APPENDICES

Appendix A:
Regulatory Framework Overview

Appendix A. Regulatory Framework Overview

ENVIRONMENTAL REGULATORY CONTEXT

One of the purposes of Tacoma's Urban Waters Protection Plan (UWP Plan) is to facilitate compliance with local, state, and federal regulations that guide development activities and help protect and restore the city's natural resources. these regulations require the city to maintain or improve surface and groundwater quality; manage stormwater runoff volumes to protect stream and marine habitat; preserve sensitive and critical areas that may include biodiversity areas, streams and wetlands; and concentrate growth in highly developed areas. Here we summarize the primary regulatory drivers related to the goals of the UWPP to ensure stormwater requirements are met under the following regulations:

- The Growth Management Act
- The Clean Water Act and NPDES Permit Requirements
- The Shoreline Management Act and Critical Areas Protection
- The Endangered Species Act
- The South Tacoma Groundwater Protection District

GROWTH MANAGEMENT ACT & LONG-TERM PLANNING

Since the Washington State Growth Management Act 27(GMA) was passed by the Legislature in 1990, Washington counties and cities have used the GMA's planning framework to adopt comprehensive plans and development regulations to guide development into urban growth areas while protecting the environment including water quality.

Prioritization of receiving waterbodies for stormwater retrofits allows the City to target needed infrastructure where it will have the most environmental benefit. Stormwater planning that facilitates development in regional growth centers implements a number of the multi-county planning policies in Vision 2050. Vision 2050 is the regional plan that guides how and where growth will occur and follows the framework provided by Washington's GMA. The UWP Plan will align with those principles outlined in Vision 2050 and the City's One Tacoma Comprehensive Plan.

CLEAN WATER ACT (CWA)

Established in 1972, the federal Clean Water Act (CWA) requires the identification and cleanup of polluted surface waters, and establishes water quality standards for surface waters throughout the United States. In addition, the CWA regulates discharges to surface waters by requiring NPDES permits for discharges to receiving waters from municipal, industrial, and other regulated "point sources" of pollution and "nonpoint sources" like stormwater runoff that is dispersed across large areas (see a more detailed discussion in NPDES subsection below). Specific sections of the CWA also require preparation of a list of impaired waterbodies (Section 303(d) list) and permit approvals, such as Section 401 Water Quality Certifications, to ensure CWA standards are met. Within Washington State, the U.S. EPA has delegated administration of these CWA requirements to the Washington State Department of Ecology and United States Army Corps of Engineers. In addition, the state regulates water quality through the Washington Pollution Control Act (WPCA).

303(d) list of impaired water bodies

Surface water quality standards for the state are established in Chapter 173-201A of the Washington Administrative Code (WAC) (Ecology 2006). The purpose of these standards is to designate "beneficial uses" for surface waterbodies and establish specific chemical and physical criteria for protecting these uses. The Section 303(d) list of impaired waterbodies is periodically updated by Washington State Department of Ecology (Ecology) and submitted to the U.S. Environmental Protection Agency (EPA) for review and approval. Ecology currently submits these lists on a 2-year alternating cycle of the freshwater listing and the marine water listing. The water quality information used for the watershed assessment in this UWP Plan is based on the information available in December 2019. The City will use existing water quality data to help inform prioritization of water quality projects throughout the City.

Category 5 waterbodies are placed on the state's 303(d) list of impaired waterbodies. Pursuant to CWA requirements, the state must perform a Total Maximum Daily Load (TMDL) study for all Category 5 waterbodies identified on the Section 303(d) lists. A TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet the water quality standards. It also identifies the sum of the allowable loads of a single pollutant from all point and nonpoint sources and determines a margin of safety to ensure that the waterbody can be protected in case there are unknown pollutant sources or unforeseen events that may impair water quality. The most recent 303(d) list for freshwaters identifies several impaired Category 5 water bodies in the City (*Ecology 303d Listing*). A complete list is included in Appendix C.

NPDES Phase I Municipal Stormwater Permit

On August 1, 2019, the Ecology issued the 2019-2024 National Pollutant Discharge Elimination System (NPDES) Stormwater Permit for Phase I Municipalities (Permit) including Tacoma. The Permit regulates the discharge of stormwater to surface waters and groundwaters of the state from Tacoma's Municipal Separate Storm Sewer System (MS4). The Permit is designed to protect and improve the water quality of our receiving waters by requiring Tacoma to implement a variety of stormwater management activities to meet Clean Water Act goals.

Tacoma documents how they meet all NPDES Permit requirements in the Stormwater Management Program Plan. The Permit's requirements in Stormwater Planning Section (S5.C.6) and the Structural Stormwater Controls Section (S5.C.7) directly relate to this UWP Plan. However this UWP Plan and related prioritization model are more comprehensive and therefore will address multiple permit annual reporting questions and Stormwater Management Program elements.

In addition to the Ecology issued MS4 Permit, the City was required to provide EPA with a NPDES Permit Application for Tacoma's stormwater system discharging to Puyallup Tribal Waters. The permit application was submitted in 2010 and the City is awaiting the issuance of the EPA NPDES Permit. Tacoma currently applies all State NPDES requirements to all areas in the City's jurisdictional boundary including stormwater outfalls to Tribal Waters.

SHORELINE MANAGEMENT ACT AND CRITICAL AREAS

Shoreline Master Plan

The City developed a Shoreline Master Plan to meet the requirements set forth in the Washington State Shorelines Management Act (Chapter 90.58 RCW and Tacoma Municipal Code Title 19). The goal of this plan is to assure that existing shoreline ecological functions are protected alongside the proposed pattern and intensity of development, and policies for restoration of degraded shorelines are implemented consistently. The UWP Plan will assist in accomplishing the Shoreline Master Plan goals of achieving a net gain of ecological function and improved water quality.

Critical Areas Protection

The City regulates development and other activities located in steep slopes, biodiversity corridors, wetlands, streams and their buffer areas according to the requirements under the Critical Areas Protection Ordinance (Tacoma Municipal Code Chapter 13.11.) Permitting requirements help construction projects protect ecosystem services provided by critical areas such as stormwater absorption and flooding prevention, water quality enhancement, cleaner air and cooler spaces. Tacoma's UWP Plan will coordinate with and support the habitat and ecosystem protection goals of the Critical Areas Protection program.

Related Environmental Permits

The City of Tacoma currently regulates and defines wetlands, streams, and fish and wildlife habitat areas under Title 13.11 for the Critical Areas Preservation Code and TMC Title 19 for the Shoreline Master Program. Development or maintenance activities that impact critical areas or shorelines require permit approval. Federal and state agencies with jurisdiction over impacts to wetlands and shorelines located on and near the site include the U.S. Army Corps of Engineers (USACE), the Washington State Department of Fish and Wildlife (WDFW), and Ecology. The Corps regulates wetlands under Section 404 of the Clean Water Act and the shoreline under Section 10 of the Rivers and Harbors Act. Impacts to wetland, streams and the shorelines below the ordinary high water mark would require Individual or Nationwide Permits from the Corps and a Hydraulic Project Approval by WDFW. Ecology regulates wetlands and streams under Section 401 of the Clean Water Act and shorelines under the Shoreline Management Act. Impacts to wetlands or shorelines may require a Water Quality Certification or Coastal Zones Management Certification from Ecology.

ENDANGERED SPECIES ACT

The Endangered Species Act (ESA) of 1973 requires the City to consult with the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) and the United States Fish and Wildlife Service (USFWS) to ensure actions are not likely to jeopardize species listed as threatened or endangered or their designated critical habitat. NMFS administers the ESA in relation to salmonids and other species that spend the majority of their lives in marine waters. USFWS administers the ESA with relation to terrestrial species, birds, and species that spend the majority of their lives in freshwater. The City coordinates these consultations through the Joint Aquatic Resources Permit Application (JARPA) process submitted through the U.S. Army Corps of Engineers with delegated authority from the EPA.

Regional Road Maintenance ESA Program Guidelines

The purpose of the Regional Road Maintenance ESA Program Guidelines (RRMP) is to provide a consistent regional program to allow participating municipalities who practice roadway or utility maintenance activities to obtain approval from NMFS and USFWS for such activities. The program covers maintenance or repair activities conducted on currently serviceable structures, facilities and equipment, involving no expansion or change in use, and not resulting in a significant negative hydrological impact. Examples of systems and structures within the right-of-way covered under this program include roadways, bridges, drainage, sediment containment, retention/detention, water, sewer, gas, electrical, street lighting, traffic loops and traffic signals. The program provides resources for staff training, regular networking opportunities among municipal staff leading these efforts, and ongoing updates of the most current best management practices to achieve the following conservation outcomes identified in the guidelines:

- Minimize erosion and sedimentation
- Contain pollutants
- Maximize habitat improvements

Salmon Habitat Protection and Restoration Strategy for WRIAs 10/12

In June 2018, the Salmon Habitat Protection and Restoration Strategy for WRIA 10/12 was completed by the Puyallup and Chambers Watershed Salmon Recovery Lead Entity Citizens Advisory Committee and Technical Advisory Group to help identify and encourage the voluntary installation of habitat restoration projects to benefit ESA-listed and at-risk salmonid species (Lead Entity 2018). For WRIAs 10 and 12, the designated Lead Entity is Pierce County. Besides developing the Salmon Habitat Protection and Restoration Strategy, the Lead Entity develops four-year work plans based on the strategy, administers grants for habitat projects supporting the strategy, and coordinates monitoring and adaptive management for the Puget

Sound Chinook Recovery Plan for the WRIAs 10/12 Watershed Chapter. These plans focus on the following strategies:

- Reconnecting mainstem river channels to their floodplains
- Restoring habitat in highly productive tributaries and mainstem areas
- Restoring and maintaining hydrologic regime
- Protecting highly productive tributary and mainstem areas
- Removing physical barriers to fish movement and migration
- Restoring estuarine habitats
- Restoring nearshore areas
- Improving water quality
- Coordinating regulatory and incentive programs
- Developing and implementing salmon-safe farming practices
- Conducting outreach and education

The Puyallup White River Local Integrating Organization published a regional Ecosystem Recovery Plan adopted in August 2021. This watershed-scale plan documents priority goals and actions in Tacoma and Pierce County that were agreed upon by a diverse group of watershed partners. The Ecosystem focus areas included in the plan include many topics covered in Tacoma's Watershed Planning evaluation as well:

- Equity and Human Wellbeing
- Climate Change
- Salmon
- Estuaries
- Floodplains
- Forests
- Farms and Agricultural Lands
- Stormwater and Water Quality

GROUNDWATER PROTECTION

Groundwater quality protection standards for the state are defined by Ecology in Chapter 173-200 WAC found here: *Water Quality Standards for Washington's groundwater* (Ecology 2010). The goal of the standards is to maintain groundwater quality and to protect existing and future beneficial uses through the reduction or elimination of contaminants discharged to the subsurface. Similar to the CWA, state groundwater regulations establish the following anti-degradation policies:

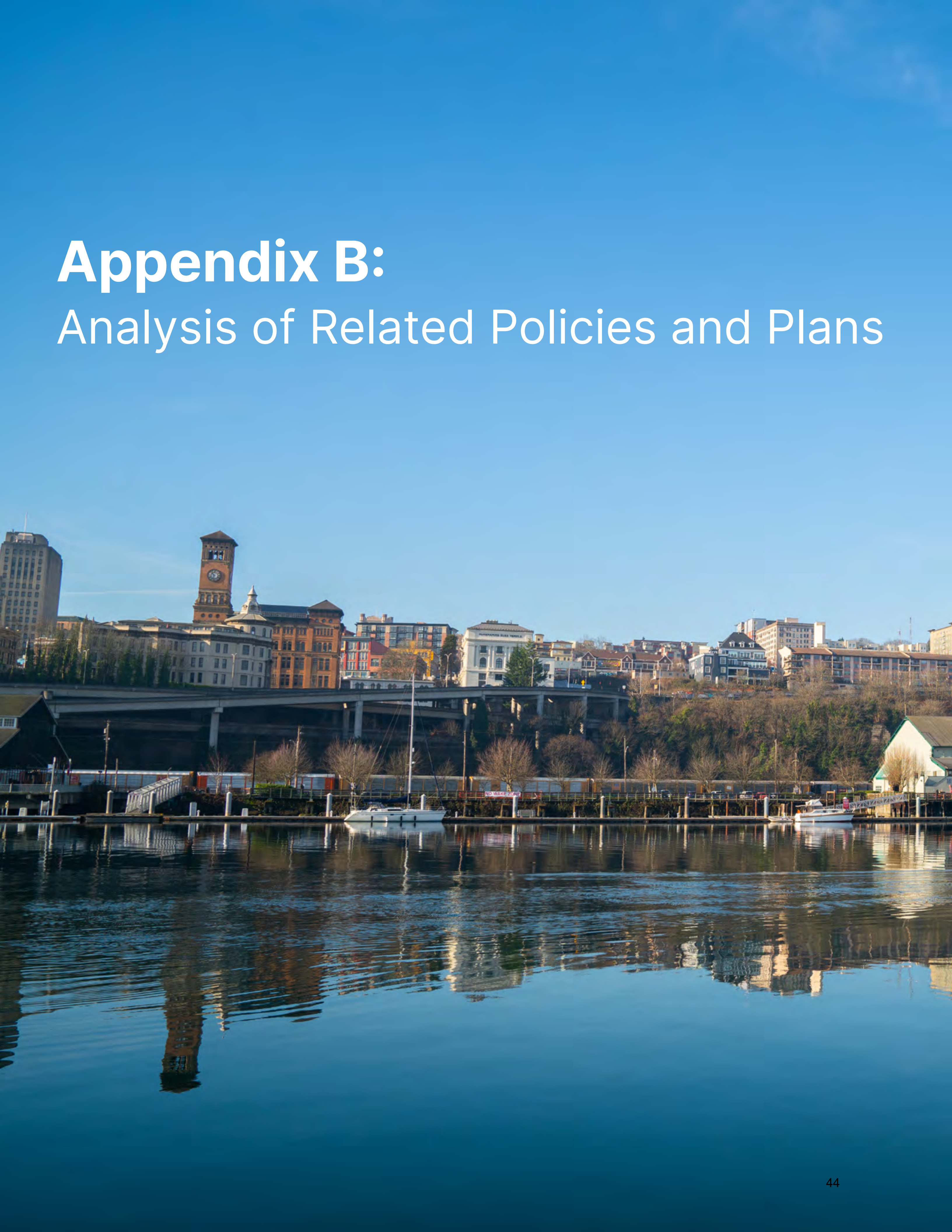
- Maintain and protect existing and future beneficial uses and prohibit the degradation of groundwater quality that would interfere with beneficial uses.
- Protect high quality ground waters constituting an outstanding national or state resource, such as waters of national and state parks and wildlife refuges, and waters of exceptional recreational or ecological significance.
- Protect existing water quality of ground waters that are of a higher quality than the criteria assigned for said waters.

State law also sets requirements for wellhead protection programs (WAC 246-290-130 and 246-290-135 [Ecology 2011]). The City has developed a wellhead protection program pursuant to this requirement. Wellhead protection programs, which are required for all large or public drinking water wells, are a proactive approach to preventing contamination of groundwater used for drinking water supplies. Wellhead protection programs identify potential sources of groundwater contamination, implementing strategies to prevent degradation, and managing existing sources of contamination to ensure appropriate actions have been taken to protect the drinking water supply.

The Tacoma Municipal Code Chapter 13.09 contains the standards and regulatory enforcement program for wellhead protection in the *South Tacoma Groundwater Protection District* located in a large portion of the City. The program is implemented by the Tacoma-Pierce County Health Department (TPCHD) and regulates properties that may store hazardous substances within the district to ensure those properties are properly maintained, inspected and tested, when necessary. The Environmental Services Department, in coordination with TPCHD, has developed an *Infiltration Policy* for stormwater infiltration within the district.

Ecology requires all injection wells, including stormwater infiltration wells (Class V wells), to be registered through the Underground Injection Control (UIC) program. This program requires all owners and operators of UIC wells to perform a self-assessment to safeguard groundwater from being contaminated by pollutants. Guidance for UIC wells that manage stormwater are included in the 2019 update of the Stormwater Management Manual for Western Washington. UIC wells may be drywells, drain fields, infiltration trenches with perforated pipes, stormwater infiltration chamber systems, french drains or bioretention systems with perforated pipes draining to treatment soils below the facility.

Appendix B:
Analysis of Related Policies and Plans



Appendix B. Analysis of Related Policies and Plans

SUMMARY OF INTERNAL PLANS AND POLICIES

The Urban Waters Protection Plan (UWP Plan) project list will incorporate similar prioritization criteria in addition to addressing ecosystem and watershed health priorities.

Comprehensive Planning

- One Tacoma Comprehensive Plan (One Tacoma). One Tacoma guides Tacoma's development over the long term, addresses the entire community, and describes how the community's vision for the future may be achieved. The plan provides a planning framework for activities through 2030 and guides decisions on land use, transportation, housing, capital facilities, parks, and the environment. The UWP Plan will align closely with the goals identified in the Watershed Health Chapter 4 and will assist with implementing a list of actions to achieve these goals.

- Transportation Master Plan. The City of Tacoma Transportation Master Plan was finalized in December 2015 as part of the One Tacoma Comprehensive Plan. The vision of the transportation plan is to build a transportation network that supports the Puget Sound region's vision and Growth Management Act goals. The plan provides guidance on how to design an environmentally sustainable transportation system with safe access for all users while encouraging healthy living and protecting Tacoma's environment. The plan emphasizes multimodal transportation choices including walking and biking and identifying opportunities for Complete Streets projects to incorporate more trees and green stormwater infrastructure options. Tacoma's Mobility Master Plan is part of this plan and identifies low volume, low speed streets targeted for traffic calming measures and bike lanes. The UWP Plan will create a prioritized list of locations where green stormwater infrastructure can both provide the most benefit to reduce stormwater impacts and support street projects that have been identified for traffic calming, walking, biking, and trail connectivity improvements.

- Shoreline Management Plan. The City developed a Shoreline Master Plan to meet the requirements of the Washington State Shorelines Management Act (Chapter 90.58 RCW). The goal of this plan is to assure that existing shoreline ecological functions are protected alongside the proposed pattern and intensity of development, and policies for restoration of degraded shorelines are implemented consistently. The UWP Plan will assist in accomplishing the Shoreline Master Plan goals of achieving a net gain of ecological function and improved water quality by considering the inventory of shoreline protection opportunities and strategies identified in the Shoreline Restoration Plan element of the SMP when prioritizing locations for stormwater improvement projects. Shoreline project siting and design will also take into consideration the shoreline trail development proposal list identified in the Shoreline Trails Plan, and design vision and guidelines in the Ruston Way Plan and Thea Foss Waterway Design and Development Plan.

- Tacoma Sub-Area Plans. The City has several subarea plans that establish a shared, long-term vision; coordinated approach to development, environmental protection, and strategic capital investments in a focused area. Four plans currently exist for the Downtown and Tacoma Mall Subareas, and a fifth subarea plan for the Tacoma Tideflats is under development with anticipated completion by 2021. These plans serve as a statement of the City's commitment for future development in these areas and can serve as a guide for community development requirements. There is currently no designated funding identified to address all the stormwater infrastructure improvement needs outlined in these plans. The UWP Plan can provide a tool for prioritizing stormwater improvements projects in these areas for investment and funding opportunities. The sub-area plans goals and strategies will also serve as a resource for current conditions assessment.

- Capital Facilities Program. The Capital Facilities Program provides coordinated planning of capital facilities and services. The Capital Facilities Program maintains an inventory of existing capital facilities, plans for new construction to meet existing deficiencies and future development needs, and contains a six-year financing plan. The goal is to provide high quality, well maintained, and equitably distributed facilities that serve the social, physical, economic, cultural, safety, communication, and other needs of the community, at the time of development to serve new growth.

  Some of the prioritization criteria to determine whether or not a project is added to the Capital Facilities Program and funded in the biennial budget include:

  - Does the project address a public health concern?
  - Is the project needed to correct existing public facility deficiencies?
  - Does the project improve the equitable access to public facilities and services?
  - Does the project align with Tacoma 2025 or other City priorities?
  - Does the project have a high level of public support?
  - Does the project reduce greenhouse gas emissions or support the adaptation of climate change?
  - Does the project meet growth patterns and projected needs for new development and redevelopment?

Environmental Plans

- Tacoma Climate Change Resilience Study 2016**.** This plan identifies storm system, natural system and social system vulnerabilities and risks associated with climate impacts and identifies specific recommendations for storm system improvements and stewardship of open spaces, wetlands, streams, lakes, and restoration sites to reduce these risks. Specific sites assessed as part of this study included shoreline improvements along Ruston Way, Salmon Beach, Marine View Drive, the Tideflats, and the Puyallup River system. It also assessed First Creek, Leach Creek Holding Basin and the Flett Creek Holding basins. The UWP Plan prioritization tool will include climate change impact vulnerability assessment information based on the criteria reviewed in this study. Implementation will consider carrying forward the recommended projects and actions in this study in prioritized areas of the watershed. Tacoma's Climate Action Plan for the next 5 years will be published in 2021 and will identify top priority actions for the community to reduce carbon loading. The UWP Plan will reflect the Climate Action Plan strategies related to stormwater and watershed management and address them in the implementation plan.

- Strategic 20-year Passive Open Space Plan. Environmental Services owns and manages nearly 500 acres of natural areas or "passive open space." Passive open space properties are typically comprised of critical areas (steep slopes, wetlands, wetland buffers) and other vegetated areas, trails, habitat conservation areas, biodiversity corridors, and natural buffers between land uses. These areas provide habitat for rare or endangered species and other wildlife, public access to natural areas, stormwater benefits, improved air, and water quality, and decreased urban heat island effects. This plan identifies goals and objectives for removing invasive plants and replacing them with native and evergreen species, which is challenging because much of the property is on steep slopes or contains wetlands or streams, has no access roads, is impacted by homeless encampment activities, and is taken over by invasive vegetation. The prioritization tool may assist with prioritizing sites for restoration and maintenance, as well as help evaluate the watershed and stormwater benefits of open space management activities in priority watershed areas.

- Urban Forestry Management Plan 2020. This plan aligns tree planting and canopy goals identified by each neighborhood, with the City's watershed assessment, green stormwater infrastructure plans, and subarea plans. The City's Urban Forester provides technical assistance for the role that trees play in achieving the goals of stormwater management and improved water quality. Prioritization will incorporate the existing urban canopy assessment and tree inventory data. The UWP Plan will support the City's Urban Forestry goal of achieving 30% urban canopy cover by 2030 by looking for opportunities in Watershed Implementation Plan to incorporate tree planting and tree preservation whenever possible.

Stormwater Plans & Policies

- Stormwater Management Program Plan. The SWMP Plan guides the City's activities to comply with the National Pollutant Discharge Elimination System Phase I Stormwater Permit. The City's SWMP Plan is divided into eleven components as outlined in Section S5 of the Permit with an additional section to document the stormwater monitoring and assessment requirements under Permit Section S8. Key SWMP components that may be guided by the prioritization recommendations in the UWP Plan including enhanced maintenance locations, source control, stormwater monitoring and pollutant source tracing locations, Green Stormwater Infrastructure structural stormwater controls, stormwater education and outreach in overburdened communities.

- Regional Stormwater Facility Plan. Tacoma has twenty-six regional stormwater holding ponds with over 800 acre-feet of capacity. Ninety percent of this capacity is contained in five large ponds in the Flett Creek watershed and Leach Creek watershed built in the 1960's in response to flooding concerns. More recently, additional regional stormwater treatment and flow control facilities have been constructed incorporating low impact development (LID) or Green Stormwater Infrastructure (GSI) best management practices such as bioretention and permeable pavement. The primary goal of the Regional Stormwater Facility Plan is to establish, use, and manage the City's Payment In-Lieu-of Construction Program to provide capacity in regional stormwater facilities for new development and redevelopment projects where stormwater flow control and/or water quality treatment is required. The UWP Plan will identify priority locations for additional regional stormwater treatment and flow control facilities to provide the most benefit for watershed protection from stormwater impacts.

- Green Roads Policy. Several of the City's GSI projects have been designed using guidance from the City's Greenroads Policy and have helped roadway projects achieve Greenroads Certification. A "Greenroad" is a roadway project that has been designed and constructed to a level of sustainability that is substantially higher than current common practice based on greenhouse gas reduction credits. The UWP Plan will identify green infrastructure projects as part of the implementation plan, and the design of these projects will be guided by the Green Roads Policy.

Equity

- Tacoma Equity and Empowerment Framework. The City of Tacoma departments have five equity goals:

    - The City of Tacoma workforce reflects the community it serves
    - Purposeful community outreach and engagement
    - Equitable service delivery to residents and visitors
    - Support human rights and opportunities for everyone to achieve their full potential
    - Commitment to equity in policy decision making

The UWP Plan will involve purposeful ongoing community engagement to steer program priorities and policy decisions. Implementation will be focused to achieve more equitable stormwater service delivery and access to opportunity.

The NPDES Phase I Stormwater Permit uses the EPA definition of overburdened communities minority, low-income, tribal, or indigenous populations or geographic locations in Washington State that potentially experience disproportionate environmental harms and risks resulting from greater vulnerability to environmental hazards, lack of opportunity for public participation, or other factors. Increased vulnerability may be attributable to an accumulation of negative or lack of positive environmental, health, economic, or social conditions within these populations or places. The stormwater permit requires the public education and outreach program to address overburdened communities and incentivizes locating structural stormwater controls in areas where overburdened communities live.

Prioritization ranking will consider the needs of overburdened community members through an equity analysis. The GIS equity data available through the Tacoma Equity Index map will provide quantitative equity information for ranking locations. Public engagement with diverse community groups will be used to select UWP Plan actions that will benefit the most impacted community members and may include benefits such as: green streets, a healthier tree canopy, access to waterways and open space areas, projects to reduce urban blight and flooding, multi-modal transit projects, or more local green jobs.

- Tacoma's Strategic Plan – Tacoma 2025. Tacoma 2025 is a plan that guides where the City of Tacoma government and community is headed between 2015- 2025. The plan is meant to direct our efforts and resources in ways that reflect our growing community's evolving needs. Based on extensive community engagement in 2014-2015, community priorities were identified and summarized into five key focus areas with lists of indicators under each area:
    - Livability
    - Economy and Workforce
    - Education
    - Civic Engagement
    - Equity and Accessibility

While none of the indicators identifies stormwater or watershed health specifically, the UWP Plan outcomes have the potential to support various indicators listed under each category and should be reported to the City Manager's Office for reporting and tracking of the indicators.

SUMMARY OF EXTERNAL PLANS AND POLICIES

Pierce County

- Vision 2050: Environment Chapter. Vision 2050 identifies the region's top environmental priorities including caring for the natural environment by protecting and restoring natural systems, conserving habitat, improving water quality, and reducing air pollutants. Planning at all levels, including watershed and stormwater planning, should consider the impacts of land use, development, and transportation on the ecosystem. The City works to implement these strategies through the regulation of new and redevelopment and through non-regulatory actions such as protecting and enhancing open spaces for public benefit and incentivizing green building. Recommendations in the UWP Plan will include actions that may touch on land use, stormwater management, parks and recreation, and transportation choices outlined in the One Tacoma Comprehensive Plan and will inform the Capital Facilities Plan.

