TMDL IMPLEMENTATION PLAN

For the Willamette River & Tributaries

City of Portland, Oregon
March 2019

ENVIRONMENTAL SERVICES
CITY OF PORTLAND
working for clean rivers

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Resubmitted October 2019 to address DEQ feedback

Crystal Springs Creek in Westmoreland Park
Cover photo by Greenworks

Table of Contents

List of Case Studies

List of Figures

List of Tables

Appendix A – Reporting Matrices

Acronyms and Abbreviations

BES	Bureau of Environmental Services, City of Portland
BDS	Bureau of Development Services
BMPs	best management practices
BOD	biochemical oxygen demand
City	City of Portland
CSO	combined sewer overflow
CWA	Clean Water Act
DDT	dichloro-diphenyl-trichloroethane
DEQ	Department of Environmental Quality
DMAs	designated management agencies
EDT	Ecosystem Diagnosis and Treatment
EPA	Environmental Protection Agency
LAs	load allocations
LCDS	Land Conservation and Development Commission
MS4	Municipal Separate Storm Sewer System
N/A	not applicable
NPDES	National Pollutant Discharge Elimination System
NRI	natural resource inventory
PAH	polycyclic aromatic hydrocarbon
PAWMAP	Portland Area Watershed Monitoring and Assessment Program
PCB	polychlorinated biphenyl
PP&R	Portland Parks and Recreation Bureau
SVS	settleable volatile solids
SWMM	Stormwater Management Manual
SWMP	stormwater management plan
TDG	total dissolved gas
TIP	TMDL Implementation Plan
TIR	thermal infrared imagery
TMDL	total maximum daily load
TSS	total suspended solids
WLAs	waste load allocations
WPCF	water pollution control facility
WQMP	water quality management plan
WWTP	wastewater treatment plant
UIC	underground injection control

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SECTION 1
INTRODUCTION

1.1 Purpose

A total maximum daily load, or TMDL, serves as a restoration plan for waterways that have been impaired by pollution and habitat degradation. TMDLs have been developed for watersheds within and surrounding the Portland area, covering all local waterways for certain pollutants of concern.

This TMDL Implementation Plan (TIP) identifies management strategies that the City of Portland will use to reduce pollutants from nonpoint sources to restore and protect water quality in local waterways and the Willamette River. It updates the City's previous TIP (City of Portland, 2014) following an Oregon Department of Environmental Quality (DEQ) TMDL survey to report on progress over the last 5 years. The survey and 5-year retrospective provided an opportunity to identify improvements to management strategies. No strategy or implementation gaps were identified during the process; however, the City has identified several new or updated strategies and general improvements that are incorporated in this TIP. The City will implement the TIP strategies within its jurisdiction during the next 5-year implementation plan cycle (March 1, 2019 to March 1, 2024).

This report is separated into eight sections, including this introductory Section 1: Section 2 summarizes TMDLs and associated watershed subbasins in the Portland area; Section 3 provides the management strategies implemented by the City to address TMDL pollutants; Section 4 discusses relevant goals and targets; Section 5 discusses performance monitoring and periodic plan review and revision; and Sections 6, 7, and 8 include additional required information about funding, legal authority, and compliance with land use requirements. A definition is provided in the glossary for terms listed in ***bold italics***. All tables and figures are attached after the glossary at the end of the document, and Appendix A provides the annual reporting matrices for management strategies and temperature goals.

1.2 Background

A TMDL is a regulatory mechanism under the Clean Water Act that serves as a plan for restoring impaired or polluted waters. It identifies the maximum amount of a specific pollutant that a body of water can receive while still meeting water quality standards. A document called a TMDL or a TMDL Plan is developed by the state that divides pollution "loads" into allocations. In Oregon, this process is conducted by DEQ. In a TMDL, ***load allocations*** (LAs) are identified for ***nonpoint sources*** of pollution, and ***waste load allocations*** (WLAs) are assigned to ***point source*** pollution discharges.[1] Point sources of pollutants and associated WLAs are regulated under the ***National Pollutant Discharge Elimination System*** (NPDES) permitting program, and nonpoint sources are managed by TIPs, such as this one. TMDLs in Oregon also include a ***Water Quality Management Plan*** (WQMP) that outlines specific implementation activities required for ***designated management agencies*** (DMA). A DMA is a federal, state, or local government agency that has legal authority over a sector or source of contributing pollutants and is identified as such in the TMDL.

Great blue heron—Portland's official bird—on the banks of Crystal Springs Creek

TMDL implementation relies on different mechanisms to achieve the goal of restoration. Point source discharges of pollutants (covered by WLAs) are regulated through conditions in applicable NPDES permits. For example,

1 A portion of a water body's pollutant loading may also be allocated to account for future growth and a margin of safety.

industrial and municipal stormwater and waste discharge NPDES permits include narrative or numeric effluent limits and/or required best management practices (BMPs) that address the WLAs identified in a TMDL. Alternatively, nonpoint sources of pollutants are addressed through an ***implementation plan*** that DMAs are required to develop.[2]

Lower Columbia Slough

Like wastewater, municipal stormwater is governed through the NPDES program that regulates point source pollution. The ***Municipal Separate Storm Sewer System*** (MS4) NPDES permit requires a municipality to develop a stormwater management plan (SWMP) with mandatory measures that control pollutant runoff. An MS4 permit also requires the municipality to establish pollution load reduction benchmarks for relevant TMDL pollutants. However, a SWMP required by an MS4 permit addresses only some, but not all, sources of TMDL pollutants. For example, SWMPs are not required to address temperature sources because stormwater has been determined to not be a significant contributor of heat or "thermal loading" to surface waters. In addition, MS4 permits apply to a municipality's storm sewer system and may not address nonpoint sources of TMDL pollutants. DMAs covered by MS4 permits are therefore expected to address temperature and nonpoint sources of TMDL pollutants not addressed by the MS4 SWMP in a TIP.[3] This is usually accomplished through submittal of a plan that addresses pollution reduction strategies for TMDL pollutants not addressed in the SWMP and, in so doing, should complement rather than re-create a stormwater management plan.[4]

1.3 Requirements

DMAs are required to develop a TIP, report on implementation progress annually, and provide a summary of overall progress every 5 years. According to DEQ's TMDL Implementation Plan Guidance (DEQ, 2007), a TIP should document the ***management strategies*** necessary to prevent, control, and/or treat specific sources of TMDL pollutants.

The required components of a TIP are described in Oregon Administrative Rule (OAR) 340-042-0080(3) and include the following:

1. Identify the management strategies the DMA or other responsible person will use to achieve load allocations and reduce pollutant loading;
2. Provide a timeline for implementing management strategies and a schedule for completing measurable milestones;
3. Provide for performance monitoring with a plan for periodic review and revision of the implementation plan;
4. To the extent required by [Oregon Revised Statute] ORS 197.180 and OAR chapter 340, division 18, provide evidence of compliance with applicable statewide land use requirements; and
5. Provide any other analyses or information specified in the WQMP.

2 Implementation mechanisms are documented in DEQ's May 2007 TMDL Implementation Plan Guidance, which states that "plans are required by Oregon Administrative Rule (OAR) 340-042-0080(3) for nonpoint sources of pollution that are not covered by permits."

3 Stormwater management plans that cover all TMDL parameters can serve as a TMDL implementation plan per DEQ. This can be done by including the additional parameters in the stormwater management plan at the permittee's discretion.

4 Over the years, confusion between DEQ and DMAs has obscured whether MS4 discharges should be considered point or nonpoint source discharges. Based on the federal Clean Water Act and the Oregon TMDL rule, MS4 discharges covered by an NPDES permit are point sources and must be assigned a WLA. MS4 discharges that are not covered by a permit (typically smaller cities), are considered nonpoint sources and should be assigned a load allocation. Given that the City's MS4 discharges are covered by a Phase I MS4 NPDES permit, they are a point source covered by WLAs.

With respect to item E, the Oregon TMDL rules (OAR 340-042-0025) approved in 2002 included the requirement for DEQ to develop WQMPs within the TMDL. The Columbia River and Columbia Slough TMDLs were issued prior to 2002 and, therefore, did not include WQMPs. The Willamette River and Tualatin River TMDLs were issued after 2002 and note that DMAs should include the following specific activities in their TIPs:

Willamette River TMDL 2006 (Chapter 14):

- ODEQ believes that public involvement is essential to any successful water quality improvement process. When developing and implementing TMDL implementation plans, DMAs will determine how best to provide for public involvement based on their local needs and requirements.
- DMAs will be expected to provide a fiscal analysis of the resources needed to develop, execute, and maintain the management strategies described in their TMDL implementation plans.
- Local governments are expected to describe in their Implementation Plans their specific legal authorities to carry out the management strategies chosen to meet the TMDL allocations.
- DMAs located along the mainstem Willamette River from river mile 50 downstream to the confluence with the Columbia River need to address cold water refugia within their TMDL Implementation Plan.

Tualatin River TMDL 2012 (Chapter 4):

- DMAs will determine how best to provide for public involvement based on their local needs and requirements and must include public participation activities in their TMDL Implementation Plans.
- DMAs and RPs will be expected to provide a fiscal analysis of the resources needed to develop, execute and maintain the programs described in their TMDL Implementation Plans.
- Local governments are expected to describe in their Implementation Plans their specific legal authorities to carry out the management strategies chosen to meet the TMDL allocations.

Crystal Springs Creek in 2017, flowing through Westmoreland Park in Southeast Portland, 4 years after restoration project. See page 42 for more details.

SECTION 2

PORTLAND AREA TMDLs

The subsections below provide details on Portland-area TMDL subbasins and pollutants, along with the suspected sources of those pollutants. The Applicability section (Section 2.2) discusses how TMDLs are implemented in Portland and how this TIP is applied relevant to the different drainage and regulatory areas that exist in the City.

2.1 TMDLs and Pollutant Sources

Figure 1 shows the different watershed subbasins that make up the Portland area. With the exception of certain drainages along the northern portion of the City that discharge to the Columbia River, the majority of subbasins ultimately flow into the Willamette River and are considered part of the Lower Willamette Basin. The City of Portland is a listed DMA in three TMDLs: the Columbia Slough Watershed, Willamette Basin, and Tualatin Subbasin.[5]

Table 1 lists the TMDLs and associated watershed subbasins that are applicable in the Portland area, and Table 2 provides a summary of the suspected nonpoint sources of Portland-area TMDL pollutants and issues associated with those pollutants.

2.2 Applicability

Stormwater from roughly a third of the Portland area drains to surface waterways through the City's MS4 and other publicly or privately-owned storm systems. The central Portland area drains to the City's combined sewer system connecting to the wastewater treatment plant. The remaining areas, mostly in southeast and northeast Portland, are served by underground injection control (UIC) sumps that drain into the ground and recharge groundwater. There are also nonpoint runoff sources of pollutants that discharge to local surface waters. Each of these areas is regulated differently with regard to TMDL applicability and implementation (see Figures 2 and 3).

- **Areas discharging to groundwater – TMDLs do not apply.** UICs do not discharge directly to surface waters and are therefore not regulated by the NPDES or TMDL programs.[6] In Portland, the City's UIC system is covered by a Water Pollution Control Facility (WPCF) Permit. The TMDLs listed in Table 1 do not include allocations or implementation strategies that apply to these discharges; however, infiltration of stormwater into the ground does reduce pollutant loads that would otherwise discharge to surface waters. UICs also recharge groundwater, which supplements summer stream flows, therefore providing temperature-related benefits. Generally, the strategies used by the City to reduce pollutants in stormwater under the MS4 NPDES permit are also applied under the City's UIC WPCF permit.
- **Point-source discharge areas – TMDLs are applied through NPDES permits.**
  - » **Stormwater Discharges from the Separated Sewer Area.** In these areas, the City's MS4 is covered by a Phase I NPDES MS4 Discharge Permit. DEQ issued the City its first permit in 1995, renewed it for a second term in 2004 (with modifications in 2005),

Ash Creek stream enhancement project

5 There is a Columbia River TMDL that applies to the Lower Columbia River area, including Portland, but does not include specific WLAs or LAs for the City of Portland. Urban areas are included in an allocation type referred to only as "reserved."

6 Groundwater is regulated under the Safe Drinking Water Act which does not address TMDLs. However, groundwater is discussed as a source of TMDL parameters in the Columbia Slough TMDL but requirements for the City to address the source are not included.

and issued the third and current permit in 2011.[7] For these areas within the Columbia Slough, Tualatin Subbasin and Willamette Basin, DEQ is responsible for implementing TMDL requirements through MS4 permit conditions. In addition to pollutant load reduction strategies, DEQ's requirements in the MS4 permit have evolved since the first 1998 Columbia Slough TMDL to include relevant monitoring and development of TMDL pollutant load reduction benchmarks for all of the applicable TMDL WLAs. Benchmarks represent a targeted pollutant load reduction goal for the permit term and are intended to illustrate progress toward achieving WLAs. Benchmarks for temperature are not included in the City's NPDES MS4 permit for these TMDL basins because "temperature is generally not considered to be a significant contributor to stormwater pollution and thus is not addressed through a stormwater permit." (DEQ, 2006)

  - **Stormwater and Wastewater Discharges from the Combined Sewer Area.** For a portion of the City, stormwater and sanitary wastes are conveyed through a combined sewer system and conveyed to the City's Columbia Boulevard Wastewater Treatment Plant (CBWTP), which then discharges treated water to the Columbia River. CBWTP discharges are covered by an NPDES Waste Discharge Permit (#101505) that includes effluent limits that incorporate applicable TMDLs.
  - **Wastewater Discharges from the Separated Sewer Area.** Treated wastewater from the Tryon Creek Wastewater Treatment Plant flows to the Willamette River and is covered by NPDES Waste Discharge Permit (#101614). The permit includes effluent limits that incorporate applicable TMDLs.
  - **Industrial Wastewater and Stormwater Discharges.** Most industrial facilities are required to obtain permits for their wastewater and/or stormwater discharges. Wastewater permits issued by DEQ contain effluent limits that incorporate TMDL WLAs. The 1200-Z stormwater discharge permits contain benchmarks that are derived from TMDL WLAs but do not address temperature because DEQ does not consider stormwater to be a source of elevated temperatures in receiving waters.

- **Non-City jurisdiction areas – City's TMDL WLA/LAs do not apply.** Stormwater in some pockets of Portland is under the jurisdiction of non-City entities. Examples include stormwater system discharges from the Oregon Department of Transportation, Multnomah County, and the Port of Portland. These drainages are scattered throughout the City, and TMDLs may still apply in these areas, but implementation and coordination with DEQ are the responsibility of the respective party.
- **Nonpoint-source discharge areas – TMDLs are implemented though the TIP.** This TIP covers discharges to the TMDL water bodies from nonpoint sources of pollution outside of the areas listed above. These areas are predominantly located in large forested areas or along riparian corridors where runoff enters the waterways through diffuse, overland sources (i.e., surface runoff that is not conveyed through the City's storm sewer system). These areas are addressed under this TIP for all TMDL parameters listed in Table 1 for the Columbia Slough, Tualatin Subbasin and Willamette Basin.

7 The current MS4 permit expired on January 30, 2016 but reissuance has been delayed. DEQ administratively extended the 2011 permit until the new permit is issued.

SECTION 3

MANAGEMENT STRATEGIES

The City is proposing a range of management strategies that will be used to reduce TMDL pollutants from nonpoint sources in the Columbia Slough, Tualatin Subbasin and Willamette Basin. These strategies are designed to restore and protect water quality in local waterways and the Willamette River.

Table 3 provides a complete description of all the strategies the City will employ to address applicable TMDL pollutants. The table includes management strategies conducted under the City's MS4 Permit and associated SWMP, as well as the temperature-specific strategies described in this TIP. The City will implement the strategies identified in Table 3 within its jurisdiction during the next five-year implementation plan cycle.[8]

3.1 Stormwater Strategies

Table 3 identifies the City's key management strategies to reduce TMDL pollutants and improve water quality. Many of these strategies are being conducted under the City's MS4 Permit and associated SWMP, which describe the BMPs the City implements to reduce pollutants in stormwater runoff. Although the SWMP addresses discharges from the MS4, most of the SWMP strategies are applied City-wide and reduce TMDL pollution from nonpoint sources as well.

Most of the management strategies are ongoing and will be implemented throughout and beyond the five-year implementation plan cycle. Stormwater strategies are discussed in more detail in the MS4 Permit and SWMP. Strategies that specifically address temperature and coldwater refugia are discussed in more detail in the following sections.

3.2 Temperature Strategies

The temperature TMDL for the Lower Willamette basin includes load allocations for all perennial streams, including the Columbia Slough, Johnson Creek, and Tryon Creek. The Tualatin River subbasin temperature TMDL applies to the perennial or fish-bearing streams located in the Fanno Creek and Rock Creek basins. The TMDLs use ***percent effective shade*** as a surrogate for measuring temperature nonpoint source pollutant loading. Effective shade is the proportion of solar radiation that is attenuated or scattered before reaching the stream. DEQ defines ***system potential shade*** as the maximum effective shade possible for a stream reach. System potential shade is achieved when the riparian plant community has reached its mature, undisturbed condition in which vegetation heights are at or near their expected potential, resulting in the maximum effective shade. The TMDL identifies restoration and protection of riparian vegetation as the primary methods for increasing stream shading and bases the nonpoint source load allocations on achieving system potential shade conditions.

Anthropogenic activities throughout the area have degraded riparian conditions, resulting in a loss of riparian vegetation and an increase in solar loading. Based on modeling for the 2006 TMDL, the loss of stream shade has resulted in a 25% increase in solar loading to the Columbia Slough mainstem. The increase in solar loading due to the loss of riparian shade, or excess thermal load, to the Johnson Creek mainstem was found to be 51% above system potential shade conditions.

The Lower Willamette temperature TMDL includes site-specific shade targets for Tryon Creek, the Columbia Slough, and Johnson Creek mainstems, and the Tualatin temperature TMDL specifies similar targets for Fanno Creek and Rock Creek. These site-specific targets were calculated as part of the TMDL modeling. For the other perennial streams in the two subbasins, DEQ defines shade targets using "effective shade curves." Effective shade curves

8 The 1998 Columbia Slough TMDL identifies specific DMA obligations related to BOD, eutrophication, bacteria, lead and toxics. This TIP addresses those obligations through the city-wide management strategies listed in Table 3.

represent the relationship between the potential shade from mature vegetation and the physical characteristics of the stream (channel aspect and width). DEQ developed different effective shade curves for a range of vegetative characteristics found within the subbasin.

DEQ identified the following actions as the means of achieving the conditions necessary to meet system potential shade: (1) restoring and protecting riparian vegetation, (2) increasing instream flows, and (3) narrowing stream channel widths where appropriate. In the Columbia Slough, DEQ also identified the management of rooted aquatic macrophytes as an approach to addressing elevated water temperatures.

The City currently employs multiple strategies to address elevated stream temperatures in Portland streams and meet nonpoint source load allocations. The City uses a combination of approaches, including planning, resource protection through City code, land acquisition, active restoration and planting, monitoring, and public outreach. The specific strategies are described in Table 3.

Maps of riparian corridors by subwatershed are presented in Figures 4A-4F. Riparian corridors are defined as zones along waterways, 100 feet wide along each bank, drawn in one of two ways: (1) from the edge of water for larger features and (2) from the center of streamlines for smaller features. The riparian corridors are categorized to highlight the relevance of temperature management strategies.

3.2.1 Assessment and Prioritization

The City engages in assessment and planning activities to protect and improve natural resources. These efforts bring together the different drivers for natural resource improvement (e.g., city, state, and federal requirements, operation and maintenance needs), available data, and the goals of the public.

3.2.1.1 Effective Shade Assessment

To support and help meet nonpoint source load allocations of the Lower Willamette subbasin temperature TMDL, the City will assess the current level of effective shade along the streams in the City covered by the load allocation. This assessment builds off efforts that were conducted under the previous TIP and more accurately evaluates the City's progress toward meeting the TMDL load allocation of system potential shade.

As part of the assessment, the City will evaluate two scenarios using the shade module of DEQ's Heat Source model. The first scenario will be based on the current condition of the riparian tree canopy and will be characterized using the available LiDAR data. The second scenario will model the anticipated effective shade that will be achieved when riparian areas that have already been planted reach maturity. Both scenarios will be compared with the TMDL load allocation of system potential shade that is described in the Lower Willamette subbasin temperature TMDL.

Crystal Springs Creek before (left) the removal of a large inline pond in Westmoreland Park and after (right) the City implemented the project to restore the natural stream channel. The pond added heat to Crystal Springs Creek, increasing water temperatures by 2-4°C. These substantial increases in temperature are no longer observed.

By comparing the modeling scenarios to system potential shade, the City can evaluate the current progress toward meeting the nonpoint source load allocation and identify areas for future riparian plantings. The results will be used to inform prioritization of possible additional restoration areas.

The total area of riparian corridor protected by environmental overlay zones is over 6,000 acres and about 9 times the size of Portland's downtown core.

