to development. Development along the edges of our rivers, streams, and sloughs has eliminated or greatly reduced floodplain area and thus the ability of our floodplains to absorb, retain, and slow

floodwaters. In addition, floodplains have been stripped of their native vegetation, drained for agriculture, filled to accommodate development, and covered by pavement for transportation. Increasing stormwater runoff from impervious areas, and the loss available storage in the floodplain cause more frequent and larger floods in watersheds not protected by levees. In Portland, development in floodplains includes industrial facilities, commercial and mixed-use buildings, housing, and recreation facilities, as well as open areas and protected natural areas. Flood waters flow wherever the terrain allows or directs them, regardless of how those places are used or developed by people. However, healthy vegetated floodplains slow and absorb flood waters, providing habitat for protected species at the same time they reduce the economic, social, and human impact of flood events.

ii. Floodplain Geographies That Are Regulated in the City of Portland

100-Year Floodplain/Special Flood Hazard Area (SFHA)

This area is defined in the Flood Insurance Study for the City of Portland, Oregon: Multnomah, Clackamas and Washington Counties (2010) as the area that has a one percent (or one in one hundred) chance of flooding each year, based on FEMA's models.

Since the 100-year floodplain map defines the geographic scope FEMA's flood insurance program and FEMA sets the terms of participation in the National Flood Insurance Program, the 100-year floodplain defines the area where Endangered Species Act compliance is required to maintain access to federally backed and discounted flood insurance for Portland residents and businesses.

Metro Title 3/1996 Flood Inundation Area (adopted Metro Title 3 Map)

The Metro Title 3 map was created after the February 1996 flood and is referred to as either the 1996 Flood Inundation Area or the Metro Title 3 Map. This map includes most but not all of the areas flooded in 1996. For example, South Waterfront flooded in 1996, but was excluded from the Metro Title 3 map. This map was created using aerial photography from the day after the peak of the flood. The flood peaked at night, so aerial photos of the peak were not available. Flood insurance is not required for residential lots with federally backed mortgages that are located in portions of the Metro Title 3 area that extend outside the 100-year floodplain, but the City, in Title 24 Building Code does require buildings in the Metro Title 3 area to be built to floodplain development standards. The City also requires flood capacity compensation for fill on sites, by removing an equal amount of fill either in the same flood area, or in the case of Johnson Creek, on the same development site.

iii. Other Floodplain Areas

1996 Actual Flood Extent (full extent of flooding – not adopted)

In order to better understand the full extent of the flooding that occurred in 1996 and evaluate the potential impact of regulations and potential risks of flooding for this area, this report also includes information on the full extent of flooding in 1996, which includes the three areas that were excluded

from the adopted Metro Title 3 map. The full extent includes South Waterfront and other inundated areas that were excluded from the regulated Metro Title 3/1996 Flood Inundation Area, including some industrialized areas in the North Reach of the Willamette, but it does not include areas of disconnected ponding or “puddles.” Tables and maps that are included in this document display data and statistics for the 1996 Flood Extent side by side with data for the 1996 Flood Inundation Area. It is important to understand how much area and how many lots were excluded from Metro Title 3 areas because many of these areas may still be prone to flooding. If fill has been added to these areas since the 1996 flood or if fill is added in the future, flood waters could be displaced onto other lots in future flooding events.

500-Year Floodplain

This is the area with a 1 in 500 chance of flooding or a 0.2-percent chance of flooding each year. FEMA insurance is not required here, but FEMA creates the 500-Year floodplain map. This flood risk area is sometimes used as a rough proxy for the effects of climate change, but it is not necessarily sufficient or an accurate representation of changes in flood risks due to climate change.

iv. Updates to Floodplain Mapping

The hydrologic and hydraulic models that are used as the basis of the FEMA-mapped floodplains on the Willamette River in Portland were developed in the 1970s, and they have not been significantly updated since. In the intervening years, there has been significant development in the Portland floodplains and in the floodplains of communities that are upstream of Portland. There have also been changes to the riverbed caused by dredging and siltation. The FEMA floodplain maps do not reflect these changes. The United States Army Corps of Engineers is in the process of creating a new hydraulic model that will incorporate new terrain mapping and bathymetry to produce a more accurate floodplain map. Once completed, this new mapping will help to better define which areas in Portland are most likely to be susceptible to flooding in the future. The Army Corps floodplain model is expected to be completed by the end of 2021. The expected outcome of this process will be a more refined 100-year floodplain.

Completion of the hydraulic model is an important step in the development of a new FEMA 100-Year Floodplain, but the official adoption of the FEMA 100-year Floodplain map is a multi-year process. The Floodplain Resilience Plan, which is in development, will include a proposal to apply floodplain building and zoning code regulations to an area that will be defined as the “combined flood hazard area.” This will include the existing 100-Year Floodplain and the 1996 Flood Inundation Area, both which are already subject to City of Portland floodplain regulations.

As a part of the Floodplain Resilience Plan, the City will work with Metro to update the Metro Title 3 map with an up-to-date estimate of the extent and elevations of a flood consistent with the February 1996 flood, incorporating Light Detection and Ranging (LiDAR)-determined topography, recent river bathymetry data, and current development patterns. This estimate will be a significant improvement over current floodplain mapping, which is based on outdated historical data.

Once the Metro Title 3 map is updated, the City will advocate for FEMA to adopt an updated 100-year Floodplain as soon as possible. The City will begin work to develop floodplain estimates that better address climatic change. Climate change is expected to cause disruptions to precipitation patterns in northwest Oregon, which may cause changes to flood severity and recurrence intervals.

v. History of Floodplain in Portland

Portland's location at the confluence of two major rivers, while a major driver of the city's historical growth and economy, has resulted in numerous flood events with catastrophic losses of life and property. Significant historic flooding occurred on the Willamette and Columbia Rivers in 1861, 1880, 1881, 1894, 1909, 1913, 1927, 1928, 1942, 1946, 1948, 1961, 1964/65, 1996, and 2007 (MAP, 2016). These flood events have drastically shaped both the natural and human environment in Portland. And while the protection or loss of floodplains and flood capacity directly impacts ESA-listed salmonids, the loss of these two things also directly endangers the people of Portland.

Portland is susceptible to flooding caused by either winter rain or spring snowmelt and runoff. Historically, the most severe floods have been the result of winter storm events where heavy rain falls on both the lowlands and in the mountains (rather than snow). This rainfall and resulting snowmelt create water flows that exceed the carrying capacity of rivers and other water courses and storage facilities, resulting in downstream flooding. Because of the huge geographic scope of the Columbia River and Willamette River Basins, increased flows rarely coincide on the two rivers. However, when they do, the resulting potential for flooding in Portland is amplified by its location at their confluence. And although the historic flood events, described in brief below, give insight into the potential for flooding in Portland, the disruption in historic patterns of seasonal storm and flood events by climate change has the potential to increase the likelihood of severe flood events on both the Columbia and Willamette Rivers.

June 1894

The worst flood recorded on the Willamette River since the start of the colonization of the region by people of European ancestry occurred in June of 1894 when rains, accompanied by a sharp rise in temperature, resulted in flooding on both the Columbia and Willamette Rivers. In downtown Portland, the river reached a high-water mark of 33.5 feet and inundated 250 square blocks of the city, destroying public utilities, docks, and stranding residents on either side of drawbridges stuck open across the river. In addition to the flooding in Portland, towns, farms, and transportation facilities were destroyed across the region (Willingham, 1983). However, businesses continued operating from second story windows, or with the help of boats on downtown streets, and residents constructed makeshift "sidewalks" in spite of the flood waters, as shown in Figure 1 and Figure 2.



Figure 1: 1894 flooding at the intersection of SW 3rd and SW Washington (Portland Archives)



Figure 2: 1894 flooding along the North Park blocks (Portland Archives)

May 1948: The Vanport Flood

This flood event destroyed the entire city of Vanport, a community of 18,500 people (over 6,000 of whom were black residents) and the largest public housing project in the nation, when a railroad embankment was breached by the Columbia River and catastrophic flooding occurred in a matter of minutes. Although estimates varied wildly following the flooding, a total of 15 people were killed by the flood. Many other areas of Portland were also inundated by floodwaters in May of 1948 (see Figure 3). The city of Vanport, at one time the second largest city in Oregon, was hastily constructed by Henry Kaiser to house his shipbuilders and their families. Given Portland's racist and exclusionary history, black workers coming to work in these shipyards powered by the newly constructed Bonneville Dam had little choice but to live in this boggy city at the site of what is now Delta Park and Portland International

Raceway. Following the flood, displaced black residents could only find permanent housing in Albina and years of racial discrimination and further displacement would follow.



Figure 3: 1948 flooding of Vanport (Portland Archives)



Figure 4: 1948 flooding north of the Ross Island Bridge (Portland Archives)

December 1964

Known as the Christmas Flood, weather stations across Oregon recorded new records for precipitation and nearly every river in the state exceeded its flood stage in December of 1964. The resulting debris flows, bridge failures, and flooding caused airports, railways, and roads to be closed and thousands evacuated across the region. In total, this flood event resulted in over \$157 million in damages and 20 people were killed (MAP, 2016). As shown in the following aerial photograph (Figure 5), flood waters stretched well into the Central Eastside district of Portland. In addition to flooding from the Willamette

River, approximately 1,200 structures were flooded by Johnson Creek, particularly in the Lents Neighborhood (BES, 2001).



Figure 5: 1964 flooding of the Central Eastside (Credit: John Killen, *The Oregonian*)

February 1996

The most damaging flood event in recent memory occurred in the winter of 1996 when warm temperatures, heavy snowpack, and consecutive days of record-breaking rain combined to cause five deaths statewide, forced thousands of people into shelters, and destroyed hundreds of homes. In downtown Portland, the Willamette River rose to a depth of 28.55 feet, which is 11 feet above flood stage and threatened to overtop the harbor wall. In an effort to prevent damage in the Central City, Portland erected makeshift barriers along Waterfront Park. In addition to the flooding on the Willamette, the Columbia River crested at 11 feet 2 inches above flood stage, and Johnson Creek crested at 6 feet 5 inches above flood stage (MAP, 2016). Following this flood, the City and Metro created a map of the 1996 Flood Inundation Area (Metro Title 3 Map) using aerial images from the day

after the peak of the flood and the City began requiring additional flood-related building requirements under Title 24, Building Regulations.



Figure 6: 1996 flooding of Oaks Amusement Park (Credit: The Oregonian)

B. Flood Insurance and the FEMA NFIP Biological Opinion

The owners of properties that are located in a FEMA-mapped 100-year floodplain are at an elevated risk of being impacted by flooding compared to the owners of other properties that are not in a mapped floodplain. Purchasing flood insurance can help to offset the inevitable and predictable costs that are associated with repairing or rebuilding structures, or relocating, after floods occur. Portland and other communities in Oregon require that property owners comply with building and zoning code regulations to reduce the risk of impacts to life and property that are caused by flooding and to help to reduce the cost of flood insurance to community members. A recent Biological Opinion that was issued by the National Marine Fisheries Service found that the National Flood Insurance Program, as administered by the Federal Emergency Management Agency, was in violation of the Endangered Species Act, and that changes to floodplain regulation requirements would be required.

i. National Flood Insurance Program

The National Flood Insurance Program is a United States federal government-backed program that is intended to provide more affordable insurance to the owners of properties that are located in places that are at risk of flooding. The program was created through the passage of the National Flood Insurance Act of 1968. The 1973 Flood Insurance Protection Act mandated that lenders must require the

recipients of all federally backed loans for the purchase of properties that are located in the floodplain to obtain flood insurance. In order for individual property owners to have access to flood insurance policies that are offered through the NFIP, the jurisdictions/communities that they live in must voluntarily enroll in the program and they must implement policies and requirements regarding development in the floodplain. Communities may go beyond the minimum requirements by passing more stringent regulations and taking other voluntary actions that reduce risk to life and property. These additional actions earn points in the Community Rating System (CRS) and reward homeowners in participating communities with flood insurance premium reductions. Portland has been enrolled in the CRS program since 2001.

ii. Update to the FEMA Flood Insurance Program: Risk Rating 2.0

Risk Rating 2.0 is a change to the way that FEMA determines the potential risk that flooding poses to specific properties. The updated approach takes into account a broader spectrum of factors to determine flood insurance rates. These factors include flood frequency, the types of flooding that frequently occur in the area, distance to a water source, and factors that are specific to individual properties, such as the cost of rebuilding. The program will also make the rates more equitable. Under the previous program, higher value properties were often paying far less than the cost that represents the actual flood risk and value of the property. Risk Rating 2.0 went into effect for new policies on October 1, 2021. Existing policies up for renewal after April 1, 2022 will be subject to the new Risk Rating 2.0 methodology and rates.