Vision 2050 also cautions that equitable access to all these community benefits will require identifying gaps in service and planning for expanded or improved services and facilities, which will require significant investment. Inadequate provision of services in underserved areas (especially water, wastewater, and stormwater) could become public health, safety, and environmental justice issues. The UWP Plan prioritization tool will include an equity analysis of existing services to shift investment priorities as necessary to address any disparities.

- Countywide Planning Policies for Pierce County. The requirements for the One Tacoma Comprehensive Plan are outlined in this document. The UWP Plan prioritization mapping tool outputs will assist City planners with implementing the best practices outlined in this document including;
    - Protect the natural habitat critical for the conservation of salmonid species listed under ESA.
    - Coordinate watershed planning and land use activities to utilize true watershed boundaries instead of jurisdictional boundaries for plans and studies and to consider the implications of planning efforts outside of jurisdictional boundaries within the same watershed.
    - Work with other jurisdictions to identify and protect natural habitat corridors that cross jurisdictional boundaries.
    - Coordinate on critical areas regulatory updates and develop complementary, coordinated, integrated and flexible approaches for the collection, analysis, and sharing of monitoring information.

- Pierce County Lead Entity Salmon Habitat Protection and Restoration Strategy for WRIA 10 and WRIA 12. Besides developing the Salmon Habitat Protection and Restoration Strategy, the Lead Entity develops four-year work plans based on the strategy, administers grants for habitat projects supporting the strategy, and coordinates monitoring and adaptive management for the Puget Sound Chinook Recovery Plan for the WRIAs 10/12 Watershed Chapter. These plans focus on salmon protection strategies such as restoring and protecting productive salmon habitat, maintaining hydrologic regime, and improving water quality. The UWP Plan goals will support these strategies and ranking criteria for determining priority focus areas in the City will incorporate salmon habitat considerations, where applicable.

- Puyallup White River Local Integrating Organization Ecosystem Recovery Plan 2021. We anticipate many areas of alignments between the work from this group and Tacoma's UWP Plan. The Ecosystem Recovery Plan includes a comprehensive review of all WRIA 10 regional plans related to watershed management and identifies eight focus areas with relevant goals and strategies including salmon, estuaries, floodplains, forests, farms and agricultural land, stormwater and water quality, equity and human well-being, and climate change. Tacoma's UWP Plan will support Ecosystem Recovery Plan strategies and projects in Tacoma. The main alignment is the focus area of stormwater and water quality to support clean water for people and fish.

- Chambers Clover Creek Watershed Council 2018-2023 Action Agenda. Strategy 2 of this action agenda focuses on promoting watershed stewardship. Goals include engaging volunteers, protection, and recovery of priority waterbodies, engaging communities and landowners in these efforts, and restoring riparian habitat. Strategy 3 supports watershed protective policies and regulations that protects aquifers and salmonids. Goals include promoting developing practices that reduce runoff, enhance water conservation, and improve water quality for both surface water and ground water. The UWP Plan will align with these goals and implement similar strategies in Tacoma.

- Pierce County Community Health Assessment 2019 and Community Health Improvement Plan 2020. Community health and watershed health outcomes are linked in many ways as identified in these reports. Per the 2015 Health Equity Assessment entitled "Fairness Across Places – Your Health in Pierce County," positive health outcomes depend on environmental health and healthy watershed conditions including:
    - Walkability and access to green space such as woods, creeks, trails, and parks
    - Quality housing free from moisture and mold (due to frequent flooding)
    - Good outdoor air quality
    - Safe and reliable drinking water
    - Clean and safe swimming and shellfish beaches
    - Minimal exposure to historical and current pollution
    - Minimal climate change impacts (heat waves, flooding, poor air quality)

  Some data gaps were noted in the 2015 report: "We do not currently have sufficient information to determine whether there are income, educational, racial, ethnic, or geographic inequities in surface water quality" and "We do know that communities or cultures that disproportionally rely on the recreational harvest of fish and shellfish as a regular food source are at a higher health risk. Currently, we have limited data available to indicate which specific communities might harvest in high-risk areas." These are potential areas where the UWP Plan analysis identifying the neighborhoods where surface water pollution hot spots occur could help clarify where overburdened communities are located near surface water quality issues and may experience disproportionate impacts.

  The 2019 Community Health Assessment provided a snapshot of existing health and socio-economic conditions in the county as well as the highest priorities and needs identified by community members (App. A and B). Priority "communities of focus" in East Tacoma and South Tacoma were selected based on outcomes revealed by this study. UWP Plan development will involve participating with partner organizations and groups to build community relations and achieve community health outcomes identified in the Community Health Improvement Plan.

In 2020-2021, the TPCHD held a series of community listening sessions with community members most impacted by the COVID-19 pandemic to identify top concerns and areas where health equity could be strengthened. Based on the feedback provided, TPCHD identified ten areas for potential policy changes and is launching a Pilot Participatory Policy-making Project with community/agency integrated teams to address the top-ranking policy areas. Where possible, the UWP Plan strategies should support these policy areas:

- Economic Stability
- Housing Accessibility and Affordability
- Behavioral and Physical Healthcare Access
- Food Accessibility and Affordability
- Healthy Community Planning and Built Environment
- Youth Behavioral Health
- Early Childhood Development
- Education Access
- Social Services Access
- COVID Specific Care

For example, targeted stormwater management actions and green space protection and enhancement actions in the UWP Plan have the potential to support Economic Stability, Housing Accessibility and Affordability, Healthy Community Planning and Built Environment, Youth Behavioral Health, Early Childhood Development, and Education Access through providing more green jobs, redevelopment-ready neighborhoods, and enhancing access to natural systems throughout Tacoma.

- Sustainability 2030: Pierce County's Greenhouse Gas (GHG) Reduction Plan. The Sustainability 2030 plan outlines a ten-year goal and actions to take to reduce greenhouse gas emissions across Pierce County to help improve the health of Pierce County residents, improve our air, and water quality and save money. The plan identifies actions that Pierce County government and community members can take to achieve the County's goal for GHG reductions. These actions are listed under five areas of focus:
    - Energy and Built Environment
    - Transportation
    - Consumption and Waste Reduction
    - Carbon Sequestration
    - Education and Outreach

Implementation of the UWP Plan will support several of the key actions called out under the focus areas for carbon sequestration include several watershed related actions: countywide forest plan, incentivized green infrastructure, and working with the Puyallup Tribe and others to identify innovative ways to sequester carbon in estuaries and nearshore environments (e.g. kelp grass beds)

Watershed planning could also collaborate on several actions under Education and Outreach including targeted community engagement with underrepresented communities, a countywide Sustainability Newsletter, an annual youth environmental and sustainability summit, and creating a sustainability collaborative with the Puyallup Tribe, cities, and major employers to share best practices.

- Pierce Conservation District (PCD) Strategic Plan 2020. The Pierce Conservation district provides multiple opportunities for community education, stewardship, and incentive programs to help property owners and residents protect and restore watershed health. Their strategic plan included measurable goals and strategies round the following watershed programs:

- Natural Yard Care programs (rain gardens, Depave, Urban Tree Planting, Streamside planting, rain barrels)
  - Habitat Stewardship program (no sites currently in Tacoma)
  - Shore Friendly property program
  - Community Gardens
  - Stream and Lake monitoring citizen science program

  PCD will be a good resource when developing the UWP Plan action and implementation plan. Additionally, PCD developed a Water Quality Improvement Program Prioritization Analysis in December 2019. This analysis identified a set of priority areas for green stormwater infrastructure and public outreach and engagement. The main focus areas identified in Tacoma include Flett Creek and Leach Creek Watersheds where we will be able to partner with PCD to implement green infrastructure projects identified in the UWP Plan.

- Watershed Recovery and Enhancement Committee Streamflow Restoration Plans for WRIA 10 (Puyallup-White River Watershed) and WRIA 12 (Clover/Chambers Creek Watershed) 2021. The WREC plans support stream flows in critical salmon-bearing stream systems while ensuring rural communities have access to water. The plans were developed to offset consumptive groundwater use from small-sized permit-exempt wells through a collaborative effort with tribes, counties, cities, state agencies and special interest groups. Projects were selected both to offset consumptive water use impacts in the watershed as well as to provide net ecological benefit through habitat improvements. Implementation of the UWP Plan will include stormwater management projects that may potentially provide habitat benefits or to offset consumptive groundwater use from small-sized permit-exempt wells to offset consumptive groundwater use from small-sized permit-exempt wells infiltrate stormwater to support enhanced stream flows when located within the recharge area of impacted stream systems in Tacoma.

Tribal Strategies

- Tribal Habitat Strategy: 2018. There are several relevant goals outlined in this strategy including:
  - Protecting and restoring riparian corridors in western Washington to conditions that help sustain and support historical salmon and shellfish populations and productivity.
  - Protecting, restoring, and enhancing hydrological and geomorphic connectivity between rivers and their floodplains and deltas.
  - Improving water quality to provide a fit home for salmon, shellfish, and all of tribes' treaty-reserved resources.

The UWP Plan will support these strategies in Tacoma and identify priority receiving waters to focus habitat protection efforts.

- Puyallup Tribe Climate Change Impact Assessment and Adaptation Options 2016. The purpose of this document is to identify strategies for protection, restoration, and management practices for fisheries, hatcheries, and shellfish. This includes reducing nutrient sources that contribute to harmful algal blooms; in the future, as conditions worsen. Implementation of the UWP Plan will include strategies to assist in achieving these habitat outcomes by using Green Stormwater Infrastructure techniques, minimizing impervious surfaces, and considering climate change impacts when constructing or rehabilitating stormwater infrastructure.

Port of Tacoma

- Port of Tacoma Strategic Plan 2021-2026. The Port of Tacoma mission statement includes protecting and enhancing our environment, and one of the five foundational goals identified in the strategic plan is Environmental Leadership: Protect and enhance the environment of Commencement Bay and the Puyallup River by continuing to clean up contaminated land, improve habitat and water quality, and minimize air emissions from Port operations. The key supporting strategies for this goal focus on contaminated site remediation, investing in stormwater management to comply with permits, and create wetland opportunities and fish habitat independent of regulatory obligation. Key to implementing these strategies is the Port's commitment under the foundational goal of Community Connections to strengthen, build and maintain strategic relationships with local governments and the Puyallup Tribe of Indians. The UWP Plan should include projects identified in coordination with the Port and Puyallup Tribe of Indians to address stormwater impacts and habitat restoration needs in the Tideflats watershed.

Puget Sound Partnership

- Puget Sound Action Agenda. The Puget Sound Action Agenda is a regional road map that lays out the work needed to achieve the restoration of a healthy Puget Sound. The Action Agenda promotes activities that support three strategic initiatives: preventing pollution from urban stormwater runoff; protecting and restoring salmon habitat; and restoring and re-opening shellfish beds. Stormwater runoff from urban and urbanizing areas like Tacoma causes the majority of habitat and water quality degradation in small streams. Multiple strategies focus on stormwater management and new and redevelopment requirements in urban settings.

- B-IBI Implementation Strategy identifies priority strategies to address the effects to stream health from the built environment and effects from the runoff of working lands, and strategies to protect heathy streams from the impacts of development.

- Toxics in Fish Strategy focuses on geographic prioritization through a toxics source-tracking effort to identify top hotspots at neighborhood or parcel scale, target source control efforts and install retrofits in existing developments not scheduled for redevelopment. The UWP Plan will assist with prioritizing areas for investments based on pollutant loading, help identify these hotspots and model and measure the impacts of implementation.

- Chinook Salmon Implementation Strategy - Puget Sound Partnership Salmon Recovery Council 2018. The UWP Plan goals align with several salmon recovery strategies outlined in this document. Implementation will involve communication with partners and the exploration of new partnerships and collaboration opportunities for salmon recovery, protecting water quality in local receiving waters and habitat restoration projects.

CONCLUSIONS

Based on the review of City and regional plans and policies related to watershed planning, the UWP Plan will identify goals around common focus areas identified by these plans. The following list of draft goals is a starting point to be finalized through conversations with community stakeholders and partner organizations:

- **Goal 1 – Clean Water and Healthy Ecosystems:** Strategically select stormwater management investments to minimize impacts of stormwater runoff on receiving waters to protect and restore clean water and ecosystem function in designated critical areas.
- **Goal 2 – Healthy Neighborhoods:** Engage with community members and organizations to focus stormwater investments on solutions that will address needs identified by the community.
- **Goal 3 – Equity and Environmental Justice:** Provide equitable stormwater service delivery and improved access to green space to eliminate disparities caused by historic lack of investment.
- **Goal 4 – Resilient Community:** Invest now in stormwater system improvements to meet the future needs of population growth, affordable housing and climate change.
- **Goal 5 – Smart Government Spending:** Choose cost-effective stormwater management actions to achieve the greatest environmental and community benefits.

The prioritization analysis for the UWP Plan actions will consider the priorities identified and discussed in this document and other interviews, discussions, and workshops to inform the design of the watershed planning top priorities.

Appendix C:
Watershed Characterization Report

Watershed Characterization Report

A history and assessment of stormwater management, habitat and receiving water conditions, and general watershed information.

Tacoma, WA 2023

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Appendix C Watershed Characterization Report

City of Tacoma

COVER PHOTO SOURCE: METRO PARKS TACOMA. ALL OTHER PHOTOS UNLESS NOTED ARE FROM THE CITY OF TACOMA, WA

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

AFM	American Forestry Management
BMPs	Best Management Practices
BNSF	Burlington Northern Santa Fe
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
City	City of Tacoma
CIPP	Cured-In-Place Pipe
COCs	Contaminants of Concern
USACE	U.S. Army Corps of Engineers
CWA	Clean Water Act
DNR	Department of Natural Resources
EAP	Environmental Action Plan
Ecology	Washington State Department of Ecology
EIS	Effective Impervious Surfaces
EPA	Environmental Protection Agency
FLAT	Forest Landscape Assessment Tool
FWDA	Foss Waterway Development Authority
GMA	Growth Management Act
GSI	Green Stormwater Infrastructure
HSPF	Hydrological Simulation Program - Fortran
IDDE	Illicit Discharge Detection and Elimination
ISWGP	Industrial Stormwater General Permit
JARPA	Joint Aquatic Resources Permit Application
LID	Low Impact Development
MS4	Municipal Separate Storm Sewer System
NMFS	National Oceanic and Atmospheric Administration's National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
OEPS	Office of Environmental Policy and Sustainability
ROW	Right-of-Way
RRMP	Regional Road Maintenance Program
SWMM	Stormwater Management Manual
SWMP	Stormwater Management Program
TPCHD	Tacoma-Pierce County Health Department
UIC	Underground Injection Control
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
WAC	Washington Administrative Code
WMP	Watershed Management Plan
WPA	Washington Pollution Control Act
WRIA	Water Resource Inventory Areas
WRIA 10	Puyallup-White Watershed
WRIA 12	Chambers-Clover Watershed

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this Watershed Characterization Report (WC Report) is to document existing land use development and habitat conditions of the City's nine urban watersheds and summarize the data and criteria that will be used to guide future stormwater management actions and policy decisions that best support natural systems management in each watershed. This document is part of the Phase 1 Research conducted for the City of Tacoma (City) Urban Waters Protection Plan to gather information needed to make data-driven recommendations and decisions related to stormwater management in Tacoma.

1.2 OBJECTIVES

This watershed characterization analysis meets the following goals and objectives:

- Provide a centralized catalog of existing conditions for surface waters in each of the City watersheds related to stormwater conveyance and discharge locations, receiving water hydrology and water quality, fish and wildlife habitat, land use and other factors and criteria to evaluate watershed and ecosystem health and human impacts.
- Identify and track changes in stormwater impacts to receiving waters in each watershed within the City and Puyallup Tribal land boundaries
- Generate a base of comparable geographic information that can be used for evaluating the relative rehabilitation potential of the City's nine urban watersheds.

1.3 GEOGRAPHIC SCOPE

Tacoma covers 50 square miles, forty-six percent of which are impervious surfaces that produce stormwater runoff into surrounding receiving waters. While the City is home to many wetlands and streams, many of these surface waters were historically filled, piped or channelized during Tacoma's development into a highly urbanized landscape. This document identifies and describes the nine urban watersheds and smaller Stormwater Asset Management Areas (basins) resulting from the construction of the Municipal Separate Storm Sewer System (MS4) within the City of Tacoma. For the purposes of this document, Water Resource Inventory Areas (WRIAs), City watersheds and City Asset Management Areas are displayed in the following figure and defined as follows:

- WRIAs – These are large geographically based Water Resource Inventory Areas usually associated with large river systems. Sixty-two WRIAs have been identified throughout Washington State by Ecology. The City limits encompass portions of both the Puyallup-White WRIA (WRIA 10) and the Chambers-Clover WRIA (WRIA 12).
- City Watersheds - There are nine watersheds located within the City limits of Tacoma. Some of these watersheds are associated with stream systems. Several watersheds cross jurisdictional boundaries including both Pierce and King Counties, the Puyallup Tribe Reservation lands, and various municipalities within these counties. The City's watersheds are delineated on both topographical contours and storm system drainage collection areas.
- City Asset Management Areas – Within the City limits of Tacoma, the City's watersheds are further divided into Asset Management Areas. Asset Management Areas generally comprise of major "branches" of the stormwater drainage system and the drainage basin area served by each branch. The Asset Management areas for each watershed are designated by a double letter and double number labeling system.

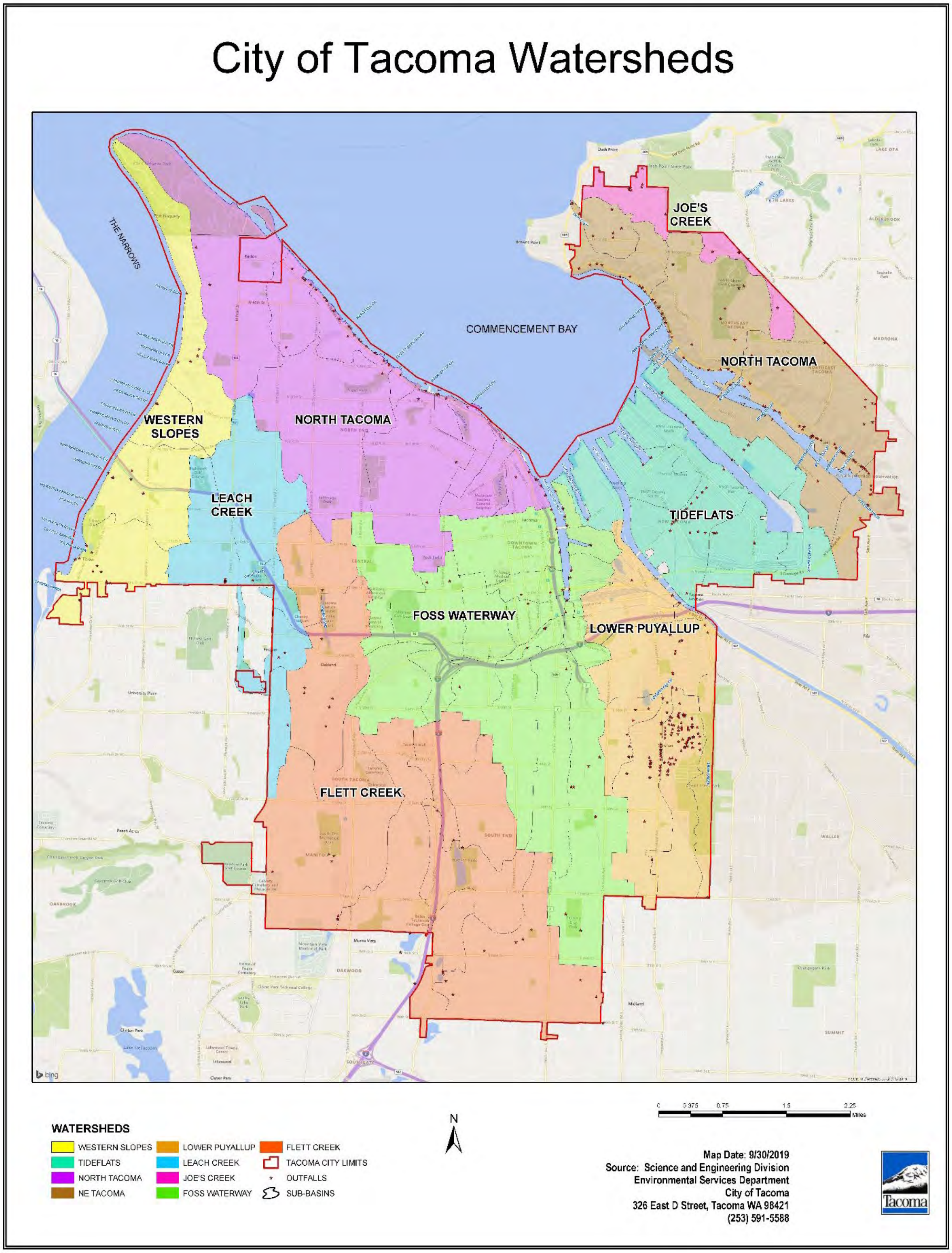

Figure 1-1. City of Tacoma Watersheds

This WC Report characterizes conditions in Tacoma's nine watersheds[1]. The nine Tacoma watershed areas and their asset management area designations are as follows:

- *Flett Creek Watershed* (FL)
- *Leach Creek Watershed* (LC)
- *Lower Puyallup Watershed* (LP)
- *Thea Foss Waterway Watershed* (FS)
- *Western Slopes Watershed* (WS)
- *North Tacoma Watershed* (NT)
- *Northeast Tacoma Watershed* (NE)
- *Joe's Creek Watershed* (JC)
- *Tideflats Watershed* (TF)

1.4 Report Organization

An overview is given of the City of Tacoma soils and geology, climate conditions, land use, receiving waterbodies, and regulatory conditions related to natural systems protection and stormwater management. Next there are separate chapters for each of the nine watersheds with detailed information specific to that watershed:

- General description of the watershed – Size, geographic location, land use and development current conditions and history, geology, significant habitat features and waterbodies.
- Stormwater system features – Stormwater system discharge locations to receiving waters, current or planned regional stormwater management facilities, privately and publicly-owned stormwater conveyance systems and neighborhood stormwater facilities, jurisdictional boundaries for the City stormwater system and stormwater maintenance activities.
- Major Receiving waterbodies – Summary for each major receiving waterbody to include geographic information, ESA listed species, critical habitat areas, water quality information, restoration activities and stormwater drainage system elements .
- Site-specific considerations – NPDES sensitive habitat site locations, groundwater protection district, infrastructure at risk due to climate change impacts (https://cms.cityoftacoma.org/Sustainability/Climate_Resilience_Study_Final_2016.pdf) , localized flooding issues.

2.0 CITY OF TACOMA OVERVIEW

The City of Tacoma (City) is a mid-sized urban area located in the state of Washington and is situated on the banks of the Puget Sound. With a population of about 220,000 residents within a 50 square mile area, it is the third-most populous city in the state, after Seattle and Spokane. The Puget Sound Regional Council regional growth planning is projecting population increase in Tacoma of up to 37% by 2040. (G:\ES_Asset_Management\5.0 CIP Planning\5.3 Work Products\WW Comprehensive Plan\Population and Employment Projections)

This chapter summarizes existing natural conditions within the City including topography, soils, groundwater, climate, receiving waterbody conditions and regulatory information that will be used to assist with the prioritization of stormwater management actions in the City of Tacoma. Additional data related to social and economic conditions, environmental justice and equity concerns, neighborhood needs and perspectives, and tribally-significant traditions and socio-ecological systems are being assessed and incorporated into the Urban Waters Protection Plan via the Tacoma Equity Index map (https://www.cityoftacoma.org/cms/One.aspx?portalId=169&pageId=175030) and ongoing conversations with community members and partner organizations.

2.1 TOPOGRAPHY, SURFACE GEOLOGY AND SOILS

Tacoma lies within the Puget Sound Lowland, a basin with surface elevations ranging between 0-550 feet above mean sea level and bordered by the Cascade and Olympic Mountains. The surface geology and topography were created during the Vashon Stade of the Frazier glaciation. The glaciation ended about 13,000 years ago. Tacoma geology is dominated by alternating glacial and interglacial deposits that rest on an irregular bedrock surface. (Kathy Troost, Geology of the Puget Lowland, September 7, 2006). The surface deposits are Vashon Stade glacial sediment units. The general stratigraphy from oldest to youngest (surface): glaciolacustrine silt and clay; deposited in proglacial lakes, advance outwash; sand and gravel deposited by braided streams, till; deposited beneath the glacier, and recessional outwash; deposited by braided streams as the glacier retreated. The recessional outwash was not deposited as a continuous unit across much of Tacoma, so the till is often the surface sediment. Also, in Tacoma there are numerous north-south ridges oriented to the ice flow direction. The ice movement smoothed the glacial sediment into the elongated teardrop shapes.

The local surface geology is mainly defined by historic glacial activity which created terraces and channels with mostly layers of advanced outwash, recessional outwash and glacial Vashon till. The Vashon till is a clay, silt, sand and gravel mixture with low permeability and porosity. There are also areas of Steilacoom gravel in the southern portions of Tacoma, which are highly permeable. The surface soils (top 60 inches of the subsurface) are identified on USDA (1939) maps and are generally types of gravelly sandy loam.

Local geotechnical data such as soil type and depth to groundwater can be found in boring logs collected in many locations throughout Tacoma, and some boring logs are available publicly and can be found at the Department of Natural Resources Washington Geologic Information Portal.

2.2 CLIMATE AND WEATHER CONDITIONS

The City experiences relatively mild weather conditions typical of the Puget Sound Lowlands. The warmest months are typically July and August with an average high temperature of 77°F. The coolest months are December, January and February, when the average low temperature is approximately 36-37°F (Table 3-1).

Most precipitation in the City occurs during the cool, winter months. Between November and March, average monthly precipitation totals range from 4.1 to 6.7 inches, while the months of May through September are generally dry and typically have precipitation totals of less than 2.2 inches. The high volume of rainfall received during the winter months, the intensity of this rainfall, and the fact that it often falls onto an already saturated watershed means that management of wet-weather stormwater is a critical function for the Tacoma's storm system. Winter rains are also the primary water source for recharging groundwater supplies, the primary source for stream summer base flows and a handful of Tacoma Public Utilities drinking water wells.