3.2.1.2 Stream Habitat Assessment

One of the key components of the City's Stormwater System Plan is an inventory and assessment of the condition of all assets that comprise the stormwater system, including rivers and streams. Knowledge of an asset's condition is necessary to understand the issues that may impact its function. BES will be conducting stream habitat surveys throughout Portland to characterize the current condition of the City's streams. The surveys will provide information on both instream habitat and riparian conditions. The survey data will be used to determine where high-quality habitat should be enhanced or protected, and which stream reaches would benefit from restoration. The results will help identify priorities and guide investments to improve water quality. All of the perennial Portland streams covered by the Lower Willamette subbasin TMDL will be surveyed as part of this effort.

3.2.1.3 Ecosystem Diagnosis and Treatment Analysis

BES is developing an Ecosystem Diagnosis and Treatment (EDT) model to evaluate the availability of existing stream habitat to support endangered salmonids and the benefit restoration work has had on fish populations. Model results will also be used to forecast the benefits of planned projects, as well as incorporate the anticipated impacts that will result from climate change. EDT models are being developed for the Columbia Slough, Johnson Creek, and Tryon Creek for Chinook, coho, and steelhead.

The EDT model includes a structure for evaluating and rating the quality, diversity, and abundance of habitat for a focal species within a stream reach. The analysis assesses the habitat needs—which includes both physical habitat and water quality requirements—for the different life stages of each species of interest. Using species-specific, life-stage habitat requirements and the reach-scale environmental conditions, the model calculates population performance for the species of interest. BES will be evaluating multiple scenarios to estimate current fish population performance and expected performance under future conditions. The results will highlight priority reaches where investment in watershed restoration is projected to have the largest benefit to salmonids.

3.2.2 Environmental Conservation and Protection

The City employs multiple strategies to conserve and protect aquatic resources within Portland watersheds. Environmental protections through City Code, regulations, and zoning restricts activities that may negatively impact the City's aquatic resources. Figures 4A-4F show areas of privately owned riparian corridor covered by Conservation or Protection zones ("C-zones" or "P-zones") in orange and yellow. Privately owned riparian corridor located outside environmental zones is shown in red.

3.2.2.1 Floodplain, Riparian, and Wetland Protection

The City protects floodplains, riparian areas, and wetlands through natural resource inventories, protection plans, and environmental overlay zones. The environmental overlay zone code (City Code Chapter 33.430: Environmental Zones) is intended to protect and conserve natural resource values and functions, including water quality and fish and wildlife habitat. The City's adopted natural resource inventories and protection plans identify features to which the environmental overlay zones are applied; those features include floodplains, wetlands, riparian and upland vegetation, and waterways.

The environmental overlay zone is a key component of the City's strategy to protect and preserve floodplain and riparian plant communities that will help the City meet the nonpoint source load allocation of system potential shade. The environmental overlay zone regulations require that proposed development meet development standards, avoid adversely affecting natural resources where practicable, and/or mitigate for unavoidable impacts. There are three environmental overlay zones:

1. The *Environmental Protection zone* provides the highest level of protection to the most important resources and functional values. Development is approved in the environmental protection zone only in rare and unusual circumstances. Figures 4A-4F refer to this as "P-zone."
2. The *Environmental Conservation zone* conserves important resources and functional values in areas where the resources and functional values can be protected while allowing environmentally sensitive urban development. Figures 4A-4F refer to this as "C-zone."
3. The *River Environmental overlay zone* (Figures 4A-1 and 4A-2 only) protects, conserves, and enhances important natural resource functions and values while allowing environmentally sensitive development. The purpose of the zone is to limit the impacts from development and vegetation maintenance on the natural resources and functional values contained within the overlay zone. The environmental regulations encourage flexibility and innovation in site planning and provide for development that is carefully designed to be sensitive to the site's protected resources. Mitigation is required for unavoidable impacts and is intended to have no net loss of natural resource features or functions over time. The River Environmental overlay zone applies to specific natural resource areas identified in the detailed study Willamette River Central Reach Natural Resources Protection Plan (Chapter 33.475.010; City of Portland, 2017a). Figures 4A-1 and 4A-2 show privately-owned riparian corridor within the River Environmental overlay zone in magenta. The precise extent of coverage and specific rules governing uses within this zone are currently under development and mapping extents and chart values are approximate.

The City's three environmental overlay zones limit development activities in these sensitive areas, including the removal of trees and encroachment into the floodplain. Title 33 requires that all trees with a diameter at breast height (dbh) greater than or equal to six inches removed from a site be replaced with a minimum of two replacement trees per removed tree or payment to a mitigation fund that is used to plant trees in the same watershed (Chapter 33.430.140).

To help protect Portland's natural resources, the City developed the natural resource inventory (NRI), which documents the location, extent, and condition of Portland's aquatic resources (including rivers, streams, floodplain, wetlands, and the lands adjacent to these waterbodies) and wildlife habitat. The City's NRI builds on an earlier inventory completed by Metro. As part of the NRI, the relative quality of a natural resource is evaluated for specific ecological functions relating to watershed hydrology, water quality, and fish and wildlife habitat. The City uses the NRI to inform zoning and planning activities.

Portland's Bureau of Planning and Sustainability is currently working on an effort to update and refine the environmental overlay zones. The purpose of the Environmental Overlay Zone Map Correction Project is to synchronize the mapped location of the overlay zones with the location of existing identified natural resources, including mapped wetland areas. The project will not alter the protections placed on the City's natural resources through the environmental overlay zones. Rather, the intent of the Map

Lower Tryon Creek

Correction project is to identify and protect additional natural resources—such as streams and wetlands—that are not currently covered by the existing environmental overlays. This effort will bring the zoning code into alignment with the City's 2035 Comprehensive Plan, which addresses statewide planning goals and Metro requirements. The project will ensure that resources across Portland are mapped accurately and regulated in a consistent way.

In addition to Portland's environmental zones, the City protects the integrity of vegetation communities through the City's Outdoor Maintenance Requirements (Chapter 29.20.010). Title 29 requires the eradication all invasive plants identified on the City's Nuisance Plants and Required Eradication Lists. The code applies to all property owners, covering both riparian and upland areas.

3.2.2.2 Tree Protection

In addition to the environmental overlay zones, the City's Tree Code (Portland City Code, Title 11) also helps to preserve the City's tree canopy. The code limits the removal of trees from a property. In development situations, the Code requires preservation of larger trees on private property or payment to a mitigation fund at the cost per replacement tree (Chapter 11.50.040).

3.2.2.3 Onsite Stormwater Retention and Low Impact Development

As noted in the Lower Willamette subbasin TMDL, reduced summer baseflows can have a negative effect on stream temperatures. The TMDL nonpoint source load allocation does not affect groundwater recharge; however, actions that improve summer stream flows will likely have a positive benefit on stream temperatures. Within Portland, impervious surfaces can limit stormwater infiltration, reducing groundwater recharge. To address stormwater issues, the City manages impervious areas through the City's Stormwater Management Manual (SWMM).

The SWMM provides policy and design requirements for stormwater management throughout the City. The requirements in the manual apply to all development, redevelopment, and improvement projects within the City of Portland on private and public property and in the public right-of-way. The SWMM prioritizes stormwater infiltration, requiring that stormwater must be infiltrated onsite to the maximum extent feasible, before any flows are discharged offsite. By prioritizing stormwater infiltration on a property, the City is encouraging actions that will increase infiltration and groundwater recharge within Portland, supporting summer stream flows that may benefit summer stream temperatures.

3.2.2.4 Invasive Species Management and Treatment

Invasive species management is one of the City's key strategies to maintain healthy riparian communities within Portland's watersheds. In addition to active planting, the City's Revegetation Program provides vegetation management in many of the City's natural areas. The program manages the treatment of invasive species in natural areas in all Portland watersheds. In many areas, invasive species have compromised understory plant communities. The program works with regional partners and private contractors to collect native seeds and grow native groundcover plants that are not commercially available. The effort produces a sustainable regional source of native seeds.

The City also operates a targeted invasive species program to address species of concern. For example, the Early Detection/Rapid Response (EDRR) Program focuses on controlling invasive plant infestations in the City when their distribution is limited and patches are small. This approach increases the possibility of eradication and is much less expensive than trying to control well-established invasive species. The program targets approximately 10 invasive species, including the invasive aquatic macrophyte Ludwigia spp. and Alliaria petiolata (garlic mustard). The program is implemented throughout Portland, targeting species in both riparian and upland areas. Addressing the spread of invasive species before they overtake an area helps to protect riparian plant communities and supports TMDL goals.

OAKS BOTTOM HABITAT ENHANCEMENT PROJECT

Reconnecting the Lower Willamette River to its Largest Remaining Natural Floodplain Area

Oaks Bottom Wildlife Refuge is a 170-acre complex of wetlands, springs, tidal channels and woodlands providing valuable habitat to fish and wildlife. Just upstream of the city center, the refuge offered a unique opportunity to collaborate with the U.S. Army Corps of Engineers and implement a large-scale restoration project to improve the refuge's hydrologic connection to the mainstem Willamette.

The goal: Maximize access for migrating salmonids to provide essential resting and rearing habitat for at least 90% of the time they are present. The strategy: Enhance flow between tidal channels in the refuge and the river. The actions: Remove an old flow control structure, expand tidal channels and replace the undersized 5-ft culvert with a 16-ft box culvert that's being called "The Salmon Subway".

The project reflects the City's integrated approach to restoring ecosystems services. Vegetation management includes invasive species treatment and riparian plantings. The enhanced plant ecology will provide improved shade and cover to the spring-fed tidal channels, enhancing habitat for amphibians, bats, birds, reptiles and fish including protected salmonids.

Photo credit: U.S. Army Corps of Engineers

Additionally, the City conducts surveys for invasive wood-boring pests that would negatively impact tree health and lead to a future loss of tree canopy. To date, the focus has been on two insects that would impart substantial loss of riparian canopy in the region: the Asian longhorned beetle and the emerald ash borer. City staff visually monitor for signs of both species and actively set and monitor traps for emerald ash borers with state and federal partners. The City also acts as a partner with state-led surveys and controls for both Asian and European gypsy moths.

3.2.3 Watershed Restoration

In addition to the protection strategies described above, the City engages in active restoration to improve natural resources throughout Portland. The City's restoration efforts include an extensive revegetation program and programs that aim to improve stream conditions, including actions to address water quality impairments such as excess stream temperatures. Figures 4A-4F show areas currently or previously managed through revegetation or restoration activities in dark green. Areas classified as "Restoration Potential," shown in light green, are publicly owned and may represent future opportunities for similar enhancements. Project potential depends on numerous factors, including effective shade and stream conditions.

3.2.3.1 Riparian Revegetation

The City's Revegetation Program provides vegetation management and planting in natural areas throughout the City, including riparian areas. The Revegetation Program's natural areas restoration and management efforts began in 1995 in the Columbia Slough watershed. Today, the program is active in all Portland watersheds. The Revegetation Program includes the planting of native trees and shrubs in riparian areas throughout Portland as part of revegetation efforts, but also in conjunction with other restoration projects. The Revegetation Program includes collaboration on restoration projects with other City bureaus and many public and private groups. Planting riparian trees and shrubs is a key strategy in addressing stream temperatures and meeting the nonpoint source load allocations identified in the TMDL.

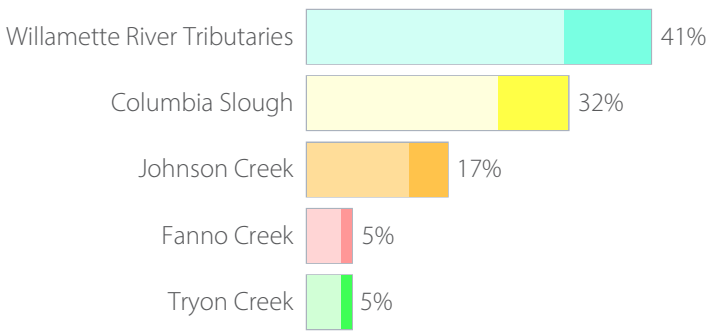
3.2.3.2 Hydrologic Connectivity

The City actively works to restore hydrologic connectivity by purchasing and restoring properties. BES also actively works with the City's transportation bureau and the Oregon Department of Transportation to identify and replace culverts that are current fish passage barriers to improve hydrologic connectivity. When conducting watershed restoration, the City relies on the Portland Watershed Management Plan (PWMP) to inform project objectives and identify actions that will contribute to the City's overall goals for watershed health (City of Portland, 2005a).

3.2.3.2.1 Portland Watershed Management Plan

The PWMP was developed in 2005 and guides City decisions and projects by providing a comprehensive approach to restoring watershed health. The PWMP identifies priority actions and areas that require attention, and provides both a structure to evaluate watershed health, and a long-term commitment to adapt and improve over time. The PWMP is a Citywide effort that relies on the coordination of City bureaus and community partners to address the complex issue associated with urban watershed management.

THE CITY PLANTED
439,000 NATIVE TREES AND SHRUBS
FROM 2013-2018



Percent of Total Plantings
(Shrubs/Trees - shrubs are the light shade and Trees are the darker shade)

The plan is built on a scientifically sound foundation that addresses the sources and causes of environmental problems rather than focusing on symptoms. Portland's watershed approach is described in the City's Framework for Integrated Management of Watershed Health (City of Portland, 2005b). The framework describes watershed health goals, why the goals are desirable, and relevant ecological principles and restoration guidelines that support the goals, which comprise the following:

- Hydrology: Move toward normative stream flow conditions to protect and improve watershed and stream health, channel functions, and public health and safety.
- Physical habitat: Protect, enhance, and restore aquatic and terrestrial habitat conditions and support key ecological functions and the improved productivity, diversity, capacity, and distribution of native fish and wildlife populations and biological communities.
- Water quality: Protect and improve surface water and groundwater quality to protect public health and support native fish and wildlife populations and biological communities.
- Biological communities: Protect, enhance, manage, and restore native aquatic and terrestrial species and biological communities to improve and maintain biodiversity in Portland's watersheds.

In addition to the watershed goals, the PWMP includes watershed objectives. The objectives describe the desired changes in watershed conditions and functions needed to achieve watershed health and set the stage for identifying the strategies to attain those objectives. Improving stream temperature is a key objective of the PWMP, and revegetation is one of the six watershed improvement strategies. Consequently, achieving the goals of the PWMP also contributes toward meeting TMDL nonpoint source load allocations.

3.2.3.3 Stream, Floodplain, and Wetland Restoration

The City's aim is to restore natural stream functions and processes through watershed restoration projects, including floodplain reconnection, riparian plantings, wetland restoration, habitat enhancement for fish, and treatment facilities to improve water quality. Active restoration improves instream and riparian conditions, which contribute toward the TMDL load allocation of system potential shade.

In 2006, BES launched the Watershed Investment Fund (WIF) to jump-start work under the 2005 PWMP. BES provides up to $1.5 million per year for watershed restoration projects. Over 20 restoration projects have been completed throughout the City to date and include stream daylighting, wetland enhancement, culvert replacement, and riparian revegetation.

3.2.3.4 Land Acquisition

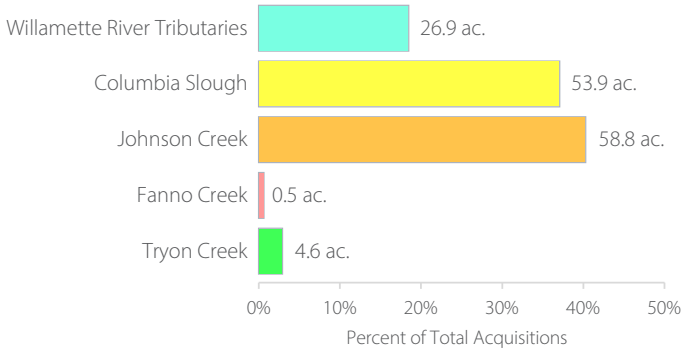
The City currently operates three land acquisition programs designed to identify and protect properties with significant ecological resources. Through the programs, the City is able to purchase parcels of land to prevent the loss of natural resources to development and to implement restoration projects that improve hydrologic connectivity. Properties purchased through these programs are managed by the City as natural areas to support ecological functions and, where applicable, to support riparian conditions. Riparian corridors within the natural areas managed by the City are planted and stewarded to promote healthy conditions that will achieve a mature riparian canopy. These mature conditions help shade the stream and achieve the TMDL nonpoint source load allocation of system potential shade.

The City acquired 56 parcels totaling nearly 145 acres from 2013-2018.

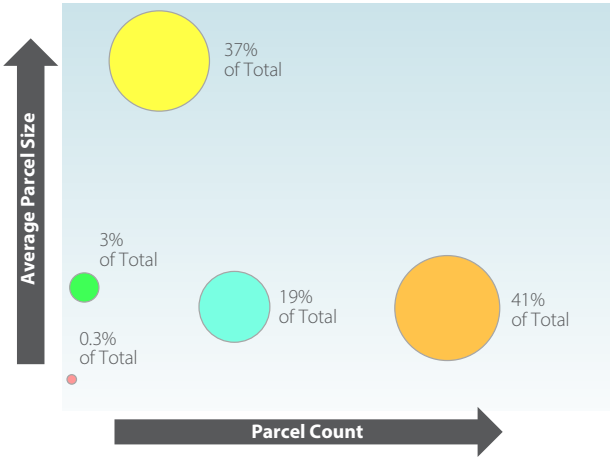
That's equal to over 72 soccer fields of new protected lands.

BES currently operates the Watershed Land Acquisition Program to fund the acquisition of prioritized properties across Portland watersheds. In 2017, BES initiated the Watershed Land Acquisition Program, which evolved from the City's earlier Grey to Green initiative to boost green infrastructure in Portland, including the purchase of natural areas. The Watershed Land Acquisition Program is designed to protect ecological resources, landscapes susceptible to stormwater runoff, and habitat for species listed under the Endangered Species Act. Targeted property acquisition helps facilitate the restoration or enhancement of priority stream reaches. Property owners are under no obligation to sell their property, but if they do, BES offers fair market value for the property. BES is actively developing an assessment methodology to prioritize properties for acquisition. Using available geospatial data, properties are evaluated based on their ecological function and restoration potential. The assessment method will be used to identify and compare properties.

Land Acquisition by Subwatershed (2013-2018)



Land Acquisition by Parcel Count and Average Size



In 1997, BES developed the Johnson Creek Willing Seller Land Acquisition Program. The program helps move people and properties out of areas that frequently flood. As part of the program, BES offers willing sellers the fair market value for their floodplain property. Again, owners are under no obligation to sell their property. Properties that are purchased by the City have deed restrictions that designate them as open space in perpetuity and ensure no future development on the property. Once purchased, the City implements restoration projects to create constructed wetlands; floodplain terraces; and open space for flood management, habitat, and passive recreation. Revegetation work on these acquired properties frequently includes riparian plantings and invasive species management. The Willing Seller Land Acquisition Program is an implementation strategy for the 2001 Johnson Creek Restoration Plan, which addresses nuisance flooding, water quality problems, and fish and wildlife declines as related issues (City of Portland, 2001). The plan identifies common solutions to restore natural floodplain functions.

The Portland Parks and Recreation (PP&R) bureau operates a land acquisition program to purchase new properties for the City's park system. The program funds the acquisition of land for all park types, including natural areas. To guide the program, PP&R developed a land acquisition strategy that provides a framework for determining which potential acquisition projects to pursue. For natural areas, the strategy specifically targets properties with streams, wetlands, and riparian areas. The objectives of the PP&R land acquisition program are to establish an interconnected system of natural areas, protect the City's natural areas and environmentally sensitive habitats, and increase natural area land within the City as identified in the 2006 Natural Area Acquisition Strategy (City of Portland, 2006).

CRYSTAL SPRINGS CREEK RESTORATION PROJECT

Instream Pond Removal Enhances Cold Water Refugia in the Lower Willamette

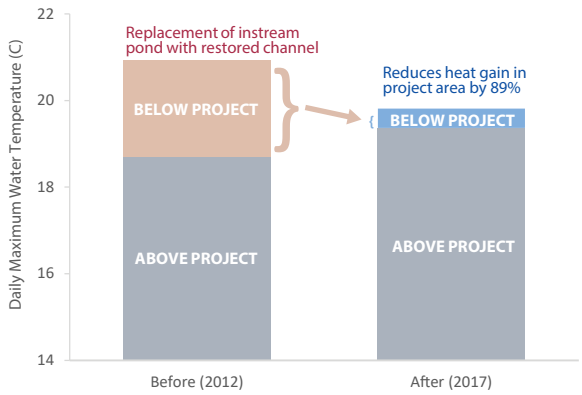
Crystal Springs Creek is a major influence on lower Johnson Creek before it meets the Willamette River. It flows consistently year-round, sustained by cold spring water inputs. Water temperature monitoring in the Crystal Springs watershed found that much of the cold water benefit is lost when the stream enters the impoundments (ponds) along the stream. These ponds cause the water temperatures to rise, degrading summertime conditions in both Crystal Springs and lower Johnson Creek. One of the largest ponds, located in Westmoreland Park, presented a big opportunity for improvement.