Under the previous methodology, the flood insurance rate that is charged to individual lots in the 100-year floodplain is determined by the Flood Insurance Rate Map (FIRM) zone. The zones are primarily based on the elevation of the lot relative to the Base Flood Elevation (BFE), which is the elevation to which water would be expected to rise in a 100-year flood event. The lower a property is relative to the BFE, the more damage that property would be expected to incur in a major flood event, and the higher the flood insurance rate that is charged for that property.

iii. Other Flood Insurance

There are many private insurance companies that offer flood insurance outside of the NFIP. These policies offer some benefits that the NFIP policies do not, such as higher coverage limits and coverage of living expenses of displaced homeowners that aren't covered by NFIP policies. But these policies are not regulated the same way that NFIP policies are. Policy premium increases are not capped, and the policies can be cancelled for any reason, unlike NFIP policies which are legally prohibited from being cancelled by insurers.

Portland's floodplain regulations have been implemented, in part, to comply with NFIP requirements and to allow residents and homeowners to have access to discounted flood insurance. But Portland's

floodplain regulations apply to all properties that are located in the 100-Year Floodplain and the 1996 Flood Inundation Area, including those that are not recipients of federally backed mortgages.

iv. National Marine Fisheries Service (NMFS) Biological Opinion

The City of Portland has long recognized the importance of maintaining and improving habitat, including for salmonids. It has also been a participant in the NFIP since 1980 in order provide a means for property owners to financially protect themselves from floods through federally backed insurance. In 2016, when National Marine Fisheries Service (NMFS) issued a Biological Opinion in consultation under Section 7 of the Endangered Species Act (ESA), these issues, including the impact of development in the floodplain on salmon habitat, were first considered together rather than as independent parts of disparate regulatory and restoration efforts. This Biological Opinion, or FEMA BiOp, was issued in response to the settlement of a 2009 lawsuit brought by the Audubon Society of Portland, National Wildlife Federation, Northwest Environmental Defense Center, and the Association of Northwest Steelheaders against the Federal Emergency Management Agency's (FEMA) implementation of the NFIP. The lawsuit argued that the NFIP jeopardizes the continued existence and recovery of threatened and endangered salmon and steelhead runs in Oregon that are protected under the ESA. In the FEMA BiOp, NMFS concluded that FEMA's implementation of the NFIP does jeopardize protected salmon and steelhead and directed FEMA to amend the requirements of participation in the NFIP so as to ensure the protection of floodplain habitat and flood storage.

Using the FEMA BiOp and expected FEMA requirements to maintain access to flood insurance as a catalyst, the City is developing the Floodplain Resilience Plan. This multi-bureau project is an effort to advance City goals for health, safety, and the environment, while meeting all FEMA requirements for the NFIP and ensuring compliance with ESA, in excess of the FEMA requirements. Beyond the steps that will be required to comply with the BiOP, Portland's plans, goals, and policies provide solid guidance to improve floodplains and flood resilience, respond to climate change, protect and enhance the environment, support salmon recovery, and encourage functional, healthy, and vibrant riverfronts. The effects of climate change are anticipated to intensify and influence our local and regional weather patterns with the potential for more frequent and/or more significant flood events, exacerbated by sea level rise continuing apace. With these considerations mind, this project is also an attempt to plan for these changes and to direct development in ways that reduce risks to Portlanders, as well risks to salmon and steelhead and their habitat.

B. State, Regional and Local Floodplain Regulations

There are state, regional and local planning goals and policies that require the City of Portland to draft and adopt floodplain regulations that protect life and property from hazards, allow for economic activity, growth and housing in the floodplains, and that preserve natural resources and functions of the

floodplains and associated river systems. These policies are described in brief in this section. Appendix A also includes information on these policies in greater depth and detail.

i. State Policies

At the state level, land use planning goals provide a framework for floodplain management in Portland. Goal 5 addresses natural resource protection and making land management decisions that weigh and balance conflicting uses and that consider the Economic, Social, Environmental and Energy related consequences in the decision-making process. Goal 6 requires that communities adopt regulations that protect natural resources and maintain water quality. Goal 7 addresses planning around natural hazards, such as flooding, and requires that communities adopt land use practices that are consistent with the risk that is imposed by potential natural hazards in specific locations. Goal 9 requires communities to plan for economic development and job growth. Because a large proportion of Portland's industrial lands and employment centers that provide middle wage jobs are located in and around Portland's floodplains, it is important that any floodplain regulations that are adopted take into account the impacts on current and future development in these sectors. Goal 15 applies specifically to the Willamette River. It requires jurisdictions to conserve and maintain portions of the Willamette that flow through their borders.

ii. Metro Policies

Metro is the regional authority that oversees land use planning and policy for the tri-county Portland metropolitan region. Metro adopts policies and requires compliance to ensure that local governments within its jurisdiction follow state and federal regulations. Metro policies that apply to floodplain management include Title 3, which pertains to land use planning in regard to natural hazards, such as flooding, and Title 13, which applies to natural resource management, with specific focus on the preservation of riparian resources and wildlife habitat.

iii. City of Portland Policies

The City of Portland has numerous policies that pertain to the diverse aspects of floodplain management. They can be found in the Comprehensive Plan, the Climate Action Plan, the Central City Plan, The Mitigation Action Plan, the Watershed Management Plan, the Stormwater Management Manual and other City Resolutions. Policies pertain to such topics as equity, resilience, water quality, health, natural resource management and urban design.

II. The City's Floodplain

A. Floodplains, Citywide

The City of Portland and its metropolitan region are uniquely situated at the confluence of the Columbia and Willamette Rivers, the 4th and 13th largest rivers in the contiguous United States in terms of discharge¹. Although numerous smaller named and unnamed tributaries of the Willamette River pass through the city, FEMA has only mapped floodplains on the largest tributaries in the city: Johnson Creek, Tryon Creek, and Fanno Creek (which flows to the Willamette River via the Tualatin River). The mapped floodplain of Johnson Creek also includes the floodplain of Crystal Springs Creek, a spring-fed tributary of Johnson Creek that provides important cold water refugia for salmonids. In the statistical data listed below, Crystal Springs Creek floodplain area is treated as part of Johnson Creek. In addition to these streams, FEMA has mapped floodplains on the Columbia River and Columbia Slough. The City has identified 1996 Flood Inundation Area on Johnson Creek, the Willamette River, Crystal Springs Creek, the Columbia River and the Columbia Slough, but not on Tryon Creek or Fanno Creek. The 1996 Flood Inundation Area is largely consistent with the FEMA 100-Year Floodplain, with relatively minor variations primarily along the Willamette River. A U.S. Army Corps of Engineers study that is currently underway will update the hydraulic model that is used to map the floodplain on the lower Willamette River, taking into account current river bathymetry and elevation profiles. Preliminary results of this study are expected by the end of 2021. Figure 7 illustrates where the mapped floodplain is located in each of the Portland watersheds.

¹ The Willamette River is the 13th largest in the conterminous United States in terms of discharge and is the largest of all major United States rivers in terms of discharge per square mile of drainage area (Uhrich and Wentz, 1999).

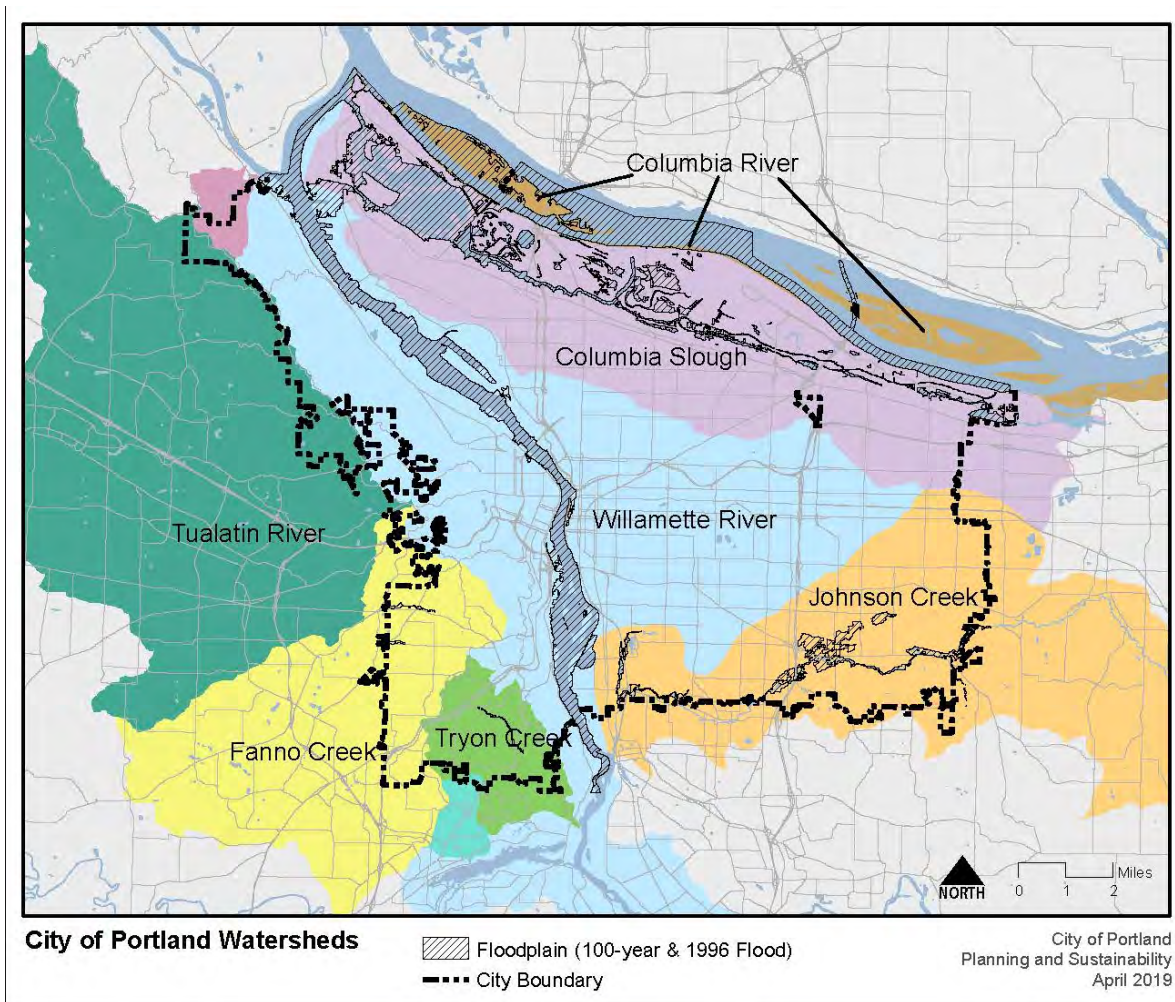


Figure 7: City of Portland Watersheds and Floodplains

Tables 1 and 2 provide a breakdown of the zoning and land uses of the lots that are located fully or partially in the citywide floodplain. These are the lots that face the greatest risk of flooding, and they are the lots that are most impacted by flood related zoning and building regulations, and development on these lots can have a significant impact on habitat that is used by threatened and endangered species. Table 1 includes statistics on both lots that are fully in the floodplain and lots that are partially in the floodplain. While the IG2 zone is the most common zone that is applied to lots in the floodplain, the majority of the lots with this zoning are only partially in the floodplain, meaning that it may be possible to develop these lots without building in or impacting the floodplain. But IG2 is an industrial zone, and industrial land uses typically require large amounts of space. If any portion of an industrial lot is located in the floodplain, this could limit the developable area, and thereby significantly reduce the development potential of the lot.