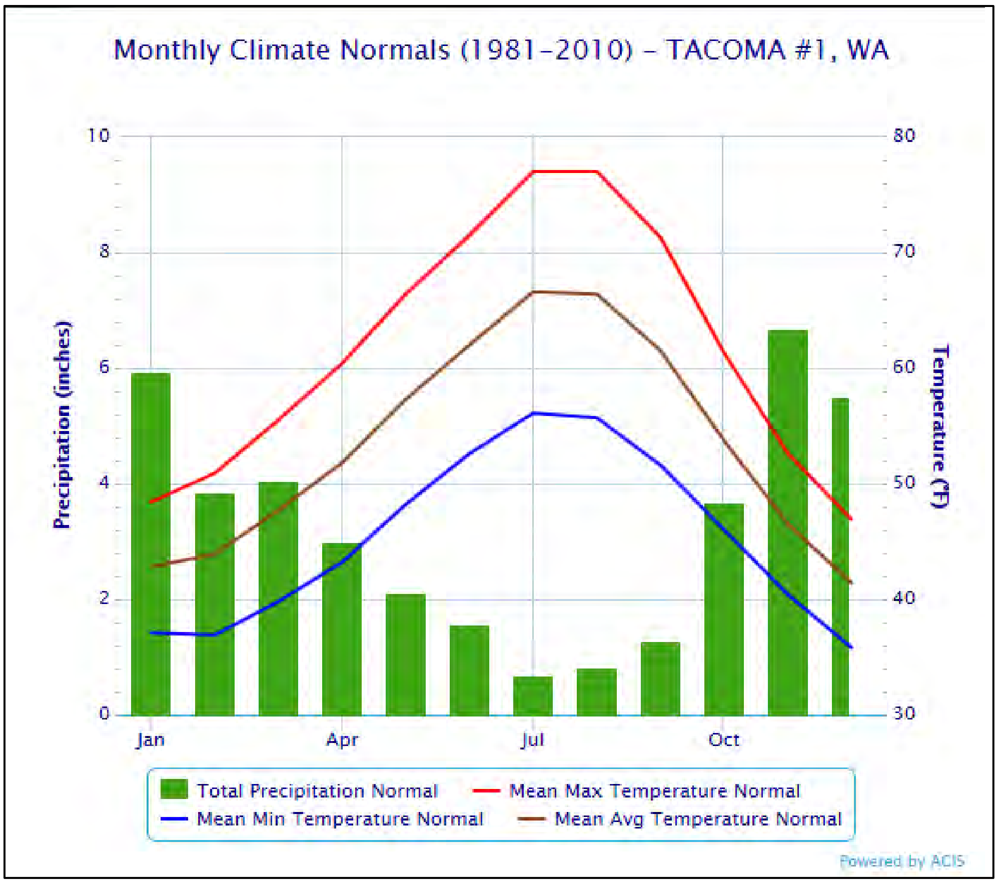

Figure 2-1. NOAA Monthly Climate Normals (1981-2010) Tacoma #1 WA[2]

[2] *Reference: NOAA. National Weather Service. Tacoma No. 1 Station.* *http://w2.weather.gov/climate/xmacis.php?wfo=sew*

The *University of Washington Climate Impacts Group* of researchers has developed a climate model of Puget Sound that predicts an increase in intensity of storm events and decrease in snowpack which could lead to even lower summer stream flows and more localized flooding events in the winter months. Tacoma's storm pipe design standards are being evaluated to determine if pipes should be upsized based on currently available climate model predictions. Tacoma is also planning to evaluate future stormwater system performance under various climate change scenarios to identify where critical system failures may occur.The Tacoma Climate Change Resilience Study was completed in 2016. The study provides an assessment of how climate change is expected to impact Tacoma's built infrastructure, natural systems, and social services. It also provides recommendations on near-term actions to prepare for the impacts of increased precipitation intensity, more landslides, warmer temperatures and sea level rise. Specific watershed locations that were assessed in the study include: Ruston Way, Salmon Beach slopes, Marine View Drive, First Creek, Leach Creek Holding Basin, Flett Creek Holding Basin, Commencement Bay Tideflats and Shoreline, and the lower Puyallup River including the delta, levees, historic channel zone, and habitat restoration sites.

2.3 LAND USE

The City is a diverse urban center located on the banks of the Puget Sound. The City's land use can be described as a mix of residential, commercial, industrial, and recreational areas with small streams and natural habitat areas mixed throughout.

2.3.1 Historic Land Use

Prior to the first European settlers' arrival in the 1850's, these lands were primarily inhabited by tribal peoples including The Puyallup Tribe of Indians, the Muckleshoot Indian Tribe, the Nisqually Indian Tribe and the Squaxin Island Tribe who harvested and managed the natural resources in the South Puget Sound from time immemorial. The Tacoma area was considered a social center and many Pacific Northwest Tribes traveled and traded here. Tribal communities stewarded these resources for subsistence use in support of their economy, social organization, cultural values and identity.

Following the Medicine Creek Treaty negotiations of 1854, resulting Treaty Wars between 1855-1856, and the Fox Island Council of 1856 to renegotiate the reservation land boundaries, most of the Puyallup, Nisqually, Squaxin and Muckleshoot people were forced to relocate onto reservation lands set aside for them. Subsequently, European settlements continued to grow and overtake most of the land in and around Tacoma with logging, farming, and mining. By the early 1900s, the forested lowland areas were logged and converted to other uses, including agriculture and residential developments. Most of the urban and industrial land uses were concentrated at the Puyallup River delta and the shorelines of Commencement Bay. Throughout the late 20th century, the Puyallup Tribe of Indians continued to fight for their treaty right to continue to hunt, fish and gather on all usual and accustomed grounds throughout the region. Members of the Puyallup Tribe led a nonviolent resistance effort against local authorities to continue to fish under the Puyallup River Bridge (later dubbed the Fish Wars) which led to the 1974 Boldt Decision protecting tribal fishing rights. In 1990, the Puyallup Tribe also negotiated a monumental Lands Claim Settlement reclaiming historic Puyallup tribal lands in the Port of Tacoma. As a result of these and other efforts by the Puyallup Tribe of Indians, a significant amount of land in the Lower Puyallup and Tideflats watersheds is still under the ownership of the Puyallup tribe or tribal members, and tribal members continue to live and own businesses both on and off the reservation. Existing Upland Land Use

The City is approximately 31,600 acres of land and the developed areas exhibit a variety of different types of land cover. The majority of land in the City has been fully built out for over fifty years. For this watershed planning effort, the City's land uses are classified into one of four existing land use categories:

- Commercial (includes multi-family of four or more dwellings) - 16%: Tacoma's commercial areas are a mix of retail, dining and entertainment. The downtown area is the main business district with high-rise buildings, office space and a variety of other businesses and restaurants.
- Industrial - 14%: Tacoma is known for its industrial activities with a large industrial port that serves as a major gateway for international trade. The City has a significant industrial land use, including manufacturing, warehousing and distribution facilities located in several designated industrial zones throughout the City.
- Residential (single family up to three-unit dwellings) - 51%: Residential land use makes up the largest land use in the City. These neighborhoods area typically characterized by single family houses with a mix of landscapes. Through the Home in Tacoma Project, part of the Affordable Housing Action Strategy, the City is in the process of rezoning most of the residential neighborhoods along major arterial streets and commercial districts to allow more multi-unit options such as townhomes and small apartment buildings.
- Parks and open spaces – 19%: Most of Tacoma's undeveloped open space is clustered on steep slopes and around gulches and often has restrictions on access and use especially within a stream or wetland buffer or biodiversity corridor under the Critical Areas Preservation Ordinance. Tacoma Metro Parks properties and recreational facilities provide many opportunities for outdoor activities in the urban landscape. The Metro Parks Strategic Master Plan has identified a "10-minute walk" level of service with a goal to provide every resident with easy access to nearby parks. Additionally, many of Tacoma's shoreline waterfront areas offer public access to further recreational opportunities and enhance the livability in the City.

2.3.2 Types of Urban Land Cover

A recent 2018 Urban Tree Canopy Report evaluated the extent of different types of land cover in Tacoma. In 2017, the City of Tacoma looked like this:

- 20 percent urban tree canopy
- 13 percent non-canopy vegetation (4,257 acres)
- 14 percent soil/dry vegetation (4,469 acres)
- 52 percent impervious (hard) surfaces (16,344 acres)
- < 1 percent surface waters (132 acres)

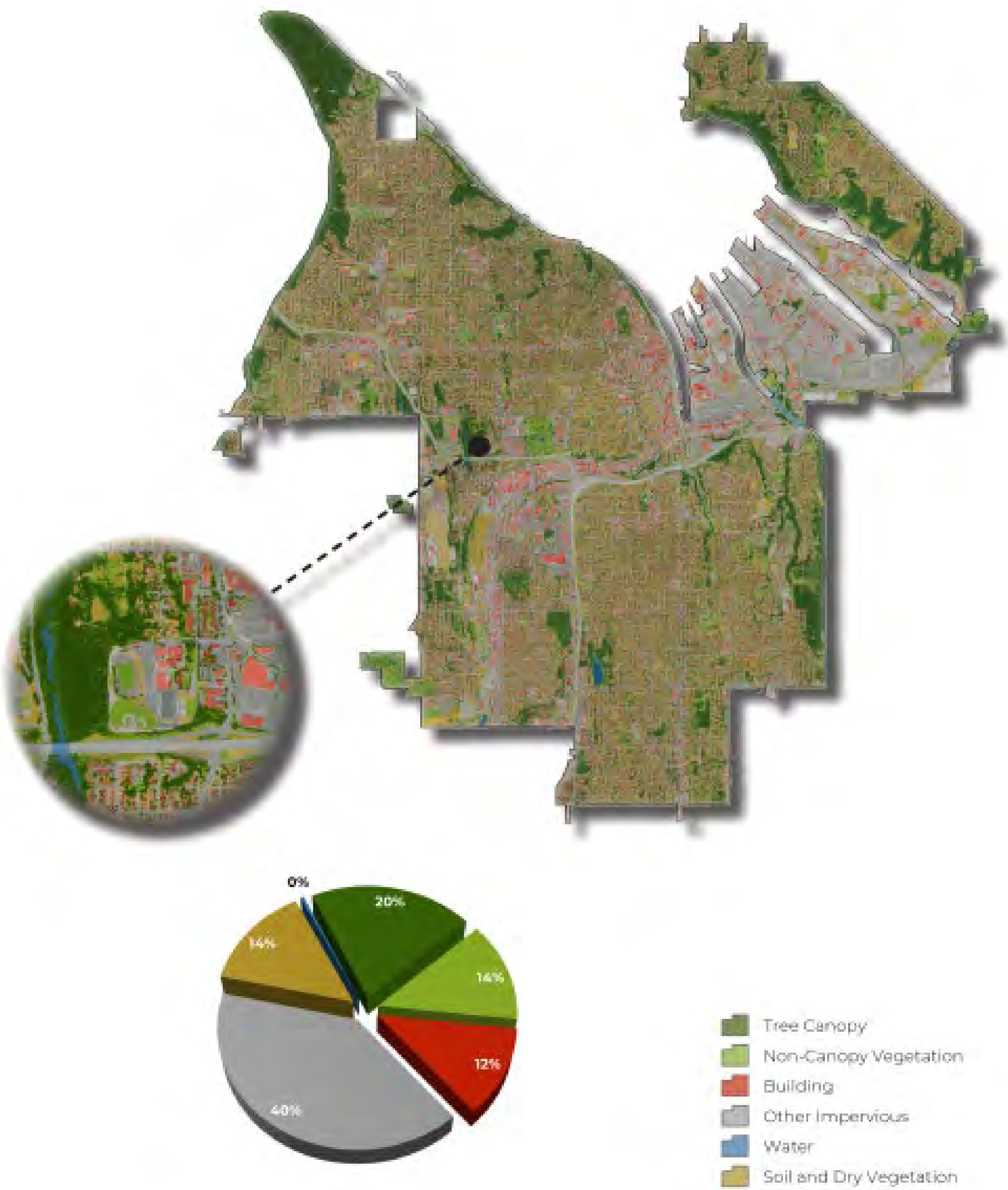

Figure 2-2. Excerpt from the Urban Tree Canopy Report: Land cover classes for Tacoma, Washington based on 2017 NAIP imagery and 2017 Washington State DNR LiDAR data. (Percentages based on total acres.)

The majority of the hard surfaces (known as effective impervious surfaces, EIS) and some landscape areas are directly connected to the municipal separate storm sewer system and when it rains, water drains off these surfaces as "runoff" that is piped to local creeks, streams and marine shorelines and can sometimes cause flooding and erosion.

When an area remains pervious (like landscaping or porous pavement), it allows water to soak into the ground, and helps to reduce the amount of polluted runoff flowing into surface waterbodies. Pervious areas can also help filter pollutants as well as recharge groundwater aquifers, providing important benefits for both the environment and human health.

There have been several research studies conducted to evaluate the relationship between impervious area and the threshold at which it can cause negative impacts on the environment. Overall, studies indicate that when impervious cover exceeds 10-40% this can impact stream health and increase temperatures in urban environments. IT is important for planners and policymakers to consider these thresholds when making decisions about land use and development in areas discharging to receiving waters. While the overall impervious cover in the City is 52 percent there are natural space open areas, biodiversity areas, and high-value ecosystems that should be protected.

2.3.3 Existing Shoreline Land Use

The shorelines of Tacoma have great social, ecological, recreational, cultural, economic and aesthetic value. Tacoma's extensive freshwater and marine water shoreline areas are unique and irreplaceable and provide multiple benefits including access to deep-water port and related industrial operations in the Tideflats; habitat for a variety of fish and wildlife including salmon, shellfish, forage fish, and waterfowl; archaeological and historical sites; open space; and areas for boating, fishing, and other forms of recreation. Because managing all of these competing shoreline uses is extremely complex and challenging, the City of Tacoma has a *Shoreline Master Program* to help balance and regulate these uses to ensure that these shoreline resources can be maintained over time.

The City's shoreline classification system consists of six shoreline environments that are consistent with the Washington State Shorelines Management Act (Chapter 90.58 RCW), the *Shoreline Master Program* guidelines (Chapter 173-26 WAC), and the City of Tacoma Comprehensive Plan. The goal of these guidance documents is to assure that existing shoreline ecological functions are protected alongside the proposed pattern and intensity of development, and policies for restoration of degraded shorelines are implemented consistently. The City of Tacoma, Port of Tacoma, and Puyallup Tribe of Indians are collaborating with other stakeholders in the development of the *Tideflats Subarea Plan* to create a shared long-term vision and more coordinated approach to development, environmental review, and strategic capital investments in the Tideflats to promote economic prosperity for all while restoring and protecting critical shoreline habitat.

2.4 RECEIVING WATER BODIES

The City defines receiving waters as, "Naturally and/or reconstructed naturally occurring surface water bodies, such as creeks, streams, rivers, lakes, wetlands, estuaries, and marine waters, or groundwater, to which a stormwater system (MS4) discharges" (Tacoma SWMM 2021).

The City's stormwater system discharges into two types of receiving waters: marine/estuarine waters and freshwater. A majority of the city drains to marine/estuarine waters of Puget Sound in particular Commencement Bay, the Lower Puyallup River (a salt-wedge estuary) and the Narrows.

The watersheds that drain to these receiving waters are Northeast Tacoma, North Tacoma, Thea Foss Waterway, Tideflats, Lower Puyallup and Western Slopes.

The remaining watersheds drain to freshwater including Flett Creek, Leach Creek, Joe's Creek and a small drainage area flowing to Swan Creek. Additionally, North Tacoma and Western Slopes have several small freshwater creeks that originate from underground springs and shallow groundwater along the steep slopes in these areas. Generally, the small creeks in Tacoma are in deep isolated gulches that do not receive stormwater runoff from surrounding developed areas.

There are also many smaller high probability and known wetlands and minor waterbodies that receive stormwater runoff and are protected by local, state and federal environmental regulations. The existing GIS mapping layer used by the City to identify the locations of known, high probability and non-jurisdictional wetlands is continually updated with additional information as new wetland studies and delineations become available through private development and public improvement projects.

2.5 SURFACE WATER/RECEIVING WATER ENVIRONMENTAL CONDITIONS

Many marine waterways, rivers, lakes and streams in Tacoma have been ranked based on their level of habitat impairment under federal and state environmental regulations. This section describes the environmental conditions and designations of various waterbodies that will be considered when prioritizing watershed basins for stormwater management actions to reduce stormwater impacts to receiving waters.

2.5.1 Restoration and Protection Areas

Finding balance between the vital role that port activities play in the economy of the Pacific Northwest and the need to protect and restore this important environmental resource has led to the development of numerous habitat restoration sites within the Commencement Bay area as well as upstream in the Puyallup River and Hylebos Creek, among other areas. The City and other responsible parties have constructed key habitat sites or sensitive areas for many reasons including; mitigation sites that have been constructed as part of environmental cleanup projects, restoration sites built to offset damages that were caused by past contamination (Natural Resource Damage Assessment Sites), mitigation sites built in conjunction with development projects, etc. These sites typically have restrictive covenants or institutional controls that are conveyed with the property to ensure that the habitat is protected in perpetuity.

2.5.2 Endangered Species

Salmonid fish species are one of the key indicators of stream health and focus for protection under the federal Endangered Species Act. The federal status of Puget Sound salmonid species in WRIA 10 and 12 is listed below (referenced from the *Salmon Habitat Protection and Restoration Strategy for Puyallup and Chambers Watersheds*, June 2018). Washington State Department of Fish and Wildlife *Salmon Scape Map* shows which streams in Tacoma have been identified as salmonid habitat based on species. These streams will receive priority for stormwater quality treatment in the upstream drainage basins.

Table 2-1 Federal Status of Puget Sound Salmonid Species WRIA 10/12				
Common Name	**Scientific Name**	**Evolutionary Significant unit**	**Critical Habitat**	**Regulatory Agency Status**
Chinook salmon	*Oncorhynchus tshawytscha*	Puget Sound Chinook*	Yes/2005	NMFS / Threatened / 1999
Chum salmon	*Oncoryhnchus keta*	Puget Sound Chum	No	No listing
Coho salmon	*Oncorhynchus kisutch*	Puget Sound/Strait of Georgia Coho	No	NMFS/Species of Concern / 1997
Pink salmon	*Oncorhynchus gorbuscha*	No listing	No listing	No listing
Dolly varden / Bull trout	*Salvelinus confluentus*	Puget Sound Dolly Varden / Bull Trout	Yes	USFWS / Threatened / 1999
Coastal cutthroat trout	*Oncorhynchus clarki ssp.*	No listing	No listing	No listing
Steelhead trout	*Oncorhynchus mykiss*	Puget Sound Steelhead	Yes/2016	NMFS / Threatened / 2007

*Includes Puyallup River Fall Chinook and White River Spring Chinook

2.5.3 Surface Waters of the State Use Designations

Water quality criteria that apply to all fresh waters, marine waters and lake uses in Washington State are described in WAC 173-201A.

All surface waters of the state named in WAC 173-201A are to be protected for the designated uses of: Salmonid spawning, rearing, and migration; primary contact recreation; domestic, industrial, and agricultural water supply; stock watering; wildlife habitat; harvesting; commerce and navigation; boating; and aesthetic values. The following water use designations are listed for the mouth of the Puyallup River and the Commencement Bay waterways, which are the main receiving waters in the

City that receive stormwater runoff from the City's stormwater system. Smaller, basin-specific surface waters of the state are discussed in their respective watershed sections.

Waterbody	Use Designations	Miscellaneous Uses
Puyallup River upstream from the mouth to river mile 1.0	Fresh Waters: Rearing/migration only, primary contact, water supply for industrial, agricultural and stock.	Wildlife habitat, harvesting, commercial/navigation, boating, and aesthetics
Commencement Bay south from "Brown's Point" and north through the Hylebos waterway	Excellent aquatic life, shellfish harvest, primary contact	Wildlife habitat, harvesting, commercial/navigation, boating, and aesthetics.
Commencement Bay, inner, through Hylebos waterway except the city waterway south and east of south 11th Street	Good aquatic life, primary contact	Wildlife habitat, harvesting (excludes shellfish), commercial/navigation, boating, and aesthetics
Commencement Bay, city waterway south and east of south 11th Street	Fair aquatic life, primary contact	Wildlife habitat, commercial/navigation, boating, and aesthetics

The Washington State Department of Fish and Wildlife and the Tribes co-manage these waterbodies to maintain their habitat-related beneficial uses. The Department of Ecology enforces water quality standards in collaboration with the US Army Corps of Engineers. The Urban Waters Protection Plan will also take these use designations into consideration when prioritizing stormwater management actions in the upstream drainage basins.

2.5.4 303d listed waterbodies

The Clean Water Act (CWA) also requires states to identify impaired waterbodies (Section 303(d) list) and permit approvals, such as Section 401 Water Quality Certifications, to ensure CWA standards are met. Within Washington State, the U.S. EPA has delegated administration of these CWA requirements to the Washington State Department of Ecology and United States Army Corps of Engineers. In addition, the state regulates water quality through the Washington Pollution Control Act (WPCA).

The Section 303(d) list of impaired waterbodies is periodically updated by Ecology and submitted to the U.S. EPA for review and approval. Ecology currently submits these lists on a 2-year alternating cycle of the freshwater listing and the marine water listing. The water quality information presented in this WMP is based on the information available in December 2019. Ecology anticipates having a new draft list of impaired waters for review in early 2024.

In developing the Section 303(d) list, Ecology identifies five categories of water quality health:

- **Category 1** – Meets Tested Standards for Clean Waters
- **Category 2** – Waters of Concern
- **Category 3** – Insufficient Data
- **Category 4** – Polluted Waters that do not require a Total Maximum Daily Load (TMDL) limit of targeted pollutant(s) to achieve the surface water quality standards. Three subcategories are:
- **Category 5** – Polluted waterbodies that require a TMDL

Category 5 waterbodies are placed on the state's 303(d) list of impaired waterbodies. Pursuant to CWA requirements, the state must perform a TMDL study for all Category 5 waterbodies identified on the Section 303(d) lists. A TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet the water quality standards. It also identifies the sum of the allowable loads of a single pollutant from all point and nonpoint sources and determines a margin of safety to ensure that the waterbody can be protected in case there are unknown pollutant sources or unforeseen events that may impair water quality. The most recent 303(d) list for freshwaters identifies the following impaired Category 5 water bodies in the City (*Ecology 303d Listing*):

Table 2-2 WRIA 10 & 12 Waterbody Impairments		
Waterbody	**Impairment**	**EPA Waterbody Report**
Puyallup River	Recreation primary contact (Fecal Coliform)	Puyallup River Tacoma Waterbody Report (epa.gov)
Leach Creek	Bacteria and Mercury	Leach Creek Waterbody Report (epa.gov)
Flett Creek	Dissolved oxygen and Fecal Coliform	Flett Creek Waterbody Report (epa.gov)
Chambers Creek	Fecal Coliform	Chambers Creek Waterbody Report (epa.gov)
Wapato Lake	Aquatic Life (Total P) & Recreation primary contact (Fecal Coliform)	Wapato Lake Waterbody Report (epa.gov)
Wapato Creek	Multiple Impairments	Wapato Creek Waterbody Report (epa.gov)
Joe's Creek	Recreation Primary Contact (Fecal Coliform)	Joe's Creek Waterbody Report (epa.gov)
Commencement Bay	Multiple impairments	Tacoma Community Waterbody Report (epa.gov)

Wapato Lake has a current TMDL limit (Ecology 1993) for phosphorus and this is discussed further in Section 3.2. The Urban Waters Protection Plan will use the 303(d) listing designations to help determine options for protection and restoration activities in the drainage basins.

2.5.5 Superfund Sites

Commencement Bay Superfund Designation (Commencement Bay Superfund Map)

Over time, the accumulated environmental impacts to the former Puyallup River delta area including dredging and filling the waterways, shoreline armoring and years of discharges of toxic chemicals and industrial waste into the ground and water took its toll. In 1981, Commencement Bay was identified by the Environmental Protection Agency (EPA) as one of the highest priority sites in the nation requiring environmental cleanup. CERCLA is commonly referred to as the Superfund program.

In 1994, the City, Ecology and Metro Parks Tacoma negotiated a first-of-its-kind area-wide consent decree for cleanup of the upland properties of Commencement Bay. This set into motion decades of additional study, cleanup and monitoring of the various contaminated areas. Ongoing monitoring of the capped cleanup areas and stormwater discharging into these areas will continue. The Nearshore/Tideflats portion of the Commencement Bay site includes contaminated areas of bottom sediment located in the Hylebos Waterway (Northeast Tacoma Watershed), Sitcum and Middle Waterways (Tideflats Watershed), and Thea Foss Waterway (Foss Waterway Watershed). In addition to the Nearshore Tideflats portion of the Commencement Bay site, the Asarco Smelter area (North Tacoma) and the South Tacoma Field area (Flett Creek Watershed) were identified as areas requiring remediation of contaminated soil and groundwater. Detail on the cleanup work that has been done at these sites is included in each of the individual watershed sections.

2.5.6 South Tacoma Groundwater Protection District

Groundwater is a critical part of the water cycle throughout the Puget Sound lowlands. Groundwater aquifers can be important drinking water sources, and movement of water from the shallow groundwater aquifer into local streams is critical for maintaining adequate stream flow and for cooling streams during dry summer months.

In 1985, the City of Tacoma adopted the South Tacoma Plan, which formally designates the South Tacoma Groundwater Protection District (STGPD) as an “environmentally sensitive” area Figure 3-4). The majority of the STGPD is in the Flett Creek drainage basin, while small portions overlap the Leach Creek and Thea Foss Waterway Watersheds. The plan lists several action steps designed to protect the South Tacoma Aquifer, which has several drinking water wells used by the City of Tacoma to supplement supply during drought conditions. The local groundwater protection program requirements for the STGPDare described in Tacoma Municipal Code Chapters 13.09.010 through 13.09.200, currently under revision.

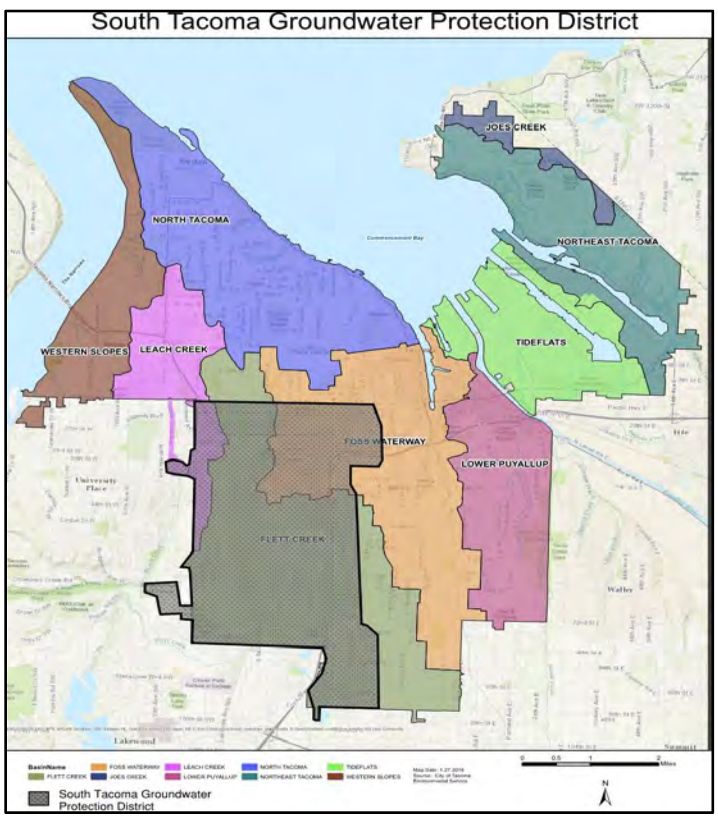

Figure 2-3 South Tacoma Groundwater Protection District

The purpose of the STGPD is to prevent potential sources of groundwater pollution from reaching groundwater. This program is administered by the Tacoma-Pierce County Health Department (TPCHD) in coordination with Environmental Services Department, Tacoma Public Utilities and the Tacoma Fire Department. TPCHD is responsible for reviewing, authorizing, and issuing permits for business and industrial operations that are regulated under the program. TPCHD staff also performs site inspections. The City of Tacoma Environmental Services is responsible for the review and approval of all stormwater site plans.