Pond removal and channel restoration eliminated the open water where sunlight and slow flow caused the water to warm. BES continuously monitored temperature in the creek both before and after project completion in the summer of 2013.

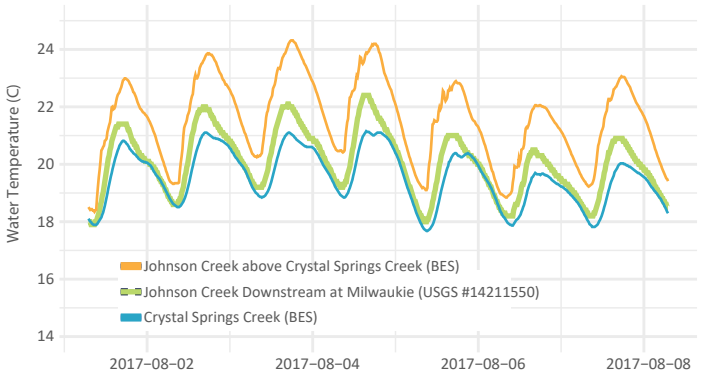
The bar chart of daily peak temperatures during summer (bottom left), averaged across July and August, shows the change over time from above and below the project site. Before the project, the daily peak temperatures of the water flowing out of the project site (downstream of the pond) were 2-4°C warmer than the creek above the project. Since the project removed the pond, the increase in temperature was measured at only 0.26°C from above to below, meaning the project eliminated 89% of the impact from the pond. As riparian plantings along the restored channel mature and canopy shades the creek, we can expect the water to be even cooler for its mile-long journey south to Johnson Creek.

Removing the pond in Westmoreland Park not only benefits the lower one and a half miles of Crystal Springs, but the temperature benefits also extend along the lower 2 miles of Johnson Creek to the confluence with the Willamette River. In 2017, BES monitored temperature where Crystal Springs meets Johnson Creek, with sensors located on each creek upstream of their confluence. The line graph (bottom right) shows that Crystal Springs has a strong cooling effect on Johnson Creek, with daily peaks in Johnson Creek being 2-3°C cooler below the confluence than above. Because the confluence of Johnson Creek and the Willamette River is considered a cold water refuge, the benefits of the Crystal Springs Restoration Project support aquatic life in multiple waterways.

Restoration Project on Crystal Springs Creek Reduces Peak Water Temperatures in July-August



Early August Water Temperature (2017)



3.2.3.5 Upland Tree Planting

Upland trees provide a benefit to those living in Portland. The urban forest canopy intercepts rain which reduces stormwater runoff, provides shade and habitat for wildlife, and helps reduce the urban heat-island effect. Through partnerships with nonprofits, community members, businesses, and schools, the City actively enhances watershed health by planting trees in the upland built environment using community engagement and volunteer support. These trees expand the urban forest canopy, managing stormwater locally while improving habitat connectivity in the urban matrix between natural areas. Since 2008, the City has collaborated with multiple partners to plant more than 50,000 trees across Portland.

3.2.3.6 Restoration and Planting Partnerships

Through partnerships with nonprofits, community groups, and schools, the City actively enhances natural areas using volunteer support. Activities include invasive plant species removal, native plant installation, and community education.

3.3 Coldwater Refugia

The Willamette Basin temperature TMDL designates the mainstem of the Willamette from its confluence with the Columbia River upstream to River Mile 50 as a year-round salmon and steelhead migration corridor. For this migration corridor, the TMDL establishes a numeric criterion for water temperature and a narrative criterion for ***coldwater refugia***. OAR 340-041-0002(10) defines coldwater refugia as "those portions of a water body where or times during the diel temperature cycle when the water temperature is at least 2 degrees Celsius colder than the daily maximum temperature of the adjacent well-mixed flow of the water body." In addition to the comprehensive strategies described in previous sections to meet TMDL nonpoint source load allocations, the City is also working to identify, preserve, and enhance coldwater refugia in the Lower Willamette River.

In 2011, thermal infrared imagery (TIR) was collected to capture the surface temperature of the Willamette River. The data included imagery of tributary confluences, which was used to identify whether they provided cold water to the mainstem Willamette River during summer. Using TIR data, the City identified multiple sources to the Willamette River that were at least 2°C colder than the main channel. The City and its partners have implemented multiple restoration projects at these tributary confluences to enhance conditions and provide essential habitat for both juvenile and adult migrating salmonids.

The City continues to use the results from the TIR data to inform priorities for restoring and protecting coldwater refugia on the Willamette, and the City continues to strategically deploy temperature loggers to explore the temperature dynamics of the Willamette and identify cold-water patches. Over the next TIP cycle, the City will evaluate the data to update the inventory of coldwater refugia in Portland.

In addition to the City's internal efforts, City staff are assisting with DEQ's current effort to draft a coldwater refuge plan for the lower 50 miles of the Willamette River. BES staff have provided DEQ with an inventory of all available temperature data for Portland area waterways and are serving on DEQ's scientific expert and peer review panel on coldwater refuges in the Lower Willamette River.

While the City and its partners have successfully implemented restoration projects at many coldwater confluences, the City is

Restoration of Crystal Springs Creek between SE Tenino Street and SE Umatilla Street. Two culverts were replaced to provide fish passage and large wood and boulders were added to the channel to provide habitat.

continuing to evaluate the feasibility of additional refugia enhancement projects. The City continues to use the TIR data, along with more recent continuous stream temperature data to guide the implementation of restoration projects along the mainstem Willamette. Additionally, the City's watershed restoration efforts described above also serve to protect or enhance coldwater refugia in the Willamette River. For example, during the summer of 2013, the City removed an in-line pond from Crystal Springs Creek (a tributary to Johnson Creek) that was warming the stream. After the removal, the daily maximum summer stream temperatures were reduced by 3-4°C. Due to Crystal Spring's consistent summer discharge, the thermal benefit of the project persists from the confluence with Johnson Creek to the confluence of Johnson Creek with the Willamette River. In 2017 the City found that the daily maximum Johnson Creek water temperatures recorded by the U.S. Geological Survey gage at Milwaukie were approximately 2-3°C cooler than the temperatures upstream of the Crystal Springs confluence. The restoration work on Crystal Springs provides a benefit to the stream system itself, but it also provides a coldwater benefit to the lower 2 miles of Johnson Creek and at the Willamette River confluence. The City is actively exploring other projects that may benefit tributary streams and enhance coldwater refugia.

SECTION 4

GOALS AND TARGETS

As noted in Section 3, many of the City's key management strategies to reduce TMDL pollutants and improve water quality are conducted under the City's MS4 Permit and associated SWMP. The SWMP defines the target levels, or measurable goals, to implement BMPs to reduce pollutants in stormwater runoff. While the focus of the SWMP is to address discharges from the MS4, many strategies described in the SWMP are applied City-wide and reduce TMDL pollution from nonpoint sources as well.

As part of this TIP, the City has identified specific goals and targets to assess progress toward meeting nonpoint source temperature load allocations. The City's TMDL goals and targets for the temperature strategies identified in Section 3 are provided in Table 4.

Columbia Slough

SECTION 5

PERFORMANCE MONITORING AND PLAN UPDATES

This section provides a summary of activities conducted by the City to evaluate performance of the TMDL management strategies and to support the adaptive management process for reviewing and revising this TIP. Section 5.1 provides a summary of environmental monitoring, Section 5.2 provides an overview of the process to assess performance and conduct adaptive management, Section 5.3 summarizes the process to coordinate the review and revision of strategies with the City's MS4 permit, and Section 5.4 discusses public involvement that can inform TIP updates.

5.1 Environmental Monitoring

The City conducts extensive storm and surface water monitoring as required under the MS4 permit. The monitoring supports multiple objectives, including pollutant source evaluation, stormwater runoff characterization, assessment of instream water quality trends, TMDL pollutant load reduction benchmarking, and programmatic adaptive management. These monitoring activities are detailed in the *Monitoring Plan for Stormwater and Surface Water Sampling by the City of Portland in Compliance with MS4 Permit Requirements*, dated July 2016. The monitoring program includes different types of comprehensive stormwater monitoring, including probabilistic and fixed-site land-use sampling for an extensive list of pollutant parameters.

The watershed monitoring activities implemented by the City that supports TMDL implementation include the collection of water quality and benthic macroinvertebrate samples, instream time-series data, physical stream habitat surveys, bird surveys, and fish surveys. The City currently monitors water quality (including continuous stream temperature) at 80 sites on perennial streams throughout Portland as part of the Portland Area Watershed Monitoring and Assessment Program (PAWMAP). PAWMAP is a coordinated long-term monitoring effort designed to measure the City's current and changing ecological resources that began in 2010. The program is intended to systematically measure changes in habitat, water quality, and biological communities over time. As part of the program, the City monitors stream temperature using continuous loggers at each sampling site.

The City also operates a Project Effectiveness Monitoring program to evaluate the City's watershed restoration projects across the Portland area. As part of the program, the City collects pre- and post-project data to evaluate the success of a restoration project relative to both project and City-wide restoration targets. The data collected through the monitoring program is used to facilitate project and permit reporting as required by the U.S. Army Corps of Engineers and Oregon Department of State Lands, and the data also informs both site-specific adaptive management needs and recommendations for future restoration projects based on lessons learned. BES is actively working to develop a comprehensive manual for the program that will standardize the City's data collection efforts across projects, establish monitoring protocols, define the frequency of data collection, and facilitate improved project reporting. The program manual will allow for consistent monitoring among project sites and across watersheds. Monitoring the effectiveness of watershed restoration projects is an important strategy that the City uses to assess progress toward meeting nonpoint source load allocations for temperature included in the Lower Willamette and Tualatin TMDLs. Ongoing monitoring ensures that a restoration project continues to function as intended and remains on a trajectory to reach mature conditions or system potential.

5.2 Adaptive Management

The City conducts an annual adaptive management process while also preparing its annual MS4 and TMDL status reports. This annual review is used to determine if the City's TMDL programs are being implemented in accordance with the TIP and to identify whether any adjustments are needed. The City submits the progress reports to DEQ each year on or by November 1. The reports summarize strategy implementation and identify programmatic issues or modifications identified as part of the annual review. An updated version of the City's annual TMDL reporting matrix is provided in Appendix A.

In addition, every 5 years, the DEQ requires DMAs to review implementation of management strategies that are in their TIPs. The resulting report indicates whether the plan is adequately meeting pollution reduction goals. As part of the process, the City reviews the TIP to assess its strategies and progress toward meeting goals and to propose changes as appropriate. Existing strategies are reviewed and refined to reflect progress made over the last 5 years, and the TIP is updated accordingly, if needed. Similarly, the TIP may require updates if DEQ issues new TMDLs in the Portland area or revises existing TMDLs.

5.3 Regulatory Driver Updates

Many TMDL strategies listed in this TIP are conducted to comply with the City's NPDES MS4 permit and associated SWMP. It is the City's intent to maintain consistency between the SWMP and the TIP, as most of these programs are applied City-wide regardless of regulatory applicability. The City's SWMP is reviewed and changes are evaluated in accordance with the MS4 permit renewal process prior to the end of each 5-year permit term. The SWMP is updated at permit reissuance to comply with new permit conditions and as needed thereafter. In cases where there is a lag time between the expiration of the City's existing permit and DEQ's issuance of the new permit, the City's permit is put into administrative extension. Only very minor changes can be made to a SWMP during the permit period or during administrative extension of the permit. Given the uncertain timeline for permit renewals, a schedule for the SWMP updates is uncertain. Therefore, the timeline for initiation of an updated SWMP is unlikely to sync up with the 5-year timeline for reviewing and updating the TIP. To maintain consistency between the two plans, the City may update the TIP to align with stormwater management strategies that are updated as part of the NPDES MS4 program when they occur. These updates will be reflected in the following year's TMDL annual progress report.

5.4 Public Involvement

The City conducts a variety of public involvement activities related to TIP implementation and the management strategies identified, including the following:

- The City's current TIP, annual reports, 5-year evaluations, and other relevant information are posted online and made publicly available. The website provides a contact number for those who have questions or want to provide input on the City's plans, strategies, and other environmental program activities.
- The 2019 TIP update was designed to be more accessible, easier to use, and understandable by the public. The City added clarifying language and regulatory background, a table summarizing the applicable TMDLs and associated surface waters, information related to potential TMDL pollutant sources, an acronyms and definitions section, and graphics and maps to clearly illustrate basin boundaries and coverage areas.
- A significant amount of public involvement and outreach activities (i.e., grant distribution, community events, workshops, and stewardship projects) are undertaken as part of the stormwater management strategies associated with the City's MS4 Permit. Additional details can be viewed in the City's MS4 and TMDL annual reports (City of Portland, 2017b; City of Portland, 2018).

SECTION 6

FUNDING

The Tualatin Subbasin and Willamette Basin TMDLs state that DMAs are expected to perform a fiscal analysis to estimate the resources needed to develop, execute, and maintain the programs described in their implementation plans.

Since 1995, the City of Portland has invested more than $1.59 billion in stormwater management services and facilities. Last year alone (fiscal year 2017-18), City stormwater and watershed management expenditures totaled roughly $128 million. The majority of the funding sources (approximately 88%) required to implement the strategies identified in the TIP and related environmental activities are financed directly through BES utility fees. The remaining sources include system development charges (SDCs) and a much smaller portion coming from other services, fees, grants, and penalties. The Portland City Council approves revised monthly user fees and SDCs at the start of each fiscal year. Rate adjustments are based upon cost-of-service principles, which aim to ensure equity by charging ratepayers and developers based on the amount of sewer and drainage service they use.

- **Monthly User Fees.** Monthly user fees are adjusted to reflect operating, maintenance, and capital costs of the City's sanitary sewer and drainage system.
- **SDCs - Stormwater.** SDCs are assessed for new development and significant redevelopment based on two things: (1) onsite stormwater management — the charge for stormwater facilities that handle runoff from individual properties and (2) public right-of-way (ROW) runoff management — the cost of stormwater facilities that handle runoff from public ROWs. Riparian properties that drain directly to the Columbia Slough, Columbia River, or Willamette River are exempt from the onsite portion of the fee. Discounts may be granted only for the "onsite" part of the charge for facilities constructed as part of new development.

While investments in stormwater and watershed programs and projects will vary from year to year, implementation of this TIP is expected to be fully financially supported given the stability of these funding mechanisms. Current and out-year investment fluctuates annually based on a variety of factors including the nature and cost of capital improvement projects, the stage and timing of project completion at any point in the year, operational improvements, and inflationary factors. BES, as the lead City bureau overseeing implementation of the TIP, is on a long-term trajectory to provide stable rates for ratepayers and has factored TIP implementation into that long-term plan. Annual stormwater and watershed related expenditures, both actual and planned, are documented in the City's MS4 annual report.

SECTION 7

LEGAL AUTHORITY

The City of Portland's legal authority to implement TMDL management strategies is provided by relevant Oregon State Constitution sections, Oregon state statutes, and City of Portland charter and code. Specific Portland City Code sections and authorities relevant to TMDL implementation are listed below:

- **Title 10 - Erosion and Sediment Control Regulations.** This title provides requirements related to sediment and erosion control for development and construction-related activities. These requirements are intended to: (1) reduce sediment and pollutants contained in erosion caused by construction and development, (2) reduce the amount of sediment and pollutants entering storm drainage systems and surface waters from ground disturbing activities, (3) prevent dirt and mud from accumulating on the public streets and surrounding properties during construction and development, and, 4) reduce or prevent airborne dust during ground-disturbing activities. Title 10 gives legal authority to the Bureau of Development Services (BDS) and the Bureau of Environmental Services (BES) to administer and enforce erosion and sediment control requirements.
- **Title 11 - Trees.** This title provides requirements to address trees in both development and nondevelopment situations and seeks to enhance the quality of the urban forest and optimize the benefits that trees provide. Relevant objectives in this title include helping to filter stormwater and reduce stormwater runoff; maintaining slope stability and preventing erosion; reducing the urban heat island; and meeting the objectives of the Urban Forest Plan, including reaching and sustaining canopy targets for various urban land environments. This title provides the legal authority for the City Forester and Director of BDS to administer and enforce all regulations in Title 11.
- **Title 17 – Public Improvements.** This title regulates public improvements, including sewer and stormwater collection systems. Chapters specific to the TMDL management strategies listed in this TIP include:
  - **17.32 – Public Sewer & Drainage System Permits.** This chapter regulates access and connection to, and the use, construction, modification, maintenance, repair or removal of, components of the City sewer, storm sewer, and drainage systems and their easements. It operates in conjunction with Chapter 17.38 (below) to regulate the collection, conveyance, and disposal of sanitary and stormwater discharges from public and private properties.
  - **17.33 – Required Public Sewer Connection.** This chapter facilitates timely connection of individual properties to the public sewer system when available, facilitates conversion of nonconforming private sewer systems, and provides for financial assistance to property owners required to make a new sewer connection.
  - **17.38 - Drainage and Water Quality.** This chapter details requirements for the effective management of stormwater, groundwater, and drainage and to protect and improve water quality. It includes details for the protection of drainageways and stormwater management requirements related to new development and redevelopment.
  - **17.39 - Stormwater System Discharges.** This chapter contains requirements for discharges to the City's storm system to convey, manage, and protect water quality. It includes details regarding allowable discharges, prohibited discharges, notifications, and control of illicit connections and discharges.
- **Title 24 – Building Regulations.** This title establishes standards for building and construction, including clearing, grading, earthwork, and erosion control on private property. Title 24 also restricts or prohibits uses that are dangerous to health, safety, or property in times of flood or which cause increased flood heights or velocities, and by requiring that uses and structures vulnerable to floods be protected from flood danger at the time of initial construction. Title 24 complies with Metro's Title 3 (Water Quality and Flood Management) by incorporating Metro's Water Quality and Flood Management Area Maps in Title 24.
- **Title 29 – Property Maintenance Regulation.** This title has requirements pertaining to outdoor property maintenance requirements. Section 29.20 requires the eradication of all plants identified on the City's Nuisance Plants List and on the City's Eradication List.

- **Title 33 – Planning and Zoning.** The City's zoning code is intended to implement Portland's Comprehensive Plan and related land use plans to protect the health, safety, and general welfare of the citizens of Portland. Section 33.430 (Environmental Zones) describes the City's environmental conservation zones to conserve important resources and functional values in areas where they can be protected while allowing environmentally sensitive urban development. Section 33.440 (Greenway Overlay Zone) protects; conserves; enhances; and maintains the natural, scenic, historical, economic, and recreational qualities of lands along Portland's rivers. It stipulates a vegetated corridor to separate protected water features from development and maintaining or reducing stream temperatures and natural stream corridors. It also stipulates minimizing erosion, nutrient, and pollutant loading while stabilizing slopes to prevent landslides contributing to sedimentation of water features. Section 33.475 (River Overlay Zones) promotes the protection, conservation, restoration, enhancement, and maintenance of the economic, natural, scenic, and recreational qualities of lands along the central reach of the Willamette River. This is achieved by applying regulations that control development of land, change of use, and intensification of use.

SECTION 8

COMPLIANCE WITH LAND USE REQUIREMENTS

One of the required elements of a TIP is evidence or acknowledgement that the management strategies to significantly affect land use are carried out in a manner that complies with the statewide land use goals and are compatible with comprehensive plans.

The City is required to adopt a Comprehensive Plan that implements the applicable Statewide Planning Goals at a local level. After a 4-year update process, the City's 2035 Comprehensive Plan was adopted in June 2016. In December 2017, the plan was approved and acknowledged by the Land Conservation and Development Commission to be compliant with the Statewide Planning Goals. The plan became effective in May 2018. Portland's plan is a long-range one intended to help the City prepare for and manage expected population and employment growth and to coordinate major public investments.

One of the five guiding principles used to shape the individual policies and projects in the 2035 Comprehensive Plan is related to environmental health, and it includes "weaving nature into the city and fostering a healthy environment that sustains people, neighborhoods, and fish and wildlife." It also recognizes "the intrinsic value of nature and sustaining the ecosystem services of Portland's air, water and land." Chapter 7 of the plan covers Environment and Watershed Health and includes goals and policies related to this TIP:

- Recognize the economic, health, cultural, and intrinsic values of nature, and the importance of community stewardship.
- Preserve natural resources and the beneficial functions and services they provide. Improve air quality and watershed health, including hydrology, water quality, fish and wildlife habitat, and biodiversity.
- Prevent incremental environmental degradation, including the spread of invasive species, loss of habitat, and adverse impacts of additional impervious surfaces.
- Advance good decisions and adaptive management through better data collection.
- Provide guidance that addresses the distinct ecological issues of specific watersheds.
- Ensure that plans and investments are coordinated with relevant policies from other City plans such as the Portland Watershed Management Plan, Urban Forest Management Plan, Climate Action Plan, Climate Change Preparation Strategy, PP&R plans, Natural Hazard Mitigation Plan, and plans addressing environmental equity.

The TMDL management strategies outlined in this TIP support and align with the City of Portland's 2035 Comprehensive Plan.