After IG2, the next most common zone that is applied to lots in the floodplain is R5 (other than OS, in which development is only allowed by exception). Of the R5 lots in the floodplain, the majority (2/3) are fully in the floodplain (meaning that 95% or more of the lot area is covered by floodplain). This means that no new development would be possible on these lots without adding fill and/or impacting natural resources in the floodplain. The remaining lots in the floodplain are a mix of residential, industrial, open space, and commercial.

TABLE 1: NUMBER OF TAX LOTS THAT ARE COMPLETELY OR PARTIALLY IN THE FLOODPLAIN BY BASE ZONE

Base Zone	Fully Within (>95%)	Partially Within	Grand Total
IG2	98	548	646
OS	270	284	554
R5	354	177	531
IH	103	285	388
R10	66	260	326
R7	152	142	294
RM1	36	131	167
CM2	2	142	148
R20	19	121	140
EG2	24	95	119
CE	51	50	101
RF	45	48	93
RM2	42	29	71
CX	7	46	53
IG1	16	33	49
EX	6	31	37
CM1	12	18	30
RX	1	8	9
RMP	0	6	6
CI1	0	5	5
CM3	0	3	3
CR	3	0	3
EG1	0	3	3
IR	0	1	1
Grand Total	1,312	2,471	3,783

Table 2 provides a closer look at the lots that are located fully within the combined flood hazard area. For the purposes of this analysis, fully in the floodplain is defined as having 95 percent or greater of the area located within the combined flood hazard area. In this table, the different zones are grouped into their respective land uses: Industrial includes IG2, IH, EG2, IG1, and EG1. Single dwelling residential includes R5, R10, R7, and RF. Multi-dwelling residential includes RM1, RM2, RX, RMP, and IR. Commercial includes CM2, CE, CX, EX, CM1, CI1, CM3, and CR. Open space is OS.

When the zones are grouped into their larger land use categories, it is clear that the predominate type of land use in lots that are fully in the floodplain is residential. When the OS zoned lots are excluded, residential lots account for 69 percent of the lots that are fully in the floodplain, and the majority of these are single-dwelling residential (61% of the total non-OS lots). After residential land uses, industrial and employment is the next most common land use category, accounting for 24 percent of the total number of non-open space zoned lots that are fully in the floodplain. Only 8 percent of the lots in that are fully in the floodplain are zoned commercial. Clearly, single dwelling residential lots are the most likely to be at risk of the impacts of flooding, and the owners and residents of single dwelling lots are the most likely category of landowner to be impacted by flood plain regulations in the City of Portland.

TABLE 2: NUMBER OF TAX LOTS THAT ARE FULLY WITHIN (>95%) FLOODPLAINS CITYWIDE BY LAND USE TYPE

	Tax lots	% of Fully Within	% of Fully Within, excluding OS
Residential	716	54%	69%
Single-dwelling	636	48%	61%
Multi-dwelling	80	6%	8%
Industrial/Employment	247	19%	24%
Commercial	79	6%	8%
Open Space	270	21%	NA
Total Citywide	1,312	100%	100%

Although the development or redevelopment of tax lots that are fully within a floodplain cannot avoid impacting the floodplain to some extent, development on tax lots that are only partially within a floodplain has the potential to avoid or significantly reduce floodplain impacts. There are 2,471 tax lots that are located partially within a floodplain, citywide (See Table 3). These tax lots represent 65 percent of the total number of tax lots partially or fully within a floodplain. While residential tax lots do constitute a significant portion of the lots that are partially in the floodplain, the largest percentage (40%) of tax lots that are partially within a floodplain are zoned industrial or employment.

TABLE 3: TAX LOTS PARTIALLY WITHIN FLOODPLAINS CITYWIDE BY LAND USE TYPE

	Tax lots	% of Partially Within	% of Partially Within, excluding OS
Residential	928	37%	42%
Single-dwelling	748	30%	34%
Multi-dwelling	180	7%	8%
Industrial/Employment	1,000	40%	46%
Commercial	259	11%	12%
Open Space	284	12%	NA
Total Citywide	2,471	100%	100%

B. ESA-listed Species and Species of Concern in the Floodplain

The findings of the National Marine Fisheries Service’s 2016 Biological Opinion were that FEMA’s National Flood Insurance Program has a negative impact on the health and viability of threatened and endangered runs of salmon and steelhead on rivers in Oregon. There are 13 Endangered Species Act-listed species that have been found or that have potential habitat in Portland’s waterways. Ongoing monitoring by BES has documented the current condition, and the future potential, of each of the watersheds with respect to specific parameters spelled out in the Biological Opinion. Table 4 identifies ESA-listed salmonid species that have been found in the city by watershed.

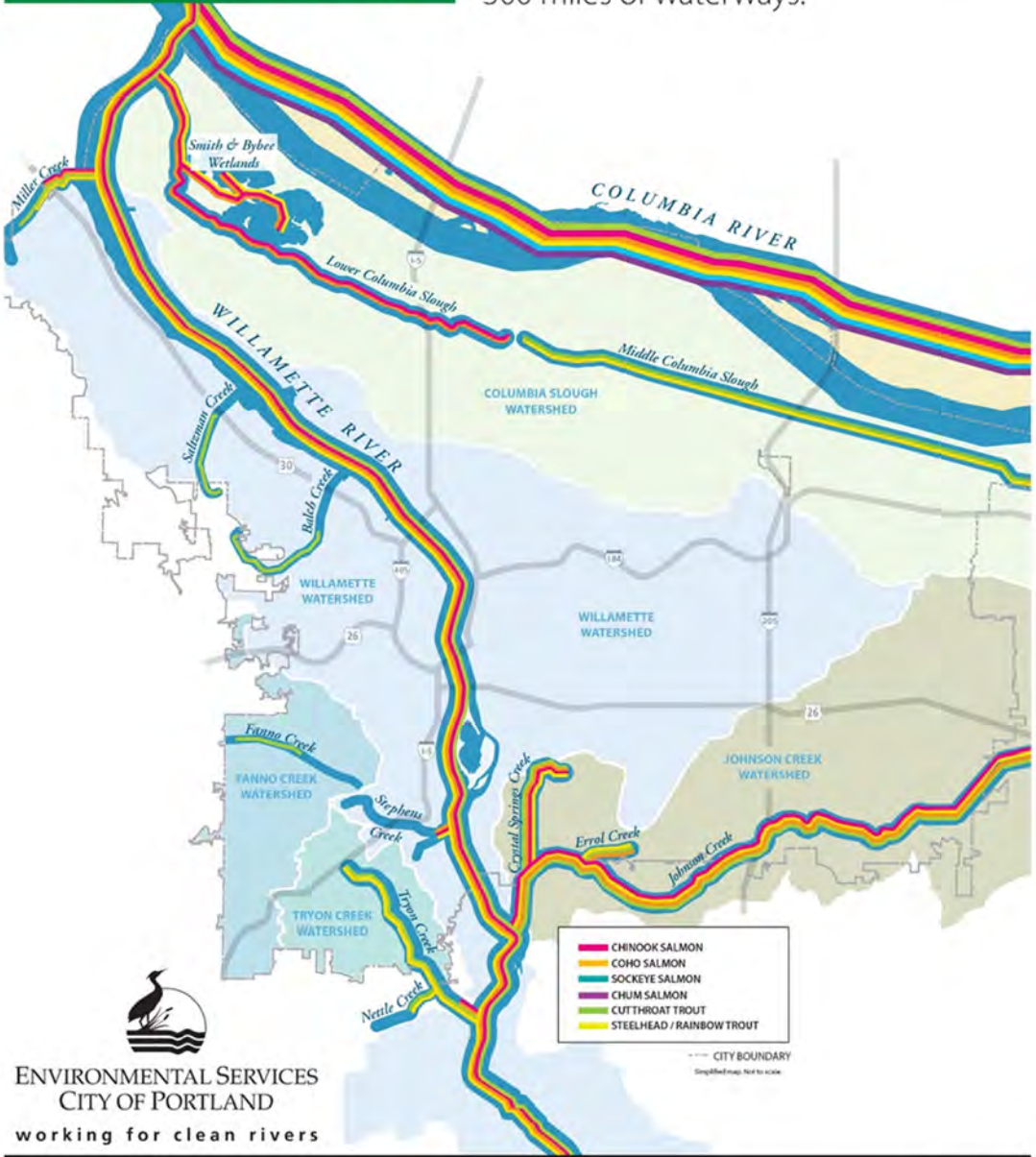
TABLE 4: ESA-LISTED SALMON AND STEELHEAD

ESA listed salmon and steelhead in Portland by Watershed (as of 2017)								
ESA-Listed Species		Columbia River	Willamette River	Columbia Slough	Johnson Creek	Tryon Creek	Fanno Creek	Willamette Tributaries
Steelhead								
	<i>Lower Columbia</i>	x	x	x	x	x	x	x
	<i>Upper Willamette</i>	x	x	x	x	x	x	x
	<i>Middle Columbia</i>	x	x	x				
	<i>Upper Columbia</i>	x	x	x				
	<i>Snake River</i>	x	x	x				
Chinook								
	<i>Lower Columbia</i>	x	x	x	x	x	x	x
	<i>Upper Willamette</i>	x	x	x	x	x	x	x
	<i>Upper Columbia</i>	x	x	x				
	<i>Snake River Fall</i>	x	x	x				
	<i>Snake River Spring</i>	x	x	x				
Coho								
	<i>Lower Columbia</i>	x	x	x	x	x	x	x
Chum								
	<i>Columbia River</i>	x						
Sockeye								
	<i>Snake River</i>	x						

Adult Chinook, coho, and steelhead migrate through the lower Willamette River to reach spawning areas in the Clackamas River and the middle and upper reaches of the Willamette River Basin. In addition to adult Chinook, coho, and steelhead, chum and sockeye migrate along the Columbia River in Portland to reach spawning areas in the upper reaches of the Columbia River Basin, including the Snake River. Due to the importance of these migratory routes through Portland, habitat quantity and quality substantially affects pre-spawn survival, spawning success, juvenile growth and survival, and overall potential population productivity of these salmonids. In addition, fry, subyearling, and yearling salmon rear and reside in available habitats within the City of Portland (BES, 2006). Figure 8 shows where salmonids have been documented in the city by BES.

Salmon in Our City

Native salmon and steelhead are found in more than 125 miles of Portland's 300 miles of waterways.



OD 1758 SEPT 2017

Figure 8: Where fish populations can be found in Portland streams and rivers

In addition to the ESA-listed species of salmon and steelhead, the city and its floodplains and riparian habitats are used and relied upon by numerous other special status species. To support and achieve the watershed health goals and objectives in the *Portland Watershed Management Plan*, BES coordinated and developed the *Terrestrial Ecology Enhancement Strategy*. As part of this process, BES created a comprehensive list of all vertebrate wildlife species know to occur in Portland, or that could occur based on their natural ranges and habitat requirements. The following list (Table 5) of Special Status Species contains all those species whose range includes Portland and that are officially identified by a variety of federal, state, and environmental organizations as species of concern.