The City of Tacoma Environmental Services Department and TPCHD developed a policy and guidance document that provides the circumstances and requirements for approval of stormwater infiltration facilities for managing stormwater runoff in the STGPD. The document, “Implementation of Stormwater Infiltration for Pollution-Generating Surfaces in the South Tacoma Groundwater Protection District” is available online here. The Urban Waters Protection Plan will take this guidance into account when evaluating opportunities for infiltration in the STGPD.

3.0 FLETT CREEK WATERSHED

3.1 OVERVIEW

The Flett Creek Watershed is approximately 7,930 acres with 7,130 acres within the City of Tacoma limits and is the largest watershed in the City (Figure X). The Flett Creek Watershed is located in the Chambers-Clover Water Resource Inventory Area (WRIA12). Stormwater runoff from the entire watershed ultimately flows into the Flett Creek Holding Basins and discharges from a single point to the Flett dairy wetlands and Flett Creek. The area is predominately residential with commercial and light industrial uses in localized areas. The watershed is 43 percent impervious.

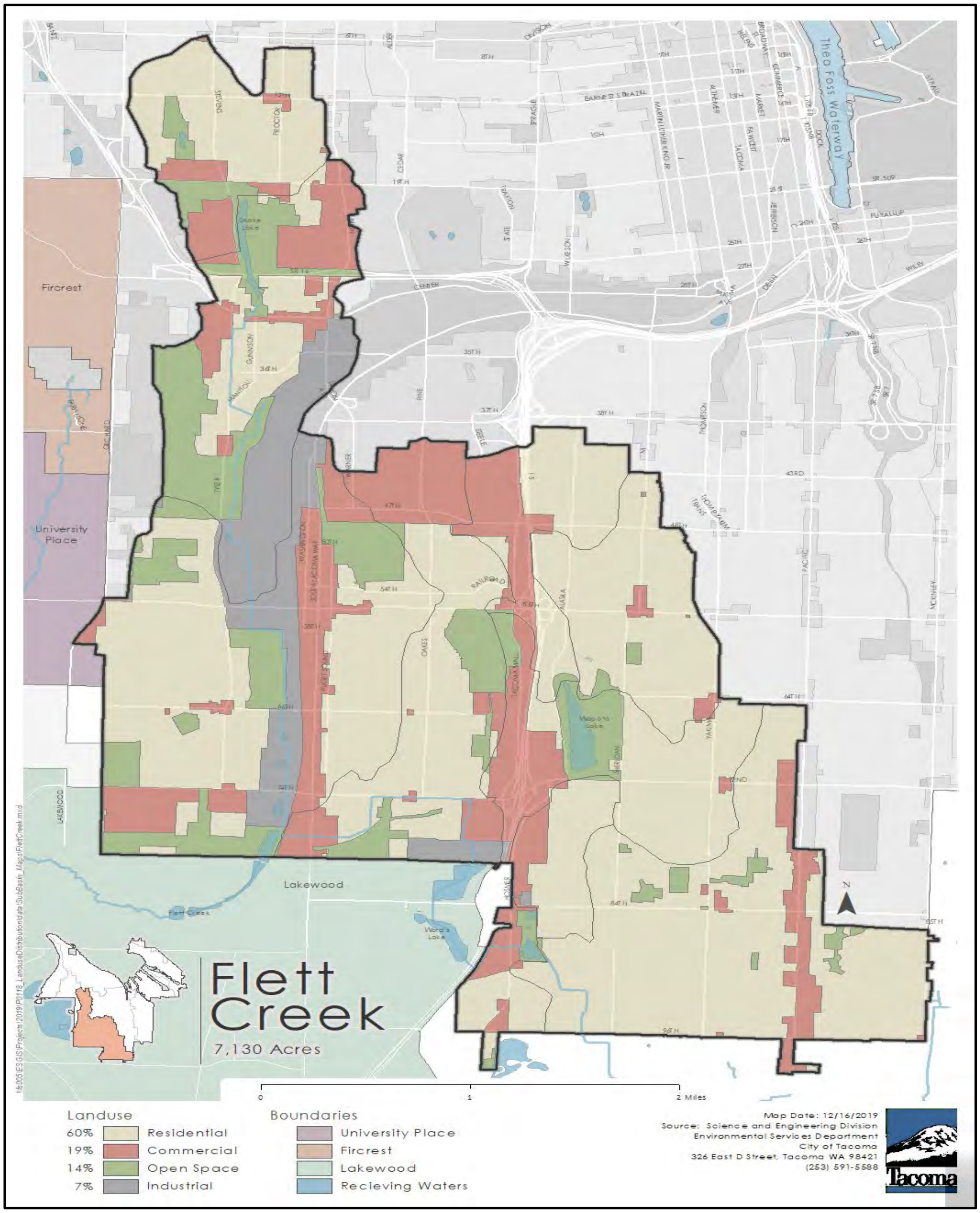

Figure 3-1. City of Tacoma Flett Creek Watershed Landuse Map

Flett Creek Watershed is bordered by the Thea Foss Watershed to the east, Leach Creek Watershed on the west and Pierce County to the south. The watershed includes Snake, Wapato and Wards Lakes, Hosmer and 84th Street Holding Basins, the Flett Creek Holding Ponds, portions of Interstate 5 and State Route 16, the South Tacoma Groundwater Protection District and the South Tacoma Channel Superfund Site.

3.1.1 Stormwater Conveyance

All 7,930 acres of the watershed drain into the Flett Creek Holding Basins, which are pumped from a single pump station into the Flett Dairy Wetlands and Flett Creek. For the purpose of describing flow through the Flett Creek Watershed, the watershed is divided into an eastern and western portion. Both portions ultimately discharge to Flett Creek and subsequently to Chambers Creek, which is located outside the City of Tacoma city limits. Stormwater is conveyed through the watershed primarily by underground conveyance systems and open water holding basins, some localized ditch systems exist (Figure 3-3).

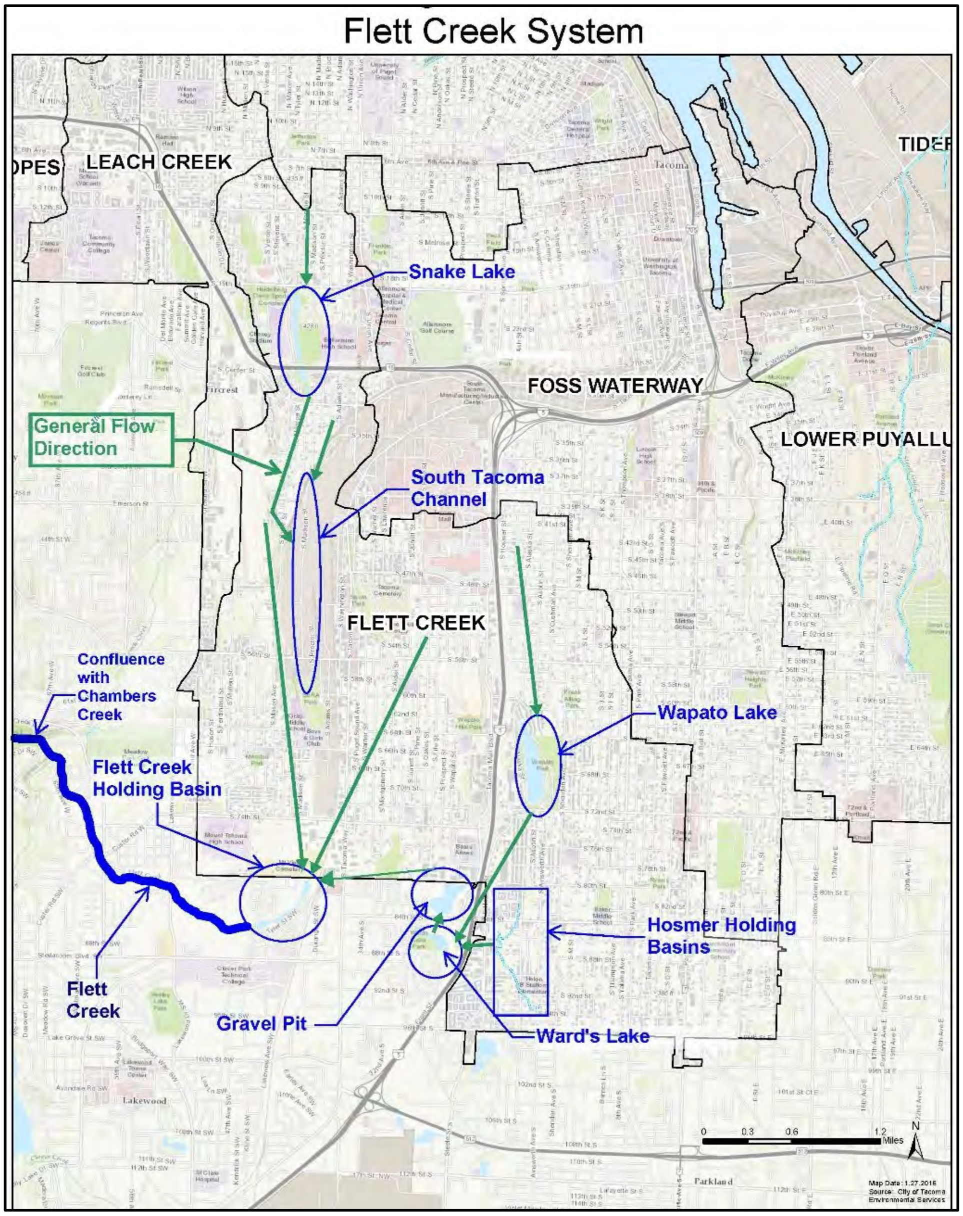

Figure 3-2 Flett Creek Stormwater Conveyance System

Flett Creek Watershed – Eastern Portion

The eastern portion of the watershed drains 4,782 acres (3,982 within Tacoma) and, in order of drainage, includes Wapato Lake, Hosmer Holding Basin, Wards Lake, the 80th Street Holding Basin (Gravel Pit) and the Flett Holding Ponds. Each of the holding basins, and Wapato and Wards Lakes, have outlet gates. While all outlet gates may be adjusted to modify discharge rates, only the 80th Street Holding Basin is regularly adjusted for this function. All drainage is via gravity flow until the Flett Creek Pump Station at the terminus of the Flett Holding Basins, which discharges to Flett Dairy wetlands and Flett Creek.

The northeastern headwaters (~900 acres) drain to the north cell of Wapato Lake. Except during intense rain events (< 2% of all flow, > 1in/24hrs), water entering the north cell bypasses the main lake (recreation area), drains south under I-5, and enters Wards Lake.

Wards Lake is part of a series of holding ponds known as the Hosmer System (see Figure 3-X). The Hosmer System consists of the Hosmer Holding Basin, the Ward's Lake Holding Basin, and the 80th Street Holding basin (formerly known as the Gravel Pit Holding Basin). The drainage area for the Hosmer system is approximately 3,082 acres (~3,882 acres including unincorporated Pierce County) of which 41% is impervious surface.

Stormwater drains to the Hosmer Holding Basin primarily through underground conveyance, though limited ditch systems exist within Ryan's Park, the eastern edge of the basin and portions of the 800 acres draining from unincorporated Pierce County. Water from Hosmer flows under I-5 and enters Wards Lake alongside the Wapato Lake outfall. Water from Ward's Lake then flows to the Gravel Pit Holding Basin where it is further conveyed via gravity flow to the Flett Creek Holding Ponds. Water flow out of the Gravel Pit is controlled by a storm gate maintained at 70% open. In addition to Tacoma and unincorporated Pierce County flow contributions, a portion of stormwater runoff from Lakewood and WSDOT right-of-way flows into Ward's Lake. A portion of stormwater runoff from the City of Lakewood also discharges directly to the Gravel Pit Holding Basin as well as the Flett Ponds (Figure 3-3).

Flett Creek Watershed – Western Portion

Stormwater runoff from the western portion of the watershed (3,147 acres) flows directly to the Flett Creek Holding Basins via the piped stormwater conveyance system or through Snake Lake and the South Tacoma Channel. Stormwater runoff from the northwest portion of the watershed discharges to Snake Lake and then flows to the South Tacoma Channel. Water reaching the South Tacoma Channel enters a series of open ditches and is largely infiltrated. During periods of above normal precipitation, stormwater runoff leaves the South Tacoma Channel (1,451 drainage acres), joins the piped conveyance to the south (1,696 acres) and enters the Flett Creek Holding Ponds (Figure 3-3).

Flood Storage

The Flett Creek Watershed has unique flood control opportunities due to the large number of holding basins. Some basins, such as Wapato Lake, have facilities only slightly higher than current water levels and thus are defined by a dominance of dead storage (consistently filled with water). The other holding basins have large active storage volumes that reduce peak flows that could cause flooding and erosion. The lakes and holding ponds provide an estimated total of 734 acre-feet of active storage.

3.2 Receiving Waterbodies and Regional Stormwater Facilities

This watershed discharges to several receiving waterbodies including Snake Lake, Wapato Lake, Flett Creek, and Chamber's Creek. Other major facilities, conveyances and environmental considerations discussed here include the Hosmer Holding Basin, Wards Lake (Owens marsh) in Lakewood, 84th Street Holding Basin (Gravel Pit), Snake Lake, South Tacoma Channel, Flett Ponds and the South Tacoma Groundwater Protection District (Table 3.3). There are also several high probability and known wetlands.

Several receiving waterbodies discussed in this section are located outside of the City's boundaries, though in some cases the City takes an active role in maintenance of these systems. All waterbodies in the Flett Creek Watershed discharge to the Flett Wetlands and Creek downstream of the City of Tacoma Flett Creek Pump Station. Stormwater protection and mitigation requirements are based upon protection of receiving waterbodies and the South Tacoma Groundwater Protection District. The following table outlines major receiving waterbodies, facilities and conveyances, which influence management of stormwater flow and water quality (Table 3.3).

Table 3-1 Flett Creek Watershed Major Waterbodies and Stormwater Holding Basins/Facilities						
Site	**[1]Type**	**Size (ac)**	**[2]Storage D, A(ac-ft)**	**[3]Active % of Total**	**[4]Uses**	**Ops**
Wapato Lake North Pond	W	2.5	7, 6	46%	Wildlife, aesthetics, flood control, stormwater treatment	MP/COT
Wapato Main Lake (south)	L	20.5	107, 51	32%	Fishing, boating, wildlife, aesthetics, FC, ST	MP
Hosmer HB	F	11.7	13, 140	91%	Flood control, stormwater treatment	COT
Wards Lake (Owens Marsh)	W	13.8	25, 102	80%	Wildlife, aesthetics, flood control, stormwater treatment	COT/LW
84th St HB (Gravel Pit)	F	17	10, 196	95%	Aesthetics, flood control, stormwater treatment	COT
Snake Lake	W	17	46, 51	53%	Wildlife, aesthetics, flood control, stormwater treatment	MP/COT
S. Tac. Channel	CV/S/W	1.7	2, 105	98%	Conveyance	COT/BN
Flett Ponds	F	18	18, 190	95%	Wildlife, aesthetics, flood control, stormwater treatment	COT
Flett Wetland	W				Wildlife, aesthetics, flood control, stormwater treatment.	CPTC, LW
Flett Creek	S				Salmonid fish presence	LW
Total		102.2	219, 844	79%		

[1]Describes primary function of site. Wetland (W), Lake (L), Stream/Creek (S), Facility (F) or Conveyance (CV).

[2](D)ead storage, presented as volume during optimal (low-water) winter operating level. (A) Active storage is the volume defined by the level flood impacts may be observed, minus dead storage. Storage calculations are draft and the long-term goal is to gain greater understanding of active capacity. References Wapato = Clean Lakes, Inc., Hosmer, Wards and 84th Street = Cosmopolitan Engineering Group. 1996. Wapato, Snake and South Tacoma Channel conservatively estimated.

[3]Percent of active storage vs. total storage. Highlights which basins are managed for flood capacity (>90%). South Tacoma Channel is the exception; it is a depression in the landscape on lands partially under City of Tacoma and Burlington Northern control. It still serves as a peak flow delaying mechanism, regardless of ownership and lack of active management.

[4]Uses are described according to actual local use. Wapato Lake is the only waterbody that has been assessed and water quality standards applied by the Department of Ecology (in the last 20 years). Wapato does not have uses specifically defined in WAC 173-201A-602.

Snake Lake

Snake Lake is a 17-acre urban lake and wetland. It is the central feature of the Tacoma Nature Center, a 54-acre facility dedicated to nature education, research and appreciation, operated by Metro Parks Tacoma. Valued recreational uses include walking the trails and viewing wildlife. The lake does not support fishing or swimming.

The lake drains an urban residential watershed of approximately 584 acres and stormwater contributes approximately 80% of the annual flow. Large impervious areas in this drainage basin include the eastern portion of Cheney Stadium, Foss High School and a Fred Meyer shopping center. Cheney Stadium was recently retrofitted with a pervious pavement parking lot and bioretention facilities and most of the stormwater now infiltrates and no longer directly discharges to the lake.

Snake Lake sustains large seasonal fluctuations in its surface area; from 17 acres during wet weather to less than 4 acres during the summer. The water from Snake Lake discharges to the South Tacoma Channel and, during high flow events, to the Flett Creek Holding Basins.

Also located in this drainage basin is the Delong Pond wetland. It currently is an isolated water body (in the past it had a pumped outlet to the storm drainage system). It drains a small tributary area in the basin. The Pierce County Conservations Futures Program purchased part of the wetland and buffer to be preserved as wildlife habitat and open space.

Wapato Lake

Wapato Lake is a small, shallow 23-acre urban lake that drains 900 residential and commercial acres from the north. The lake is the central feature of Wapato Park, an 80-acre facility owned by Metro Parks Tacoma. As a shallow lake, Wapato vacillates between rooted plant (macrophyte) and algae dominated states (Scheffer et al. 1998). Wapato is the only recreational lake in the City, so it is the target of intense watershed and in-lake maintenance and management. The goal of these activities is to reach and maintain a clear-water state to support fishing and secondary contact (boating). Major ongoing watershed activities include:

- Listed as a ‘phosphorus limited’ watershed in the Tacoma Municipal Code. This requires stormwater phosphorus treatment in large development/redevelopment projects.
- LID including permeable concrete/pavement, raingarden, bioswale and canister systems.
- Cleaning of legacy sediments from all stormwater pipes (greater than 18 inches).
- Wastewater and stormwater pipe rehabilitation.

- Illicit discharge detection and elimination. Sampling, smoke testing and video to ensure stormwater and sanitary systems are separated and functioning correctly. Also identifies priority areas for pollutant source control. The entire watershed has been smoke tested.
- Education. Natural Yard Care program, Wapato specific catch basin marking.
- Within the park, Metro Parks has completely redesigned the shoreline to discourage roosting of geese, no longer uses turf fertilizers and funds current lake monitoring projects.

In lake activities include:

- Dredging in 1910, 1937 (180,000yd^3) and limited in 1980.
- Rooted plant harvesting, 50% of the lake was covered by rooted plants in 1971 and >90% in 1976 (Canning et al. 1976).
- 1981 major lake restoration (Entranco 1986),
- Drawdown to compact sediments,
- Divide lake to support essential functions,
- North pond - Stormwater detention, treatment and diversion. A dike was installed dividing the lake into two sections, and stormwater diverted around the southern lake.
- South Lake - Recreation including fishing, boating, aquatic life and aesthetics.
- Dilution of phosphorus with City drinking water through the north pond and south lake.
- Phosphorus inactivation with alum (chemical treatment).
- Phosphorus inactivation with alum applications occurring in 2008 and 2017.

Water quality in Wapato Lake is a challenge, due to its morphometry (shallow) and urban setting. Prior to the stormwater bypass, the lake exchanged volume 1.7 times per year. Post bypass, volume exchange is closer to every eight years. While stormwater pollutants largely bypass the lake, the impact of pollutants from birds, especially geese and release of phosphorus from lake sediments are greater. Wapato is Ecology Category 5 listed (Impaired) for fecal coliform bacteria, though the most recent bacteria samples were taken in 2010. A bacteria TMDL, or water quality improvement plan, has not been scheduled. Wapato has a TMDL for phosphorus and is currently category 4a – EPA TMDL plan in place and implemented (James 1993). Phosphorus load allocations from this TMDL were based on estimated loads achieved in 1984 (Entranco 1986), when all stormwater bypassed the main lake. Information obtained by the City of Tacoma, Metro Parks and University of Washington-Tacoma have been used evaluate phosphorus sources and management alternatives in a manner similar to a TMDL (Gawel et al. 2011). Current water quality is far better than historical (recent and record dating back to 1910, Canning et al. 1976, Entranco 1980, Entranco 1986, Gawel et al. 2011). The 2008 phosphorus inactivation treatment limited algae blooms and associated cyanobacteria toxicity for five years, toxic conditions returned 2013, 2015 and 2016. Toxicity samples have not been obtained since the 2017 treatment.

Flett Wetland and Creek

Flett Creek is approximately 3.0 miles long and is located in the City of Lakewood. The historic headwaters of the creek were located at least partially in Tacoma but were ditched and/or piped long ago. The Flett Pump Station transfers water from the Flett Ponds to the effective headwaters of Flett Wetland and Creek. Flett creek flows to Chambers-Clover Creek which ultimately discharges to the Tacoma Narrows. The United States Geologic Survey (USGS) monitors flow conditions of Flett Creek at Station 1209110. Flow data is available at http://waterdata.usgs.gov.

The Flett Wetlands are extremely flat and the creek channel slope is 0.06% for the first mile downstream of the pump station. The Flett Dairy dug and maintained this channel yearly until 1979. Post-maintenance, farm road culverts collapsed and the creek channel filled in with swamp smartweed, reed canarygrass and cattails. Further, vegetative matter collected, collapsed and created large tangles with barbwire fencing that crisscrossed the former dairy.

Invasive species dominance and blockages reduce the water quality and habitat complexity within the wetland. Summertime water temperatures can reach 80ºF and the few fish present (bullhead and stickleback) become stranded and die during low water periods.

While one benefit of wetlands are their flood storage capacity, collapsed culverts, beaver and vegetative dams caused water to backup, crossing the emergency spillway and re-enter the Flett Ponds (2009 and 2011). Adjacent and upstream properties were flooded. Multiple projects are executed yearly in an effort to increase flow rate while enhancing fisheries habitat. Projects include removal of two roads/collapsed culverts, beaver dams, barbwire tangles and clearing of invasive reed canary grass from the creek channel. The creek is very weakly confined, the banks are planted yearly with willow in an effort to start hummock? formation, eventually providing a substrate for shade producing woody plant species. While water levels remain high in the wetland, water has not passed back over the dike separating the ponds from the wetland since 2011 and cutthroat trout were observed the last two years in the channel (after lack of observed presence from 2009-2017). The City will continue to work with wetland/creek partners to enhance this system.

Hosmer Holding Basin

The Hosmer Holding Basin was constructed in 1965 and drains approximately 2100 acres. The basin consists of two cells. The southern cell receives the majority of discharge and drains residential areas to the north, south and east of the basin. The north basin receives local discharges and largely acts as an equalization basin – or balancing reservoir.

The north cell was expanded and part of the northern portion of the southern cell was cleared to design grade in 2002. The improvements followed analysis of major flood events that occurred at Hosmer in 1990 (2 events), 1991 and 1996 (Cosmopolitan1997). Subsequently, Hosmer and Wards Lake exceeded flood capacity in 2009 and 2011. The southern cell is impacted by sedimentation and extensive vegetation. A project is scheduled to excavate the southern cell to design elevation in 2020.

Flett Holding Ponds

Stormwater runoff from the entire watershed ultimately flows into the Flett Creek Holding Basins, located in the City of Lakewood. In 1957, before widespread development, the Flett Creek Holding Ponds were originally called the “South Tacoma Swamp,” a natural depressed area that was the headwaters of Flett Creek. The South Tacoma Swamp spanned from South 48th Street to South 74th Street. A threaded channel within the wetland buffer ran from the South Tacoma Swamp location to Bridgeport Way. From 1903-1979, Flett Creek above Bridgeport Way was maintained as a distinct channel to support hay production and pasture for the Flett Dairy. Because the channel wasn’t maintained after 1979, existing roads and other natural mechanisms such as vegetation, beaver dams, and channel infilling blocked channel flow (B&C 1957 and Tacoma 2010).

The current Flett Creek Holdings Ponds and pump station were constructed in 1981 to alleviate localized flooding. The Flett Creek Holding Basin system consists of 4 consecutive connected cells, approximately 4,500 feet in length, with associated piping, and a pump station. Water entering the Flett Creek Holding Basin is pumped to the Flett Dairy Wetlands and Flett Creek. Flett Creek converges with Chambers Creek which ultimately discharges to the Puget Sound.

The Flett Holding Ponds and downstream wetland flooded in 2009 to the extent that the emergency automatic shutoff triggered at the pump station. The pump station was upgraded in 2014-2015 with the following key operational benefits:

- Raise pump station 3 feet. The station is able to continue pumping water during higher flows, providing greater flood protection to adjacent and upstream landowners.
- Sealed gates. The water level of the wetland has increased since 1979, due to collapsed culverts, beaver dams and vegetative blockages. Water was escaping from the wetland back into the ponds at a rate of 6 cfs during the summer. Sealed gates prevents this inefficiency.
- Full time 40,000gpm capacity. The prior station was able to achieve 40,000gpm through use of an axillary pump. Installing a permanent 4th pump provided additional certainty.

Currently, the Flett Ponds have an extensive monoculture of swamp smartweed (Polygonum hydropiperoides). The plants cover >90% of two of the ponds, and ~50% of the other two. In addition to loss of active storage, the plants break off during fall/winter storms blocking transmission pipes between the ponds and intake screens of the pump station. The plants were harvested in 2011, yielding 600 yd^3 of biomass, which was disposed of upland. Fragmentation and seedbank from the plants led to regrowth of a similar monoculture by late 2017. Following herbicide testing from 2016-2018, the ponds are now scheduled for herbicide applications to take place in 2020 and 2021.

Wards Lake

Ward’s Lake is a single cell basin which receives water from the Hosmer Holding Basin, WSDOT right-of-way, and Wapato Lake. Water entering Wards Lake from the Wapato and Hosmer outfalls is impacted by an expanding sediment delta, which is 60% of the outfall pipe(s) height. The delta forms the eastern edge of Owens Marsh, which deepens to become Wards Lake at the far western end of the property. The marsh will continue to fill in as a result of natural succession. The City of Tacoma is looking at multiple flood control options to address this impediment within the Hosmer-Wards-80th Street Holding Basin system. Water exits Wards Lake to the north through a pair of gates, one designed for normal flow conditions and one designed as an emergency overflow.

80th St Holding Basin (Gravel Pit)

The 80th Street Holding Basin (formerly known as the Gravel Pit Holding Basin) was originally an open pit gravel extraction facility. Gravel was extracted in the 1950s for use in road construction. In 1959, when gravel mining ceased, the City began using the gravel pit as a regional stormwater detention facility. The Gravel Pit is a single cell holding basin which receives water from the Ward’s Lake Holding Basin and a small portion of water from the City of Lakewood. The City expanded the holding capacity of the existing Gravel Pit Holding Basin in 2016. The expansion was enrolled in the Payment In-Lieu-of Construction Program which allows the City to accelerate environmental improvements in the Flett Creek Watershed and to Flett Creek. New development and redevelopment projects within the Flett Creek Watershed have the option of participating in the Payment In-Lieu-Of Construction Program by paying a system development charge instead of constructing individual site-specific flow control facilities. More information regarding this expansion at the Gravel Pit Regional Stormwater Flow Control Facility can be found in the City’s Regional Facilities Plan (Tacoma, 2017).