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DEQ, 2007. TMDL Implementation Plan Guidance for State and Local Government Designated Management Agencies. May 2007. https://digital.osl.state.or.us/islandora/object/osl:20723/datastream /OBJ/view (accessed December 10, 2018)

DEQ TMDL Homepage: https://www.oregon.gov/deq/wq/tmdls/Pages/default.aspx (accessed December 10, 2018)

OAR Section 340 Division 42, TMDLs: https://secure.sos.state.or.us/oard/displayDivisionRules. action?selectedDivision=1459 (accessed December 10, 2018)

U.S. Environmental Protection Agency TMDL Homepage: https://www.epa.gov/tmdl (accessed December 10, 2018)

GLOSSARY

Best management practices (BMPs)	Activities, controls, prohibition of practices, maintenance procedures, and other management practices designed to prevent or reduce pollution. BMPs also include treatment requirements, operating procedures, and practices to control stormwater runoff (MS4 Permit).
Coldwater refugia	Those portions of a water body or times during the diel temperature cycle when the water temperature is at least 2°C colder than the daily maximum temperature of the adjacent well-mixed flow of the water body (OAR 340-041-0002[10]).
Designated Management Agency (DMA)	A federal, state, or local governmental agency that has legal authority over a sector or source of contributing pollutants and is identified as such by the Department of Environmental Quality in a TMDL (OAR 340-042-0030[2]).
Load allocation (LA)	The portions of the receiving water's loading capacity that are allocated to existing nonpoint sources, including runoff, deposition, soil contamination, and groundwater discharges, or to background sources (OAR 340-042-0040[4][h]).
Management strategies	Strategies to control the addition of pollutants to waters of the state and include application of pollutant control practices, technologies, and processes; siting criteria; operating methods; best management practices; or other alternatives (OAR 340-042-0030[6]).
Maximum extent practicable (MEP)	The statutory standard that establishes the level of pollutant reductions that operators of regulated MS4s must achieve. This standard is considered met if the conditions of the permit are met (MS4 Permit).
Measurable goals	The BMP objectives or targets used to identify progress in implementing the Stormwater Management Plan. Measurable goals are prospective and, wherever possible, quantitative. Measurable goals describe what the co-permittee intends to do and when they intend to do it (MS4 Permit).
Municipal Separate Storm Sewer System (MS4)	An MS4 is a conveyance or system of conveyances including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains that are: a. Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State Law) having jurisdiction over disposal of sewage, industrial wastes, stormwater, or other wastes, including special districts under State Law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian Tribal organization, or a designated and approved management agency under §208 of the Clean Water Act that discharges to waters of the United States; b. Designed or used for collection or conveying stormwater; c. Which is not a combined sewer; and d. Which is not part of a Publicly Owned Treatment Works (POTW) as defined by 40 CFR §122.2. (MS4 Permit)
National Pollutant Discharge Elimination System (NPDES)	The NPDES program is a national regulatory program for issuing, modifying, revoking, reissuing, terminating, monitoring, and enforcing permits and for imposing and enforcing pretreatment requirements under Section 307, 402, 318, and 405 of the Clean Water Act for the discharge of pollutants to surface waters of the state from point sources. These permits are referred to as NPDES permits and, in Oregon, administered by the Oregon DEQ.
Nonpoint source	Nonpoint sources are typically defined as those sources that enter surface waters through more diffuse and dispersed overland flow (e.g., surface runoff from agricultural and forested lands). Load allocations are listed in the TMDL for these nonpoint sources.
Percent effective shade	The proportion of solar radiation that is attenuated or scattered before reaching the stream.

Point source	Point sources are typically defined as sources that are covered by an NPDES permit and enter surface waters through a pipe or defined conveyance system (i.e., municipal and industrial stormwater and/or wastewater). They include "any discernible, confined, discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft from which pollutants are or may be discharged (OAR 340-045-0010[17]). Waste load allocations are listed in the TMDL for these point sources.
Stormwater Management Plan (SWMP)	A comprehensive set of activities and actions, including policies, procedures, standards, ordinances, criteria, and best management practices established to reduce the discharge of pollutants from the Municipal Separate Storm Sewer System to the "maximum extent practicable" to protect water quality and to satisfy the appropriate water quality requirements of the Clean Water Act (MS4 Permit).
System potential shade	The maximum effective shade possible for a stream reach. System potential shade is achieved when the riparian plant community has reached its mature, undisturbed condition where vegetation heights are at or near their expected potential, resulting in the maximum effective shade.
Total maximum daily load (TMDL)	A written quantitative plan and analysis for attaining and maintaining water quality standards and includes the elements described in OAR 340-042-0040. These elements include a calculation of the maximum amount of a pollutant that a water body can receive and still meet state water quality standards, allocations of portions of that amount to the pollutant sources or sectors, and a Water Quality Management Plan to achieve water quality standards (OAR 340-042-0030[15]).
Total suspended solids (TSS)	TSS is the dry weight of suspended particles that are not dissolved in a sample of water that can be trapped by a filter and are analyzed using a filtration apparatus.
Waste load allocation (WLA)	Portions of the receiving water's loading capacity that are allocated to existing point sources of pollution, including all point source discharges regulated under the Water Pollution Control Act Section 402 (33 USC Section 1342). For purposes of assigning WLAs, point sources include all sources subject to regulation under the NPDES program, e.g., wastewater treatment facilities, some stormwater discharges, and concentrated animal feeding operations (OAR 340-042-0040[4][g]).
Water Quality Management Plan (WQMP)	This plan is an element of a TMDL plan describing strategies to achieve allocations identified in the TMDL to attain water quality standards. The elements of a WQMP are described in OAR 340-042-0040(4)(l).

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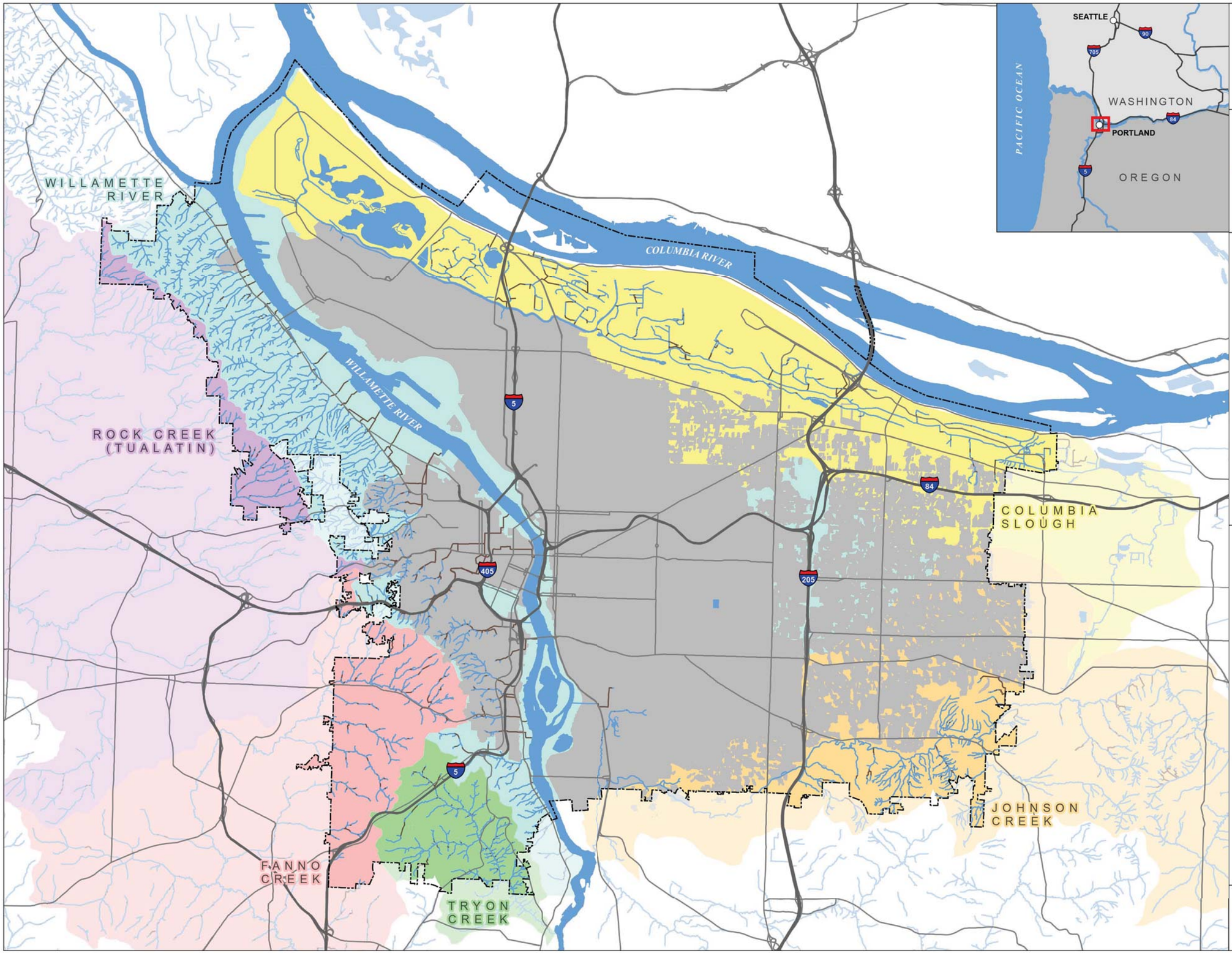
FIGURE 1

Subbasin Overview

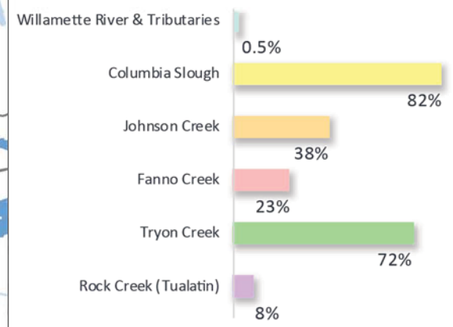
TMDL IMPLEMENTATION PLAN - MARCH 2019



LEGEND

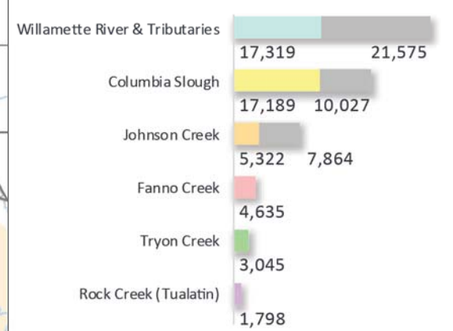
- Piped Watercourse
- Watercourse
- City of Portland Boundary
- Combined Sewer/City UIC Area

PERCENT OF ENTIRE SUBWATERSHED WITHIN CITY LIMITS



Percent of subwatershed describes the portion of each total watershed area located within City limits, indicating the extent to which the City's management strategies in the plan may be applied to each subwatershed.

SUBWATERSHED AREA (ACRES) INSIDE CITY LIMITS



The acreage within each topographic subwatershed is the total of colored and gray bar segments. Fanno, Tryon and Rock Creeks are not served by combined systems or UICs. Colored segments show acreage flowing to surface waters potentially subject to the City's management strategies described in the plan. Gray segments represent areas managed by either the City's combined sewer or UIC systems, where stormwater is conveyed to the wastewater treatment plant or to groundwater through sumps.

Gray shows acreage within combined sewer and UIC service areas

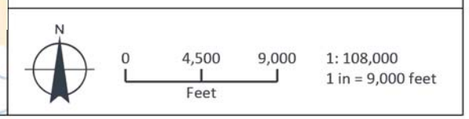


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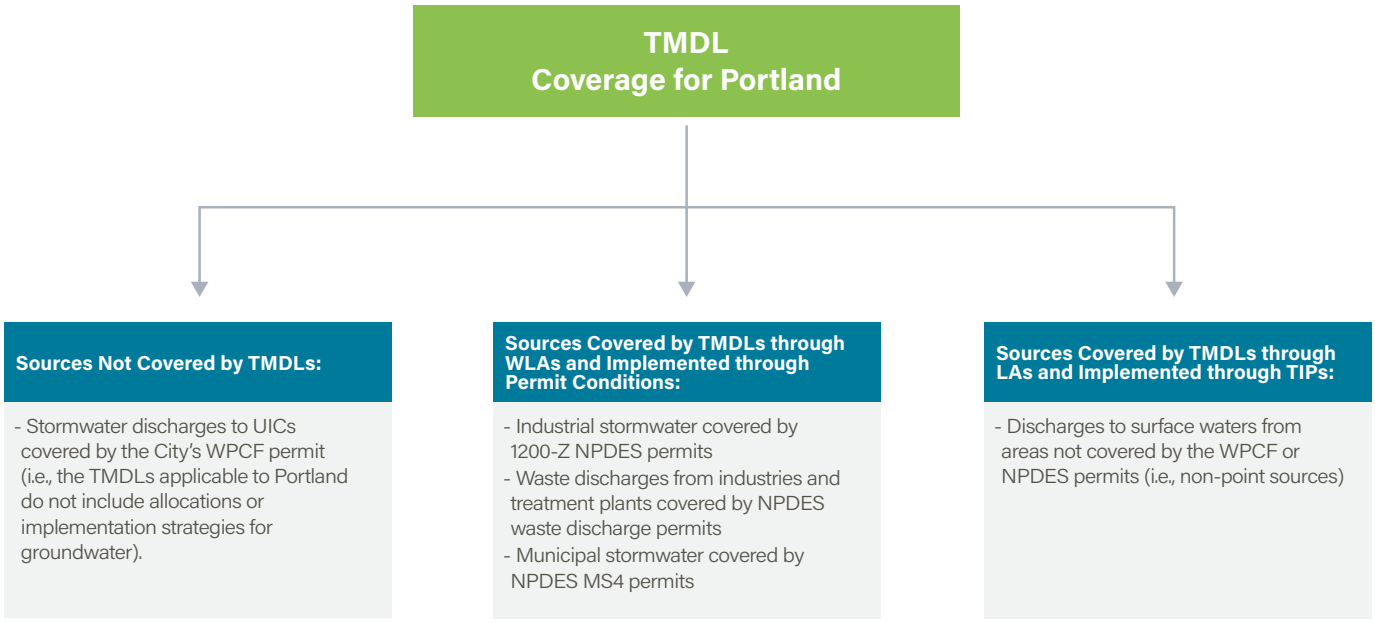
Figure 2: TMDL Applicability in the City of Portland



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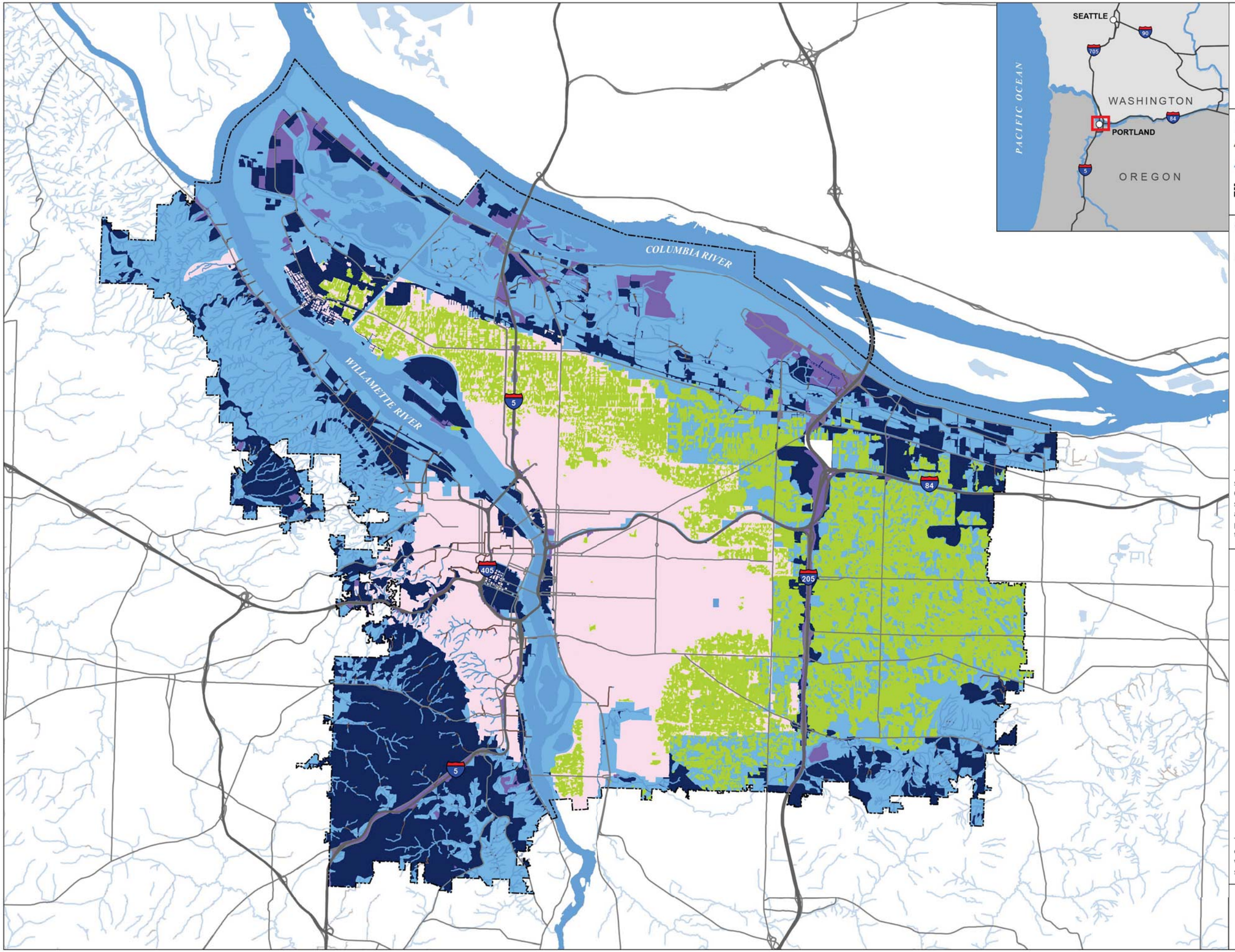


FIGURE 3

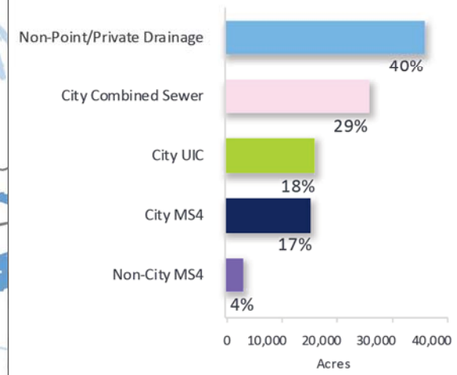
Stormwater Management

TMDL IMPLEMENTATION PLAN - MARCH 2019

LEGEND

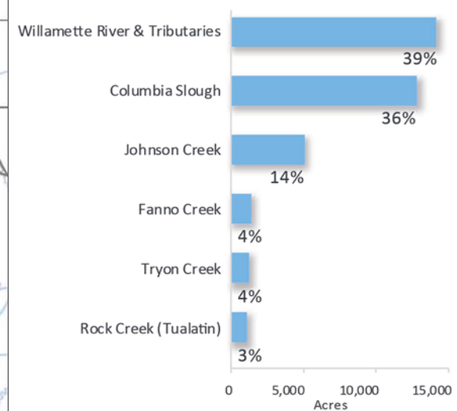
- Piped Watercourse
- Watercourse
- City of Portland Boundary

CITY AREA BY SYSTEM TYPE

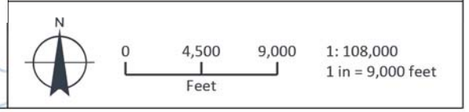


The chart illustrates the distribution of stormwater management systems across the City. The total area is greater than the area within City limits due to overlaps in coverage and mapping of the different system categories. The 'Non-Point/Private Drainage' category includes areas of open water in addition to natural drainages, private pipes, private UICs, green streets, and open spaces. This category represents the areas of the City most relevant to the TMDL Implementation Plan.

NON-POINT/PRIVATE DRAINAGE BY SUBWATERSHED



The chart shows areas mapped as "Non-Point/Private Drainage" within each topographic subwatershed. This includes open spaces and surface water. The percentages illustrate the distribution between subwatersheds of the city-wide total non-point/private drainage area.