TABLE 5: WILDLIFE - SPECIAL STATUS SPECIES IN PORTLAND

	Federal Status	State Status	NWPCC Focal Spp. ²
Amphibians			
Northern red-legged frog	Species of Concern	Sensitive-Vulnerable	X
Clouded salamander		Sensitive-Vulnerable	
Reptiles			
Northwestern pond turtle	Species of Concern	Sensitive-Critical	X
Western painted turtle		Sensitive-Critical	
Birds			
American bittern			
American kestrel			X
American white pelican		Sensitive-Vulnerable	
Bald eagle	Delisted ³	Delisted ⁴	X
Band tailed pigeon	Species of Concern		
Black throated gray warbler			
Brown creeper			
Bufflehead			
Bullock's oriole			
Bushtit			
Chipping sparrow		Strategy Species	X

² Identified in the Northwest Power and Conservation Council Willamette Basin Subbasin Plan as Focal Species. These include species that are: listed or that are current candidates for listing as threatened or endangered by federal agencies; listed as threatened, endangered, sensitive—critical, or sensitive—vulnerable by ODFW; declining in the basin or region as indicated by Breeding Bird Survey (BBS) data; endemic to the Willamette Basin; or perform ecological functions quite different from those performed by other species that regularly occur in the same habitat type.

³ <http://www.fws.gov/pacific/ecoservices/BaldEagleDelisting.htm>

⁴ http://www.dfw.state.or.us/conservationstrategy/news/2012/2012_may.asp

	Federal Status	State Status	NWPCC Focal Spp.²
Common nighthawk		Sensitive-Critical	
Common yellowthroat			X
Downy woodpecker			
Dunlin			X
Great blue heron			
Green heron			X
Hammond's flycatcher			
Hermit warbler			
Hooded merganser			
House wren			
Hutton's vireo			
Loggerhead shrike		Sensitive-Vulnerable	
Long-billed curlew		Sensitive-Vulnerable	
Merlin			
Nashville warbler			
Northern harrier			X
Olive-sided flycatcher	Species of Concern	Sensitive-Vulnerable	X
Orange crowned warbler			
Pacific slope flycatcher			
Peregrine falcon	Delisted ²⁷	Delisted ⁵	
Pileated woodpecker		Sensitive-Vulnerable	X
Purple finch			
Purple martin	Species of Concern	Sensitive-Critical	X
Red crossbill			
Red-eyed vireo			X
Red-necked grebe		Sensitive-Critical	
Rufous hummingbird			
Short-eared owl		Strategy Species	
Sora			X
Streaked horned lark	Candidate	Sensitive-Critical	X
Swainson's thrush			
Swainson's hawk		Sensitive-Vulnerable	
Thayer's gull			

⁵ http://www.dfw.state.or.us/conservationstrategy/news/2010/2010_april.asp

	Federal Status	State Status	NWPCC Focal Spp.²
Varied thrush			
Vaux's swift			X
Vesper sparrow	Species of Concern	Sensitive-Critical	X
Western meadowlark		Sensitive-Critical	X
Western sandpiper			
Western wood pewee			X
White-breasted nuthatch		Sensitive-Vulnerable	X
White-tailed kite			
Willow flycatcher - Little	Species of Concern	Sensitive-Vulnerable	X
Wilson's warbler			
Winter wren			
Wood duck			X
Yellow warbler			X
Yellow-breasted Chat	Species of Concern	Sensitive-Critical	
Mammals			
American Beaver			X
California myotis (bat)		Sensitive-Vulnerable	
Camas pocket gopher	Species of Concern		
Fringed myotis (bat)	Species of Concern	Sensitive-Vulnerable	
Hoary bat		Sensitive-Vulnerable	
Long-eared myotis (bat)	Species of Concern		
Long-legged myotis (bat)	Species of Concern	Sensitive-Vulnerable	
Northern river otter			X
Red tree vole	Species of Concern	Sensitive-Vulnerable	X
Silver-haired bat	Species of Concern	Sensitive-Vulnerable	
Townsend's big eared bat	Species of Concern	Sensitive-Critical	X
Western gray squirrel		Sensitive-Vulnerable	X
White-footed vole	Species of Concern		
Yuma myotis (bat)	Species of Concern		

C. Floodplain Watersheds

There are six distinct waterbodies in the City of Portland that have mapped floodplains, the Willamette River, the Columbia River, Johnson Creek, the Columbia Slough, Tryon Creek and Fanno Creek. Each waterbody has distinct characteristics, ecology and hydrology. With the exception of Tryon Creek and the Columbia Slough, the watersheds of the rivers and tributaries with mapped floodplains in Portland extend far beyond the Urban Services Boundary of the City of Portland. The following is a brief

description of the watersheds within Portland. A more complete evaluation of existing conditions of these watersheds can be found in Sections 3 of this document.

i. Willamette River

The Willamette River watershed drains roughly 11,478 square miles of Oregon (about 12 percent of the state’s land area) and flows 187 miles from its headwaters to the confluence with the Columbia River in Portland. The lower Willamette River (the reaches that extend from Willamette Falls in Oregon City to the confluence with the Columbia River) is defined by its connection to the Columbia River. River flows, water levels, and flooding, among other characteristics, are strongly influenced by tides and flows in the Columbia River. In addition, the U.S. Army Corps of Engineers operates 13 dams on tributaries to the Willamette River upstream of Portland. The management of these dams results in less variable flows downstream and reduced peak flows, but has had significant detrimental impact on salmon populations. The Willamette River is mapped within the 1996 Flood Inundation Area.



ii. Columbia River

The Columbia River watershed encompasses more than 200,000 square miles of lands across seven states and British Columbia, Canada, and the river itself flows over 1,200 miles from its source in the Canadian Rockies to the Pacific Ocean. By comparison, the 130 square miles of the City of Portland, 1/16 of 1 percent of the Columbia River Basin, is a small, but ecologically and economically important part. The mainstem of the Columbia River is blocked by 14 dams in the U.S. and Canada, while there are over 60 dams with the Columbia River Basin; these dams provide electricity, irrigation, and downstream flood protection, but with devastating and lasting impacts on salmonid species. The 1996 Flood Inundation Area map also applies to the Columbia River.



iii. Columbia Slough

The Columbia Slough Watershed encompasses approximately 51 square miles (32,640 acres) and flows for 19 miles from Fairview Lake through portions of Troutdale, Fairview, Gresham, Maywood Park, and Wood Village to the Willamette River at Kelley Point Park. There are also roughly 30 miles of secondary waterways and water features. The Columbia Slough is often divided into three sections: Lower Slough, Middle Slough, and Upper Slough. The Lower Slough is the only section free of fish passage barriers and is tidally influenced. Although the entire slough has seen significant channelization and modification by development and the dike and levee systems, the Middle and Upper Sloughs are actively managed by a system of pumps to provide hydrologic management and flood control. The Columbia Slough also is mapped within the 1996 Flood Inundation Area.



iv. Johnson Creek

The Johnson Creek watershed covers 54 square miles (34,560 acres) across Multnomah and Clackamas counties. From its source in the foothills of Mount Hood near Boring, Johnson Creek passes through the jurisdictions of Gresham, Happy Valley, Portland, and Milwaukie before entering the Willamette River in the City of Milwaukie, 18.5 miles upstream from the mouth of the Willamette River. Although restoration projects have resulted in significant improvements to the biological conditions in the watershed, a history of development, including extensive alterations performed in the 1930s by the Works Progress Administration, has negatively impacted habitat and increased flood risks along the creek. Crystal Springs Creek and Kelley Creek are Johnson Creek's most significant tributaries, and both have mapped floodplains within city limits. However, while Crystal Springs Creek is entirely within the City of Portland, Kelley Creek has only a small segment within the city. Johnson Creek also is mapped within the 1996 Flood Inundation Area.



v. Tryon Creek

Tryon Creek is a free-flowing stream in Southwest Portland that drains a 4,237-acre watershed and runs for seven miles from its source in the West Hills of Portland to the Willamette River near Lake Oswego. It is primarily a low gradient stream with steep hillslopes and limited floodplain habitat. A substantial portion of the creek is located in the Tryon Creek State Natural Area managed by Oregon State Parks, as well in Marshal Park. However, culvert and road crossings have resulted in degraded habitat and fish migration barriers. Although Tryon Creek has mapped floodplain, it is not mapped within the 1996 Flood Inundation Area.



vi. Fanno Creek

Fanno Creek is a tributary to the Tualatin River, which encompasses 20,500 acres and eventually flows into the Willamette River south of Oregon City. Unlike the other tributaries to the Willamette River in Portland, the mouth of the Tualatin River is upstream of Willamette Falls. Most of Fanno Creek within the City of Portland is inaccessible to anadromous fish because of impassable culverts downstream of City limits. However, anadromous salmon and steelhead likely historically used upper Fanno Creek for spawning and rearing. Although Fanno Creek has mapped floodplain, it is not mapped within the 1996 Flood Inundation Area.



D. Summary of Floodplain Characteristics by Watershed

The six Portland watersheds that contain mapped floodplains vary significantly in size and character. So too do the floodplains, themselves. Altogether, the combined 100-year floodplain and 1996 Flood Inundation Area comprise 5,863 acres (Table 6), but the floodplain area is not evenly distributed in the different watersheds. More than half of Portland's floodplain is located in the Columbia Slough watershed. Both the Portland floodplains of the Willamette River and the Columbia River cover about a third as much area as the Columbia Slough floodplain. In terms of area, the Johnson Creek floodplain is roughly a fifth of the size of the Columbia Slough floodplain and only half as large as the Columbia River or Willamette River floodplains. But the Johnson Creek floodplain covers a much larger number of tax lots than any of the other floodplains, reflecting the fact that land uses in the Johnson Creek watershed are significantly different than they are in the other large floodplains in Portland.

The U.S. Army Corps of Engineers is in the process of updating the hydraulic model that is used to map the floodplain in the Lower Willamette River, including the portion of that flows through the City of Portland. This work is expected to be completed by the end of 2021. The Floodplain Resilience Plan will include proposals to extend flood-related building code and zoning code regulations to an area that will be defined as the combined flood hazard area, which will include the FEMA 100-Year Floodplain, the 1996 Flood Inundation Area, and all additional area that is identified as being floodplain by the U.S. Army Corps of Engineers study.

TABLE 6: FLOODPLAIN AREAS (IN ACRES)

Watershed	# Tax lots	100-Year Floodplain Area	Metro Title 3/ 1996 Flood Inundation Area	1996 Actual Flood Extent Area⁶	100-Year & 1996 Flood Inundation Area
Columbia River	389	494	456	456	552
Columbia Slough	1,027	3,246	2,346	2,491	3,350
Fanno Creek	139	33	0	0	33
Johnson Creek	1,615	607	149	149	623
Tryon Creek	56	21	0	0	21
Willamette River	557	1,135	1,052	1,129	1,284
Grand Total	3,783	5,537	4,003	4,226	5,863

i. Zoning

The figures in the preceding table provide a general sense of the relative sizes of the respective floodplains. Table 7 provides a detailed breakdown of the zoning in the various floodplains, giving more details and context to the types of land uses that may be impacted by flooding in the different floodplains and which may be impacted by regulations that apply to new development in the floodplain.

⁶ Statistics for the actual 1996 Flood Extent are included for informational purposes, only. Portland does not apply floodplain regulations to this area.