South Tacoma Channel Superfund Site

The South Tacoma Channel Superfund site has recently been delisted but continues to be subject to deed restrictions. The site is located between South Tacoma Way and Tyler Street and extends between South 56th and South 38th streets. Developers are advised to contact EPA, Region 10 at (206) 553-1200, for additional development restrictions and guidance.

This area was also formerly known as the South Tacoma Swamp. The western edge of the site contains a long, linear channel extending from S. 38th Street to S. 50th Street. The channel is not entirely under City control or operation yet provides significant area which detains and infiltrates flood flows, without damage to nearby structures.

South Tacoma Groundwater Protection District

The majority of the STGPD is in the Flett Creek drainage basin, while small portions overlap the Leach Creek and Thea Foss Waterway Watersheds as shown in the Figure below. The STGPD is discussed in more detail in Section 2.5.6.

3.3 ESA-LISTED FISH SPECIES CRITICAL HABITAT (STATEMENT OF FISH WE HAVE FOUND)

Chambers Creek is a fish bearing creek and there is one fish hatchery located on the creek. Washington Department of Fish and Wildlife (WDFW) list the following fish populations for the Chambers/ Clover Creek watershed:

Table 3-2: WRIA #12 Natural Fish Population

Population Name	Species	Federal Status
South Sound Tributaries Winter Steelhead	Steelhead	Threatened
Chambers Creek Coho	Coho	Candidate
Chambers Creek Summer Chum	Chum	Not Warranted
Chambers Creek Winter Chum	Chum	Not Warranted
West South Sound Coastal Cutthroat	Cutthroat	Not Warranted

(Available online at: WDFW Chambers/Clover Fish Populations)

For Flett Creek, three populations of fish were presumed present or documented as present including: (additional information is available on-line at WDFW Salmon Scape Map):

- Coho, documented spawning downstream of Custer Rd W and Bridgeport Way W and presumed presence downstream from 45th Ave SW to Custer Rd W
- Summer/Fall/Winter Chum, presence downstream of 59th Ave W
- Winter Steelhead, presumed presence downstream from 45th Ave SW to 59th Ave W, and presence downstream of 59th Ave W
- Fall Chinook, presumed presence downstream of Custer Rd W and Bridgeport Way W

For Chambers Creek downstream of the confluence of Leach and Flett Creeks, three populations of fish were presumed presence or documented presence including (available on-line at WDFW Salmon Scape Map):

- Coho, documented spawning
- Fall Chinook, potential presence
- Summer/Fall/Winter Chum presence
- Winter Steelhead presence
- Kokanee presence

Neither Flett Creek nor Chambers Creek are considered Critical Habitat for Puget Sound Chinook or Puget Sound Steelhead. Salmonid spawning habitat can be found from Chambers Creek up to Bridgeport Way.

4.0 LEACH CREEK WATERSHED

4.1 OVERVIEW

The Leach Creek watershed within the City boundaries covers 1,728 acres and includes residential and commercial land uses. It is located in the west-central section of Tacoma and is bordered by the Western Slopes and North Tacoma Watersheds to the north, the Flett Creek Watershed to the east, and the Cities of Fircrest and University Place to the southwest. Like the Flett Creek watershed, this watershed does not contain any saltwater shorelines.

Leach Creek has a drainage area of approximately 1,867 acres or 6.5 square miles. Land use is residential and commercial. Included in this watershed is a portion of Hwy 16, Hwy 163 (Pearl Street), Westgate Shopping Center, James Center, Highland Hills Shopping Center, and Tacoma Community College (TCC). A portion of the Tacoma Landfill Superfund site is also included in this watershed. China Lake and a system of 16 wetlands on the TCC campus are the significant water bodies in this watershed within City limits (Figure 3-5).

4.2 STORMWATER CONVEYANCE

Stormwater within this watershed is piped to the Leach Creek Stormwater Holding Basin (near S 35th & Orchard St.). The holding basin has a gated outlet that discharges to Leach Creek and effectively acts as the headwaters to the creek. The holding basin manages stormwater runoff from Hwy 16, the City of Tacoma and the City of Fircrest.

Leach Creek Holding Basin

The Leach Creek Holding Basin collects 2,500 acres of the Chambers Creek Watershed. In 1961, the holding basin was built by the City of Tacoma to control stormwater runoff into Leach Creek and help prevent downstream property flooding and stream scouring. A 1,100-foot earthen dam was constructed across a naturally depressed swampy area below Fircrest where natural springs made up the headwaters of Leach Creek (Brown and Caldwell 1957 and Tacoma 1982).

The holding basin covers approximately 42 acres and contains 32 acres of wetlands. In response to downstream flooding in the mid-1980's, residents sued the City which resulted in a settlement agreement. Following the lawsuit, the City constructed a pump station to relieve downstream flooding by pumping water from the holding basin to the Thea Foss Waterway during high flow events. An open channel emergency spillway was also added to prevent dam breaching. The outlet is a gated 42-inch diameter outlet pipe, which controls storm flow up to about 100 cfs. During heavy rainfall events, stormwater is also pumped from the holding basin to the Thea Foss Waterway at a rate up to 96 cubic feet per second (cfs) through the Nalley Valley force main.

The holding basin has a normal operating storage capacity of approximately 80 acre-feet. During extreme storms (3.5 inches or more in 24 hours), the pond level will continue to increase and may discharge over the emergency spillway to Leach Creek. Depth over the emergency spillway may range from 6 to 12 inches which leaves one foot of freeboard on the dam. The total emergency storage is approximately 120 acre-feet to top of dam.

Over the years, capacity of the holding basin has decreased due to sedimentation and vegetation growth, while development in the Leach Creek watershed has increased the need for stormwater storage capacity (Grette Associates, 2011). A holding basin maintenance project to increase capacity and hydraulic connectivity from the pump station to the outlet is planned for construction in 2024.

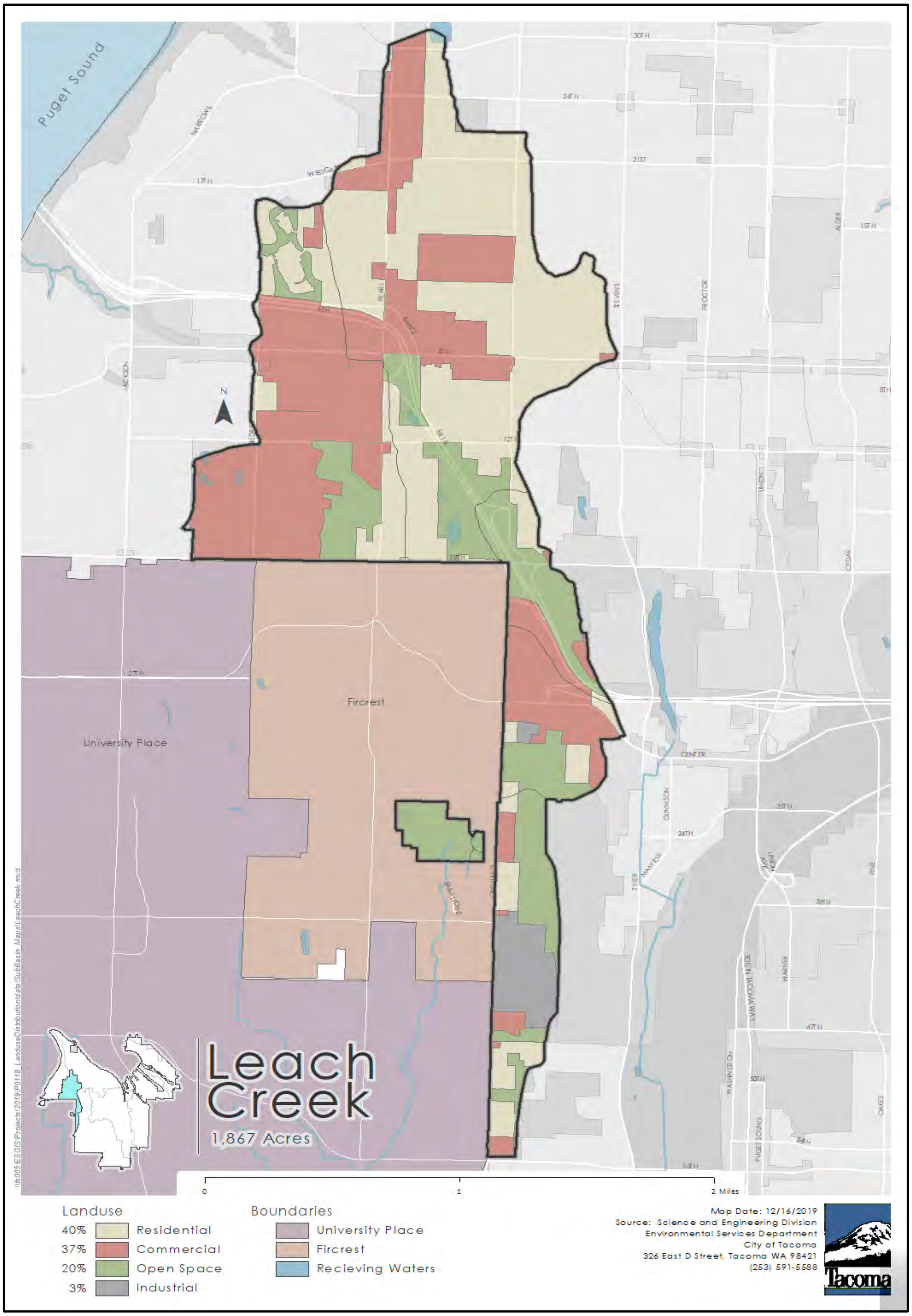

Figure 4-1 City of Tacoma Leach Creek Watershed Land Use Map

4.3 Receiving Waters

Chambers Creek System

The Chambers Creek Watershed includes the following major water bodies: Steilacoom Lake, Leach Creek, Flett Creek, Clover Creek and Chambers Creek. Clover Creek discharges into Steilacoom Lake. Chambers Creek flows from Steilacoom Lake northward to the confluences with Flett and Leach Creeks. Turning westward, Chambers Creek then flows rapidly through steep wooded ravines to a short estuary and out to Puget Sound.

Leach Creek

Leach Creek is a little over 2 miles long. Salmonid spawning habitat can be found from Chambers Creek up to Bridgeport Way (the lower portion of the Creek). The upper portions of the Creek also have pockets of spawning grounds; however, the elimination of vegetation and channelization by streamside homeowners and erosion during storm events has impacted these areas. Leach Creek flows into Chambers Creek just downstream of the confluence of Flett and Chambers Creek. Chambers Creek Watershed is designated as Water Resource Inventory Area 12 (WRIA 12) by the State of Washington. Chambers Creek is a fish-bearing creek, and there are two fish hatcheries located on Chambers Creek.

Before construction of the holding basin, Leach Creek flowed through a flat marshy valley land (Brown and Caldwell 1957). Presently, Leach Creek proper begins south of the holding basin dam. After passing through residential areas, Leach Creek passes through a wetland, to steep-sided and heavily wooded ravines, and finally joins Chambers Creek.

Table 4-1 Chambers Creek System & Contributing Drainage Areas (B&C 1957)

Receiving Water	Acres		
	Tacoma	Pierce	Total
Leach Creek	2,000 (40%)	3,010	5,010
Flett Creek	6,850 (72%)	2,620	9,470
Clover Creek		45,090	45,090
Chambers Creek		5,940	5,940

US Geological Survey (USGS) has been collecting streamflow data in Leach Creek at two flow meters for decades:

- **Site 1** LEACH CREEK NEAR FIRCREST, WA, #12091200, located at Emerson Street just Downstream of the holding pond. Data collected since 1957. **http://waterdata.usgs.gov/wa/nwis/inventory/?station=12091200**
- **Site 2** LEACH CR AT MEADOW PARK GC AT UNIVERSITY PLACE, WA, #12091290, located at Bridgeport Way before the confluence of Chambers Creek. Data collected since 2005. http://waterdata.usgs.gov/nwis/inventory?agency_code=USGS&site_no=12091290

China Lake

China Lake was formed by a natural depression and receives surface runoff from the surrounding area (Tacoma 1982). Historical records document that China Lake has been significantly excavated for peat (B&C 1989). Stormwater from a large portion of the upper Leach Creek watershed (about 840 acres) is piped to China Lake, which has an overflow piped to Leach Creek

Holding Basin. However, overflows from China Lake have not been observed in recent years because water in the lake infiltrates into the underlying soils.

4.4 WATER AND SEDIMENT QUALITY.

Ecology detected several instances of elevated bacteria and mercury concentrations at the mouth of Leach Creek during routine water quality monitoring in 2007-2008 (Ecology 2011). Ecology conducted a follow-up study to better characterize mercury levels in the creek and assess specific reaches as sources during monthly monitoring from September 2009 through August 2010 at four locations. An effort was made to collect samples during stormwater runoff events. Copper was also analyzed in view of concerns about its potential impact to salmon. Water quality exceedances were detected for both mercury and copper in Leach Creek. Total mercury exceeded (did not meet) the Washington State chronic water quality criterion during four sampling events. The chronic criterion for dissolved copper was exceeded during two sampling events, one of which also had an exceedance of the acute criterion. Sources appear to lie towards the upstream end of the Leach Creek watershed.

In March 2015, Ecology proposed that Leach Creek, from the holding basin to the confluence with Chambers Creek, be placed in Category 5 on the 303(d) list of the state Water Quality Assessment as being water quality limited for mercury, copper and bacteria based on the 2007-2008 and the 2009-2010 sampling data. (Ecology Water Quality Assessment & 303d List).

4.5 ESA-LISTED FISH SPECIES CRITICAL HABITAT.

No ESA-listed fish species utilize Leach Creek within the holding basin (Grette 2011). Chambers Creek is a fish-bearing creek with several species of fish. WDFW lists the following fish populations for the Chambers/ Clover Creek watershed:

Table 4-2: WRIA #12 Natural Fish Population

Population Name	Species	Federal Status
South Sound Tributaries Winter Steelhead	Steelhead	Threatened
Chambers Creek Coho	Coho	Candidate
Chambers Creek Summer Chum	Chum	Not Warranted
Chambers Creek Winter Chum	Chum	Not Warranted
West South Sound Coastal Cutthroat	Cutthroat	Not Warranted

(Additional information available here: WDFW Chambers/Clover Fish Populations.

For Leach Creek, WDFW has determined presumed presence or documented presence of the following salmonids (WDFW Salmon Scape Map):

- Coho, documented spawning downstream of 53rd St W
- Summer/Fall/Winter Chum, presence downstream of 53rd St W

- Winter Steelhead, presumed presence downstream of 53rd St W to Bridgeport Way W and presence downstream of Bridgeport Way W.
- Fall Chinook, presumed presence downstream of 53rd St W

For Chambers Creek, downstream of the confluence of Leach and Flett Creeks, WDFW has determined presumed presence or documented presence of the following salmonids (WDFW Salmon Scape Map):

- Coho, documented spawning
- Fall Chinook, potential presence
- Summer/Fall/Winter Chum presence
- Winter Steelhead presence
- Kokanee presence

Leach Creek nor Chambers Creek are considered Critical Habitat for Puget Sound Chinook and Puget Sound steelhead. Salmonid spawning habitat can be found along the lower portion of Leach Creek from Chambers Creek up to Bridgeport Way. The upper end of Leach Creek also has pockets of spawning grounds; however, habitat quality is impacted by the elimination of vegetation, channelization by streamside homeowners, and erosion from high storm flows. Washington Department of Fish and Wildlife (WDFW) Fish Passage Program has identified the Leach Holding Basin dam as a partial blockage to fish passage (available on-line at http://wdfw.wa.gov/conservation/habitat/fish_passage/data_maps.html).

4.6 GROUNDWATER IMPACTS FROM LANDFILL SUPERFUND SITE

The Solid Waste Management Division of the Environmental Services Department operates the Tacoma Transfer and Recovery Center, formerly known as the "Landfill," which is a Superfund site. Groundwater extraction wells were installed at the border of the landfill to intercept and monitor any contaminants that may be traveling through the groundwater from the unlined portions of the landfill. Currently, groundwater at this location is no longer being re-directed to the wastewater treatment plant. The offsite groundwater extraction wells located along Leach Creek were shut down in March 2010. Since shutdown, monitoring well data indicates that groundwater elevations have returned to pre-remediation elevations, and groundwater contaminants monitoring analytical results meet Consent Decree groundwater performance standards. The Environmental Protection Agency approved decommissioning selected offsite groundwater extraction wells in 2010. The last offsite extraction well was decommissioned in March 2018.

5.0 LOWER PUYALLUP WATERSHED

5.1 OVERVIEW

The Puyallup River Watershed's boundary (WRIA 10) stretches from the crest of the Cascade Mountains and the summit of Mt. Rainier, at 14,411 feet to Commencement Bay and the City of Tacoma at sea level, draining approximately 670,000 acres with over 728 streams.

The Lower Puyallup watershed covers 2,982 acres, with 939 acres of impervious surface.

The Lower Puyallup Watershed in Tacoma drains the lower reaches of the Puyallup River Watershed, discharging to what was historically the Puyallup River Estuary. The Puyallup River is a critical habitat for a variety of salmonids including spring Chinook and bull trout, which are listed as endangered.

The Lower Puyallup Watershed is located in the southeast portion of Tacoma and borders the Thea Foss Waterway Watershed, the Tideflats Watershed, Pierce County and the Puyallup River (Figure 3-6). At present, portions of the watershed are predominately residential with some undeveloped open space and a few small commercial areas while industrial activity dominates the former estuary now identified as the Tideflats. Included in this watershed are Interstate 5, Hwy 509, the Salishan Neighborhood, McKinley Neighborhood, Lower and Upper Portland Avenue Business Districts, and the Dome District. The northern portion of the watershed consists of industrial and commercial areas. In recent years, there has been a noticeable increase in dumping debris and human waste associated with homeless encampments in the First Creek area, which creates a human health risk, degrades water quality, and interferes with needed utility maintenance activities. City programs to address neighborhood blight and assist individuals and families experiencing homelessness are not able to fully address the issues in the First Creek area. Significant water bodies within the Lower Puyallup Watershed include the Puyallup River, Swan Creek and First Creek, which are part of the larger WRIA 10 Puyallup-White Rivers watershed.

The Puyallup Tribe of Indians were the original inhabitants of this region, and the mouth of the Puyallup River was the main village site of the Puyallup Tribe and an intersectional area for many other tribes. The Puyallup Tribe also inhabited village sites along upland rivers and creeks in Tacoma and along the shores of the Salish Sea. Following the Medicine Creek Treaty of 1854 and subsequent negotiations, the modern reservation land boundaries were established along with the right of taking fish "at all usual and accustomed grounds and stations." The rights of hunting and gathering on their ancestral lands were defended by the Tribe through the Fishing Wars of 1960's and 1970's and finally protected by the Boldt Decision of 1974 that specified the Tribe's fishing right to harvest 50% of each salmon run both on and off assigned reservation lands and the right to commonage the fisheries resources along with the Washington State Department of Fish and Wildlife.

The lower reaches of the Puyallup River were historically straightened with levees due to extensive flooding and the estuary was filled and dredged to create property for industrial activities and navigable waterways for use by the Port of Tacoma.

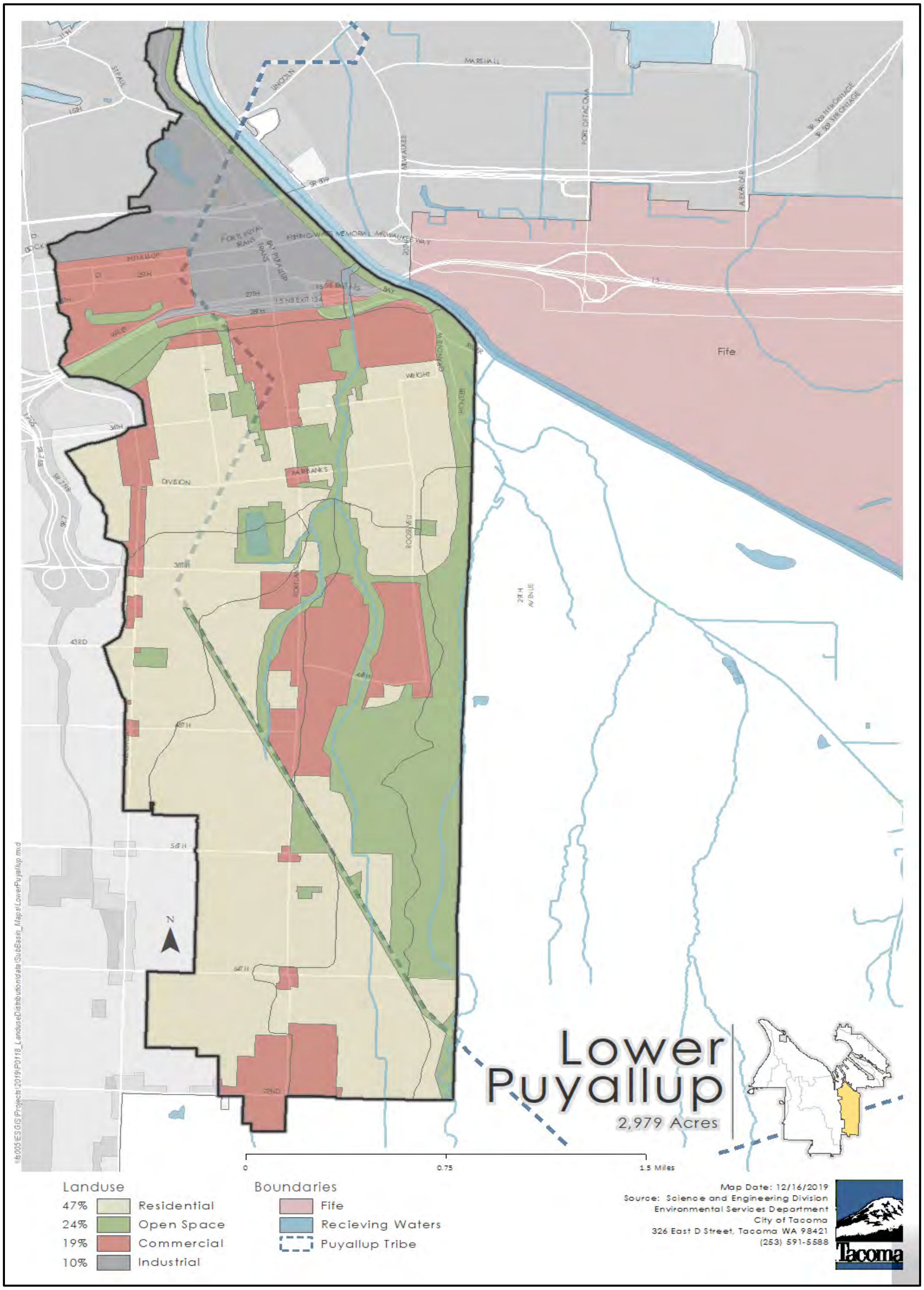

Figure 5-1 City of Tacoma Lower Puyallup Watershed Land Use Map

5.2 STORMWATER CONVEYANCE

Stormwater is conveyed through the watershed through a mixture of creeks, gulches, culverts, ditches and the City's piped stormwater system. Stormwater from the City's Lower Puyallup Watershed discharges into the Puyallup River through two adjacent outfalls, the Cleveland Way Pump Station Outfall, and the T-Street Gulch/First Creek Outfall (Figure 3-6).

Cleveland Way Pump Station

The Cleveland Way Pump Station is located west of the Cleveland Way right-of-way, immediately south of the Puyallup Avenue Bridge and receives stormwater discharges from the northern industrial/commercial area of the watershed, including stormwater draining from the City's Central Wastewater Treatment Plant. This outfall also receives stormwater overflow from the First Creek area. Flow from the overflow structure (manhole 6777476) is conveyed north to the First Creek Outfall except during high flow conditions when it is diverted west to the ditch on E 29th and then the Cleveland Way Pump Station (Figure 3-6).

The Cleveland Way pump station was designed and constructed in the early 1960s to pump the stormwater to a high enough grade to discharge to the Puyallup River. Due to outdated mechanical equipment and flooding concerns, the City upgraded the pump station in 2015. The City upgraded the pumps for increased pumping capacity, upgraded the electrical and improved ventilation and airflow with a new HVAC system. While the system was not designed to reduce sediment loading to the Puyallup River, the system acts like a sediment trap and needs to be periodically cleaned of sediment and debris. Since the installation and upgrade of the higher capacity pumps, flooding has not been a concern in this area.

First Creek

The First Creek outfall receives stormwater runoff from the east side of the Lower Puyallup Watershed, which is primarily residential with some commercial land use. This includes stormwater discharging from the Tacoma Dome, Portland Avenue, First Creek neighborhood, and the Salishan affordable and sustainable housing development.

First Creek is a perennial stream flowing north towards the Puyallup River. The First Creek drainage basin encompasses approximately 2,500 acres of residential/commercial area. The majority of the basin is within the City of Tacoma, although approximately 600 acres lie within unincorporated Pierce County. First creek consists of the main channel, located west of East T Street, and two tributaries: the West Tributary and the "West-West" Tributary. All three channels of First Creek are largely located in 20 to 30 foot deep ravines. The First Creek corridor is bordered by residential development, two schools, Portland Avenue Park and The Puyallup Tribe of Indians Emerald Queen Casino. A significant portion of the corridor is within the Puyallup Reservation lands. Several City roads cross the creek, including Fairbanks Street, E 34th Street and other key arterial roadways.

First Creek and it's tributaries contain stormwater and sanitary conveyance pipes, manholes, stormwater outfalls, and several utility access roads managed by the Environmental Services Department. In the 1990s, Environmental Services completed channel modifications to control erosion, which included rock armoring and piping to prevent channel erosion in the lower Gulch. It has been estimated that 70 percent of the stream channel has been armored to reduce erosion. Approximately 60 percent of the stormwater system in the gulch is open channel, and roughly 40 percent is piped. While these stormwater system modifications within the gulch were necessary to address erosion concerns, these changes may have affected habitat conditions in First Creek.

Surface flows from First Creek are collected in a 72-inch storm pipe that flows north beneath E. 34th Street. This area needs ongoing maintenance due to sediment and debris accumulation at an 84-inch riser pipe where the surface flows go underground. The riser pipe is designed to capture and convey surface flows while preventing sediment and debris from discharging to the downstream storm system. The ongoing sedimentation and vegetation causes creek channel movement within the bottom of the gulch. There are also wetlands located in this area.

5.3 RECEIVING WATERS

Puyallup River

The Puyallup River is the largest river in Tacoma and a regionally significant waterway in South Puget Sound. The river along with its tributaries serve as major migration routes for a variety of salmonids, including Spring Chinook and bull trout which have both been listed as endangered species. A complete list of ESA listed species for WRIA 10 is included in the Thea Foss Waterway Watershed Section 5.4. There are four fish hatcheries located in this system upstream of Tacoma.

The associated drainage basin occupies approximately 1,065 square miles in the Puget Lowlands. Its two major tributaries are the White and Carbon Rivers which contribute 50% and 30% of the Puyallup River flow, respectively (Ecology 2011). The lower portion of the river from its mouth to approximately two miles upstream is located within the City of Tacoma. The lower Puyallup at Commencement Bay is a salt-wedge estuary, with deeper marine water overlain by a layer of fresh water. Since non-natives began settling in this region, this estuary has been extensively modified, losing up to 99% of its estuarine wetland area. Below River Mile 2.0 in the Tideflats Watershed, industrial activity is the dominant land use.