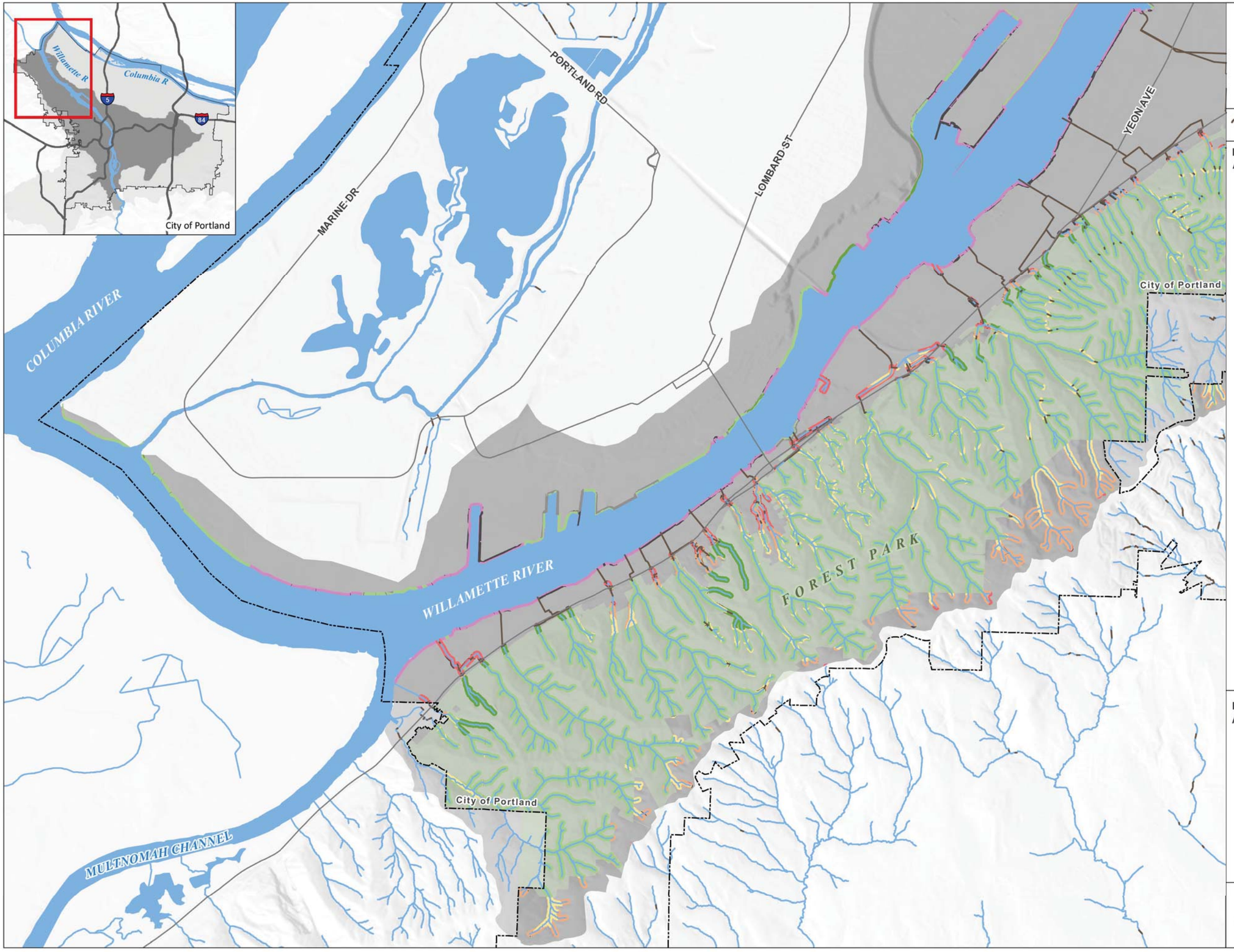


FIGURE 4A-1
Willamette Subwatershed Riparian Corridor

TMDL IMPLEMENTATION PLAN - MARCH 2019

Piped Watercourse | Watercourse | Park

RIPARIAN CORRIDOR IN SUBWATERSHED BY CATEGORY

Acres	Key	%	Riparian Category	Acres	Key	%
				74		3%
				5		0.2%
70		13%	Impervious & Private	134		5%
				299		10%
22		4%	Impervious & Public			
			No E-zone & Private			
			C-zone & Private			
			P-zone & Private	277		10%
226	MAINSTEM	43%	River E-zone		TRIBUTARIES	
				1747		60%
108		21%	Restoration Potential & Public			
99		19%	Revegetation Management Area	362		13%
524			Total Riparian Corridor	2,899		

riparian corridor based on 100-foot buffers along each bank

RIPARIAN CORRIDOR BY SUBWATERSHED AS PERCENT OF CITY TOTAL

Willamette Tributaries	38%
Columbia Slough	20%
Johnson Creek	13%
Fanno Creek	8%
Tryon Creek	7%
Willamette Mainstem	7%
Rock Creek (Tualatin)	6%

N

0 1,600 3,200 Feet

1: 38,400
1 in = 3,200 feet

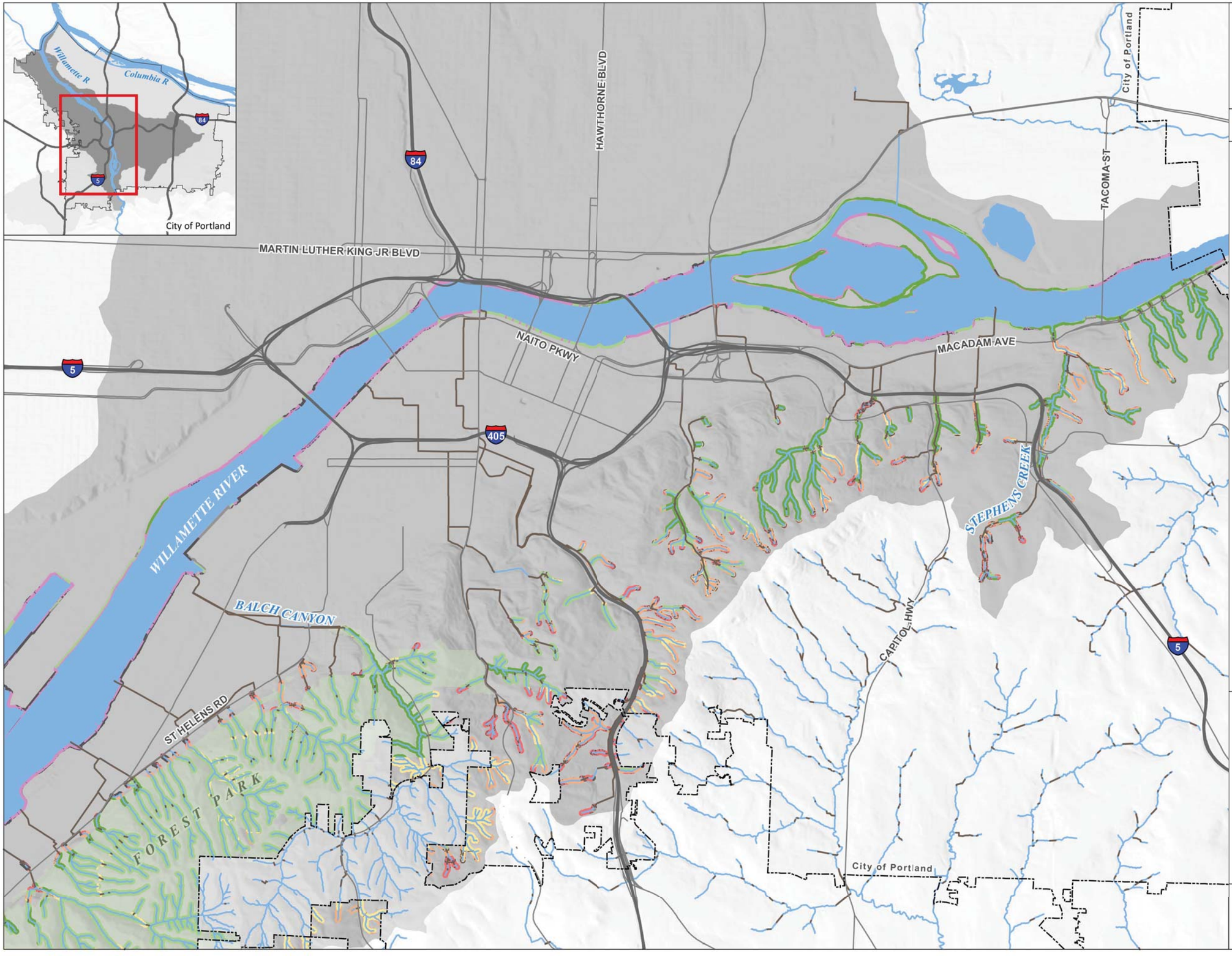


FIGURE 4A-2
Willamette Subwatershed Riparian Corridor

TMDL IMPLEMENTATION PLAN - MARCH 2019

Piped Watercourse | Watercourse | Park

RIPARIAN CORRIDOR IN SUBWATERSHED BY CATEGORY

Acres	Key	%	Riparian Category	Acres	Key	%
70	MAINSTEM	13%	Impervious & Private	74	TRIBUTARIES	3%
				5		0.2%
				134		5%
22		4%	Impervious & Public	299		10%
			No E-zone & Private			
			C-zone & Private			
			P-zone & Private	277		10%
226		43%	River E-zone			
				1747		60%
108		21%	Restoration Potential & Public			
99		19%	Revegetation Management Area	362		13%
524			Total Riparian Corridor	2,899		

riparian corridor based on 100-foot buffers along each bank

RIPARIAN CORRIDOR BY SUBWATERSHED AS PERCENT OF CITY TOTAL

Willamette Tributaries	38%
Columbia Slough	20%
Johnson Creek	13%
Fanno Creek	8%
Tryon Creek	7%
Willamette Mainstem	7%
Rock Creek (Tualatin)	6%

N

0 1,600 3,200 Feet

1: 38,400
1 in = 3,200 feet

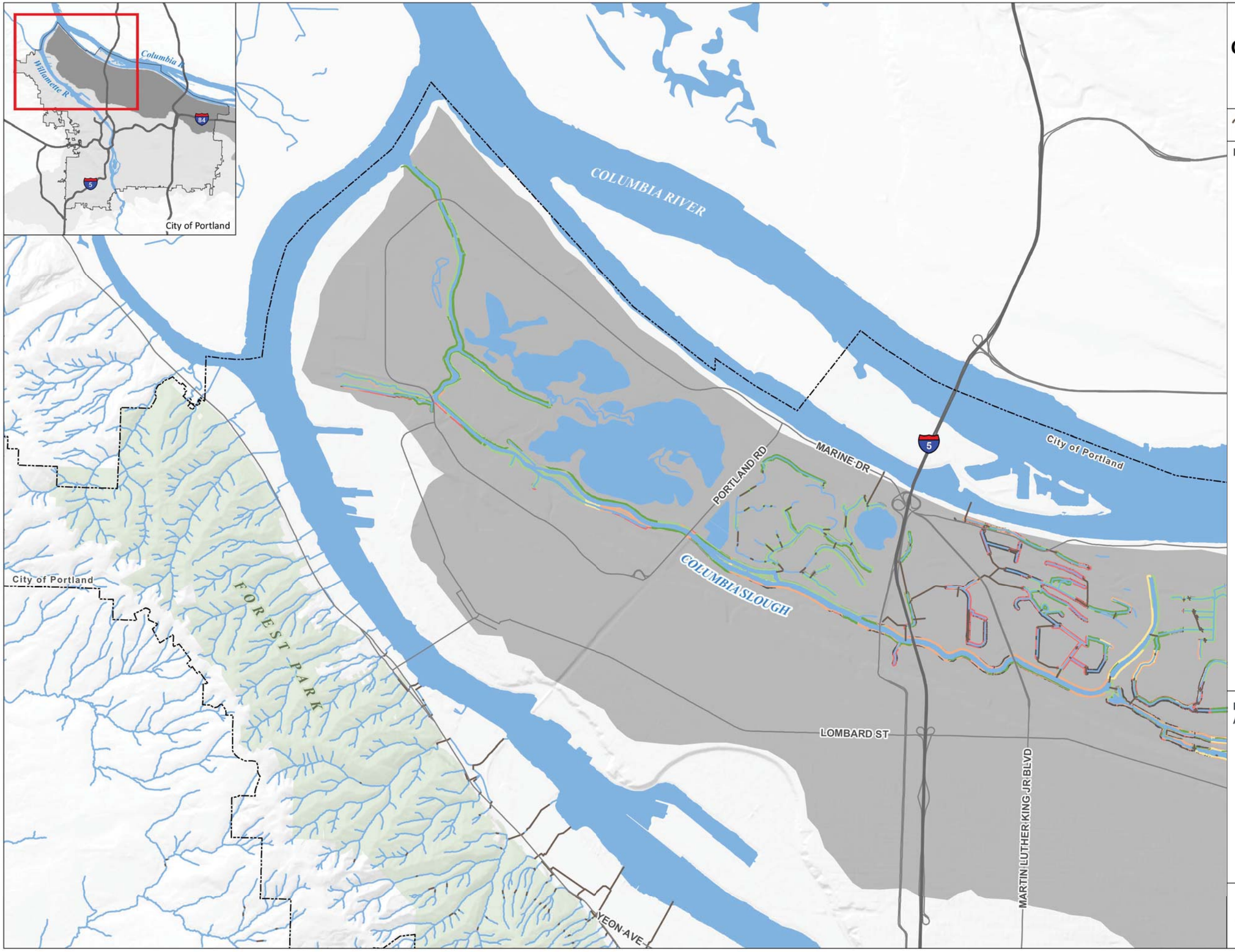


FIGURE 4B-1
Columbia Slough Subwatershed Riparian Corridor

TMDL IMPLEMENTATION PLAN - MARCH 2019

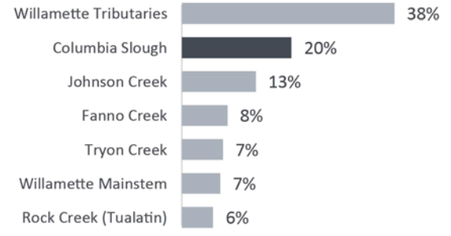
Piped Watercourse | Watercourse | Park

RIPARIAN CORRIDOR IN SUBWATERSHED BY CATEGORY

Riparian Category	Acres	Key	%
Impervious & Private	176		12%
Impervious & Public	37		3%
No E-zone & Private	134		9%
C-zone & Private	180		12%
P-zone & Private	115		8%
Restoration Potential & Public	435		29%
Revegetation Management Area	417		28%
Total Riparian Corridor	1,495		

riparian corridor based on 100-foot buffers along each bank

RIPARIAN CORRIDOR BY SUBWATERSHED AS PERCENT OF CITY TOTAL



N

0 2,000 4,000 Feet

1: 48,000
1 in = 4,000 feet

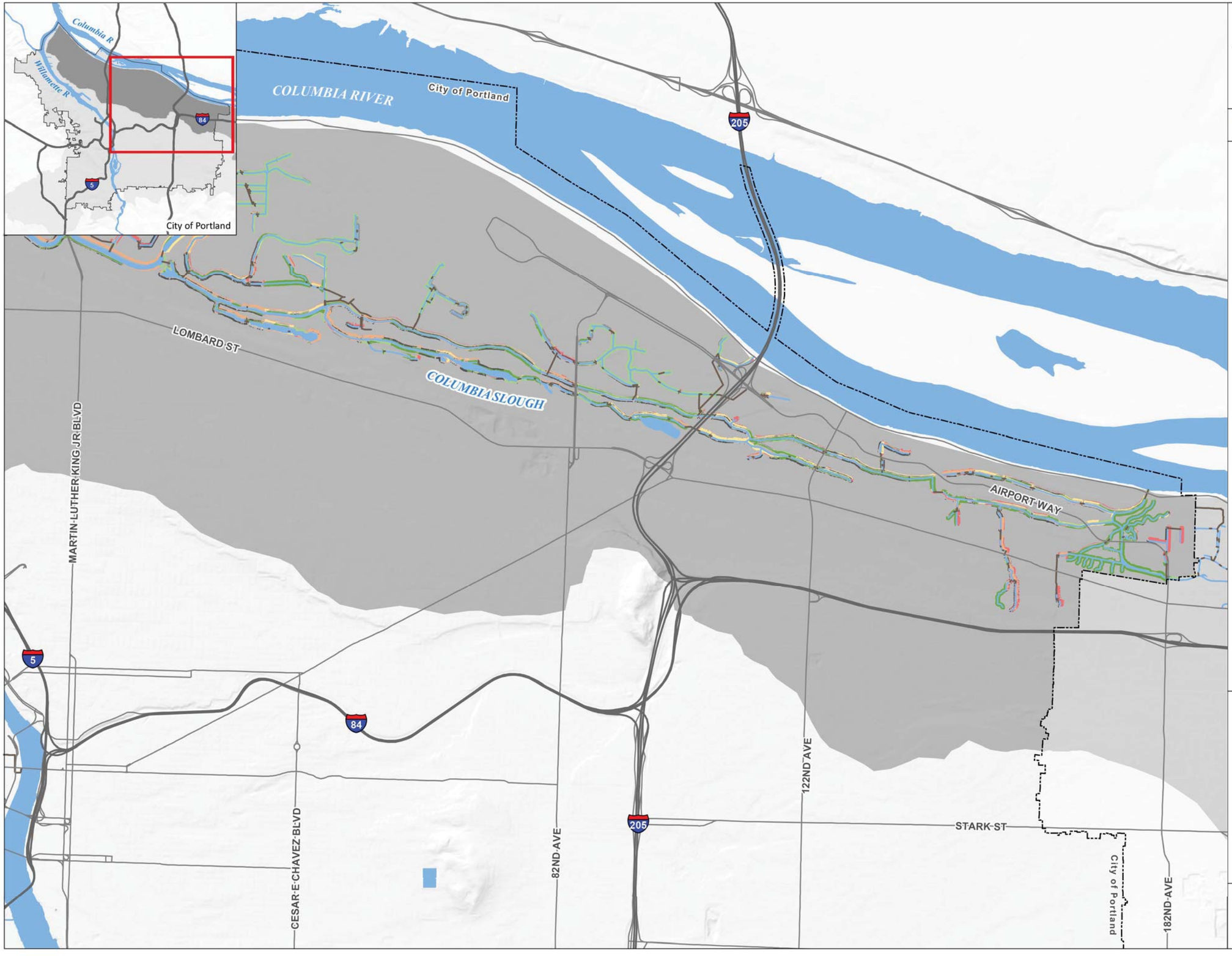


FIGURE 4B-2
Columbia Slough Subwatershed Riparian Corridor

TMDL IMPLEMENTATION PLAN - MARCH 2019

Piped Watercourse | Watercourse | Park

RIPARIAN CORRIDOR IN SUBWATERSHED BY CATEGORY

Riparian Category	Acres	Key	%
Impervious & Private	176		12%
Impervious & Public	37		3%
No E-zone & Private	134		9%
C-zone & Private	180		12%
P-zone & Private	115		8%
Restoration Potential & Public	435		29%
Revegetation Management Area	417		28%
Total Riparian Corridor	1,495		

riparian corridor based on 100-foot buffers along each bank

RIPARIAN CORRIDOR BY SUBWATERSHED AS PERCENT OF CITY TOTAL

Willamette Tributaries	38%
Columbia Slough	20%
Johnson Creek	13%
Fanno Creek	8%
Tryon Creek	7%
Willamette Mainstem	7%
Rock Creek (Tualatin)	6%