TABLE 7: ZONING (IN ACRES)

Zoning Designation	Tax lots (#)	100-Year Floodplain (acres)	Metro Title 3/ 1996 Flood Inundation Area (acres)	1996 Actual Flood Extent (acres)⁶	100-Year & 1996 Flood Inundation Area (acres)
Columbia River	389	494	456	456	552
CE	74	204	209	209	221
OS	56	88	46	46	88
IG2	47	63	73	73	88
RF	39	65	56	56	65
IH	20	30	34	34	37
RMP	2	13	11	11	21
R10	8	16	13	13	16
RM1	11	9	10	10	11
CM2	86	2	0	0	2
R7	39	2	2	2	2
RM2	5	2	2	2	2
CM1	1	0	0	0	0
EG2	1	0	0	0	0
Columbia Slough	1,027	3,246	2,346	2,491	3,350
OS	104	2,088	1,781	1,793	2,097
IG2	495	572	183	183	600
IH	229	485	325	459	549
RF	29	42	33	33	42
EG2	39	26	14	14	28
R10	68	17	4	4	18
R20	22	8	1	1	8
CM2	35	5	4	4	6
CM1	3	1	0	0	1
CE	2	0	0	0	0
IR	1	0	0	0	0
Fanno Creek	139	33	0	0	33
RM1	62	14	0	0	14
R10	34	9	0	0	9
OS	8	4	0	0	4
CM2	2	3	0	0	3
R7	22	2	0	0	2
CE	10	2	0	0	2

Zoning Designation	Tax lots (#)	100-Year Floodplain (acres)	Metro Title 3/ 1996 Flood Inundation Area (acres)	1996 Actual Flood Extent (acres)⁶	100-Year & 1996 Flood Inundation Area (acres)
RM2	2	0	0	0	0
Johnson Creek	1,615	607	149	149	623
OS	273	233	76	76	237
R10	202	74	18	18	76
R5	497	70	8	8	71
IG2	83	59	7	7	59
EG2	56	39	17	17	45
R20	32	41	14	14	42
R7	233	36	2	2	36
RM1	93	21	3	3	21
RF	22	7	2	2	8
RM2	56	8	0	0	8
RMP	4	7	1	1	7
CM1	24	5	0	0	5
IG1	14	4	0	0	4
CE	15	3	0	0	3
CI1	3	0	0	0	0
CM3	2	0	0	0	0
CR	3	0	0	0	0
EG1	3	0	0	0	0
Tryon Creek	56	21	0	0	21
OS	17	11	0	0	11
R20	26	8	0	0	8
R10	13	1	0	0	1
Willamette River	557	1,135	1,052	1,129	1,284
OS	139	508	497	497	571
EG2	53	60	7	84	64
RF	3	57	56	56	58
IH	21	43	15	15	47
EX	23	29	17	17	34
IG1	37	7	23	23	26
CI1	2	14	21	21	21
R20	60	13	17	17	19
CM3	25	15	15	15	18

Zoning Designation	Tax lots (#)	100-Year Floodplain (acres)	Metro Title 3/ 1996 Flood Inundation Area (acres)	1996 Actual Flood Extent (acres)⁶	100-Year & 1996 Flood Inundation Area (acres)
IG2	35	10	11	11	13
RM2	8	7	9	9	9
RM4	6	8	7	7	8
RX	9	2	4	4	5
CM2	2	3	3	3	3
R5	34	2	2	2	3
CX	1	0	0	0	0
R10	2	0	0	0	0
RM1	1	0	0	0	0
Grand Total	3,783	5,537	4,003	4,226	5,863

Citywide, the Open Space (OS) zone is the most widely applied zone in the floodplain by a relatively large margin. At 3,008 acres, the OS zone occupies just over 51 percent of the floodplain. The OS zone is usually only applied to publicly owned properties, such as parks and nature areas. When flooding does occur, lots that are zoned OS are less likely to be impacted because they are typically uninhabited and contain few structures that could be damaged by flood water. OS-zoned lots are also unlikely to be impacted by new regulations, as development is generally prohibited in the OS zone.

The Columbia Slough floodplain land uses are relative outliers, in that the majority of the total floodplain area that is zoned OS citywide is located in the Columbia Slough watershed. OS represents 62.5 percent of the Columbia Slough floodplain. But outside of the OS zone, the rest of the Columbia Slough floodplain is dominated by industrial zoning, alongside relatively small enclaves that are zoned residential or commercial/mixed use. At the other end of the spectrum, the relatively small Tryon Creek floodplain is also more than 50 percent open space, but all of the remaining, non-OS zoned area in the floodplain is zoned residential.

The other floodplains vary greatly in zoning. The Willamette River floodplain is mostly industrial and open space, but there are significant pockets of commercial and residential zoning in the Central City and South Reach. The Johnson Creek floodplain is mostly open space and residential, but there are significant areas of industrial zoning and small areas of commercial zoning.

Another characteristic that makes the Johnson Creek floodplain unique is the disparity in the number of tax lots in the floodplain relative to the total area of the floodplain. At 623 acres, the Johnson Creek floodplain covers roughly one-fifth the area of the Columbia Slough floodplain. But the Johnson Creek floodplain contains 1,615 tax lots, which is 57 percent more than the number of tax lots in the Columbia Slough. The reason for the disparity between the number of tax lots and the total area in the Johnson

Creek floodplain is the fact that there is so much more residential-zoned land in the Johnson Creek floodplain relative to other Portland floodplains. Residential lots, particularly single-dwelling residential lots, are typically much smaller than lots that are zoned commercial or industrial. The fact that there are so many residential lots suggests that there are many more residents and individual property owners who could be impacted by flooding or floodplain regulations in the Johnson Creek watershed relative to other areas of Portland.

Not all tax lots that are in the floodplain are impacted or constrained by the floodplain equally. As Tables 2 and 3 illustrate (see pages 19 and 20), many lots are only partially in the floodplain, and the portions of the lots that are out of the floodplain could potentially be developed without requiring fill or triggering floodplain regulations. Table 8 summarizes an analysis that was used to determine if lots could be developed to the applicable base zone maximum building capacity outside of the floodplain. If the portion of lot area that is outside the floodplain exceeds the maximum building coverage, then the lot could be developed without impacting the floodplain. Nearly 1/3 of the lots were found to have sufficient space to develop without impacting the floodplain.

TABLE 8: MAXIMUM BUILDING COVERAGE AVAILABLE OUTSIDE THE COMBINED FLOOD HAZARD AREA

Watershed	No	Yes	Open Space	Grand Total
Columbia River	253	80	56	389
Columbia Slough	492	431	104	1,027
Fanno Creek	34	97	8	139
Johnson Creek	865	477	273	1,615
Tryon Creek	5	34	17	56
Willamette River	379	82	96	557
Grand Total	2,028	1,201	554	3,800

ii. Property Ownership

Just as land uses in the floodplains vary by watershed, so do patterns of property ownership. While the majority of lots in all floodplains are privately owned, there are significant numbers of publicly owned lots in the floodplains of each of the watersheds in Portland (Table 9). The watershed with the largest percentage of publicly owned lots in the floodplain is the Willamette River (34%), and the watershed with the lowest percentage of publicly owned lots in the floodplain is Fanno Creek (7.2%). Citywide, around 24 percent of the lots in the floodplain are publicly owned. Railroad properties are treated as a separate category because railroads are largely exempt from government rules and regulations.

TABLE 9: PROPERTY OWNERSHIP IN THE COMBINED FLOOD HAZARD AREA BY WATERSHED

Watershed	Ownership	Number of Tax lots	Percentage of Tax lots
Columbia River	Private	311	80.0%
	Public	78	20.0%
Columbia River Total		389	100.0%
Columbia Slough	Private	731	71.2%
	Private-RR	15	1.5%
	Public	281	27.4%
Columbia Slough Total		1,027	100.0%
Fanno Creek	Private	129	92.8%
	Public	10	7.2%
Fanno Creek Total		139	100.0%
Johnson Creek	Private	1,292	80.0%
	Private-RR	1	0.1%
	Public	322	19.9%
Johnson Creek Total		1,615	100.0%
Tryon Creek	Private	37	66.1%
	Public	19	33.9%
Tryon Creek Total		56	100.0%
Willamette River	Private	346	62.1%
	Private-RR	20	3.6%
	Public	191	34.3%
Willamette River Total		557	100.0%
Grand Total		3,783	100.0%

iii. Building Age

The age of buildings and structures on lots are factors that are likely to have an impact on the likelihood of a lot to be redeveloped in the future. While some older structures have intrinsic value due to their historic nature, in general, as buildings age, they are likely to become functionally obsolete or to no longer be compatible with surrounding land uses and current land values. Thus, as buildings age, they become increasingly more likely to be replaced over time. Table 10 lists the age ranges of structures that are located on tax lots in the various Portland floodplains.

In general, development in Portland’s floodplains peaked in the latter part of the 20th Century, after which point, the developable land was largely built out and vacant land in the city became scarcer. Regulations, such as requirements to build a minimum of 2 feet above base flood elevation, and

compensatory cut requirements that were imposed in some parts of the floodplain restricted new development in the floodplain. These requirements were added to the code when Portland started its participation in the National Flood Insurance Program at the end of 1980.

Structures that were built in the floodplain between 1880 and 1980 were not required to address special standards for the flood hazard area in Title 24, Building Code. There are 1,356 tax lots that contain buildings that predate Portland’s participation in the NFIP. Structures and the inhabitants that live and work on these lots can be assumed to be at greater risk of damage or injury from flood events than inhabitants of structures in the floodplain that were built later. The Johnson Creek floodplain contains more structures that were built before 1981 than any other watershed.

TABLE 10: STRUCTURES IN COMBINED FLOOD HAZARD AREA BY YEAR BUILT

Watershed	Date of Construction						
	1880-1900	1901-1920	1921-1940	1941-1960	1961-1980	1981-2000	2001-2021
Columbia River	0	3	15	26	25	105	9
Columbia Slough	0	1	60	83	86	147	63
Fanno Creek	0	0	4	14	69	8	5
Johnson Creek	2	117	179	317	218	154	93
Tyron Creek	0	0	1	17	14	0	3
Willamette River	3	18	24	24	36	47	32
Total	5	139	283	481	448	461	205

iv. Buildable Land Inventory

While building age may be a reasonable proxy for likelihood of redevelopment of a specific lot, the Buildable Land Inventory (BLI) is an analytical methodology that takes into account a broader set of economic factors that can help to determine where development is likely to occur, such as physical and environmental constraints, underlying land value, the value, age and use of structures that are extant on the site, and transportation constraints. Sites on which the value that could be achieved through redevelopment exceeds the value of the current land use are determined to be underutilized. The BLI factors in zoning constraints and restrictions, such as environmental overlays. Any lot that is featured in the BLI can assumed to be economically developable even with zoning or building code restraints. Table 11 lists the number of tax lots that have been categorized as vacant or underutilized that are in the floodplain of each of the Portland watersheds.

The percentage of lots in the floodplain that are considered to be vacant or underutilized varies significantly by watershed. Though the highest total number of BLI lots are located in the Johnson Creek floodplain (320), this only represents 19.8 percent of the total number of tax lots in the floodplain the lowest percentage in all of the floodplains. The Fanno Creek and Tryon Creek floodplains contain only

43 and 16 BLI lots, respectively, but these floodplains are relatively small. The BLI lots represent roughly 31percent of all lots in the Fanno Creek floodplain and 29percent of all lots in the Tryon Creek floodplain.