The Puyallup River is listed as impaired (303d list) for fecal coliform and subject to a fecal coliform TMDL (Ecology 2011). Upstream tributaries in other jurisdictions are noted as needing a reduction in fecal coliform bacteria loading. There is a load allocation monitoring point at the Lincoln Avenue Bridge crossing, but Tacoma has not been identified as contributing to any water quality violations in this area.

Recent habitat restoration efforts completed with efforts of The Puyallup Tribe of Indians, the Port of Tacoma, the City of Tacoma and others have resulted in increased wetland acreage including a project at the Simpson pulp mill site and the creation of the Gog-le-hi-te wetland located near the mouth of the river on the east side across from the City's main wastewater treatment plant. As part of the Thea Foss and Wheeler-Osgood Waterways Remediation Project habitat mitigations sites were constructed along other waterways within the Puyallup River Watershed. The Puyallup River Side Channel Project provides off-channel habitat intended for use by juvenile salmonids for rearing and refuge during their outward migration to the Puget Sound. The project merged an existing isolated wetland and excavated an adjacent parcel, creating an off-channel habitat area. The existing flood control levee structure was breached following construction of a new levee to allow the river and associated tidal hydrology to enter.

Swan Creek

Swan Creek is a moderate sized tributary located within the larger Clear Creek basin. Swan Creek originates in Pierce County south of Highway 512. It flows north towards the Puyallup River and along the City of Tacoma-Pierce County boundary. It enters a narrow canyon at approximately creek mile three and leaves the canyon just upstream of Pioneer Road (approximately creek mile 0.5). The creek then flows north then east to its confluence with Clear Creek. Clear Creek then flows into the Puyallup River. This discharge point is located in unincorporated Pierce County.

The Swan Creek basin drains mostly residential neighborhoods and open spaces including Swan Creek Park with a drainage basin of about four square miles. Most of the drainage area is located in unincorporated Pierce County. A small portion of the basin lies along the City of Tacoma's eastern border. Much of the land located within the lower portion of the drainage basin is located within Swan Creek Park, which is owned and operated by Metro Parks Tacoma.

Chum salmon and cutthroat trout are the most common species present, with chum spawning in the lower creek. Swan Creek has a B-IBI score classified as poor (average of 21 between 2001 and 2009). Swan Creek is listed as impaired (303 d list) for fecal coliform. In the Puyallup River fecal coliform TMDL (Ecology 2011), Swan Creek was noted as needing a reduction in fecal coliform bacteria loading (54%). Pierce County is working with partners to improve water quality in terms of both bacterial and nutrient loadings. For the above reasons, Swan Creek is identified as a high priority for both water quality protection and habitat restoration.

The City restored a large habitat site near the mouth of Swan Creek through the Natural Resource Damages Assessment Consent Decree (NRDA). A recently completed fish barrier removal project by Tacoma Public Utilities is also helping open up the creek for salmon use. Stream Team volunteers monitor water quality in Swan Creek for the City. An annual Salmon Homecoming celebration is also hosted at Swan Creek to increase community awareness of this valuable resource.

First Creek

First Creek is a non-fish bearing stream and has areas with perennial (year round) flow and other areas with seasonal flow only. The creek system includes a number of associated wetlands. A number of wildlife species and habitats are associated with the First Creek Watershed. First Creek and its tributaries and wetlands are regulated by the City of Tacoma Critical Areas Preservation Ordinance (CAPO) and other state and federal agencies, although threatened, endangered, sensitive and candidate species have not been observed in the First Creek system in recent years. Historically, First Creek likely contained a hydrological connection to the Puyallup River and was accessible to fish. However, during the development of the City, a large portion of First Creek was piped eliminating any potential fish access.

In 2012, the City, The Puyallup Tribe of Indians, the Tacoma Housing Authority and other stakeholder community groups drafted the First Creek Action Plan to prioritize activities to establish First Creek as a healthy, valued natural asset in East Tacoma. The City is pursuing the following actions identified in the plan:

- Cleanup of debris and homeless encampments on City owned properties,
- Removal of invasive species and replanting of native plants in the west channel, and
- Restoration of the E 34th Street site in conjunction with sediment removal maintenance activities.

5.4 ESA-LISTED FISH SPECIES CRITICAL HABITAT

Foss Waterway, Commencement Bay and the South Central Puget Sound are rearing and migratory areas for several fish populations. Washington Department of Fish and Wildlife (WDFW) lists the following fish populations for the WRIA #10, Puyallup-White River Watershed:

Table 5-1: WRIA 10 Natural Fish Population[3]

Population Name	Species	Federal Status
White River (Puyallup) Bull Trout	Bull Trout	Threatened
Puyallup Chinook	Chinook	Threatened
White River Chinook	Chinook	Threatened
Puyallup\Carbon Winter Steelhead	Steelhead	Threatened
White River (Puyallup) Winter Steelhead	Steelhead	Threatened
Fennel Creek Fall Chum	Chum	Not Warranted
Hylebos Creek Fall Chum	Chum	Not Warranted
Puyallup/Carbon Fall Chum	Chum	Not Warranted
Puyallup Coho	Coho	Not Warranted
White River (Puyallup) Coho	Coho	Not Warranted
Puyallup Coastal Cutthroat	Cutthroat	Not Warranted
Puyallup Pink	Pink	Not Warranted

[3] **Fish distributions** come from the Washington Integrated Fish Database (WIFD) which integrates previously different fish distributions in WRIA 1-23 (Puget Sound and Outer Coast) from the NorthWest Indian Fish Commission (NWIFC) and WDFW. WDFW provided the Fish distributions for the rest of the state. Fish distribution is mapped to rivers and streams represented by the hi-resolution National Hydrographic Dataset (NHD), a USGS product that is the Federal and State hydrographic data standard, and now forms the basis for 'the blue lines' on all USGS topographic maps. (available online at: https://fortress.wa.gov/dfw/score/score/maps/map_details.jsp?geocode=wria&geoarea=WRIA10_Puyallup_White)

Based on review of the Washington Department of Fish and Wildlife SalmonScape database, Foss Waterway falls into several ESA Listing Units[4] including:

- Fall/Winter Chum and Pink Odd Year ESA Listing Unit listed as Not Warranted, Accessible
- Coho ESA Listing Unit listed as Species of Concern, Accessible
- Winter/Summer Steelhead DPS Listing Unit listed as Threatened Accessible

The waterway itself doesn't have listings for fish populations however the Puyallup River, which also discharges into Commencement Bay within 1 mile of the waterway, has seven populations of fish listed including:

- Coho: documented presence and rearing
- Spring and Fall Chinook: documented presence and rearing
- Fall Chum: documented presence
- Winter Steelhead: documented presence
- Sockeye: documented presence
- Pink Salmon (odd year): documented presence
- Bull Trout: documented presence

[4] **ESA Listing Units** map NOAA Fisheries Evolutionary Significant Units (ESUs) for salmon, and USFWS Distinct Population Segments for Steelhead trout. These are current as of January 2013. ESU/DPS are the spatial extents of populations that are defined under the Endangered Species Act (ESA) as Endangered, Threatened, a Species of Concern, or Not Warranted for listing. These maps also show areas within the ESU/DPS that had fish present historically, but now are blocked or impeded due to human activity such as dams. (additional information is available on-line at http://apps.wdfw.wa.gov/salmonscape/map.html)

6.0 THEA FOSS WATERWAY WATERSHED

6.1 OVERVIEW

The Thea Foss Waterway Watershed, also known as the “Foss Watershed,” covers approximately 5,864 acres and drains most of south-central Tacoma. The watershed is bordered by the North Tacoma Watershed on the north, Lawrence Street on the west, and East F to East K Streets on the east side of the Thea Foss Waterway. The area extends to the southeast corner of the City limits at 86th Street.

Stormwater runoff from this watershed discharges to the Thea Foss and Wheeler-Osgood Waterways, referred to in this document collectively as “the Foss Waterway.”

Up until 1995, there were approximately 65 public and private stormwater outfalls that discharged to the Foss Waterway (TPCHD 1995). With redevelopment of the area, the number of known outfalls has decreased to 35 and includes 15 municipal outfalls and 20 private outfalls (Figure 3-6).

Currently, the Foss Watershed is approximately 53 percent impervious. Most of this area has been 40 percent impervious since 1985, which means new and redevelopment projects are only required to size flow control facilities to match existing land cover conditions rather than forested land cover, per Tacoma’s Stormwater Management Manual. Overall, land use in the watershed is predominately residential, although most of the City's commercial businesses are also located in this watershed (Figure 3-7). In addition to the I-5, Hwy 16, Hwy 7 and Hwy 705 corridors crossing this watershed, a significant portion of the industrial businesses in Tacoma are located here, concentrated mainly in the eastern Tideflat and Nalley Valley areas. Business districts and mixed-use centers include the following Regional Growth and Business Centers:

- The Downtown Regional Growth Center (including the Hilltop Neighborhood),
- The Tacoma Mall Regional Growth Center ,
- The Pacific Avenue business centers, and
- The Lincoln District business center.

Long-range planning predicts the greatest concentration of growth in Tacoma is expected in Downtown Tacoma with 76,200 new residents and 67,900 new jobs by 2040.

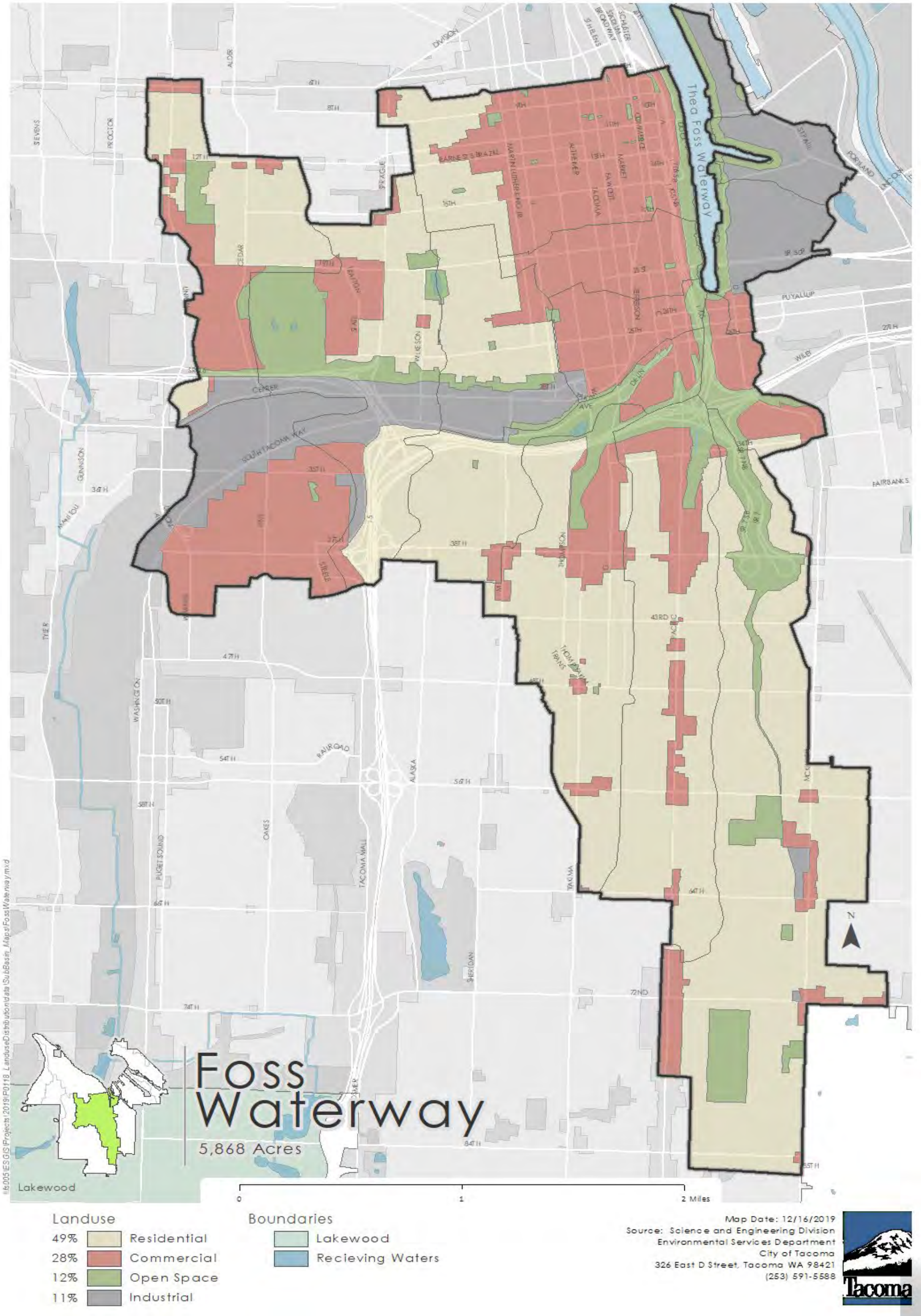

Figure 6-1 City of Tacoma Foss Waterway Watershed Land Use Map

6.2 STORMWATER CONVEYANCE

Stormwater is conveyed through the watershed primarily in underground pipes though some localized ditch systems exist (Figure 6-1). There are currently no streams or creeks remaining in the watershed. On the west-side and south end of the watershed, the landscape and conveyance system is generally flat and then becomes very steep along the west edge of the Foss Waterway. The land and collection system on the east side are very flat and the collection system is oversized to account for tidal inundation.

The eight outfalls listed in the table below drain 98% (5,744 acres) of the watershed. The drainage areas for OF230 and OF235 were changed and 98% of the flow from OF230 and 23% of the flow from OF235 no discharges to the new OF230A. There are also several other smaller outfalls that discharge to the waterway - Outfalls 221, 222, 223, 225, 207, 208, 218 and 214). These smaller outfalls collect runoff from commercial and industrial areas adjacent to the shoreline. Percentages of primary land uses draining to each of the major outfalls are described in the following table:

Table 6-1: Foss Waterway Land Use Percentage for Major Outfalls

Outfall	Area (Ac)	Asset Management Areas	Land Use[1]
230	24	FS-05	100% Commercial
230A	583	FS-05	76% Commercial and 24% Residential
235	109	FS-06	99% Commercial and 1% Residential
237A	2,823	FS-01, 02, 03, 04, 07, 08, and 09	54% Residential, 29% Commercial and 18% Industrial
237B	1,991	FS-10,11 and 12	80% Residential and 19% Commercial
243	59	Part of FS-13	66% Industrial and 34% Commercial
245	39	Part of FS-13	84% Industrial and 16% Commercial
254	119	FS-14	80% Industrial and 20% Commercial

[1] Remaining percentages are comprised of open space.

Natural drainages containing creeks and groundwater flows, were sewered in the 1960s and currently exist as baseflow in several of the stormwater pipes that discharge into the waterway. In addition, several of the outfalls discharging to Foss Waterway are tidally-influenced and portions of the pipe are inundated with marine water twice a day depending on the pipe elevations and the high tide elevation. The baseflow sources are presented in Figure 3-8 (Tacoma 2018). The largest continuous baseflow discharges are from OF237A and OF237B and small continuous baseflow discharges exist in OF235 and OF230. Tidally influenced and seasonal baseflows are present in the east-side outfalls as well.

Baseflow in OF243, OF245 and OF254 is seasonal (i.e., higher in the winter and lower in the summer) which is believed to be due to shallow groundwater tables in the tideflat area that experience recharge during winter rains. In this area there are no creeks or other freshwater sources that provide constant baseflow on the east side of the Foss Waterway, but these outfalls do experience tidal backwater conditions year-round.

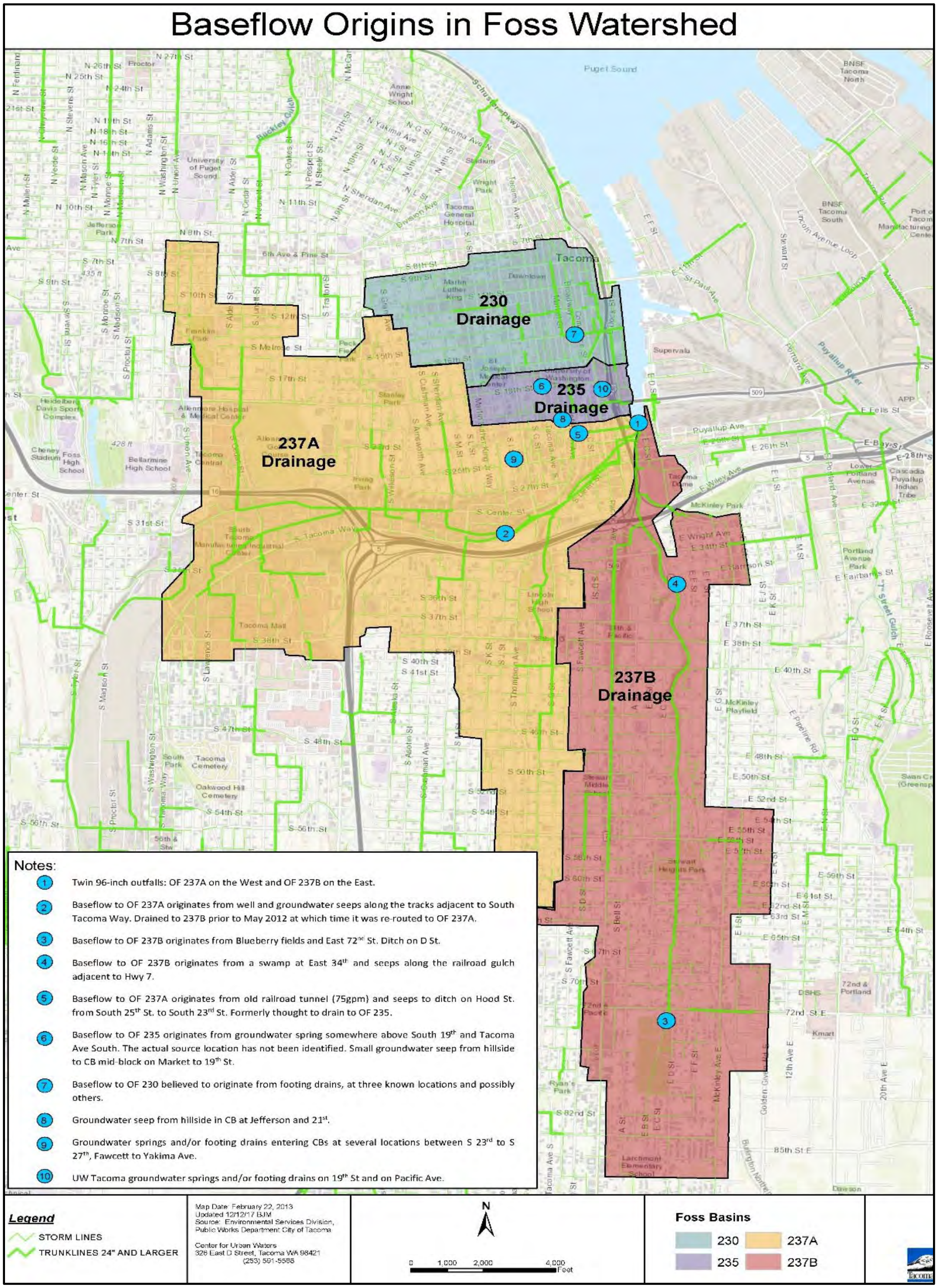

Figure 6-2 Baseflow Sources in Thea Foss Outfalls

Leach Creek Stormwater Bypass

As described in Section 3.3.2, the Leach Creek Holding Basin stormwater pump station was installed in 2001 to avoid sending high flows to Leach Creek that may cause damage to the stream and private properties. During heavy rainfall events, stormwater is pumped from the holding basin to the Foss Waterway at a rate up to 96 cubic feet per second (cfs) through the Nalley Valley force main discharging at OF237A. By comparison, stream flows in Leach Creek can reach up to several hundred cubic feet per second during large storms.

6.3 RECEIVING WATERS

Foss Waterway Watershed is part of the Puyallup-White River WRIA 10 and is located in the South-Central Puget Sound action area for Puget Sound Recovery. The two major receiving waterbodies, Thea Foss and Wheeler-Osgood Waterways were transformed from the original Puyallup River Delta into waterways with a variety of marine industrial uses, and more recently into today's showcase of downtown Tacoma.

Stormwater discharges from the Foss Watershed ultimately reach the waterways and the southeastern margin of Commencement Bay. Stormwater mitigation requirements are based upon protection of these estuarine/marine receiving waterbodies.

History of Thea Foss and Wheeler-Osgood Waterways

Prior to the late 1800s, what is now Thea Foss Waterway (formerly the City Waterway) was the old west channel branch of the Puyallup River delta (Morgan, 1982). It is important to highlight that all of this land was once Native American territory. The Puyallup Tribe of Indians were the original inhabitants of this region, and the mouth of the Puyallup River was the main village site of the Puyallup Tribe and an intersectional area for many other tribes. The Puyallup Tribe also inhabited village sites along upland rivers and creeks in Tacoma and along the shores of the Salish Sea. Following the Medicine Creek Treaty of 1854 and subsequent negotiations, the modern reservation land boundaries were established along with the right of taking fish "at all usual and accustomed grounds and stations." The rights of hunting and gathering on their ancestral lands were defended by the Tribe through the Fishing Wars of 1960's and 1970's and finally protected by the Boldt Decision of 1974 that specified the Tribe's fishing right to harvest 50% of each salmon run both on and off assigned reservation lands and the right to co-manage the fisheries resources along with the Washington State Department of Fish and Wildlife.

In 1891, the Tacoma Land Company imported a large steam-powered hydraulic dredge to construct the navigation channel that eventually became known as "City Waterway" and then "Thea Foss Waterway." Dredged materials from the west channel were deposited onshore on the intertidal delta immediately to the east to create upland area. The flood of 1891 quickly silted the new channel. As a remedy, the Tacoma Land Company with others diverted the Puyallup River by sealing the west channel with pile, timber, and soil diking. The upper portion of the remnant mouth of this branch of the Puyallup River became what is now known as the Wheeler-Osgood Waterway.

The Thea Foss Waterway federal navigation channel project was authorized for improvement of Tacoma Harbor by the Congressional Act of June 13, 1902 (Corps, 1902). The authorization identified the depths to which the waterway was to be maintained in different areas. The federal project extended between harbor lines (pierhead/bulkhead lines) for a total distance of approximately 8,000 feet from the landward end to deep water at its mouth in Commencement Bay. The federal project was completed and available to navigation for its full length and depth by April 1905 (Corps, 1907). The basic project description has remained essentially unchanged since project authorization, except for localized modifications to the harbor line boundaries made in 1982 at the request of City of Tacoma to enable planned shoreline development (Corps, 1981). In addition, the southern 1200 feet at the head of the waterway was deauthorized November 8, 2007 by a group of private Utilities who performed the remediation of contaminated sediment in this area. This deauthorization indicates that this portion of the waterway is no longer part of the federal navigation channel and the previously required depths no longer apply.

Current conditions of Thea Foss and Wheeler-Osgood Waterways

The Thea Foss and Wheeler-Osgood Waterways are estuarine waterways on the southeastern margin of Commencement Bay. In Commencement Bay and the waterways, average tidal fluctuations vary from 0 feet Mean Lower Low Water (MLLW) to 11 feet MLLW. Extreme tides, which generally occur in June and December, range from approximately –4.0 feet MLLW to 14.5 feet MLLW. The Thea Foss Waterway lies generally north-south along the City's downtown corridor. The Wheeler-Osgood Waterway lies west-east and connects to the east side of the Thea Foss Waterway just south of the Murray Morgan (11th Street) Bridge (Figure 3-7).

The Thea Foss and Wheeler Osgood Waterways were identified by the Environmental Protection Agency (EPA) as Problem Areas requiring remediation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as part of the Commencement Bay Nearshore/Tideflats site. CERCLA is commonly referred to as the Superfund program. The City of Tacoma took the lead in remediating sediments in a large portion of the Thea Foss and Wheeler-Osgood Waterways under the oversight of EPA with work completed in 2006. Sediments were actively remediated with a combination of dredging and capping at various locations within the waterways, and are monitored routinely under a Long Term Monitoring Plan to ensure that the remedy remains protective.

Prior to cleanup and as part of the remedial design process, significant study of the waterways has occurred, including a hydrodynamic field study. This study revealed the presence of a two-layer estuarine circulation pattern in the waterway driven primarily by the freshwater discharges from OF237A and OF237B. At the surface, stormwater runoff and baseflow is mixed into a brackish layer, about 5-feet thick, with a net velocity toward Commencement Bay. At depth is a compensating flow of saline marine water with a net velocity toward the head of the waterway. This reverse flow of bottom water traps and concentrates water and suspended sediments at the "dead end" head of the waterway, encouraging deposition and accumulation in this area. Eventually, the trapped water upwells to the surface layer where it changes direction and moves out toward the bay. During storm events, drainage from the seven major outfalls described in Section 1 enter this hydrodynamic system, meaning that stormwater runoff from throughout the waterway merges together and impacts the waters of the system as a whole.

Water Quality

The Ecology Water Quality Assessment for Foss Waterway includes the listing of a number of parameters for the sediments. The parameters that are listed for Foss Waterway are included in Table 3-8. All of the listings are Category 4B meaning that it has a pollution control program. The pollution control program is implemented under CERCLA as described in Section 2.1.2.

As previously described, the waterways are the discharge point for a highly urbanized drainage basin with residential, commercial and industrial land uses and transportation corridors. Sources of Contaminants of Concern (COCs) to the sediments continue to exist in the drainage basins and are conveyed to the waterway via stormwater runoff from municipal right-of-ways and private properties, aerial deposition, marinas, and groundwater discharges. The contaminants identified as having the greatest potential to affect sediment quality following the cleanup action include polycyclic aromatic hydrocarbons (PAHs) and phthalates.

Since stormwater is one of the potential sources of contamination, the City has been implementing a comprehensive monitoring and source control strategy in the Foss Waterway Watershed since

2001. Stormwater monitoring is required under the Thea Foss Waterway Consent Decree (CD) with EPA. It also meets the monitoring requirements of the NPDES Permit

Over time, the Thea Foss Post-Remediation Source Control Strategy has used a multifaceted approach consisting of aggressive source control efforts, a comprehensive monitoring program, a computer model to predict impacts to the sediments, and a decision matrix to identify the need for additional source controls. Monitoring information is used to target source control efforts in the drainage basins with "hot spots" to help provide long-term protection of sediment quality in the remediated waterways.

The Foss Waterway comprehensive monitoring program measures annual baseflow, stormwater contaminants of concern and stormwater suspended particulate matter (SSPM) from seven outfalls are used to evaluate effectiveness of ongoing source control efforts, and to provide early warning of any new problems which arise in the drainage basins.

An annual report is submitted to EPA and Ecology describing the City's existing stormwater activities and studies completed during the previous water year, and includes recommendations for additional source control activities in the watershed. Annual source control evaluations are completed specific to each major outfall using the monitoring data to assess the effectiveness of ongoing studies, source control investigations, enhanced maintenance activities such as supplemental street sweeping and stormline cleaning efforts described further below. Because of the extensive enhanced maintenance and monitoring work in this basin, the City has realized significant improvements in stormwater quality in this watershed.