N

0 2,000 4,000 Feet

1: 48,000
1 in = 4,000 feet

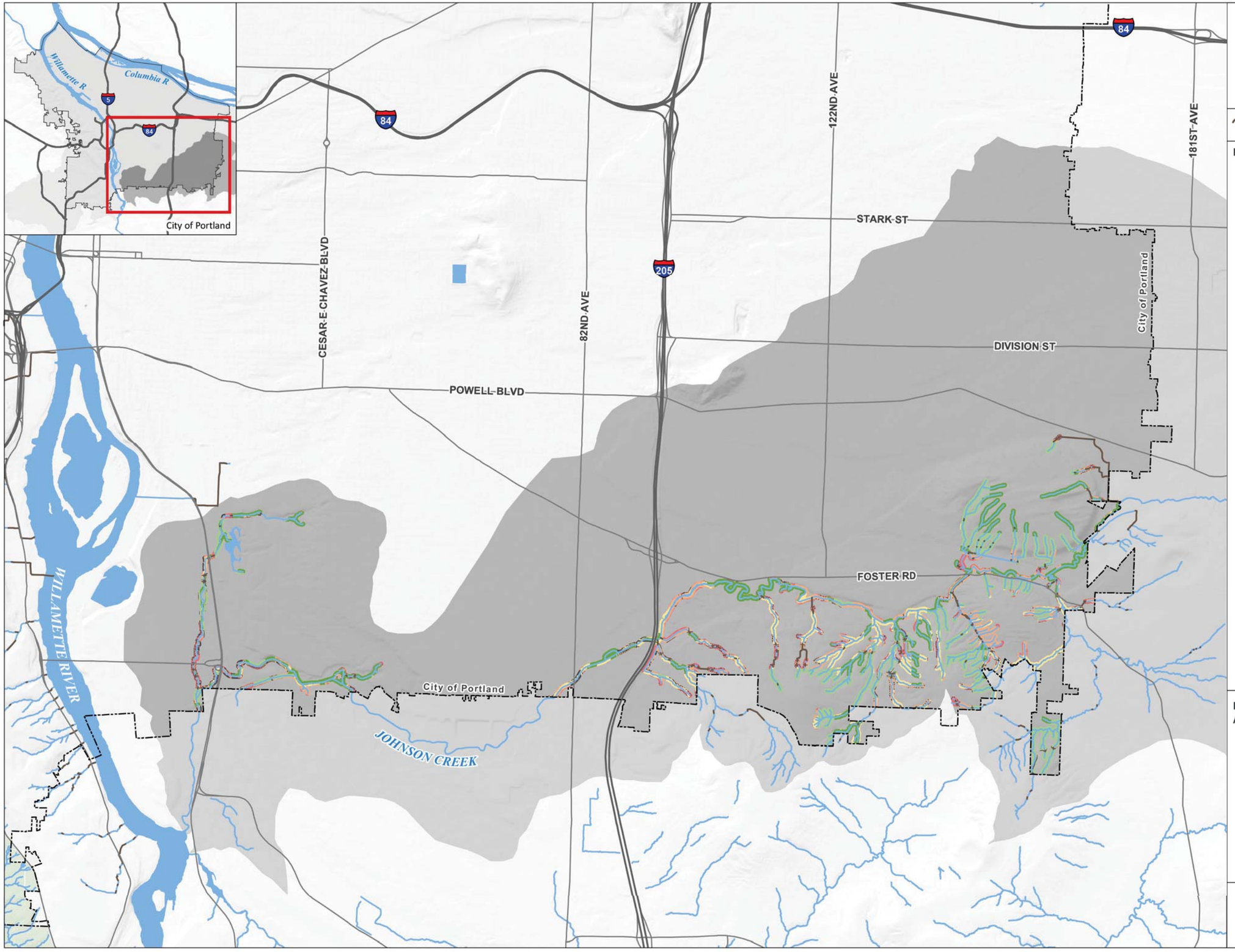


FIGURE 4C
Johnson Creek Subwatershed Riparian Corridor

TMDL IMPLEMENTATION PLAN - MARCH 2019

Piped Watercourse | Watercourse | Park

RIPARIAN CORRIDOR IN SUBWATERSHED BY CATEGORY

Riparian Category	Acres	Key	%
Impervious & Private	59		6%
Impervious & Public	2		0.2%
No E-zone & Private	66		6%
C-zone & Private	136		14%
P-zone & Private	165		16%
Restoration Potential & Public	301		30%
Revegetation Management Area	280		28%
Total Riparian Corridor	1,009		

riparian corridor based on 100-foot buffers along each bank

RIPARIAN CORRIDOR BY SUBWATERSHED AS PERCENT OF CITY TOTAL

Willamette Tributaries	38%
Columbia Slough	20%
Johnson Creek	13%
Fanno Creek	8%
Tryon Creek	7%
Willamette Mainstem	7%
Rock Creek (Tualatin)	6%

N

0 2,000 4,000 Feet

1: 48,000
1 in = 4,000 feet

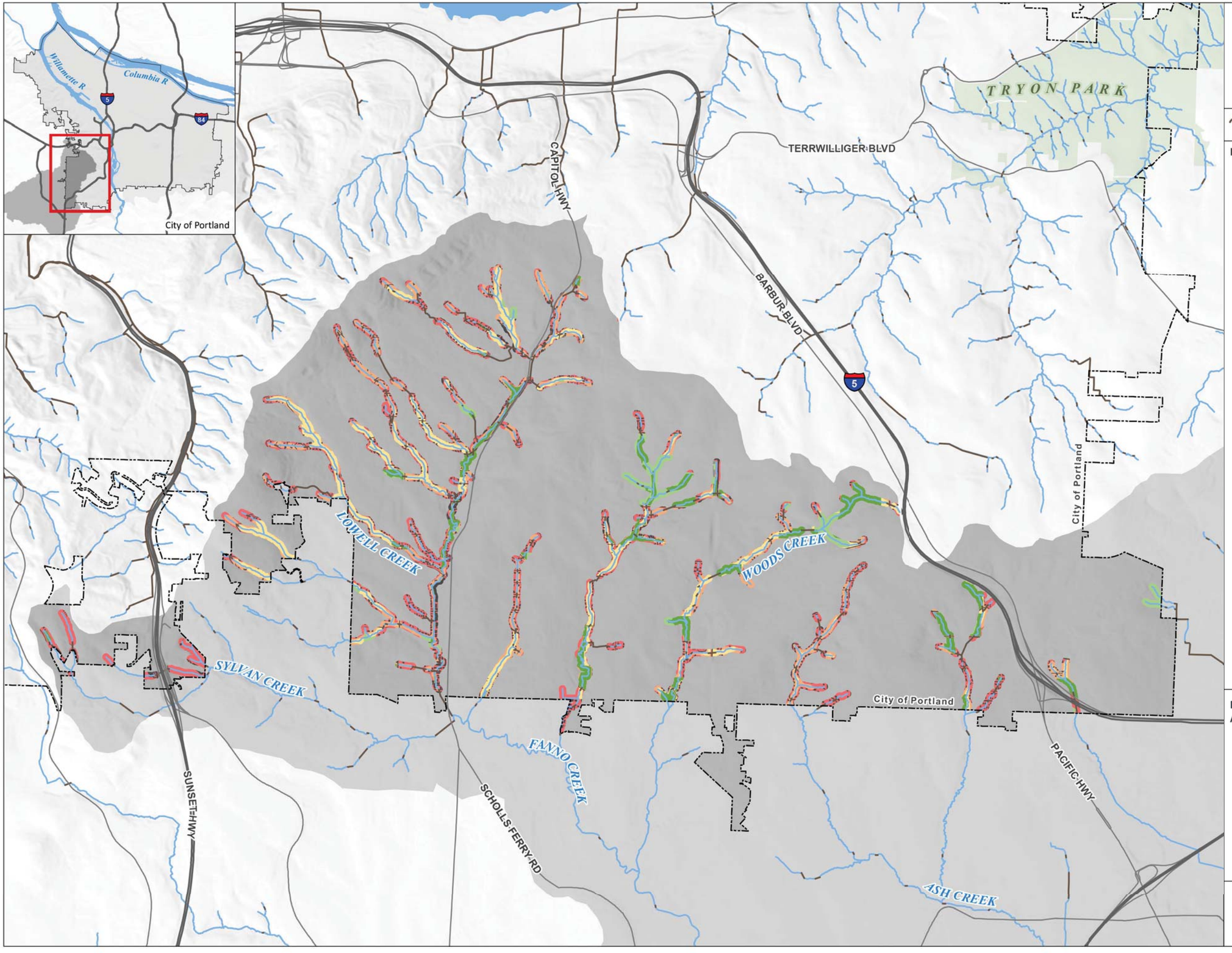


FIGURE 4D
Fanno Creek Subwatershed Riparian Corridor

TMDL IMPLEMENTATION PLAN - MARCH 2019

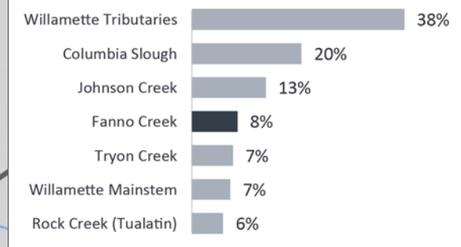
Piped Watercourse | Watercourse | Park

RIPARIAN CORRIDOR IN SUBWATERSHED BY CATEGORY

Riparian Category	Acres	Key	%
Impervious & Private	81		13%
Impervious & Public	1		0.2%
No E-zone & Private	157		25%
C-zone & Private	109		18%
P-zone & Private	133		21%
Restoration Potential & Public	39		6%
Revegetation Management Area	102		16%
Total Riparian Corridor	622		

riparian corridor based on 100-foot buffers along each bank

RIPARIAN CORRIDOR BY SUBWATERSHED AS PERCENT OF CITY TOTAL



N

0 1,250 2,500 Feet

1: 30,000
1 in = 2,500 feet

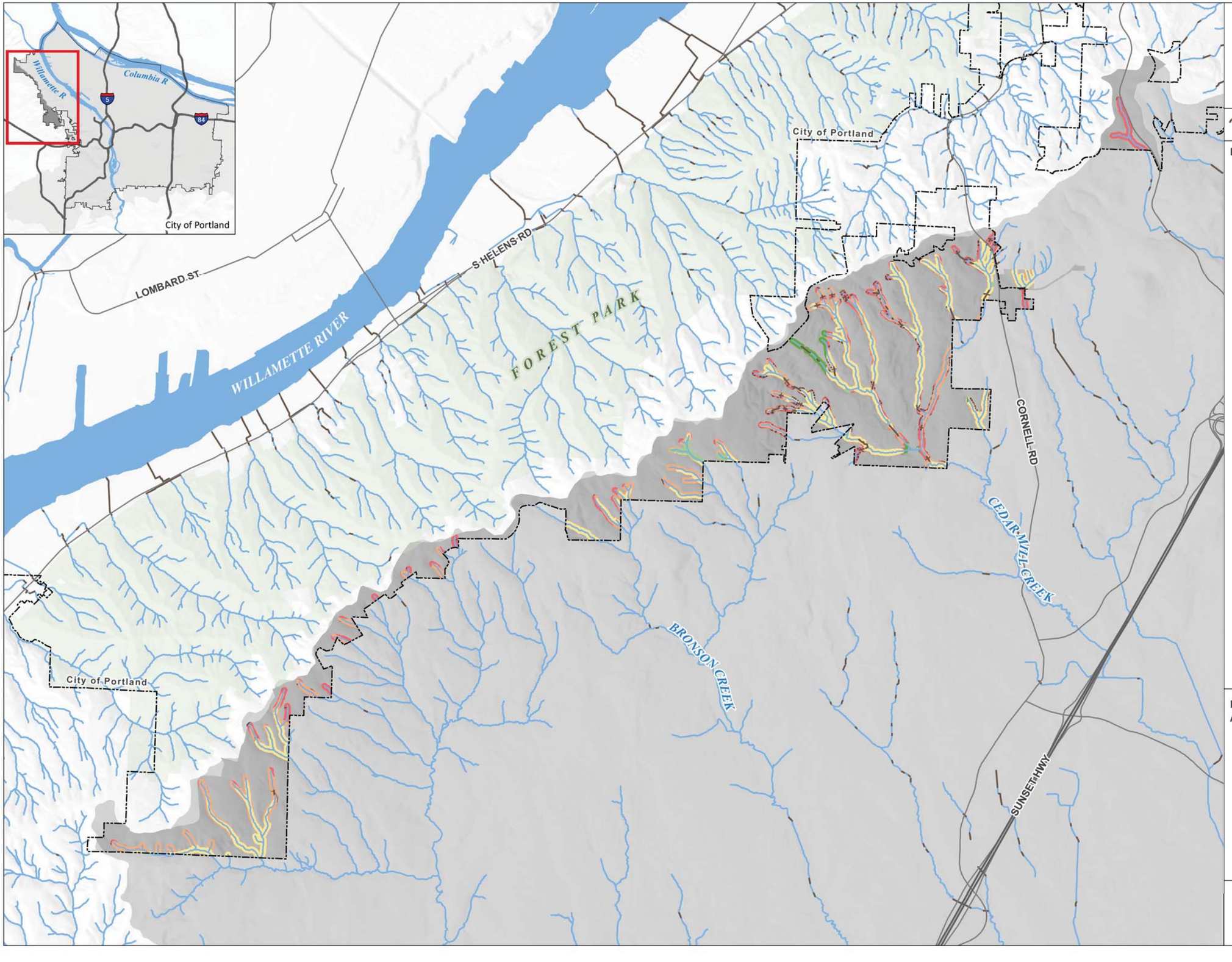


FIGURE 4E
Rock Creek Subwatershed Riparian Corridor

TMDL IMPLEMENTATION PLAN - MARCH 2019

Piped Watercourse | Watercourse | Park

RIPARIAN CORRIDOR IN SUBWATERSHED BY CATEGORY

Riparian Category	Acres	Key	%
Impervious & Private	15		3%
No E-zone & Private	68		16%
C-zone & Private	115		27%
P-zone & Private	205		48%
Restoration Potential & Public	8		2%
Revegetation Management Area	13		3%
Total Riparian Corridor	425		

riparian corridor based on 100-foot buffers along each bank

RIPARIAN CORRIDOR BY SUBWATERSHED AS PERCENT OF CITY TOTAL

Willamette Tributaries	38%
Columbia Slough	20%
Johnson Creek	13%
Fanno Creek	8%
Tryon Creek	7%
Willamette Mainstem	7%
Rock Creek (Tualatin)	6%

N

0 1,500 3,000 Feet

1: 36,000
1 in = 3,000 feet

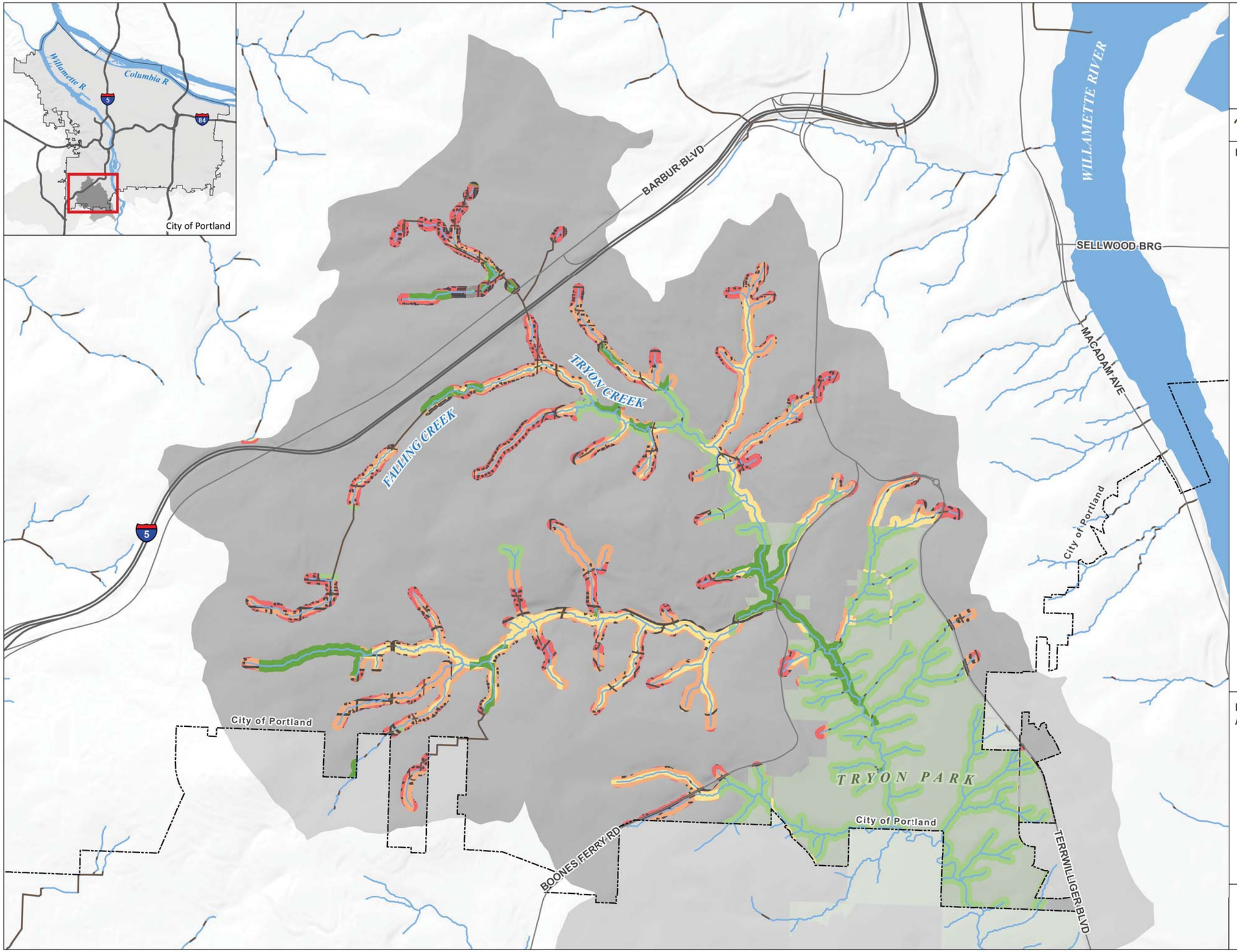


FIGURE 4F

Tryon Creek Subwatershed Riparian Corridor

TMDL IMPLEMENTATION PLAN - MARCH 2019

Piped Watercourse | Watercourse | Park

RIPARIAN CORRIDOR IN SUBWATERSHED BY CATEGORY

Riparian Category	Acres	Key	%
Impervious & Private	49		9%
Impervious & Public	1		0.1%
No E-zone & Private	65		12%
C-zone & Private	121		28%
P-zone & Private	76		14%
Restoration Potential & Public	195		35%
Revegetation Management Area	53		9%
Total Riparian Corridor	561		

riparian corridor based on 100-foot buffers along each bank

RIPARIAN CORRIDOR BY SUBWATERSHED AS PERCENT OF CITY TOTAL

Willamette Tributaries	38%
Columbia Slough	20%
Johnson Creek	13%
Fanno Creek	8%
Tryon Creek	7%
Willamette Mainstem	7%
Rock Creek (Tualatin)	6%

N

0 800 1,600 Feet

1: 19,200
1 in = 1,600 feet

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Table 1. Portland TMDLs

Basin	TMDL Subbasins *Applicable to Portland*	Date	Pollutant	TMDL Season	Surrogate[a]
Columbia River[b]	Lower Columbia River	1991	Dioxin	Annual	
	N/A	2002	Total dissolved gas (TDG)	Annual	
Columbia Slough[c]	Columbia Slough	1998	DDT/DDE	Annual	
			Dieldrin	Annual	
			Dioxin	Annual	
			PCBs	Annual	
			Lead, dissolved	Annual	
			Phosphorus	Spring through Fall	
			Dissolved oxygen	Annual	BOD_5
			pH	Spring through Fall	Phosphorus
			Chlorophyll a	Spring through Fall	Phosphorus
			Bacteria	Annual	E. coli
Willamette Basin[c]	Lower Willamette *All tributaries not otherwise specified*	2006	Mercury[e]	TBD	TBD
			Temperature	Annual	Effective shade
			Bacteria	Annual	E.coli
	Columbia Slough	2006	Temperature	Annual	Effective shade
	Johnson Creek	2006	DDT	Annual	
			Dieldrin	Annual	
			Bacteria	Annual	E. coli
			Temperature	Annual	Effective shade
	Tryon Creek	2006	Temperature	Annual	Effective shade
	Springbrook Creek	2006	Bacteria	Annual	E.coli
Tualatin Subbasin[d]	Fanno Creek	2001	Temperature	Annual	Effective shade
			Bacteria	Seasonal storm	E. coli
			Chlorophyll a	Summer	Phosphorus
			pH	Summer	Phosphorus
			Dissolved oxygen	Summer	TSS[f]
	Rock Creek	2001	Temperature	Annual	Effective shade
			Bacteria	Seasonal storm	E. coli
			Chlorophyll a	Summer	Phosphorus
			pH	Summer	Phosphorus
			Dissolved oxygen	Summer	TSS[f]

a. Pollutant surrogates are identified in a TMDL as alternative targets for meeting the TMDLs for certain pollutants. Additional surrogates are used by the City but were not specifically identified in the TMDL documents (e.g., TSS is used by the City as a surrogate for DDT/DDE, dieldrin, dioxin, and PCBs).

b. There is a Columbia River TMDL for dioxin, but it does not include WLAs or LAs for Portland. Urban areas are included in an allocation type referred to as "reserved." The only WLA is for pulp and paper mills. For total dissolved gas, only four dams (not under Portland's jurisdiction) are listed as sources.

c. The Willamette Basin TMDL includes the Columbia Slough subbasin for temperature and mercury only. Per the 2006 Willamette Basin TMDL, p. 5-13, "the 1998 TMDL established for the Slough remains in effect." Mercury, temperature and bacteria apply to all tributaries in the Lower Willamette basin. The Columbia Slough, Johnson Creek, Tryon Creek and Springbrook Creek (all of which are in the Lower Willamette Basin) are listed separately because they have unique WLAs and/or they have additional TMDL parameters.

d. The Tualatin TMDL was originally released in 2001 but was amended in 2012 to reflect further refinement of wastewater treatment plant limits. The Tualatin River is covered in the Willamette River TMDL for mercury.

e. The mercury TMDL is a phased TMDL that applies to all of the Lower Willamette and tributaries. Reduction targets were set in 2006, but LAs and WLAs were not established. WLAs are scheduled for 2019.

f. TSS is a surrogate for settleable volatile solids (SVS), which in turn, is a surrogate for dissolved oxygen.