TABLE 11: TAX LOTS IN THE BUILDABLE LANDS INVENTORY WITHIN THE COMBINED FLOOD HAZARD AREA

Watershed	Tax lots Identified in BLI	BLI Lots as a percentage of total tax lots in the floodplain
Columbia River	118	30.3%
Columbia Slough	242	23.6%
Fanno Creek	43	30.9%
Johnson Creek	320	19.8%
Tryon Creek	16	28.6%
Willamette River	196	35.2%
Grand Total	935	24.7%

E. Watershed Health

In general, Portland’s waterways have been substantially altered and degraded from historic conditions by development and other anthropogenic impacts within the city and within the region. In an effort to understand the health of these watersheds and evaluate the results of restoration projects, BES created the Portland Watershed Report Card (2010-14) that tracks a variety of indicators of watershed health including the following:

- Fish index
- Water quality
- Floodplain condition,
- Bank hardening
- Macroinvertebrates
- Impervious area

TABLE 12: WATERSHED REPORT CARD (2010-2014)

Applicable Watershed Health Indicators		
<i>Watershed</i>	<i>Measured parameter</i>	<i>Score (0-10 scale)</i>
Willamette River Mainstem	Fish Index	Under Development
	Water Quality	6.7
	Floodplain Condition	2.8
	Bank Hardening	0
	Macroinvertebrates	Under Development
	Impervious Area	3.4
Columbia River	not measured	
Columbia Slough	Fish Index	0.9
	Water Quality	5.7
	Floodplain Condition	6.7
	Bank Hardening	0
	Macroinvertebrates	Under Development
	Impervious Area	5
Johnson Creek	Fish Index	2.5
	Water Quality	5.1
	Floodplain Condition	6
	Bank Hardening	1.8
	Macroinvertebrates	4.3
	Impervious Area	7.5
Tryon Creek	Fish Index	2
	Water Quality	6.1
	Floodplain Condition	10
	Bank Hardening	10
	Macroinvertebrates	5.7
	Impervious Area	5.2
Fanno Creek	Fish Index	3.9
	Water Quality	5.5
	Floodplain Condition	7
	Bank Hardening	8.8
	Macroinvertebrates	0.5
	Impervious Area	4.2
Willamette Tributaries	Fish Index	1.3
	Water Quality	6.1
	Floodplain Condition	Not applicable
	Bank Hardening	10
	Macroinvertebrates	5.9
	Impervious Area	3.8

F. Vulnerability and Housing Assessment

The primary purpose of the NFIP, and the regulations that are applied by the City of Portland in order to comply with NFIP requirements, is to protect the people who live, work and own property in the floodplain. Any changes to the regulations will certainly have impacts, positive and negative, on these people. Thus, it is important to gather as much information as possible about the people that will benefit or be burdened by floodplain regulations.

The following section is based on a compilation of statistics that are sampled from data provided by the US Census Bureau American Community Survey (ACS) 5-Year Average dataset for the years 2013-2017, except for the subsection on Language and National Origin, which relies on ACS 5-Year Average data for the years 2015-2019⁷. The primary focus of this analysis is on identifying population characteristics that would make people more vulnerable to displacement or negative impacts of redevelopment or floodplain development regulations as well as individuals that may be more vulnerable to the impacts of damaging floods.

i. Floodplain Population

A total of 26,000 people are estimated to live in Portland's floodplains. This represents approximately 4 percent of Portland's total population which was 654,741 as of 2019. The Johnson Creek watershed contains the largest population of Portland residents living in the floodplain (estimated to be 9,514 or 37 percent of the total floodplain population), followed by the Columbia Slough watershed (estimated to be 3,921, or 15 percent of the total floodplain population).

ii. Race and Ethnicity

Thirty percent of floodplain residents identify as persons of color, which is nearly identical to the citywide population, in which 29 percent of people identify as persons of color. But the distribution of persons of color within the floodplain is not uniform. The Johnson Creek watershed and the Columbia Slough watershed are the two geographies with the highest percentages of people of color living in the floodplain (39 percent and 36 percent, respectively). All of the remaining floodplain sub geographies have population percentages of people of color that are lower than the citywide average. The Columbia

⁷ The ACS 5-Year average data is aggregated to Block Groups or Census Tracts (depending on the category of the data), which are relatively large geographic areas. None of the Block Groups or Census Tracts are located completely within the floodplain. All of them contain at least some area that falls outside of the floodplain. The statistics contained in this section are compiled using the assumption that populations are distributed homogeneously and uniformly within a given Block Group or Census Tract, and that any person is equally likely to be located and any point within that area. These assumptions often do not reflect real world conditions because population groups tend to self-aggregate within localized geographical distributions for reasons of affinity or economic and social necessity. Therefore, these statistics should be viewed as estimates that have relatively high levels of uncertainty.

River floodplain is estimated to have a population that is 26 percent persons of color, with smaller percentages of people of color in the Willamette River, Fanno Creek and Tryon Creek floodplains.

The three floodplain geographies that have the highest population percentages of people of color are not uniform in their racial and ethnic composition. Within the Johnson Creek floodplain, the percentages of people that identify as Latinx and Asian each exceed the citywide averages. Within the Columbia Slough floodplain, the Black, Asian and Native American population percentages exceed the citywide averages. And within the Columbia River floodplain, the Black population percentage exceeds the citywide average.

iii. Age

The median age of residents in the citywide floodplain is significantly higher than it is for the city as a whole (floodplain median age is 44.7 and the Portland median age is 36.8). The watersheds in which the median age of the floodplain population skews the oldest are the Columbia River (52.0) and the Columbia Slough (48.0). In both of these watersheds, 22 percent of the population living in the floodplain is over 64 years of age (compared to the citywide average of 12 percent of the population over the age of 64). At the other end of the age spectrum, the Johnson Creek watershed stands out because 29 percent of the population living in the floodplain is under the age of 20, which is significantly less than the Portland population overall, of which, 20 percent are under the age of 20.

iv. Low Income Households

Overall, the percentage of the population that is considered to be low-income (earning less than 80 percent of the Median Family Income) that is living in the citywide floodplain is slightly lower (45%) than the percentage of the total Portland population (47%). But the percentage of low-income residents of the Columbia River floodplain (58%) and the Columbia Slough floodplain (55%) is considerably higher than the Portland population as a whole.

v. Educational Attainment: 4-Year College Degree

Fifty-five percent of adults living in the citywide floodplain have attained less than a 4-year degree, which exceeds the percentage of the Portland population with less than a 4-year degree (52%). There is significant disparity between the percentage of populations with less than a 4-year degree in the various floodplains. At the high end, the percentage of the Columbia Slough (73%), Johnson Creek (71%) and the Columbia River (67%) watershed floodplains that have less than a 4-year degree is substantially higher than the overall Portland population. At the other end of the spectrum, fewer than 30 percent of the residents living in the floodplains of both the South Reach of the Willamette and the South Waterfront district of the Central City have less than a 4-year degree.

vi. Language and National Origin

There are sizable immigrant communities living in Portland’s floodplains and in neighborhoods adjacent to floodplains. Due to limitations in the ACS language data, including large margins of error, poor spatial resolution and the fact that many of the languages that are spoken by Portland immigrant communities are not included in the language data that is recorded by the survey, any attempt to determine which languages are spoken by people with limited English proficiency (LEP) in specific geographies must necessarily rely on a combination of survey responses to questions about languages spoken at home and responses to questions about the nationalities of adult immigrants. Some language and nationality data are available at the census block group level, some only at the census tract level. In order to be able to make a comparison across equivalent data scales, all of the language and nationality data was aggregated to the census tract level for this analysis. For the purposes of this analysis, a language or country of origin is determined to be significant if the percentage of adults (18 years or older) that identify as LEP that speak the language exceed the citywide average, or if a nearest neighbor analysis of adjacent census tracts identifies the prevalence of a particular language group or specific immigrant community. Table 13 summarizes the languages and nationalities that are prevalent in individual census tracts that intersect with the floodplain.

TABLE 13: NUMBER OF CENSUS TRACTS INTERSECTING THE FLOODPLAIN WITH SIGNIFICANT POPULATION OF IMMIGRANTS AND NON-ENGLISH SPEAKERS

Language or Nationality	Willamette North Reach	Willamette Central City	Willamette South Reach	Fanno Creek	Tryon Creek	Johnson Creek	Columbia Corridor & Columbia Slough (Combined)	Total, All Subareas
Spanish	4	1	0	1	0	9	1	16
Slavic	0	1	0	2	0	8	1	12
Chinese	0	0	0	0	0	7	0	7
Vietnamese	0	0	0	0	0	10	1	11
Arabic	0	1	0	0	0	2	0	3
Romania	0	0	0	0	0	5	0	5
Russia	2	0	0	0	0	5	2	9
Ukraine	0	1	0	1	0	9	0	11
Japan	0	0	1	0	2	2	0	5
Laos	2	0	0	0	0	4	2	8
Ethiopia	2	0	0	0	0	3	1	6
Somalia	0	1	1	0	0	3	0	5
Hong Kong	0	2	1	0	0	1	0	4
Cambodia	0	0	0	0	0	2	0	2
Tagalog	1	0	0	0	0	1	0	2
Korean	0	0	0	0	0	2	0	2
Thailand	1	0	0	0	0	1	0	2

Language or Nationality	Willamette North Reach	Willamette Central City	Willamette South Reach	Fanno Creek	Tryon Creek	Johnson Creek	Columbia Corridor & Columbia Slough (Combined)	Total, All Subareas
Micronesia	0	0	0	0	0	1	0	1
Nepal	0	0	0	0	0	1	0	1
Burma	0	0	0	0	0	1	0	1

There are 20 different non-English spoken languages or non-English speaking countries of origin that are present in significant numbers in different parts of the floodplain. The languages are Spanish, Slavic (which includes Russian and other languages), Chinese (including multiple different dialects), Vietnamese, Tagalog and Arabic. The countries of origin are Romania, Russia, Ukraine, Japan, Laos, Ethiopia, Somalia, Hong Kong, Korea, Thailand, Micronesia, Nepal and Burma.

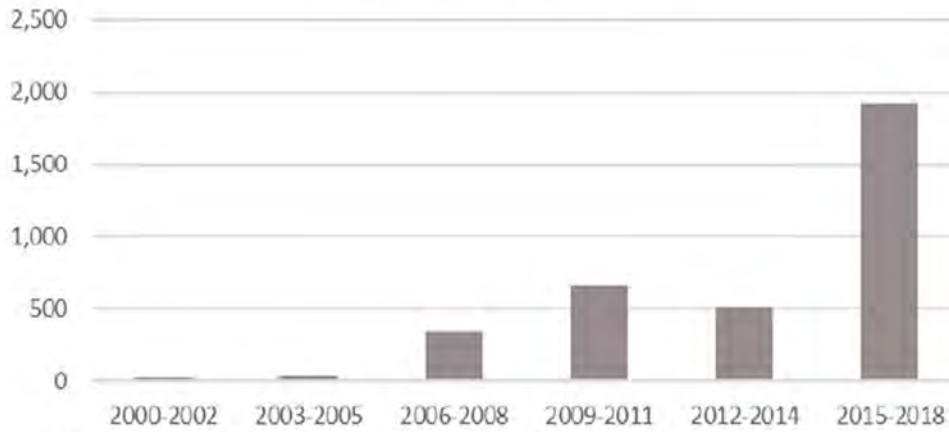
Of the different floodplain sub-geographies, the Johnson Creek floodplain has the greatest diversity of languages and countries of origin. All 20 languages and countries are present in significant numbers in at least one census tract that intersects with the Johnson Creek floodplain. Other sub-areas contained fewer significant languages and nationalities.