The City has separate sanitary and storm sewer systems. However, to accommodate times of high flow, overflow pipes from the sanitary system to the storm drain system are present in several locations. One such location is in the Dock St. Maintenance Yard located just south of the head of the Thea Foss Waterway. Over time, there have been periodic overflows that have occurred, leading to discharges of sanitary sewage into the Foss Waterway. When this occurs, the City has a procedure for documenting and reporting overflows at this location.

Groundwater Quality

South Tacoma Groundwater Protection District

The South Tacoma groundwater aquifer system serves as a significant source of drinking water for the City of Tacoma. It supplies as much as 40 percent of the City's total water demand during periods of peak summer usage. In 1988, the City of Tacoma adopted Tacoma Municipal Code (TMC) Chapter 13.09 - South Tacoma Groundwater Protection District (STGPD) to protect this important resource (Figure 3-4). This regulation was most recently updated in 2018.

The STGPD program is managed by the Tacoma-Pierce County Health Department (Health Department). The focus of the STGPD program is pollution prevention. Facilities are generally regulated based upon their use or handling of hazardous substances as a "product" or a waste". Facilities also may be regulated if they have drywells or stormwater infiltration systems on site.

Regulated facilities receive a permit and biennial site inspections from the Health Department. Compliance issues or complaints may trigger additional inspections. Whenever possible, inspections focus on education and technical assistance to businesses to achieve voluntary compliance.

University of Washington Groundwater Contamination Plume

Historic businesses left chemicals from commercial degreasers, oil, and fuel in soil and groundwater on the University of Washington Tacoma (UW Tacoma) campus cleanup site which is located on about 50 acres in downtown Tacoma. The site includes a mix of old and new buildings, ranging from new construction to structures over a century old. This part of downtown has a long legacy of industrial activity. Many of those activities contaminated the soil and groundwater with petroleum hydrocarbons and polyaromatic hydrocarbons in soil, and volatile organic compounds in the groundwater.

UW Tacoma is in the early stages of cleanup of the site under Ecology oversight. As part of their efforts, they are investigating the extent and types of contamination plumes, and will complete a smaller, partial cleanup in some areas.

ESA-Listed Fish Species Critical Habitat

Foss Waterway, Commencement Bay and the South-Central Puget Sound are rearing and migratory areas for several fish populations including several species of salmon. A complete list of ESA listed species for WRIA 10 is included in the Thea Foss Waterway Watershed Section 5.4.

6.4 HABITAT RESTORATION SITES

As part of the Thea Foss and Wheeler-Osgood Waterways Remediation Project, habitat mitigation sites were constructed along the Foss Waterway, in the Lower Puyallup and Tideflats watersheds, and along Hylebos Creek in the City of Fife. In the Foss Waterway watershed, habitat enhancement sites were constructed at four locations along the shoreline of the waterway as part of the remediation project that was completed in 2006. These sites are identified on Figure x as the Johnny's Dock Habitat Enhancement, Head of Thea Foss Shoreline Habitat, SR 509 Esplanade Riparian Habitat, and Log Step Habitat Enhancement.

In addition, as part of the remedial action, slope rehabilitation along the shoreline of the Thea Foss Waterway was also performed by the City to provide more suitable habitat in these intertidal areas. Habitat improvement areas are routinely maintained (garbage and invasive removal) and periodically qualitatively monitored to ensure that they continue to provide the intended habitat function.

6.5 STORMWATER ACTIVITIES

The following section describes stormwater activities conducted by the City in the Foss Watershed, with a goal of improving water quality and reducing potential flooding concerns.

Enhanced Maintenance

As part of the source control efforts to protect the Foss Waterway remediation work, the City has implemented enhanced maintenance practices in this watershed.

<u>Storm Line Cleaning.</u> Between 2006 and 2008, the City completed basin-wide sewer line cleaning of three entire drainage basins in the Foss Waterway Watershed (OF254, OF235, and OF230) and part of a fourth basin (OF237A). In 2010 to 2011, a fifth basin (OF237B) was cleaned. The objective of the storm line cleaning program is to remove residual sediments in the storm drains, some of which may contain legacy contamination from past years that may continue to contaminate stormwater or baseflow through resuspension and/or dissolution. While the City's Asset Management group has established a City-wide schedule of line cleaning every ten years, the Foss data will continue to be evaluated to determine whether more frequent cleaning is needed due to the sensitivity of the receiving water body.

<u>Enhanced Street Sweeping.</u> In response to relatively elevated concentrations of lead and zinc in both stormwater and baseflow in the industrial basins OF243 and OF245, the City initiated a pilot program in WY2014 to determine whether an increased frequency of street sweeping in this area would have an effect on these results. Starting on October 1, 2013, the City began sweeping the

ROW within these drainage basins at a frequency of once every two weeks rather than the usual frequency of once per month for industrial areas. The pilot project is ongoing at this time.

CIPP Lining. Approximately 41,921 linear feet of existing storm sewer has been rehabilitated in the Foss Watershed using Cured-In-Place Pipe (CIPP) construction technologies. Without requiring pipe excavation, this approach fixes pipe defects (e.g., cracks, holes) that could allow contaminated groundwater and soil from historic “hot spots” to enter the storm sewer system and discharge to downstream receiving waters. CIPP lining projects were completed in drainage basins connected to the following outfalls (OF):

Table 6-2 Foss Watershed CIPP Lining Totals

Location	2010 (linear ft. lined)	2013 (linear ft. lined)
OF230/230A	13,500	13,807
OF235		5,470
OF237A (DA-1 Line)		5,126

Effectiveness evaluations of these enhanced maintenance activities are completed annually. Over a decade of data has shown these efforts are very effective in further reducing contaminant concentrations. Through Tacoma’s City-wide Watershed Management Plan, the City will expand these efforts into other watersheds on a prioritized basis.

Regional Treatment Facilities

As an additional source control focus, regional stormwater treatment facilities have been constructed throughout the Foss Watershed.

Ferry Street Regional Facility

The Ferry Street Regional Stormwater Filter Vault treats runoff from 61.42 acres of the Foss Watershed in Asset Management Area, FS03 (see Figure 3-1). The Ferry Street Regional Facility is located on South 23rd Street just east of the South Ferry Street intersection (Figure 3-1). The facility is a 20 feet by 60 feet Contech vault holding 226 StormFilter cartridges filled with proprietary “ZPG” filter media.

Hood Street Regional Facility

The Hood Street Regional Stormwater Bioretention Facility treats runoff from 45.35 acres of the Foss Watershed in Asset Management area, FS06 (see Figure 3-5). The Hood Street Regional Facility is located along the Prairie Line Trail adjacent to South 21st Street (between Jefferson Avenue and C Street) on the University of Washington – Tacoma Campus (Figure 3-5). The facility includes six bioretention cells, ranging from 535 to 545 square feet long, with underdrains (see Figure 3-6) conveying treated stormwater back into the storm sewer system. The design and bioretention media (Americast Filterra®) were approved by Washington State Department of Ecology and is approved for Enhanced Treatment.

'A' Street Regional Facility

The 'A' Street Regional Stormwater Filter Vault Facility treats runoff from 34.5 acres of the Foss Watershed in Asset Management area, FS05 (see Figure 3-9). The A Street Regional Facility consists of two vaults, one on 10th Street and one on 11th Street, both near the A Street intersections (see Figures 3-10 and 3-11). Each vault treats a branch of the A Street stormwater system.

Washington State Department of Transportation (WSDOT) Ponds

WSDOT has several stormwater detention ponds that have been built during the course of their construction of the freeway systems in the Foss Watershed. While the majority of the ponds infiltrate stormwater discharges, overflows can discharge to the City's stormwater system.

7.0 WESTERN SLOPES WATERSHED

7.1 OVERVIEW

The Western Slopes watershed covers 2,090 acres and is the only Tacoma watershed that drains to the Narrows Passage in the Puget Sound. Except for the west end of the 6th Avenue business district and a portion of Point Defiance Park, the watershed is predominately residential (Figure 3-9). The landscape is dominated by steep slopes with underground springs, shallow groundwater, and soil conditions that cause slope instability and the hillsides north of the Narrows Bridge have experienced many landslides in recent history. Multiple short creeks are present along the slopes in this area. Significant creeks identified in the Tacoma Urban Creek Assessment Report (Tacoma 2000) include Gold Creek, Narrows Creek, Crystal Creek, Crystal Springs Creek, Marinera Creek and Titlow Park Gulch Creek. There are additional gulch systems that contain very little flow.

Critical habitat issues in this watershed include development near steep slopes and the removal or topping of trees to enhance views to the Puget Sound. The Burlington Northern Sante Fe (BNSF) railway system runs along the entire length of the waterfront along the base of the steep slope areas. Many culverts have been places under the tracks to collect and convey the stormwater runoff and creek flows under the tracks to the Puget Sound.

The Western Slopes forms a green belt between Point Defiance Park and Titlow Beach. This wildlife migration corridor is of great importance in Tacoma. Evidence of a large deer population as well as raccoons, river otter and other small animals are present along this corridor.

The community of Salmon Beach is located in this watershed and is only accessible by water or by a steep system of stairways and trails. While there is no creek located in this housing development, there are groundwater springs that discharge out of the hillside.

7.2 STORMWATER CONVEYANCE

There are four distinct sub-basins in the Western Slopes watershed discharging stormwater to the Narrows Waterway in Puget Sound (Figure 3-9). The Northern most sub-basin (WS01) discharges stormwater from the western portion of Point Defiance and the residential neighborhoods between Pearl Street and the Narrows. There are several small gulches in this sub-basin.

The WS02 is a small sub-basin discharging stormwater from a residential area along N Narrows Drive between N Mildred and N 17th Streets. The gulch systems draining this sub-basin area include Stormwater Pipe Alley, Deer Haven Gulch, Chinese Mining Gulch and Jason's Gulch.

The WS03 sub-basin is the largest sub-basin in this watershed and receives discharges from both residential and commercial areas as well as Highway 16. The gulches in this system area Water Memorial Park Gulch, Tacoma Outboarder Association (TOA) Gulch, and the Pedestrian Bridge Gulch. This sub-basin also includes Narrows Creek.

The WS04 sub-basin is the southernmost basin in this watershed and borders University Place. This sub-basin receives stormwater discharges from areas with both residential and commercial development. The basin also includes most of Titlow Park and Titlow Park Gulch, Crystal Springs Creek, and Crystal Creek, which is collected and conveyed through the Day Island Marina storm system at the end of S. 19th Street.

Stormwater runoff from a significant area of commercial and residential development in University Place also drains north and is collected and conveyed by the City stormwater system in S. 19th Street.

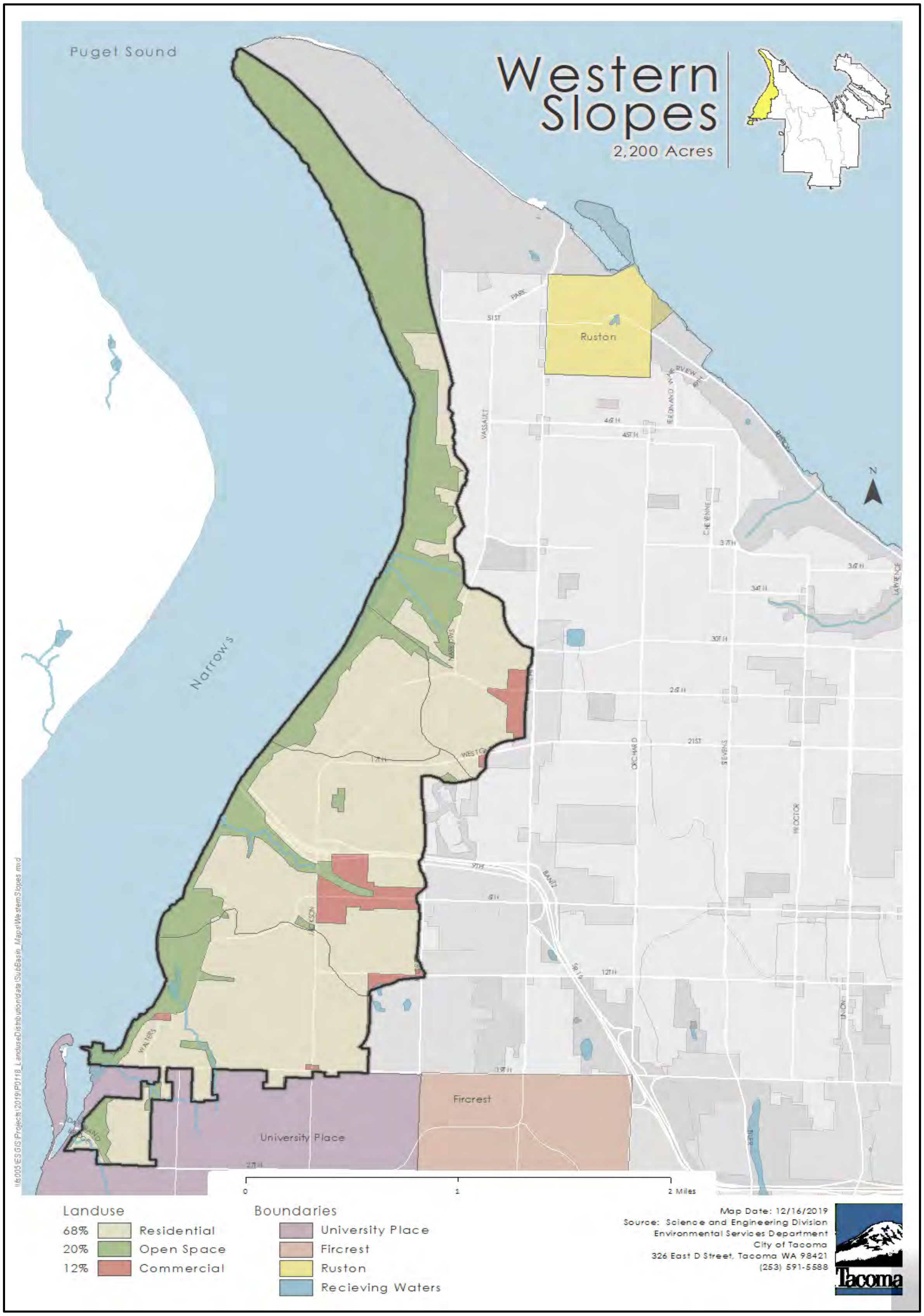

Figure 7-1 City of Tacoma Western Slopes Watershed Land Use Map

7.3 RECEIVING WATERS

The Tacoma Narrows

The Narrows is a strait that is part of the Puget Sound, separating the Kitsap Peninsula from the City of Tacoma and separates the South Sound from the Main Basin. Due to the large tidal exchange and the narrow passage the strongest currents in the Narrows can reach up to 5 knots. The Narrows is currently listed as a Category 5 on the States 303d list for dissolved oxygen.

Marinera Stream

This stream and gulch runs parallel to the south of Marinera Street, just north of Gold Creek Gulch. This is a small gulch with access at the end of Marinera Street or from the Vassault Park trail. There is a 10-inch stormwater pipe that drains Marinera Street. According to the Urban Creek Study, there is a possibility that the stream is fish accessible when the culvert is submerged during high tide.

Narrows Creek

Narrows Creek originates at the Jackson Avenue and Highway 16 off-ramp intersection. The creek parallels Highway 16 and heads west through the Narrow's Creek Apartment Complex. The creek continues down the slope to the stormwater inlet structure behind the now closed Wastewater Treatment Plant #2. The large gulch system is accessible from the entrance to the old treatment plant. There are impassable fish barriers including a trash rack on the stormline and a long culvert from the stormwater inlet structure to the outfall discharging to Puget Sound.

Titlow Park Lagoon and Beach

Titlow Park is the only beachfront park on the west side of Tacoma. The park contains a large 75-acre grassy and forested open space located at the base of 6th Avenue. There is a relatively flat, unpaved 1.6-mile hiking loop trail accessible year-round to the public.

The park contains marine shoreline, 25 freshwater wetlands and four forested perennial streams: Titlow Park Creek, Crystal Springs Creek, Pedestrian Bridge Gulch and Tacoma Outboarder Association (TOA) Gulch. The mature forest stands provide beneficial wildlife habitat for birds, fish and other wildlife. For more detail, see the Wetland Delineation and Fish & Wildlife Habitat Report.

Titlow Park Creek begins in a ditch on Sunset Drive, travels through a residential area, and crosses 6th Ave where it enters Titlow Park. The creek discharges to Upper Titlow Lagoon and the flow averages less than 0.5 CFS. Part of Metro Parks Titlow Park Master Plan, in coordination with the South Puget Sound Salmon Enhancement Group, includes restoring Titlow Park Lagoon to be a potential refuge for juvenile salmon. Currently, the lagoon is connected to the Puget Sound through two 40-inch culverts that pass under the BNSF railroad. A railroad bridge is being proposed to replace the culverts and allow open access from nearshore habitat to the lagoon. The City is investigating the potential for a regional stormwater treatment facility located in the park, to enhance stormwater quality of the water discharging into the lagoon. The Titlow Park Master Plan is available online with further details.

Crystal Springs Creek is a highly urbanized stream and receiving water containing many culverts, channelized reaches through residential backyards, and other fish barriers along the length of the creek. Crystal Springs Creek headwaters are in University Place at approximately 22nd St. Ct. W and Crystal Springs Road. Where Crystal Springs Creek enters the stormwater system at the top of Titlow Road, stormwater and creek flow are co-mingled. Two bypasses in the pipe network in the Titlow Road allow creek baseflow to continue in channel while high flows are directed into the stormwater system. A third bypass located in the manhole at 6th Avenue and Titlow Road splits flows between stormwater mains discharging to the Narrows and to Lower Titlow Lagoon. A portion of Crystal Spring Creek flowing through the stormwater system running through Titlow Park by the tennis courts was day-lighted in an open channel project completed in 2006.

Pedestrian Bridge Gulch is a small creek located west of Narrow's Glen Retirement Center near 6th Avenue and Laurel Lane. The gulch receives some stormwater runoff from a dispersal trench collecting stormwater from the retirement center and then discharges directly to the Puget Sound. Due to the steep gradient, culvert barrier under the railroad tracks, and low flows, this creek is not accessible to fish.

The creek associated with the TOA Gulch is located north of Pedestrian Bridge Gulch and west of Sunset Drive. Similar to Pedestrian Bridge Gulch, due to the culvert under the railroad tracks and low flows, there is small possibility that this stream is accessible to fish. There are no stormwater pipes draining into this gulch.

Crystal Creek

Crystal Creek has headwaters in University Place at approximately 22nd St. Ct. W. and Crystal Springs Road and travels northwest through residential areas along the border between Tacoma and University Place. The Creek continues under Grandview and Westridge, finally entering a stormwater inlet structure to a culvert underneath the railroad tracks at the 19th Street entrance to the Day Island Marina. The responsibility and maintenance of the stormwater system west of the railroad tracks is officially under University Place jurisdiction; however, the City of Tacoma has also responded to drainage complaints at the Marina in the past. The Stream contains several partial and total fish passage blockages, as identified by the Washington Department of Fish and Wildlife SalmonScape Map (WDFW 2019). Issues with this creek are heavy sedimentation, dumping, and encroaching residential development.

7.4 STORMWATER ACTIVITIES

The City conducts general citywide NPDES stormwater activities in this watershed. While there are currently no large regional treatment facilities located in this watershed, Environmental Services has been collaborating with Metro Parks to identify opportunities for stormwater treatment projects as part of the Titlow Park Master Plan.

8.0 NORTH TACOMA WATERSHED

8.1 OVERVIEW

The North Tacoma Watershed drains approximately 4,766 acres and encompasses the northern portion of Tacoma and the City of Ruston. The drainage area includes the eastern portion of Point Defiance Park extending to North 30th and Pearl Street (Hwy 163), and the area from approximately 6th Avenue and Stevens Street to Ruston Way and Commencement Bay. The area is predominately residential in nature with some commercial areas such as the 6th Avenue District, the Proctor District and Point Ruston and the open space areas along the shoreline and Point Defiance Figure 3-10.

This watershed also contains the North End Wastewater Treatment Plant (NETP) and the former ASARCO Smelter site. The nearshore area along Commencement Bay north to the former ASARCO copper smelting site has been designated as part of the Commencement Bay Nearshore/Tideflats Superfund Site.

Historically, the area along the waterfront was inhabited by The Puyallup Tribe of Indians, used for hunting and fishing grounds, and travelled by many other tribes. Once non-natives arrived, they began establishing industrial businesses and trade along the waterfront including sawmills, grain terminals, loading docks and other water-related activities.

Geologically, this area contains sandy soils on top of clay layers with steep slopes located along the northern edge of the watershed. Critical issues in the North Tacoma watershed include impaired nearshore habitats along the shoreline of Commencement Bay, erosion of steep slopes along the shorelines, historic soil contamination with lead and arsenic within the Smelter Plume, and fish passage barriers to creeks interrupted by Ruston Way, the railroad, and shoreline development.

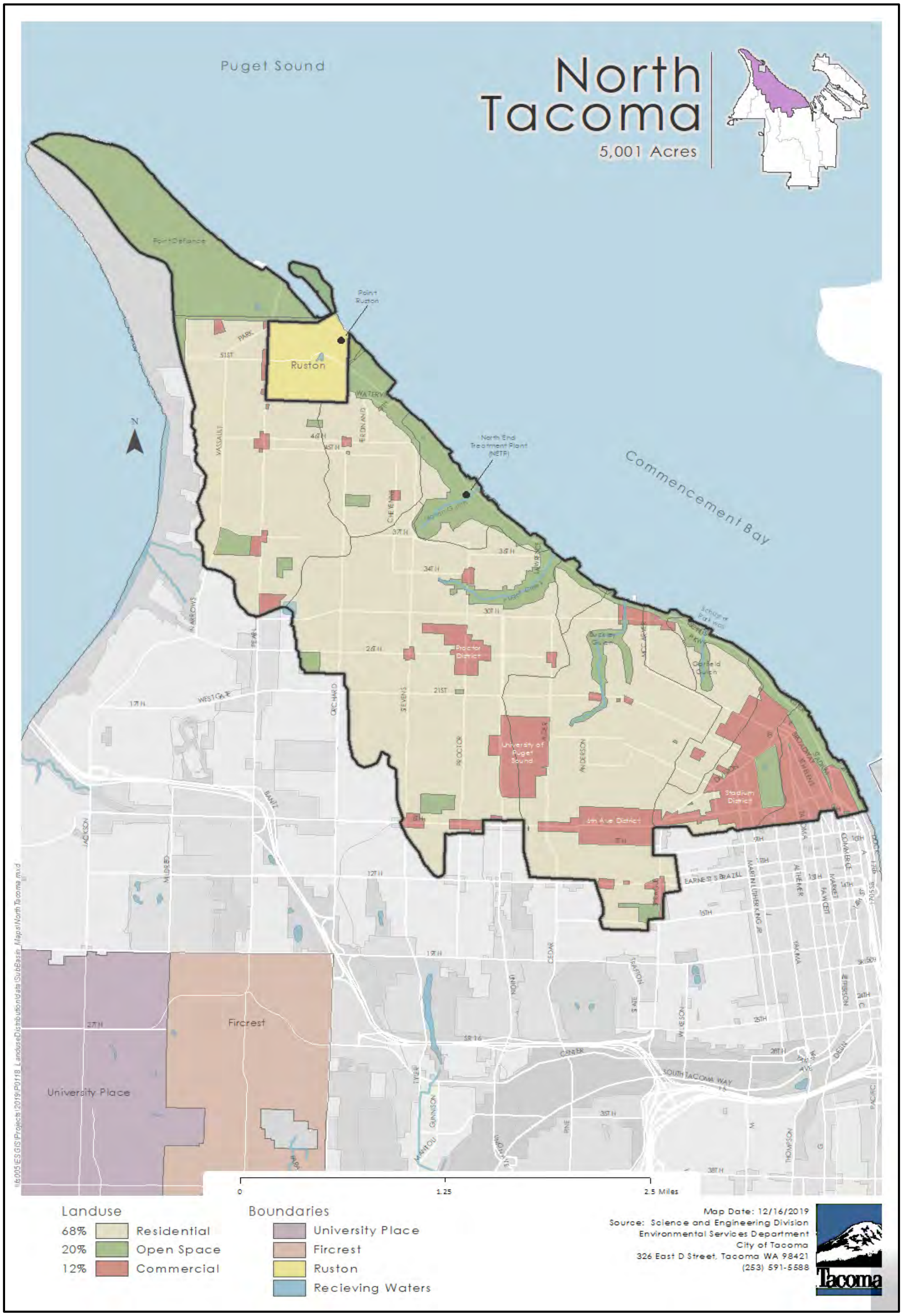

Figure 8-1 City of Tacoma North Tacoma Watershed Land Use Map

8.2 STORMWATER CONVEYANCE

The watershed is divided into eleven stormwater asset management sub-basins. Due to the size and complexity of this watershed, stormwater conveyance is discussed based on geographic areas associated with drainage areas and gulch systems. Generally, stormwater from this watershed discharges into Commencement Bay from the vicinity of Schuster Parkway into the head of the Thea Foss Waterway to the eastern side of Point Defiance (Figure 3-10).

Schuster Parkway & Garfield Gulch

There are four sub-basins discharging to Commencement Bay from the Schuster Parkway area. The southernmost sub-basins encompass the residential and commercial areas of downtown Tacoma to the Stadium District and include discharges from Tacoma General Hospital and Wright Park. There is extensive re-development planned for this area, including underground utility replacement and the extension of the downtown Sound Transit Link light rail system.

There has also been significant restoration work along the open space area of Schuster Parkway to assist with slope stabilization. The Schuster Slope Landscape Management Plan provides details on habitat, site conditions including geology, and the full details of the restoration plan. Historically, stormwater from the upland areas discharged into gullies along Schuster Parkway. Current development regulations require stormwater runoff to be collected by the City's stormwater conveyance system and not discharged directly to the slope.

Garfield Gulch is located within this drainage area. Stormwater from this sub-basin is conveyed through stormwater pipes that ultimately connects to the stormwater trunk mainline located under Garfield Gulch. The stormline continues through a culvert under Ruston Way and discharges to an outfall into Commencement Bay near the head of the Foss Waterway. Per the WDFW SalmonScape Map (WDFW 2019) and the City's Urban Stream Report (Tacoma 2000), Garfield Gulch has a low flow intermittent stream. Fish passage is not feasible in this area due to the physical barriers of the culvert and limited flow.

This sub-basin is all residential land use with a large park (Garfield Park) and Annie Wright School campus located at the head of the gulch. There is a trail system running through the gulch and a trail on the east side that connects N. 27th Street to the park.

Buckley Gulch Drainage Area

The open space area of Buckley Gulch (sometimes known as "Old Town Gulch") originates near N 16th and Junett. Perennial creek flow from groundwater seeps begins near the 24th Street Bridge and connects with the City's storm system near N. 29th Street and Carr at Ursich Park in Old Town. The stormwater pipes collect runoff from the residential and commercial areas of this sub-basin and discharges to a marine outfall near Hamilton Park after crossing under Ruston Way. There are also wastewater pipes that run through the gulch parallel to the stormwater collection system.