Table 2. TMDL Nonpoint Pollutant Sources			
Pollutant Category	**Parameter**	**Sources**	**Potential Issues**
Bacteria	E. coli	• Animal wastes (droppings from wild and domestic animals) • Human wastes (incidental or leaking sewage, homeless camps, seepage from septic tanks)	E. coli are a commonly used indicator for pathogens. Water contact may cause eye and skin irritations and gastrointestinal diseases if swallowed.
Heavy metals	Dissolved lead	• Lead-based paints • Leaded gasoline • Vehicles (improper disposal of car batteries, wear/tear of body and brakes) • Metal corrosion • Manufacturing and other specific industrial sources such as scrap metal yards	Heavy metals are toxic to freshwater aquatic ecosystems. Some can bioaccumulate in fish, which poses a risk to those whose diets include regular consumption.
	Mercury	• Sediment (from resuspension and native soil erosion) • Atmospheric deposition (from both local and far-field sources)	
Nutrients	Phosphorus *(as cause for low dissolved oxygen, high pH, and high chlorophyll a)*	• Landscaping activities (i.e., fertilizer) and yard debris • Eroded topsoil • Human waste (leaks from septic tanks and sanitary sewers) • Animal wastes • Agricultural activities (i.e., fertilizer) • Detergents (car washing) • Food processing	Elevated phosphorus loads can cause excess aquatic plant growth, surface algal scums, dense mats of algae, reduced oxygen levels, elevated pH levels, potentially toxic blue-green algae blooms, taste and odor problems, and reduced aesthetic quality of water bodies.
Sediment & Solids	Total suspended Solids (TSS) *(surrogate for metals, dissolved oxygen, toxics, and settleable volatile solids)*	• Channel erosion from increased stream flows • Construction site runoff • Landscaping activities • Agricultural or hobby farm activities • Other activities where the ground surface is disturbed	Heavy metals and toxic organic compounds have low solubility in water and are typically associated with suspended solids. TSS is used as a surrogate for volatile suspended solids, which indicates a sediment oxygen demand resulting in reduced dissolved oxygen.
Toxic organic compounds	• DDT/DDE • Dieldrin • Dioxin • PCBs	• Spills and illegal dumping • Illicit connections • Leaks from drums and storage tanks • Stockpiling and storage of contaminated materials (e.g., old transformers) • Pest control • Aerial deposition • Manufacturing by-products (PCBs) • Contaminated soil • Agricultural activities (DDT and dieldrin/aldrin on crops)	These TMDL parameters are toxic to aquatic life at very low concentrations and can bioaccumulate to high concentrations.

Table 2. TMDL Nonpoint Pollutant Sources			
Pollutant Category	**Parameter**	**Sources**	**Potential Issues**
Biochemical Oxygen Demand (BOD)	Dissolved oxygen	• De-icers • Plant debris • Animal waste • Trash • Fertilizers	High BOD indicates greater oxygen depletion which can negatively affect aquatic life.
Temperature	Temperature	• Reduced groundwater recharge causing low summer flows • Reduced riparian shading (e.g., excessive inputs of solar radiation) • Point source discharges with elevated temperatures • Reservoir and dam operations	Elevated temperatures can directly harm aquatic organisms and reduce dissolved oxygen concentrations.

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Table 3. Management Strategies to Address TMDL Pollutants

ID	Management Strategy	MS4 Strategy	POLLUTANTS ADDRESSED							BMPS ADDRESSED								Performance Monitoring Metric(s)	Implementation Timeline
			Bacteria	Heavy Metals	Nutrients	Toxic Organic Compounds	Sediment / Solids	BOD	Temperature	Education & Outreach	Operations & Maintenance	Pollution Prevention	Illicit Discharge Detection & Elimination	New Development	Natural Systems	Structural Controls	Monitoringw		
Education & Outreach																			
EO1	Clean Rivers Education Programs. Provide water quality classroom and field science education programs for K - 12 students.	●	💧	💧	💧	💧	💧			●		●						Number of students and/or number of programs engaged annually.	Ongoing
EO2	Outreach & Social Media. Educate the public about stormwater and surface water quality, pollution prevention, and riparian and wetland protection via the web, blogs, mailings, and social media.	●	💧	💧	💧	💧	💧	💧		●		●	●		●			Number of mailings, website hits, postings, etc.	Ongoing
EO3	Watershed Education & Stewardship. Support and conduct watershed-specific public education and stewardship activities, events, workshops and restoration projects.	●	💧	💧	💧	💧	💧	💧	💧	●		●			●			Number of participants and/or volunteers engaged annually.	Ongoing
EO4	Citywide Education & Stewardship. Conduct public education and stewardship activities focused on urban trees, green streets and vegetation citywide.	●	💧	💧	💧	💧	💧	💧	💧	●	●	●			●			Number of participants and/or volunteers engaged annually.	Ongoing
EO5	Pet Waste Management. Promote and facilitate proper disposal of pet waste in City parks and site dog parks away from waterways.	●	💧		💧			💧		●		●			●			Confirm program continuation and/or provide status updates.	Ongoing
EO6	Alternative Transportation. Promote carpooling, public transportation and alternative commuting strategies to reduce emissions with toxic pollutants and support climate action.	●		💧		💧				●		●						Confirm program continuation and/or provide status updates.	Ongoing
EO7	Regional Education. Support and participate in education and outreach programs with regional partners and jurisdictions.	●	💧	💧	💧	💧	💧	💧	💧	●		●	●		●			Provide status updates.	Ongoing
EO8	Community Stewardship Grants. Distribute grant monies to citizens and organizations to engage watershed protection projects and promote public involvement.	●	💧	💧	💧	💧	💧	💧	💧	●		●			●			Dollars awarded annually.	Ongoing
EO9	Public Involvement in TMDL Program. Post the TMDL Implementation Plan and annual reports on the City website.		💧	💧	💧	💧	💧	💧	💧	●								Post annually by Nov. 1.	Ongoing
Operations & Maintenance																			
OM1	City Stormwater System O&M. Conduct condition assessment activities and maintain and repair City stormwater collection, conveyance, and treatment systems.	●	💧	💧	💧	💧	💧	💧			●	●				●	●	Number or % of assets inspected, maintained and/or cleaned annually.	Ongoing
OM2	Stormwater O&M Practices. Review stormwater O&M practices, procedures and manual(s) and update as necessary.	●	💧	💧	💧	💧	💧	💧			●	●				●		Evaluate and/or update the BES Stormwater O&M Manual.	Once during next MS4 permit term
OM3	City Stormwater System Inventory & Mapping. Maintain and update systems to track and map City stormwater conveyance and treatment assets.	●	💧	💧	💧	💧	💧	💧	💧		●					●		Number and type of assets in inventory.	Ongoing
OM4	Stormwater System Planning. Implement a Stormwater System Plan to assess system risks related to capacity, condition, service needs, water quality and stream impacts.	●	💧	💧	💧	💧	💧	💧	💧		●	●				●	●	Provide status updates.	Ongoing
OM5	Private Stormwater Facilities O&M. Conduct inspection and technical assistance activities of privately-owned stormwater management and treatment facilities.	●	💧	💧	💧	💧	💧	💧		●	●	●		●		●		Number of facilities and/or properties inspected annually.	Ongoing
OM6	Street Cleaning and Debris Removal. Implement cleaning and/or debris removal activities on City streets to reduce the discharge of pollutants in stormwater.	●	💧	💧	💧	💧	💧	💧			●	●				●		Frequency of street sweeping, tons of leaf and debris removal, storm inlets cleaned annually.	Ongoing
OM7	Street Deicing. Implement City deicing practices that minimize environmental impacts as much as practicable during snow and ice events.	●						💧			●	●						Confirm program continuation and/or provide status updates.	Ongoing

Notes:
Items with MS4 Strategy checked are requirements of the City's MS4 Permit and/or associated Stormwater Management Plan.
Temperature strategies marked with an underlined raindrop 💧 are discussed in further detail in this TIP.

Table 3. Management Strategies to Address TMDL Pollutants

ID	Management Strategy	MS4 Strategy	POLLUTANTS ADDRESSED: Bacteria	Heavy Metals	Nutrients	Toxic Organic Compounds	Sediment / Solids	BOD	Temperature	BMPS ADDRESSED: Education & Outreach	Operations & Maintenance	Pollution Prevention	Illicit Discharge Detection & Elimination	New Development	Natural Systems	Structural Controls	Monitoringw	Performance Monitoring Metric(s)	Implementation Timeline
OM8	Employee Training. Provide employee training on operation, maintenance and construction practices to protect water quality.	●	💧	💧	💧	💧	💧	💧			●	●		●		●		Dates of employee training and/or number of employees trained.	Ongoing
OM9	Integrated Pest Management. Implement an Integrated Pest Management (IPM) program to minimize the use and application of fertilizers, herbicides, and pesticides in City parks and natural areas.	●		💧	💧	💧		💧			●	●			●			Confirm program continuation and/or provide status updates.	Ongoing
OM10	Sustainable City Fleet. Incorporate electric, hybrid, and fuel-efficient vehicles into the City's transportation fleet to reduce emissions with toxic pollutants and support climate action.	●		💧		💧					●	●						Confirm program continuation and/or provide status updates.	Ongoing
OM11	City Maintenance Facilities. Employ structural and non-structural BMPs at City maintenance facilities.	●	💧	💧	💧	💧	💧	💧			●	●				●		Confirm program continuation and/or provide status updates.	Ongoing
OM12	Salmon-Safe Certification. Engage City operations, maintenance and other property management practices to maintain citywide Salmon-Safe Certification.	●	💧	💧	💧	💧	💧	💧	💧		●	●				●		Confirm program continuation and/or provide status updates.	Ongoing
OM13	Water Conservation. Implement irrigation principles at City parks that conserve water, minimize runoff, increase infiltration, and optimize fertilizer use.	●			💧			💧	💧		●	●						Confirm program continuation and/or provide status updates.	Ongoing
Industrial Commercial Controls																			
IND1	Industrial and Commercial Stormwater. Implement a program to reduce and control pollutants in stormwater runoff from industrial and commercial facilities.	●	💧	💧	💧	💧	💧	💧		●	●	●	●			●		Number of facilities inspected annually.	Ongoing
IND2	Pollution Prevention Outreach (P2O). Support and participate in regional P2O efforts that promote business and public pollution prevention and mercury minimization practices.	●	💧	💧	💧	💧	💧	💧		●		●	●					Confirm program continuation and/or provide status updates.	Ongoing
IND3	Wellhead Protection. Support and provide technical assistance to businesses in the Columbia South Shore Wellhead Protection area to implement BMPs and prevent harmful releases to the well field.	●		💧	💧	💧	💧	💧		●		●	●					Confirm program continuation and/or provide status updates.	Ongoing
IND4	Pollution Source Control. Impose pollution control requirements for "high-risk" or pollutant-generating development activities.	●	💧	💧	💧	💧	💧	💧				●		●		●		Number of pollution measures required annually.	Ongoing
Illicit Discharge Controls																			
ILL1	Sewer Connections. Require new development or properties with non-conforming sanitary sewers to connect to the City sanitary sewer system if available.	●	💧		💧	💧		💧					●	●				Confirm program continuation and/or provide status updates.	Ongoing
ILL2	Sanitary Sewer Repair. Identify and repair sanitary sewer problems that cause seepage to the MS4 and surface waters.	●	💧		💧	💧		💧			●		●					Confirm program continuation and/or provide status updates.	Ongoing
ILL3	Illicit Discharge Detection & Elimination. Identify, investigate, enforce and eliminate illicit connections and discharges to the MS4.	●	💧	💧	💧	💧	💧	💧	💧				●					Number of spill hotline calls received and/or investigations performed, number or amount ($) of enforcement actions issued annually.	Ongoing
ILL4	Dry-Weather Field Screening. Conduct dry-weather field screening of MS4 outfall basins to identify and eliminate illicit discharges.	●	💧	💧	💧	💧	💧	💧	💧				●				●	Number and/or % of major and priority outfalls inspected, incidents identified and/or resolved.	Ongoing
ILL5	Portable Restrooms. Place portable restrooms at City parks for public and sporting events where necessary and near homeless encampements where possible and appropriate.	●	💧		💧			💧					●					Confirm program continuation and/or provide status updates.	Ongoing
ILL6	Curbside Collection Services. Implement solid waste and recycling programs to prevent illegal dumping of solid and liquid wastes.	●	💧	💧	💧	💧		💧		●			●					Confirm program continuation and/or provide status updates.	Ongoing

Notes:
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Temperature strategies marked with an underlined raindrop 💧 are discussed in further detail in this TIP.

Table 3. Management Strategies to Address TMDL Pollutants

ID	Management Strategy	MS4 Strategy	POLLUTANTS ADDRESSED: Bacteria	Heavy Metals	Nutrients	Toxic Organic Compounds	Sediment / Solids	BOD	Temperature	BMPS ADDRESSED: Education & Outreach	Operations & Maintenance	Pollution Prevention	Illicit Discharge Detection & Elimination	New Development	Natural Systems	Structural Controls	Monitoringw	Performance Monitoring Metric(s)	Implementation Timeline
New Development																			
ND1	Construction Runoff Control Program. Implement erosion and sediment control plan review, technical assistance and site inspections for ground-disturbing activities.	●	💧	💧	💧	💧	💧	💧		●		●	●	●				Number and/or % of active construction sites inspected.	Ongoing
ND2	Erosion Control Manual & Legal Authority. Maintain and update as needed the legal authority and guidance manual requiring erosion and sediment controls for active development construction sites.	●	💧	💧	💧	💧	💧	💧		●		●	●	●				Evaluate and/or update the City Erosion & Sediment Control Manual.	Once during next MS4 permit term
ND3	Hillside & Slope Protection. Implement a hillside development protection code to minimize erosion and soil mass-wasting.	●	💧	💧	💧	💧	💧	💧						●	●			Confirm code implementation and provide status updates.	Ongoing
ND4	Post-Construction Runoff Control Program. Implement SWMM plan review, technical assistance and inspection activities for new and re-development projects to treat and control post-development stormwater runoff.	●	💧	💧	💧	💧	💧	💧						●		●		Number of permit reviews conducted and facilities constructed annually.	Ongoing
ND5	On-site Stormwater Retention. Require stormwater management practices for new and redevelopment that optimize on-site retention and target natural surface and predevelopment functions as much as practicable.	●	💧	💧	💧	💧	💧	💧	💧					●		●		Confirm program continuation and/or provide status updates.	Ongoing
ND6	Low Impact Development. Prioritize and promote the use of LID and Green Infrastructure techniques for new and redevelopment.	●	💧	💧	💧	💧	💧	💧	💧					●	●	●		Confirm program continuation and/or provide status updates.	Ongoing
ND7	Green Streets. Promote and incorporate the use of green street facilities in public and private development.	●	💧	💧	💧	💧	💧	💧						●		●		Number of green streets in inventory.	Ongoing
ND8	Stormwater Management Manual & Legal Authority. Maintain and update as needed the legal authority and manual requiring post-construction runoff controls from new and re-development.	●	💧	💧	💧	💧	💧	💧			●			●	●	●		Evaluate and update the City's Storm Water Management Manual.	Once during next MS4 permit term
Ecosystems																			
ECO1	Floodplain Protection. Implement and maintain as needed the legal authority to protect floodways and floodplains.	●			💧		💧		💧					●	●			Confirm code implementation and provide status updates.	Ongoing
ECO2	Riparian & Wetland Protection. Implement programs to protect riparian buffers and corridors, headwaters, natural springs, wetlands, and native vegetation.	●			💧		💧	💧	💧					●	●			Confirm program implementation and provide status updates.	Ongoing
ECO3	Riparian Revegetation. Restore riparian corridors by removing invasive species and planting native trees and shrubs.	●			💧		💧		💧						●			Number of plantings and/or acreage planted or treated annually.	Ongoing
ECO4	Invasive Species Management & Treatment. Implement invasive species assessment, removal, treatment and management programs to restore hydrologic and ecological functions to riparian and upland areas.	●			💧				💧	●					●			Number of plantings and/or acreage planted or treated annually.	Ongoing
ECO5	Tree Protection. Implement and maintain as needed the legal authority for tree preservation to provide stormwater benefits and mitigate urban heat-island effects.	●			💧		💧	💧	💧						●			Confirm code implementation and provide status updates.	Ongoing
ECO6	Upland Tree Planting. Implement and support upland and street tree planting programs to expand the City's urban forest canopy.	●			💧				💧	●					●			Number of trees planted and/or incentives provided annually.	Ongoing
ECO7	Restoration & Planting Partnerships. Support and coordinate with volunteers, non-profits and community partners to engage tree planting and natural area restoration activities.	●			💧				💧	●					●			Number of events and/or acreage plantings annually.	Ongoing

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Table 3. Management Strategies to Address TMDL Pollutants

ID	Management Strategy	MS4 Strategy	POLLUTANTS ADDRESSED							BMPS ADDRESSED								Performance Monitoring Metric(s)	Implementation Timeline
			Bacteria	Heavy Metals	Nutrients	Toxic Organic Compounds	Sediment / Solids	BOD	Temperature	Education & Outreach	Operations & Maintenance	Pollution Prevention	Illicit Discharge Detection & Elimination	New Development	Natural Systems	Structural Controls	Monitoringw		
ECO8	Hydrologic Connectivity. Restore and protect hydrologic functions and floodplain connectivity through land-acquisition, culvert replacement, and supporting projects.	●			💧		💧		💧						●	●		Number of acres acquired, number of projects planned, designed, and/or constructed.	Ongoing
ECO9	Stream, Floodplain, & Wetland Restoration. Enhance watershed ecosystem functions through stream and wetland restoration projects.	●			💧		💧		💧						●	●	●	Number of acres acquired, number of projects planned, designed, and/or constructed.	Ongoing
ECO10	Cold Water Refugia. Identify and protect cold water refugia.							💧	💧						●		●	Number of acres acquired, number of projects planned, designed, and/or constructed.	Ongoing
ECO11	Natural Resource Inventory. Use and support updates to the NRI to protect riparian and wildlife corridors and inform zoning and planning activities.	●	💧		💧				💧						●			Evaluate and/or update the NRI.	Once during 5-year TIP cycle
ECO12	Climate Change Planning. Implement and maintain as needed the Climate Action Plan and supporting strategies to reduce local carbon emissions and build resilience to the projected impacts of climate change.	●							💧	●				●	●			Confirm plan implementation and/or provide status updates.	Ongoing
Retrofits																			
RF1	City Stormwater System Retrofits. Design and construct treatment and green infrastructure retrofits to the City's storm drainage system.	●	💧	💧	💧	💧	💧	💧								●		Project design and construction status updates.	During next MS4 permit term
RF2	Stormwater System Planning Retrofit Priorities. Prioritize treatment and green infrastructure retrofit projects based on identified water quality risks and asset management planning.	●	💧	💧	💧	💧	💧	💧								●		Confirm plan implementation and/or provide status updates.	Ongoing
RF3	Retrofit Funding Mechanisms. Implement "% for Green" and payment-in-lieu activities to fund green street and water quality retrofit projects.	●	💧	💧	💧	💧	💧	💧								●		Confirm program continuation and/or provide status updates.	Ongoing
RF4	Property Retrofits. Provide technical assistance, incentives, and grants to encourage onsite private property retrofits and water quality improvements for existing development.	●	💧	💧	💧	💧	💧	💧								●		Number of site projects and/or registrations annually.	Ongoing
Program Management																			
PM1	Annual Reporting. Develop an annual report by November 1 that summarizes the City's TMDL Implementation Plan activities and accomplishments.									●								Develop and submit report annually by Nov. 1.	Ongoing
Monitoring & Evaluation																			
MON1	Watershed Monitoring. Implement watershed monitoring activities to evaluate trends and assess progress toward meeting TMDLs.	●	💧	💧	💧	💧	💧	💧	💧								●	Evaluate and report monitoring results annually.	Ongoing
MON2	Effective Shade & Stream Habitat Assessment. Conduct effective shade evaluation and stream habitat surveys to inform current-state riparian conditions.								💧								●	Completed shade assessment. % habitat surveys complete.	Once during 5-year TIP cycle
MON3	Ecosystem Diagnosis & Treatment Analysis. Develop a model to evaluate the availability of existing stream habitat and restoration project benefits to support endangered salmonids.								💧								●	Completed EDT analysis.	Once during 5-year TIP cycle
MON4	Watershed Restoration Effectiveness Monitoring. Collect data to evaluate restoration projects relative to site-specific and City-wide restoration targets.								💧								●	Confirm implementation and/or provide status updates.	Ongoing
MON5	Time-series Monitoring. Evaluate time-series data collected from Columbia Slough water quality data loggers to assess status and trends and to inform adaptive management of the monitoring effort.							💧	💧								●	Evaluate data and document conclusions and recommendations.	Once during 5-year TIP cycle

Notes:
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Temperature strategies marked with an underlined raindrop 💧 are discussed in further detail in this TIP.