In the citywide floodplain, Spanish was the language that was significant across the widest geographical distribution. It was significant in 16 different census tracts that intersect with floodplains around the city. After Spanish, Vietnamese and Ukraine were tied for the language group/country of origin that were found to be significant in the second greatest number of census tracts (11 each).

vii. Housing

There are 10,450 units of housing on lots that are located fully or partially in the floodplain, representing 4 percent of all of the housing units in Portland. Of the different floodplain sub-areas, the South Waterfront district contains the greatest number of units in the floodplain (2,959). The Johnson Creek floodplain contains the second highest number of dwelling units in the floodplain (2,356). Unlike South Waterfront, in which housing is primarily multi-dwelling buildings, most of the housing units in the Johnson Creek floodplain are single dwelling homes or low-rise apartment buildings. The lowest inhabitable floors of many structures in the Johnson Creek floodplain are near the base flood elevation. Because of the age of the housing stock, hundreds of homes have basements that are many feet below base flood elevation. Other sub-areas, including the North Reach and the South Reach of the Willamette, Tryon and Fanno Creeks, and the Columbia Slough contain fewer than 700 dwelling units each.

New Housing Units in the Floodplain



Note: Finaled permits by year finalized, * Includes houseboats

Source: City of Portland, Bureau of Development Services. Note: Finaled permits by year finalized.

Figure 9. New units built in the Portland floodplains since 2000.

Eighty-four percent of new housing units built in Portland since the year 2000 have been located in floodplains. The majority of these developments were in the South Waterfront and Central Reach of the Willamette (see figure 9). Most of the housing that is located in Portland’s floodplains is multi-unit stacked or attached housing (see Figure 10). There are 7,419 multi-dwelling units in the floodplain, which represents 70 percent of all of the housing units in the floodplain. The majority of these multi-dwelling units are located in 2 sub-areas of the Willamette River floodplain: South Waterfront (2,729 or 36.7%) and the Central Reach (1,654 or 22.3%). The remaining multi-dwelling units are distributed in smaller numbers in the other Portland floodplain areas, except for the Columbia Slough, which contains no multi-dwelling units (see Figure 11).

Share of housing units by type

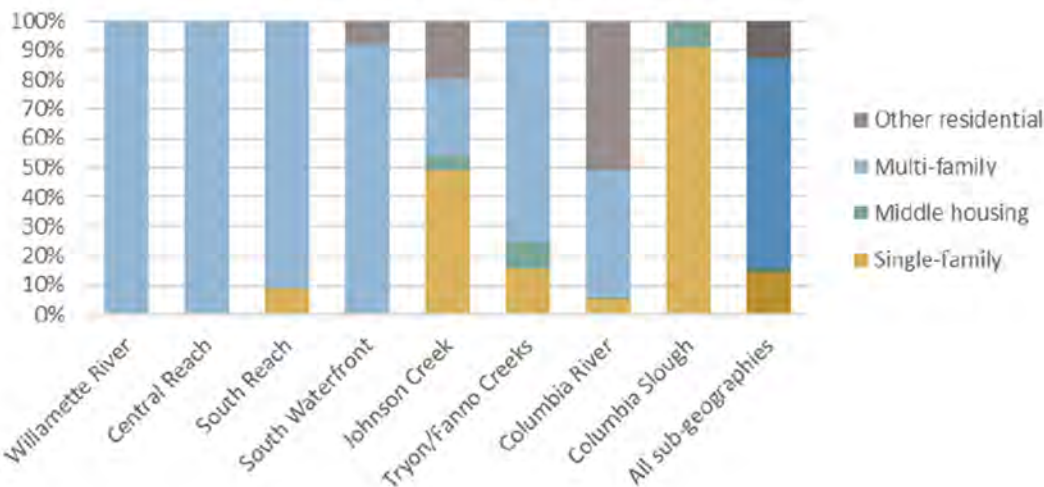


Figure 10. Share of Housing Units by Housing Category in Portland Floodplains

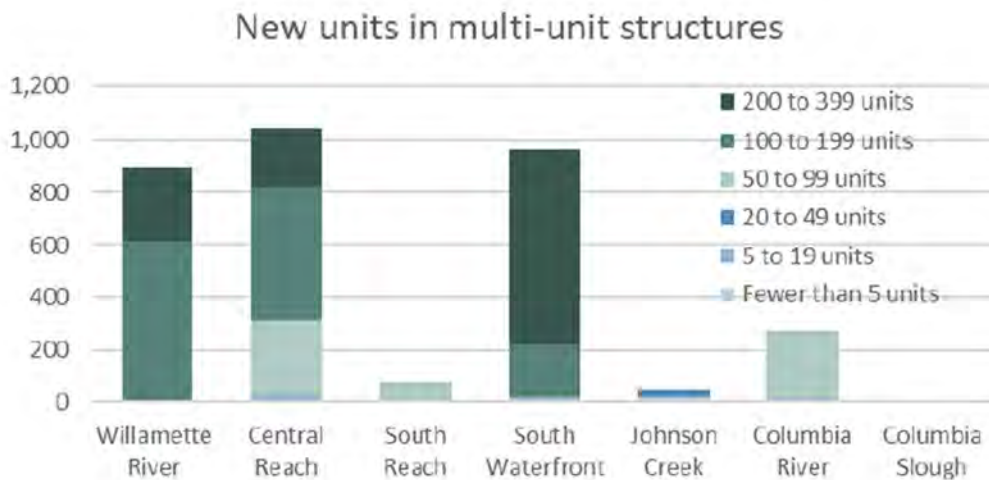


Figure 11. New Units in Recently Built Multi-Dwelling Developments in Portland Floodplains

Middle housing developments, such as townhouses, rowhouses and duplexes, are a housing stock that is relatively scarce in Portland. It is also uncommon in Portland’s floodplains. Of the middle housing that does exist in the floodplain, the majority is located in the Johnson Creek watershed (64%, or 121 units). After Johnson Creek, the Tryon Creek and Fanno Creek watersheds contain the second greatest number of middle housing units in the floodplain (48).

There are 1,320 residential units in the floodplain that are categorized as “other” (not multi-dwelling residential and not single dwelling residential houses). The floodplain sub-area that contains the largest number of this category of housing is the Columbia River (623 units). Most of these units are floating homes. Aside from floating homes, there are many other floating structures in the Columbia River, including over 3,000 boats with permanent addresses. Anecdotal evidence suggests that many of the boats that are moored in the Columbia River and the Columbia Slough are used by inhabitants as permanent or seasonal residences.

Forty-four percent of households in the floodplains are renters, which is slightly lower than the citywide proportion of renters (47%). Within the floodplain sub-areas, the Central Reach has the highest percentage of renters (76%), followed by South Waterfront, where 58 percent of households are renters. The percentage of renters in all other floodplain sub-areas is lower than the citywide percentage. The subareas that contain the lowest proportion of households that are renters are the Columbia Slough and the Columbia River (both contain 21% renter households).

Rental prices in the floodplain vary greatly from one sub-area to the next. In 2019, a two-bedroom unit in the Johnson Creek or Columbia Slough subareas rented for about 45 percent of the price of a similar unit in South Waterfront, the Central City or the South Reach.

In 2019, three-bedroom rental units in the Johnson Creek and Columbia Slough floodplain went for about \$1,650 per month, which is a price range that is considered to be affordable for a household that earns 80 percent of the MFI. The average price of a three-bedroom rental citywide was \$2,200 per month, which is only affordable for a household that earns at least 110 percent of the MFI. Three-bedroom units typically provide more space for residents than units with fewer rooms, which makes them highly desirable for families with children. The availability and affordability of three-bedroom units is particularly important for low-income households with children. The majority of the three-bedroom units that are in the floodplain are located in 2 subareas: Johnson Creek (40%) and the Columbia Slough (20%).

In the two decades since the year 2000, annual home sales in the floodplain were around 400 units per year, or around 7,600 units in total. Of the homes that were sold, 4,152, or 55 percent were condominiums, 2,395, or 32 percent were detached, single-dwelling houses, and 568, or 7.5 percent were floating homes. Most of the single dwelling houses that were sold since 2000 were in the Johnson Creek subarea.

There have been significant disruptions in the Portland housing market since the start of 2020. There has been an extended period in which there has been much higher demand for, and relatively low inventory of single-dwelling houses compared to previous years. And during that time, there has also been relatively modest demand for condominiums and apartments. It is difficult to predict at this time if these trends will continue to endure in subsequent years, or if the housing market will return to a condition that more closely follows the trends of the previous decade when Covid-19 related restrictions and disruptions no longer play a large role in daily life.

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 Extent⁸	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

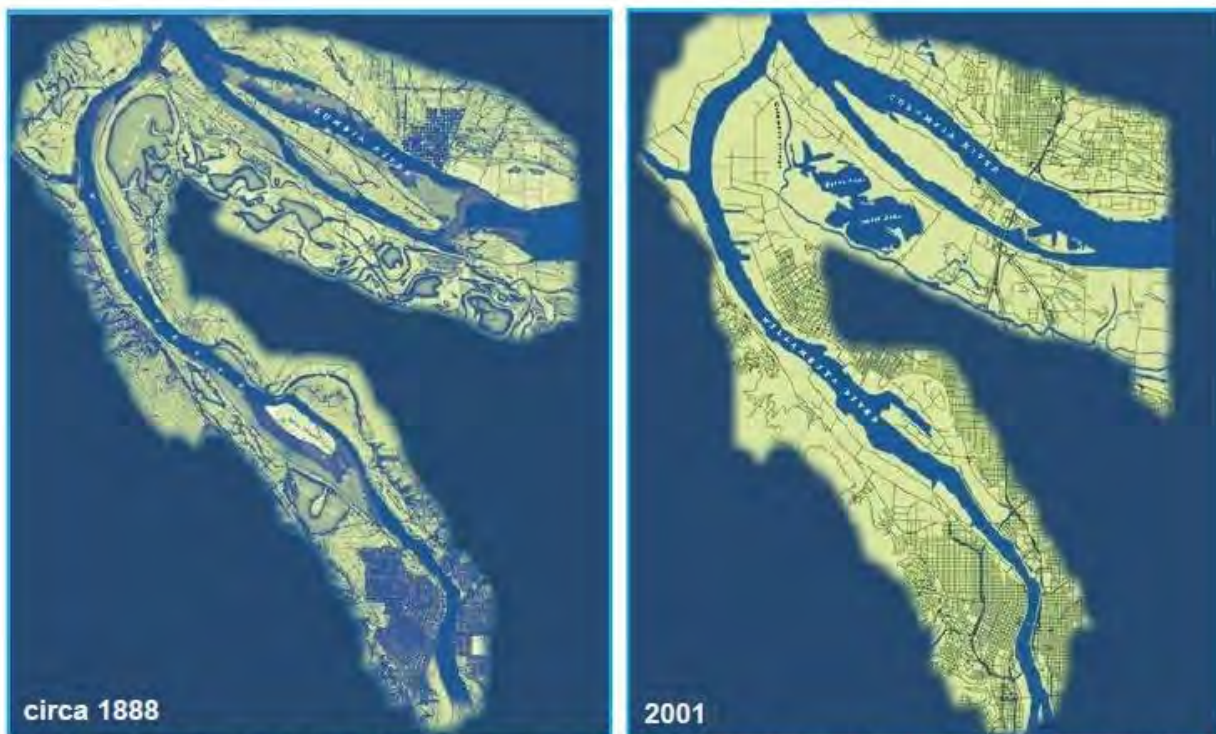
The mostly static present form of the Willamette’s floodway and floodplain differs substantially from its dynamic form prior to dams, significant development, and other alterations. Historically, the reduced landform constraints to the north of Sellwood allowed the formation of floodplains and off-channel 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.

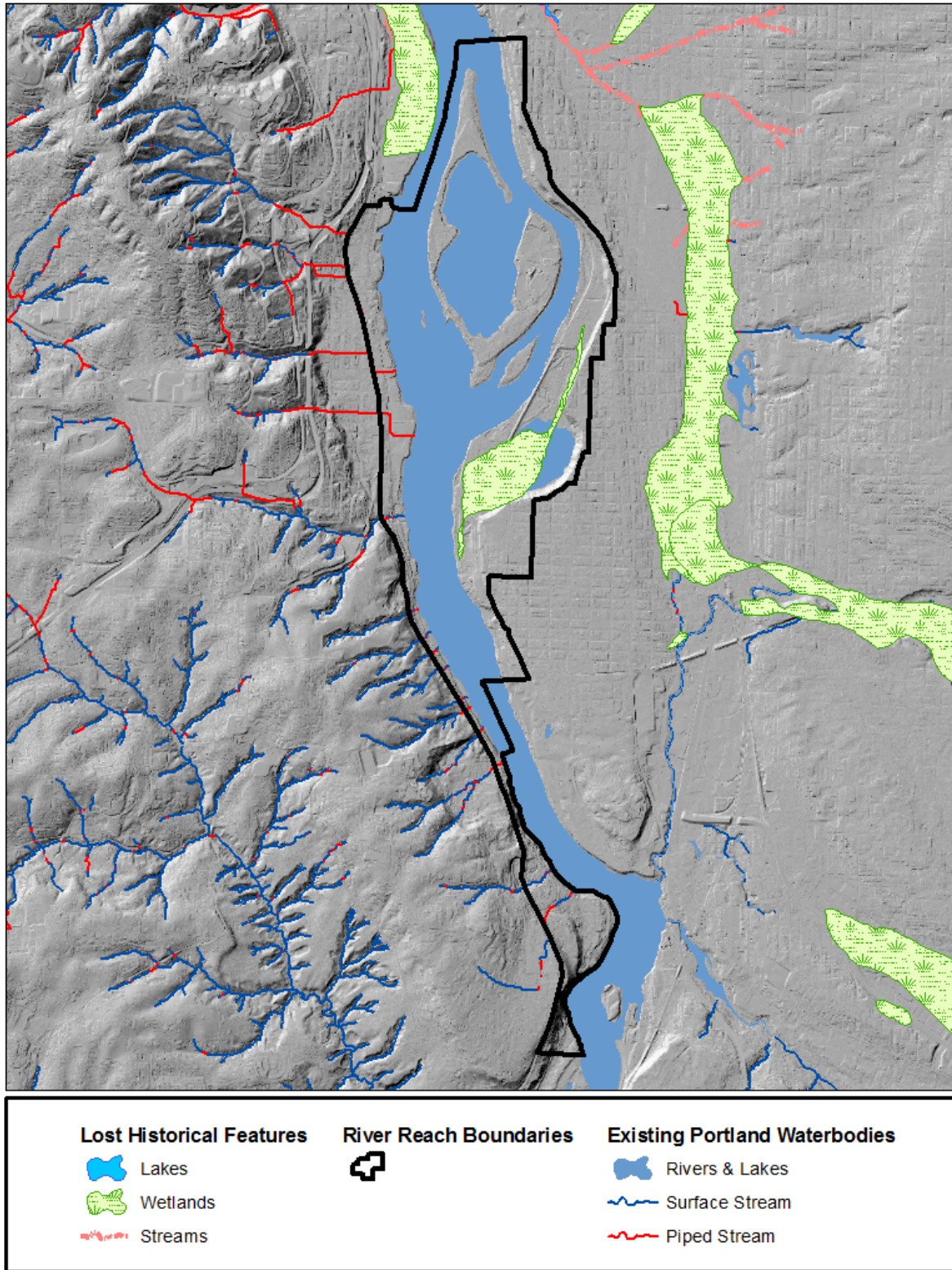


Figure 13: Historical off-channel lakes, wetlands, and streams lost to development in the South Reach (BES, 2016)

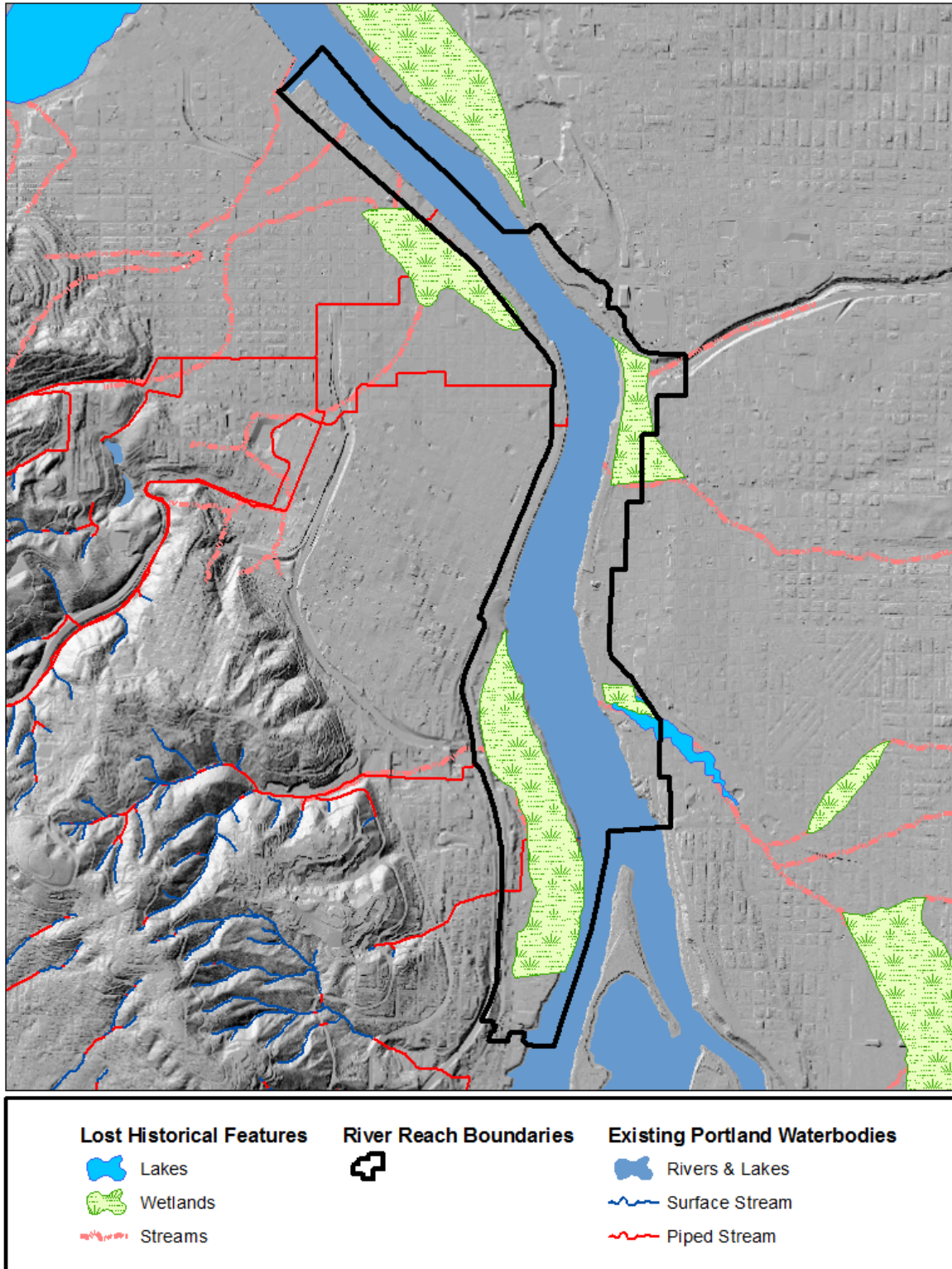


Figure 14: Historical off-channel lakes, wetlands, and streams lost to development in the Central Reach (BES, 2016)

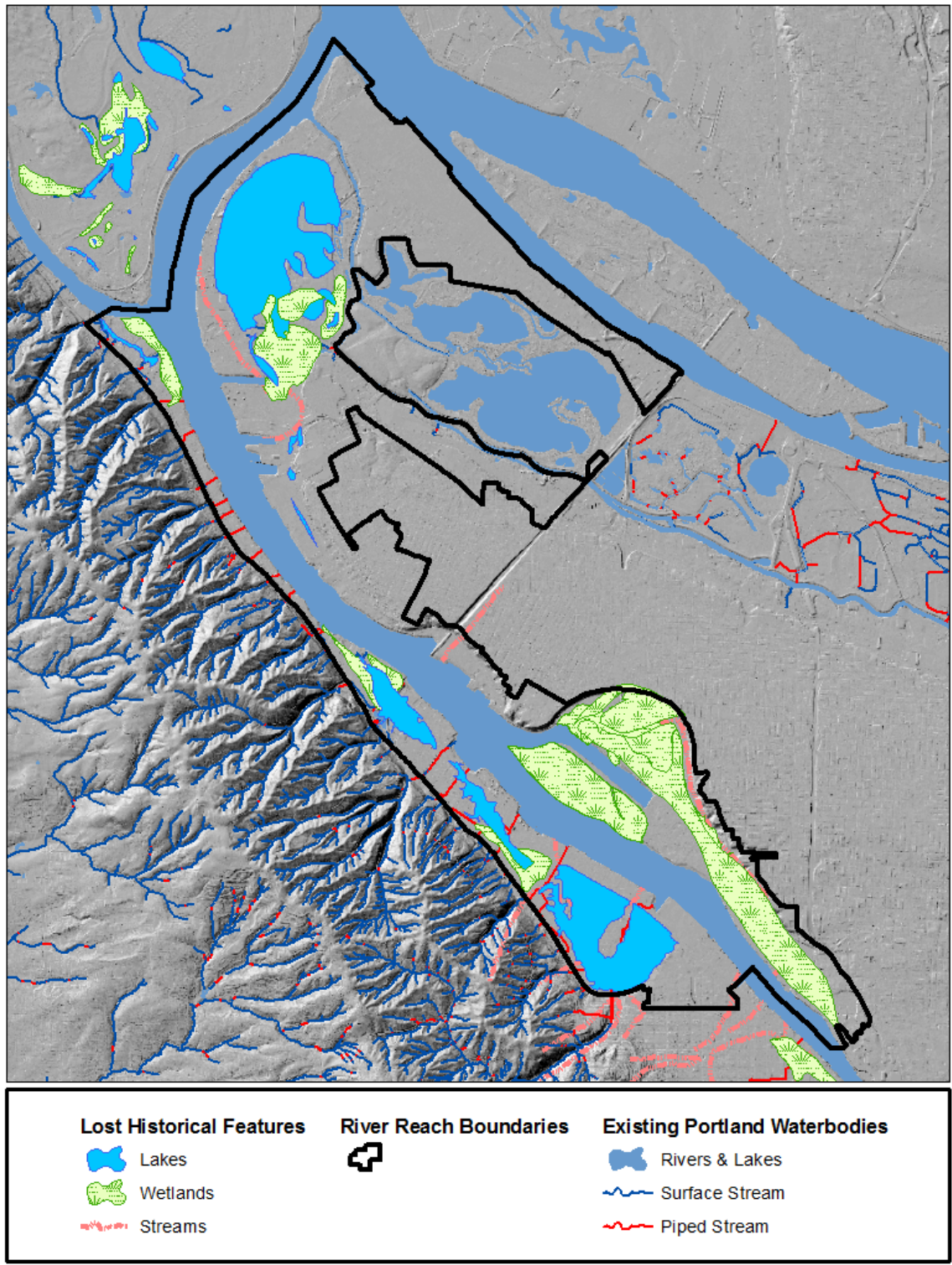


Figure 15: Historical off-channel lakes, wetlands, and streams lost to development in the North Reach (BES, 2016)

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 Extent¹⁰	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.