Table 4. Goals and Targets for Temperature TMDL Strategies				
Goal ID	**Category**	**Target/Description**	**Timeline**	**Performance Metrics**
TIP-01	Effective Shade Assessment	Conduct a geospatial assessment of riparian conditions within Portland and progress toward meeting the TMDL nonpoint source load allocations	Complete by 2021	Completed assessment
TIP-02	Stream Habitat Assessment	Conduct stream habitat surveys for all perennial streams identified as priorities in the Stormwater System Plan	Complete by 2021	Completed surveys
TIP-03	Ecosystem Diagnosis and Treatment Analysis	Generate an Ecosystem Diagnosis and Treatment (EDT) model for the Columbia Slough, Johnson Creek, and Tryon Creek areas of interest	Complete by 2020	Completed model
TIP-04	Floodplain, Riparian, and Wetland Protection	Complete the Environmental Overlay Zone Map Correction Project	Anticipate public hearings in 2020 and adoption in 2021	Updated Overlay Zone Map
TIP-05	Onsite Stormwater Retention and LID	Revise and update the Stormwater Management Manual	Within the next MS4 permit term	Updated SWMM
TIP-06	Invasive Species Management and Treatment	Perform management, assessment, and treatment of invasive species on 5,550 acres	By end of TIP cycle	Acres managed, assessed, and treated
TIP-07	Invasive Species Management and Treatment	Survey the Lower Columbia Slough for invasive aquatic macrophytes and treat where identified. Extent is 9.4 miles on center or 18.8 miles total along left and right banks	Annually for 80% or more of extent	Linear miles surveyed
TIP-08	Ecosystems	Develop an inventory of watershed restoration projects and track information such as cost, location, project goals, and outcomes	By end of TIP cycle	Completed inventory
TIP-09	Riparian Revegetation	Plant 100,000 trees and shrubs in natural and riparian areas	By end of TIP cycle	Plantings (#)
TIP-10	Land Acquisition	Acquire 50 acres of land for strategic restoration and protection of watershed hydrology*	By end of TIP cycle	Acres acquired (#)
TIP-11	Upland Tree Planting	Plant 7,500 upland trees during the plan term through partnerships with nonprofits, community members, businesses, and schools	By end of TIP cycle	Trees planted (#)

*Feasibility depends on willing sellers and real estate markets for land acquisition, landowner permissions, availability of funding, and the permitting process.

Table 4. Goals and Targets for Temperature TMDL Strategies				
Goal ID	**Category**	**Target/Description**	**Timeline**	**Performance Metrics**
TIP-12	Watershed Restoration Effectiveness Monitoring	Develop a comprehensive monitoring manual to support the City's stream and floodplain restoration projects	Complete by 2021	Completed manual
TIP-13	Coldwater Refugia	Evaluate and update an inventory and mapping of coldwater refugia in the lower Willamette River	By end of TIP cycle	Confirm program continuation and/or provide status updates
TIP-14	Hydrologic Connectivity (Watershed Restoration)	Implement five restoration projects that address canopy closure, enhancing refugia, heat source due to water impoundment, groundwater recharge, and/or protecting springs/coldwater sources*	By end of TIP cycle	Projects planned, designed, and/or constructed (#)

*Feasibility depends on willing sellers and real estate markets for land acquisition, landowner permissions, availability of funding, and the permitting process.

APPENDIX A

The tables provided in Appendix A – Reporting Matrices show the annual reporting format developed for use during the term of the TIP. Beginning with reporting for FY 2018-19, annual TMDL reports are integrated with the City's MS4 permit annual reports as an appendix. Combining the two types of reports allows for the many stormwater-related report elements to be presented in the MS4 report with the TMDL report referencing that material by the location in the MS4 report. The related reporting matrices are:

- Management Strategies to Address TMDL Pollutants
- Goals and Targets for Temperature TMDL Strategies
- Projects for Temperature Goal TIP-14 Hydrologic Connectivity (Watershed Restoration)

Management Strategies to Address TMDL Pollutants

ID	Management Strategy	Annual Report Reference
EO1	Clean Rivers Education Programs. Provide water quality classroom and field science education programs for K - 12 students.	MS4 Report: Section X.X
EO2	Outreach & Social Media. Educate the public about stormwater and surface water quality, pollution prevention, and riparian and wetland protection via the web, blogs, mailings, and social media.	MS4 Report: Section X.X
EO3	Watershed Education & Stewardship. Support and conduct watershed-specific public education and stewardship activities, events, workshops and restoration projects.	MS4 Report: Section X.X
EO4	Citywide Education & Stewardship. Conduct public education and stewardship activities focused on urban trees, green streets and vegetation citywide.	MS4 Report: Section X.X
EO5	Pet Waste Management. Promote and facilitate proper disposal of pet waste in City parks and site dog parks away from waterways.	MS4 Report: Section X.X
EO6	Alternative Transportation. Promote carpooling, public transportation and alternative commuting strategies to reduce emissions with toxic pollutants and support climate action.	MS4 Report: Section X.X
EO7	Regional Education. Support and participate in education and outreach programs with regional partners and jurisdictions.	MS4 Report: Section X.X
EO8	Community Stewardship Grants. Distribute grant monies to citizens and organizations to engage watershed protection projects and promote public involvement.	MS4 Report: Section X.X
EO9	Public Involvement in TMDL Program. Post the TMDL Implementation Plan and annual reports on the City website.	TMDL Report: Section X.X
OM1	City Stormwater System O&M. Conduct condition assessment activities and maintain and repair City stormwater collection, conveyance, and treatment systems.	MS4 Report: Section X.X
OM2	Stormwater O&M Practices. Review stormwater O&M practices, procedures and manual(s) and update as necessary.	MS4 Report: Section X.X
OM3	City Stormwater System Inventory & Mapping. Maintain and update systems to track and map City stormwater conveyance and treatment assets.	MS4 Report: Section X.X

Management Strategies to Address TMDL Pollutants		
ID	**Management Strategy**	**Annual Report Reference**
OM4	Stormwater System Planning. Implement a Stormwater System Plan to assess system risks related to capacity, condition, service needs, water quality and stream impacts.	MS4 Report: Section X.X
OM5	Private Stormwater Facilities O&M. Conduct inspection and technical assistance activities of privately-owned stormwater management and treatment facilities.	MS4 Report: Section X.X
OM6	Street Cleaning and Debris Removal. Implement cleaning and/or debris removal activities on City streets to reduce the discharge of pollutants in stormwater.	MS4 Report: Section X.X
OM7	Street Deicing. Implement City deicing practices that minimize environmental impacts as much as practicable during snow and ice events.	MS4 Report: Section X.X
OM8	Employee Training. Provide employee training on operation, maintenance and construction practices to protect water quality.	MS4 Report: Section X.X
OM9	Integrated Pest Management. Implement an Integrated Pest Management (IPM) program to minimize the use and application of fertilizers, herbicides, and pesticides in City parks and natural areas.	MS4 Report: Section X.X
OM10	Sustainable City Fleet. Incorporate electric, hybrid, and fuel-efficient vehicles into the City's transportation fleet to reduce emissions with toxic pollutants and support climate action.	MS4 Report: Section X.X
OM11	City Maintenance Facilities. Employ structural and non-structural BMPs at City maintenance facilities.	MS4 Report: Section X.X
OM12	Salmon-Safe Certification. Engage City operations, maintenance and other property management practices to maintain citywide Salmon-Safe Certification.	MS4 Report: Section X.X
OM13	Water Conservation. Implement irrigation principles at City parks that conserve water, minimize runoff, increase infiltration, and optimize fertilizer use.	MS4 Report: Section X.X
IND1	Industrial and Commercial Stormwater. Implement a program to reduce and control pollutants in stormwater runoff from industrial and commercial facilities.	MS4 Report: Section X.X
IND2	Pollution Prevention Outreach (P2O). Support and participate in regional P2O efforts that promote business and public pollution prevention and mercury minimization practices.	MS4 Report: Section X.X
IND3	Wellhead Protection. Support and provide technical assistance to businesses in the Columbia South Shore Wellhead Protection area to implement BMPs and prevent harmful releases to the well field.	MS4 Report: Section X.X
IND4	Pollution Source Control. Impose pollution control requirements for "high-risk" or pollutant- generating development activities.	MS4 Report: Section X.X
ILL1	Sewer Connections. Require new development or properties with non-conforming sanitary sewers to connect to the City sanitary sewer system if available.	MS4 Report: Section X.X
ILL2	Sanitary Sewer Repair. Identify and repair sanitary sewer problems that cause seepage to the MS4 and surface waters.	MS4 Report: Section X.X
ILL3	Illicit Discharge Detection & Elimination. Identify, investigate, enforce and eliminate illicit connections and discharges to the MS4.	MS4 Report: Section X.X

Management Strategies to Address TMDL Pollutants		
ID	**Management Strategy**	**Annual Report Reference**
ILL4	Dry-Weather Field Screening. Conduct dry-weather field screening of MS4 outfall basins to identify and eliminate illicit discharges.	MS4 Report: Section X.X
ILL5	Portable Restrooms. Place portable restrooms at City parks for public and sporting events where necessary and near homeless encampments where possible and appropriate.	MS4 Report: Section X.X
ILL6	Curbside Collection Services. Implement solid waste and recycling programs to prevent illegal dumping of solid and liquid wastes.	MS4 Report: Section X.X
ND1	Construction Runoff Control Program. Implement erosion and sediment control plan review, technical assistance and site inspections for ground-disturbing activities.	MS4 Report: Section X.X
ND2	Erosion Control Manual & Legal Authority. Maintain and update as needed the legal authority and guidance manual requiring erosion and sediment controls for active development construction sites.	MS4 Report: Section X.X
ND3	Hillside & Slope Protection. Implement a hillside development protection code to minimize erosion and soil mass-wasting.	MS4 Report: Section X.X
ND4	Post-Construction Runoff Control Program. Implement SWMM plan review, technical assistance and inspection activities for new and re-development projects to treat and control post-development stormwater runoff.	MS4 Report: Section X.X
ND5	On-site Stormwater Retention. Require stormwater management practices for new and redevelopment that optimize on-site retention and target natural surface and predevelopment functions as much as practicable.	MS4 Report: Section X.X
ND6	Low Impact Development. Prioritize and promote the use of LID and Green Infrastructure techniques for new and redevelopment.	MS4 Report: Section X.X
ND7	Green Streets. Promote and incorporate the use of green street facilities in public and private development.	MS4 Report: Section X.X
ND8	Stormwater Management Manual & Legal Authority. Maintain and update as needed the legal authority and manual requiring post-construction runoff controls from new and re-development.	MS4 Report: Section X.X
ECO1	Floodplain Protection. Implement and maintain as needed the legal authority to protect floodways and floodplains.	MS4 Report: Section X.X TMDL Report: Section X.X
ECO2	Riparian & Wetland Protection. Implement programs to protect riparian buffers and corridors, headwaters, natural springs, wetlands, and native vegetation.	MS4 Report: Section X.X TMDL Report: Section X.X
ECO3	Riparian Revegetation. Restore riparian corridors by removing invasive species and planting native trees and shrubs.	MS4 Report: Section X.X TMDL Report: Section X.X
ECO4	Invasive Species Management & Treatment. Implement invasive species assessment, removal, treatment and management programs to restore hydrologic and ecological functions to riparian and upland areas.	MS4 Report: Section X.X TMDL Report: Section X.X
ECO5	Tree Protection. Implement and maintain as needed the legal authority for tree preservation to provide stormwater benefits and mitigate urban heat-island effects.	MS4 Report: Section X.X
ECO6	Upland Tree Planting. Implement and support upland and street tree planting programs to expand the City's urban forest canopy.	MS4 Report: Section X.X TMDL Report: Section X.X

Management Strategies to Address TMDL Pollutants		
ID	**Management Strategy**	**Annual Report Reference**
ECO7	Restoration & Planting Partnerships. Support and coordinate with volunteers, non-profits and community partners to engage tree planting and natural area restoration activities.	MS4 Report: Section X.X TMDL Report: Section X.X
ECO8	Hydrologic Connectivity. Restore and protect hydrologic functions and floodplain connectivity through land-acquisition, culvert replacement, and supporting projects.	MS4 Report: Section X.X TMDL Report: Temperature Mgmt, Table X.X
ECO9	Stream, Floodplain, & Wetland Restoration. Enhance watershed ecosystem functions through stream and wetland restoration projects.	MS4 Report: Section X.X TMDL Report: Temperature Mgmt, Table X.X
ECO10	Cold Water Refugia. Identify and protect cold water refugia.	MS4 Report: Section X.X TMDL Report: Temperature Mgmt, Table X.X
ECO11	Natural Resource Inventory. Use and support updates to the NRI to protect riparian and wildlife corridors and inform zoning and planning activities.	MS4 Report: Section X.X
ECO12	Climate Change Planning. Implement and maintain as needed the Climate Action Plan and supporting strategies to reduce local carbon emissions and build resilience to the projected impacts of climate change.	MS4 Report: Section X.X
RF1	City Stormwater System Retrofits. Design and construct treatment and green infrastructure retrofits to the City's storm drainage system.	MS4 Report: Section X.X
RF2	Stormwater System Planning Retrofit Priorities. Prioritize treatment and green infrastructure retrofit projects based on identified water quality risks and asset management planning.	MS4 Report: Section X.X
RF3	Retrofit Funding Mechanisms. Implement "% for Green" and payment-in-lieu activities to fund green street and water quality retrofit projects.	MS4 Report: Section X.X
RF4	Property Retrofits. Provide technical assistance, incentives, and grants to encourage onsite private property retrofits and water quality improvements for existing development.	MS4 Report: Section X.X
PM1	Annual Reporting. Develop an annual report by November 1 that summarizes the City's TMDL Implementation Plan activities and accomplishments.	TMDL Report: Section X.X
MON1	Watershed Monitoring. Implement watershed monitoring activities to evaluate trends and assess progress toward meeting TMDLs.	Monitoring Report: Section X.X
MON2	Effective Shade & Stream Habitat Assessment. Conduct effective shade evaluation and stream habitat surveys to inform current-state riparian conditions.	TMDL Report: Temperature Mgmt, Table X.X
MON3	Ecosystem Diagnosis & Treatment Analysis. Develop a model to evaluate the availability of existing stream habitat and restoration project benefits to support endangered salmonids.	TMDL Report: Temperature Mgmt, Table X.X
MON4	Watershed Restoration Effectiveness Monitoring. Collect data to evaluate restoration projects relative to site-specific and City-wide restoration targets.	TMDL Report: Temperature Mgmt, Table X.X
MON5	Time-series Monitoring. Evaluate time-series data collected from Columbia Slough water quality data loggers to assess status and trends and to inform adaptive management of the monitoring effort.	N/A: Pending separate deliverable

Goals and Targets for Temperature TMDL Strategies

Goal ID	Category	Target/Description	Timeline (Goal)	Performance Metrics	Interim Milestones and Timelines	Reporting Activities
TIP-01	**Effective Shade Assessment**	Conduct a geospatial assessment of riparian conditions within Portland and progress towards meeting the TMDL nonpoint source load allocations	Complete by 2021	Completed assessment	1. FY 2019–20: LiDAR acquisition. 2. FY 2019–20: Process LiDAR and GIS datasets and complete modeling. 3. FY 2020–21: Compile and report effective shade results.	
TIP-02	**Stream Habitat Assessment**	Conduct stream habitat surveys for all perennial streams identified as priorities in the Stormwater System Plan	Complete by 2021	Completed surveys	1. FY 2018–19: Secure intergovernmental agreement with Oregon Department of Fish and Wildlife. 2. FY 2019–20: Complete surveys for 50% of identified stream reaches. 3. FY 2020–21: Complete surveys for remaining stream reaches.	
TIP-03	**Ecosystem Diagnosis & Treatment Analysis**	Generate an Ecosystem Diagnosis and Treatment (EDT) model for the Columbia Slough, Johnson Creek, and Tryon Creek areas of interest	Complete by 2020	Completed model	1. Implementation is scheduled for completion during FY 2019–20.	
TIP-04	**Floodplain, Riparian, & Wetland Protection**	Complete the Environmental Overlay Zone Map Correction Project	Anticipate public hearings in 2020 and adoption in 2021	Updated Overlay Zone Map	1. FY 2018–19: Release draft maps of the revised environmental overlay zones for Johnson Creek. 2. FY 2019–20: Release draft maps of the revised environmental overlay zones for East Buttes, Northwest Hills, Southwest Hills, and Columbia Slough/Columbia River. 3. FY 2020–21: Public hearings on the revised environmental overlay zones.	
TIP-05	**On-Site Stormwater Retention & LID**	Revise and update the Stormwater Management Manual (SWMM)	Within the next MS4 permit term	Updated SWMM	N/A – Schedule is outlined in accordance with provisions of the SWMP and renewed Phase I NPDES MS4 permit.	
TIP-06	**Invasive Species Management & Treatment**	Perform management, assessment, and treatment of invasive species on 5,550 acres	By end of TIP cycle	Acres managed, assessed, and treated	Perform management, assessment, and treatment of invasive species on 1,110 acres each year on average.	Acres: 2018-19 / 2019-20 / 2020-21 / 2021-22 / 2022-23 Annual: - / - / - / - / - Cumulative: - / - / - / - / - % of Goal: - / - / - / - / - For more information, see MS4 Annual Report: Section X.X.
TIP-07	**Invasive Species Management & Treatment**	Survey the Lower Columbia Slough for invasive aquatic macrophytes and treat where identified. Total extent is 9.4 miles on center or 18.8 miles along left and right banks.	Annually for 80% or more of extent	Linear miles surveyed	Survey the Lower Columbia Slough for invasive aquatic macrophytes and treat where identified. Work to cover 80% or more of the total extent: at least 7.5 miles on center or 15 miles at banks.	Miles: 2018-19 / 2019-20 / 2020-21 / 2021-22 / 2022-23 Annual: - / - / - / - / - Cumulative: - / - / - / - / - % of Goal: - / - / - / - / - For more information, see MS4 Annual Report: Section X.X.
TIP-08	**Ecosystems**	Develop an inventory of watershed restoration projects and track information such as cost, location, project goals, and outcomes	By end of TIP cycle	Completed inventory	1. FY 2018–19: Initiate effort internally with subject matter experts. 2. FY 2019–20: Complete an inventory of all active projects. 3. FY 2020–21: Populate the inventory with all recently completed projects.	
TIP-09	**Riparian Revegetation**	Plant 100,000 native trees and shrubs in identified natural and riparian areas	By end of TIP cycle	Plantings (#)	Plant 20,000 native trees and shrubs in identified natural and riparian areas each year on average	Plantings: 2018-19 / 2019-20 / 2020-21 / 2021-22 / 2022-23 Annual: - / - / - / - / - Cumulative: - / - / - / - / - % of Goal: - / - / - / - / - For more information, see MS4 Annual Report: Section X.X.

*Feasibility of land acquisition is dependent on willing sellers and real estate markets, landowner permissions, availability of funding, and the permitting process.

Goals and Targets for Temperature TMDL Strategies

Goal ID	Category	Target/Description	Timeline (Goal)	Performance Metrics	Interim Milestones and Timelines	Reporting Activities
TIP-10	**Land Acquisition**	Acquire 50 acres of land for strategic restoration and protection of watershed hydrology*	By end of TIP cycle	Acres acquired (#)	Initiate the due diligence review process for 10 new acres of property each year to enable land acquisition	Acres: 2018-19 / 2019-20 / 2020-21 / 2021-22 / 2022-23 Annual: - / - / - / - / - Cumulative: - / - / - / - / - % of Goal: - / - / - / - / - For more information, see MS4 Annual Report: Section X.X.
TIP-11	**Upland Tree Planting**	Plant 7,500 upland trees during the plan term through partnerships with non-profits, community members, businesses, and schools	By end of TIP cycle	Trees planted (#)	Plant an average of 1,500 upland trees each year during the plan term through partnerships with non-profits, community members, businesses, and schools	Trees: 2018-19 / 2019-20 / 2020-21 / 2021-22 / 2022-23 Annual: - / - / - / - / - Cumulative: - / - / - / - / - % of Goal: - / - / - / - / - For more information, see MS4 Annual Report: Section X.X.
TIP-12	**Watershed Restoration Effectiveness Monitoring**	Develop a comprehensive monitoring manual to support the City's stream and floodplain restoration projects	Complete by 2021	Completed manual	1. FY 2018–19: Draft of the monitoring manual completed. 2. FY 2019–20: Internal review of the draft monitoring manual completed. 3. FY 2020–21: Monitoring manual finalized.	
TIP-13	**Coldwater Refugia**	Evaluate and update an inventory and mapping of coldwater refugia in the Lower Willamette River	By end of TIP cycle	Confirm program continuation and/or provide status updates	1. FY 2018–19: Participate in DEQ's expert panel. 2. FY 2019–20: Continue to participate in DEQ's expert panel.	
TIP-14	**Hydrologic Connectivity (Watershed Restoration)**	Implement 5 restoration projects that address: canopy cover, enhancing refugia, heat source due to water impoundment, groundwater recharge, and/or protecting springs/coldwater sources	By end of TIP cycle	Projects planned, designed, and/or constructed (#)	Advance one project per year to the next project phase	See reporting matrix below for a list of projects, including status and description for each.

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Projects for Temperature Goal TIP-14 Hydrologic Connectivity (Watershed Restoration)

Project Name	Status*	Description & Benefits
<Project Name> <Waterbody>	<Status Description> 	<Project Description & Details> <List of project benefit categories>

*Status Notes: Design is typically comprised of four phases: Conceptual, 30%, 60%, and 90%. Gray markers indicate status in the previous report year. Black arrows indicate status in the current report year.

ENVIRONMENTAL SERVICES
CITY OF PORTLAND

working for clean rivers