Puget Gulch Drainage Area

Stormwater discharges in the Puget Creek drainage area flow through the City's Stormwater conveyance system and into the main stormwater pipe that runs through Puget Gulch. With the exception of a few smaller drainage areas, the majority of the stormwater from this sub-basin and the groundwater-fed flows from Puget Creek are conveyed under Ruston Way into Commencement Bay near Dickman Park. At the base of the gulch, Puget Creek flows through a landscaped residential property in Puget Gardens Greenspace, through a culvert under four private driveways, and then into a pipe with an underground fish ladder/culvert, and into the City's storm sewer system under Ruston Way. Similar to other gulches in this area, a wastewater trunkline runs parallel to the stormwater pipes through the gulch.

Land-use in this area is primarily residential with two business district areas at 6th Avenue and Proctor Street. The Proctor area is moving toward dense re-development with increased mixed use and commercial areas in the neighborhood. The Metropolitan Park District (Metro Parks) manages Puget Park at the upper end of Puget Gulch.

Mason Gulch Drainage Area

This drainage sub-basin is mostly residential, and stormwater runoff is collected and conveyed through several outfalls located along Ruston Way. Both the stormwater and wastewater collection systems are located around the upland edges of the gulch and do not follow the alignment of Mason Creek which flows down the center of the gulch. The creek is collected in the stormwater inlet structure at the lower end of the gulch just above the North End Wastewater Treatment Plant. The main stream is conveyed 980 feet through the 24 to 36 inch diameter culvert under the treatment plant, North Waterview Street, the Burlington Northern and Sana Fe Railway tracks, Ruston Way and the City Park to Commencement Bay. This culvert system poses a complete barrier to fish passage due to elevation drops, high gradient segments with excessive flow velocities and a water diversion structure at the culvert inlet. Ongoing sand removal in the settling area in the stream just upstream of the stormwater inlet structure is required to keep the storm system from plugging and flooding the treatment plant.

Point Defiance and Ruston Drainage Area

The Point Defiance and Ruston drainage areas contain the northern most sub-basins in this watershed which have various current land uses and a diverse history. This drainage area contains the historic Asarco Smelter Site, which is part of the Commencement Bay, Near Shore/Tide Flats Superfund site. Point Ruston LLC is in the process of cleaning up the former smelter property as part of a large mixed use residential and commercial Built Green community, under EPA's continued oversight. While the majority of this drainage area is residential and open space land-uses including several schools and parks, there are also some small commercial areas in the City of Ruston and along Pearl Street. With the exception of a few small streams in the City of Ruston, the majority of stormwater runoff is conveyed through the City's stormwater collection system and discharges into Commencement Bay near Point Ruston.

8.3 RECEIVING WATERS

Receiving water bodies within the North Tacoma watershed include Commencement Bay, Puget Creek, Mason Creek and Garfield Creek. Puget Creek, Mason Creek and Garfield Creek have been regularly monitored in the past as part of the Pierce Conservation District Stream Team (PCD Stream Team) creek monitoring program. Puget and Mason Creeks are perennial and have steep slopes associated with them. There are also several creeks located within the City of Ruston. All of the streams enter the City's stormwater system prior to discharging to marine outfalls along Ruston Way. The creeks must pass under two arterial roads, Ruston Way and Schuster Parkway, and the railroad prior to entering Commencement Bay. Activities to benefit the watershed in North Tacoma neighborhoods have primarily focused on restoration of open space and critical area habitat through the City's Open Space Management program in collaboration with volunteers and community groups.

Commencement Bay & Dalco Passage

Commencement Bay is surrounded by the Port of Tacoma at the southern end, Point Defiance on the west and Browns Point on the east separating Commencement Bay from the open Puget Sound. Commencement Bay is one of the most active ports in the region.

The Asarco Smelter Area in Commencement Bay was identified by the Environmental Protection Agency (EPA) as a priority area requiring remediation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as part of the Commencement Bay Nearshore/Tideflats site. CERCLA is commonly referred to as the Superfund Program. The North Tacoma stormwater asset sub-basin NT-02 currently outfalls near the old Asarco Smelter site at the Dalco Passage and East Passage. This nearshore area is listed as an impaired waterbody for arsenic, copper, lead and zinc (Ecology 2019).

Buckley Creek

Historically, the mouth of Buckley Creek was located where Old Town Park sits today. As sawmills moved into the area, the creek was altered to create a fresh water pond for the Dickman Mill operation at the creek's mouth. In 1925, Ruston Way was built, and the creek was directed into a culvert pipe discharging into the Puget Sound near Hamilton Park.

A Wetland and Waterway Investigation[5] and delineation within the gulch between N. 29th and N. Yakima Avenue was completed in 2015, and provides further details of the site soils, vegetation and hydrology. There is another small stream with high probability wetlands extending to the east between Carr Street and Orchard Road. The side-channel stream area crosses over privately-owned parcels. This stream combines with the main channel of Buckley Creek near Ursich Park where it enters the City's stormwater system. Unlike other gulches in North Tacoma, there is no designated trail or public use access through Buckley Gulch. While the stream channel contains significant fish passage barriers, the gulch still provides critical habitat for wildlife in the City, including deer, hawks, owls, herons, hummingbirds and raccoons.

Puget Creek

Puget Creek is approximately 1,600 feet long with perennial flows averaging about 2.9 cubic feet per second (cfs). Most of the historical flow is collected and conveyed through City's stormwater system, which runs under the length of the gulch.

Soils in this area are of the Alderwood-Everett association. These soils are moderately well drained, which is typical of glacial till and glacial outwash. The gulch consists of steep slopes at a slope of 40% or greater.

In March 2002, a wetland delineation was conducted that identified and classified the wetlands located in the lower section of Puget Gulch where the stream originates and downstream of that area. There are multiple wetlands ranging in scale from Category II to Category III wetlands (Reference – The Puget Gulch Wetland Delineation report).

Over the past decade, Puget Creek has been the subject of interest by several groups concerned with restoring this open space, including the Puget Creek Restoration Society. This group worked

[5] Can be found at: G:\ENGRNG\Environmental Programs Group\Environmental Permitting\Gulches\Buckley Creek.

with the City to reintroduce salmon to Puget Creek by improving fish access and vegetative cover in Puget Gulch and worked to restore the trail connecting the Proctor Area with Ruston Way.

A fish ladder was installed in 1997 to provide fish access to the creek, which is designed to provide access to the creek by salmonids during high tide. Members of the Puget Creek Restoration Society stated that spawning Coho were observed in Puget Creek in 2001 and 2003. Washington State Department of Fish & Wildlife identifies a documented presence in Puget Creek for both Coho Salmon and Residential Coastal Cutthroat Trout (WDFW 2019).

Puget Gulch provides beneficial habitat for a variety of wildlife including muskrats, Cooper's hawks, red foxes, great horned owls, raccoons, possums, deer, eagles, red tail owls, bard owls, mountain beavers and numerous birds, as referenced in the Puget Creek Watershed Management Plan. Eelgrass beds exist in Commencement Bay near the mouth of the creek and are important habitat for salmon fry.

Mason Creek

Mason Creek drains Mason Gulch, a 36-acre undeveloped ravine located in the North Tacoma Watershed. The main stem of Mason Creek flows perennially, primarily fed by ground water seeps and water discharging from a pipe on the northeastern hillslope near the upper end of the gulch. The creek channel is approximately 8 feet wide. There are also small tributary streams in the gulch approximately 2 to 5 feet in channel width. The tributaries are generally steep, fast moving riffles, but in some areas contain step-pool channels formed by large woody debris. Approximately 1,170 feet downstream of its headwaters, Mason Creek enters a 980-foot-long culvert at the western edge of the North End Wastewater Treatment Plant. Stream flows at culvert inlet have been measured at rates between 2 to 16 cubic feet per second (cfs) with an average of 5 cfs (PCD Stream Team data collected 2004-2014).

In 2005, the City worked with Herrera to evaluate the feasibility of partially or fully daylighting the culverted portion of Mason Gulch Creek to improve habitat conditions in the daylighted stream segment and provide passage to upstream reaches of the creek.

Two alternatives were proposed for daylighting and improving the stream. Concept 1 (estuary daylighting) consisted of daylighting the lower 170 feet of Mason Creek to create a small estuary and tidal marsh in a portion of Ruston Way Park. Concept 2 (channel daylighting) involved daylighting a longer channel segment (650 feet) around the south side of the treatment plant and installing a new 280-foot culvert to convey the stream under the railroad to Commencement Bay. While Concept 1 would not provide fish passage to upstream reaches of Mason Creek, it could benefit salmon by providing rearing and foraging habitat for juvenile fish as well as for other marine species and enhance the quantity and complexity of the nearshore habitat in Commencement Bay. Concept 2 could provide fish passage under some flow conditions, but not to the upper reaches of the stream. The best fish habitat improvement alternative would have combined elements from both concepts, and the estimated cost was between four and five million dollars. The City decided not to pursue either alternative. For additional information including more information about stream habitat, geomorphic and riparian conditions, please see the Feasibility Analysis (Herrera, 2005).

In 2014, management of the properties in Mason Gulch were transferred to the City's Environmental Services Department Open Space Management Program with the intent of improving both water quality and quantity through restoration of this site. In 2015, the City began the process of creating the Mason Gulch LManagement Plan. Goals of the pn were to achieve a sustainable forest ecosystem, improve slope stability, maximize stormwater benefits, protect public safety and infrastructure and develop a volunteer stewardship program. As of December 2019, the City has restored close to one acre of steep slopes at the top of the gulch. This work included removing invasive weeds and installing natural erosion control materials across the entire area, and installing 4,352 plants. An additional 1.5 acres of invasive plant species were treated in the lower reaches of the gulch, and 30 native evergreen trees were planted in this area. A volunteer stewardship program began in 2018.Additional information regarding soil type, slope stability, and existing vegetation and drainage details are included in the Mason Gulch Management Plan.

The creek's steep gradient, shallow water depths, and non-fish-passable culvert connecting it to Commencement Bay make it inaccessible to anadromous fish and is therefore of limited habitat value for many species of salmon. Nonetheless, the creek and Mason Gulch do provide habitat for a variety of other species, including songbirds, mammals, insects, and amphibians.

Currently there are no public trail or plans to create one. The city is recommending no public accessible trails to be developed on the steep slopes because of the potential for soil erosion and wet conditions due to groundwater saturation and soil type.

8.4 STORMWATER ACTIVITIES

Regional Treatment Facilities

In 2015, the City collaborated with Metro Parks to install a Regional Stormwater Treatment Facility at Point Defiance Park (Figure 3-11). Additional details can be found here: Point Defiance Regional Stormwater Treatment Facility. This stormwater facility is designed to improve the quality of stormwater discharging to Commencement Bay. This project is designed to treat up to 8 million gallons per day from the watershed's 754 acres. This watershed is entirely located within the Asarco Smelter Plume area. Nearly half is within the Ruston Superfund Site and the rest is in an area designated with the highest level of contamination. The treatment facility uses bioretention soil mix to filter stormwater and reduce the load of fine sediment, metals, oils and grease from cars, and nutrients and bacteria from pet waste and landscape maintenance.

Figure 8-2. Point Defiance Park Regional Stormwater Treatment Facility

9.0 NORTHEAST TACOMA WATERSHED

9.1 OVERVIEW

The Northeast (NE) Tacoma watershed covers 3,385 acres. Pierce County and the City of Federal Way border the area to the north and east, the City of Fife borders the south, and the industrial Tideflats watershed borders the west of this watershed. Much of the watershed contains steep slopes and bluffs with several intermittent streams that flow into Commencement Bay. Marine View Drive (Highway 509) separates the steep sloped areas of the NE Tacoma Watershed from the Hylebos Waterway (Figure 3-12).

The gulches and wetlands in this area generally have intermittent water flow due to seasonally fluctuating groundwater. Groundwater seeps combined with sandy soils and steep slopes creates a large potential for erosion and frequent landslides occur during winter months along Marine View Drive. While the upland area on top of the bluff is primarily residential development, the properties bordering the Hylebos Waterway and Marine View Drive are primarily industrial businesses. In order to reduce water flow and prevent flooding of these businesses, detention systems were built in the gulches. Although some of the gulches have adequate flow to support fish, culverts and other obstructions block fish passage.

The City actively manages the vegetation in a few Open Space properties in this watershed including Julia's Gulch. The vegetation in these areas is dominated by invasive and noxious weeds including poison ivy and poison oak.

9.2 STORMWATER CONVEYANCE

The Northeast Tacoma Watershed is divided into six drainage sub-basins. Five of these sub-basins discharge to the south of Brown's Point into the Hylebos Waterway and Commencement Bay, while sub-basin NE01 discharges directly into the Puget Sound north of Brown's Point.

The NE01 sub-basin receives discharges from a small residential area in the northern portion of this watershed bordering Joe's Creek and the Pierce County-side of Brown's Point. There are several schools here including Browns Point Elementary and Meeker Middle School. Stormwater runoff from this basin discharges to Dry Gulch. The gulch begins at the end of 52nd St. NE and crosses into Pierce County prior to discharging north of Brown's Point into the Puget Sound. The gulch primarily receives stormwater discharges from three locations: A 54-inch pipe discharging at the top of the gulch behind 1509 51st Street, a 12-inch pipe discharging to the gulch at 53rd Street, and an 18-inch pipe discharging near Overlook Avenue. Baseflow in this gulch is intermittent with very little flow in the majority of the gulch. Large areas of the gulch have been stabilized using riprap (roughly 2/3 of the gulch), and significant erosion is still present in the non-stabilized portions of the gulch. Fish passage is not possible in this gulch since baseflow is intermittent and due to steep slopes and fish passage barriers.

The NE02 sub-basin receives runoff from a completely residential area of NE Tacoma and borders the Pierce County-side of Brown's Point to the west. Stormwater from this area is collected by an 18-inch stormwater pipe, crossing under Marine View Drive and discharging to a marine outfall into Commencement Bay. Almost half of this sub-basin consists of steep slopes with some wetlands, but no significant stream systems. An area below the Harbor Ridge housing development off Brown's Point Blvd shows vague channel definition, but no baseflow is present.

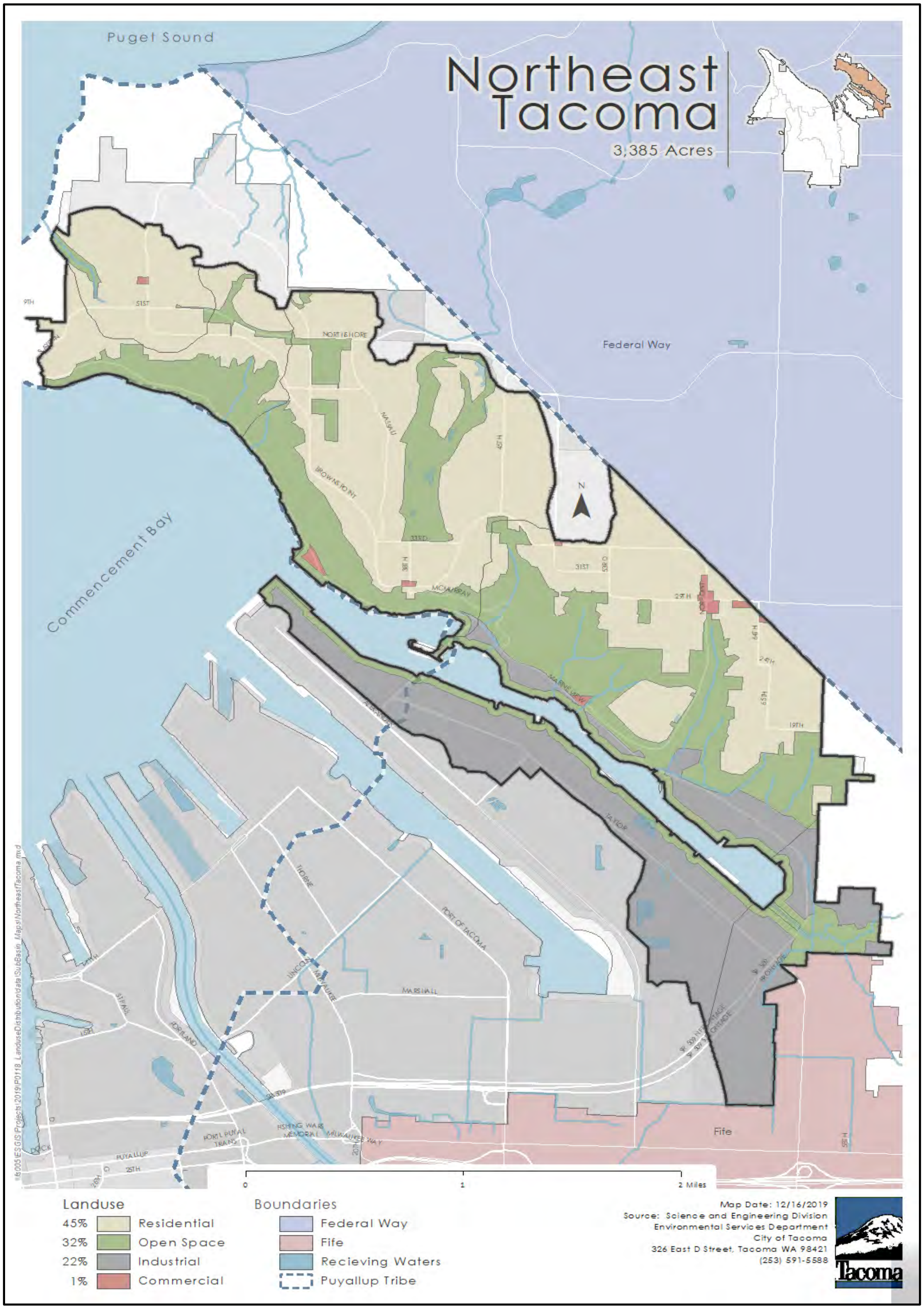

Figure 9-1 City of Tacoma NE Tacoma Watershed Land Use Map

The NE03 sub-basin drains to the northern side of Hylebos Waterway. This is a primarily residential basin with steep slopes and wetlands on the southern border along the shoreline. There are also several schools and green spaces, including Norpoint Park and the North Shore Golf Course. There are two large stormwater-fed gulches that discharge at 5002 and 4606 Marine View Drive. Both sites have erosion, flooding, excessive sedimentation and invasive species. The three smaller gulches to the southeast drain residential areas in this sub-basin and discharge into the Hylebos Waterway: Charlie's Gulch, Ole's Gulch, and Loma Court Gulch. All three gulches have issues with erosion along the steep slopes. These gulches do not receive discharges from the City's stormwater systems with the exception of a 10-inch pipe discharging into Loma Court Gulch from Loma CT NE. As the gulches receive very little piped stormwater flow, the majority of stormwater in this basin discharges into the Hylebos Waterway at an outfall near 3622 Marine View Drive.

The NE04 sub-basin drains directly to the Hylebos Waterway. The area bordering Federal Way is primarily residential and either discharges directly into the Hylebos or drains into one of the six gulches in this sub-basin. The area at the bottom of the gulches along the Hylebos Waterway is occupied by industrial uses. McMurray Gulch is located at the head of the Hylebos Waterway. This large gulch receives stormwater runoff from a 10-inch pipe off 45th Ave NE and there is extreme erosion associated with this outfall. Coski Gulch, Morning Side Ditch, and Manke Gulch also receive discharges from the City's stormwater collection system. Julia's Gulch, Metal Gulch and McBride Gulch do not receive piped stormwater. All of the gulches in this sub-basin have varying severity of erosion and invasive species issues. None of the gulches are accessible to fish due to low baseflows, steep slopes, and physical barriers such as culverts, roadways, pipes and are not considered viable fish habitat. The majority of the industries along the northern side of the Hylebos waterway are privately-owned and discharge stormwater runoff directly to the Hylebos Waterway.

The NE05 sub-basin contains mainly industrial properties at the head of the Hylebos Waterway. This basin includes the lower reach of Hylebos Creek, the only fish-bearing stream in the Northeast Tacoma Watershed.

The NE06 sub-basin makes up the portion of land discharging into the Hylebos Waterway on the southern side of the waterway. Land use in this area is industrial with all properties discharging directly into the Hylebos Waterway. The Port of Tacoma owns the majority of properties in this sub-basin. This sub-basin also includes the federally-listed contaminated Superfund site of Occidental Chemical. The Department of Ecology will be releasing the draft Cleanup Action Plan for this site in late 2019 or early 2020. Ecology's Toxic Clean-up Site: Occidental Chemical.

9.3 RECEIVING WATERS

Commencement Bay

Commencement Bay is discussed in Sections 5.3 Puyallup Watershed Receiving Waters and and 6.3 Thea Foss Watershed Receiving Waters.

Hylebos Creek

Hylebos Creek is the major tributary to the Hylebos Waterway and drains approximately 12,000 acres from tributaries in Federal, Milton, Edgewood, King County, Pierce County, and Fife to the mouth of the creek at the Hylebos Waterway in Commencement Bay. The lower portion of the Hylebos moves through Puyallup Tribal lands. The Muckleshoot Tribe also maintains fishing rights on Hylebos Creek. The West Fork drains the central and southern portion of Federal Way. The East fork begins with several small tributaries in eastern Federal Way, near North Lake and Lake Killarney and drains south into Milton. The east fork flows through a narrow ravine known as the East Hylebos Ravine, before emerging onto a broader floodplain near it's confluence with the West

Fork. The lower Hylebos is the mainstem downstream of this confluence. This tributary drains from Surprise Lake in Milton, flows through Fife and unincorporated Pierce County before emptying into the Hylebos Waterway of Commencement Bay in Tacoma. In short, Hylebos Creek flows through a variety of residential, industrial, commercial, agricultural and tribal areas and ???

The Hylebos Creek Watershed consists of approximately 350 miles of streams and 250 acres of wetlands and is believed to have been one of the most productive small stream systems in southern Puget Sound. Historical accounts indicate the system supported several thousands of Coho and Chum plus hundreds of chinook, steelhead and cutthroat trout. Overtime habitat was severely altered from its historical natural state due to development and urbanization. Residential development, erosion, channelization and frequent flooding threaten the creek and associated riparian habitat. The Salmon Habitat Protection and Restoration Strategy for WRIA 10 does not prioritize Hylebos Creek as an area for salmon recovery, due to the small size of these populations when compared with the mainstem Puyallup, White and Carbon Rivers. Despite this lack of prioritization, there is large community support to continue restoration and protection of this creek system (EarthCorps 2016).

Friends of the Hylebos (FOH) is a community group that formed in 1983 with a goal of protecting and restoring streams, wetlands, forests and open space throughout the Hylebos watershed. This group began working with EarthCorp in 2011 to develop a plan for scientifically-supported, community-based restoration in the Hylebos Watershed. The main objectives of the plan include conducting a watershed-wide assessment of basic habitat conditions, conserving and connecting remaining riparian and wetland areas, conducting local habitat assessments to characterize ecological integrity, and restoring degraded habitat. The Hylebos Watershed Plan can be viewed at the following link: EarthCorps 2016 Hylebos Watershed Plan. Additional information regarding baseline conditions in Hylebos Creek can be found in the following 1991 planning document: Hylebos Creek and Lower Puget Sound Basin Plan.

While the size of Hylebos Creek prevents it from producing a large run of Chinook salmon, restoration of urban stream ecosystems has benefits for stormwater management, water quality, wildlife habitat, biodiversity, recreation and local economies. Therefore, efforts to restore salmonid populations would also benefit greater watershed health and provide a measurable indicator of the progress in establishing healthy habitat and a functioning ecosystem in the Hylebos Creek Watershed.

Hylebos Waterway

The Hylebos Waterway is one of seven waterways situated within the Commencement Bay Tideflats, an estuary that receives fresh surface water from Hylebos Creek and direct runoff from the surrounding tideflats. Aquifers within the Puyallup Valley and the adjacent uplands also contribute fresh water to the waterway (EarthCorps, 2016)

The Port of Tacoma extended the Hylebos waterway in the 1960s to a 200-foot wide, 3-mile long waterway. Over 100 years ago, the Hylebos watershed contained over 205 miles of streams, 11 lakes and many smaller unnamed lakes. Only 25% of that surface water remains due to filling, channeling, and underground piping of surface waters. The development the industrial area and the straightening and channeling of Hylebos creek to form the current Hylebos waterway destroyed much of the historic juvenile salmon and wildlife habitat.

The Hylebos Waterway is listed impaired by Ecology for the parameters listed in the following table.

Table 9-1 Ecology 303d Listing Hylebos Waterway

Name	Parameter	Medium	Categor
Commencement Bay: Hylebos Waterway	Dieldrin	Water	5
Commencement Bay: Hylebos Waterway	PCBs	Water	5
Commencement Bay: Hylebos Waterway	Chlorinated Pesticides	Water	5
Commencement Bay: Hylebos Waterway	DDT	Water	5
Commencement Bay: Hylebos Waterway	HPAH	Water	5
Fife Ditch	Bacteria	Water	5
Fife Ditch	Dissolved Oxygen	Water	5

See http://www.ecy.wa.gov/programs/wq/303d/index.html for additional information.

Habitat Restoration Sites

Hylebos Waterway Mitigation Site

The Hylebos Waterway is listed as a Superfund site as part of the Commencement Bay Nearshore Tideflats Superfund Site. EPA placed Commencement Bay on the Superfund National Priorities List in 1983 after discovering widespread contamination. 167 of the 285 acre area listed required cleanup. The sediment in the Hylebos waterway was contaminated with PCBs, PAHs, arsenic, hexachlorobenzene, hexachlorobutadiene and other organics and metals. The contamination was tied to over 60 potentially responsible parties (PRPs) along the waterway including a chemical manufacturing plant, scrap metal recycling, log transfer facilities and shipbuilding. The clean-up plan consisted of upland source control to reduce or eliminate future discharges, dredging of contaminated sediments, capping several intertidal shoreline property's and monitoring the natural recovery of up to 20 acres. Due to partial recontamination of the Hylebos Waterway, EPA is currently considering next steps for this site. According to the City's settlement agreement with EPA, the City has generally resolved liability for past costs and future recontamination from remedy failure. In the event a new source issue arises the City could have continued involvement. EPA Fact Sheet: Hylebos Waterway EPA Superfund Fact Sheet .

In addition to the cleanup of the waterway, environmental cleanup occurred at several contaminated upland sites along the Hylebos. The Wasser Winters site is a 12.5-acre former log-sorting yard which left sediment concentrations above clean-up levels for metals, including arsenic, copper, lead and zinc. Clean-up and capping of this site occurred in 1993 and the monitoring conducted in 2019 shows that the site remediation remedy is still working. There is a covenant on this site that restricts the property use and requires the owner to maintain an asphalt cap over the contaminated area and a stormwater collection system at the site. In addition, there is a 100-foot wide stream buffer at the edge of the site along Hylebos Creek (Ecology Toxic Cleanup Site: Wasser Winters).

Another site requiring extensive clean-up was the Occidental Chemical Corp site at 605 Alexander Ave. The sediments and groundwater on this site exhibit contamination for organics, metals, solvents, PCBs and corrosive wastes. Ecology is currently working on a clean-up action plan with the Potentially Responsible Party (PRP). Further information on this site can be found on the Ecology website: Ecology Toxic Cleanup Site: Occidental Chemical.

Hylebos Creek Mitigation Site

The City of Tacoma constructed this habitat mitigation site as part of the Thea Foss and Wheeler-Osgood Waterways Remediation Project. The project area is located in the intertidal reach of Hylebos Creek on the right bank of the lower Hylebos Creek. The project site is bordered by the 4th Street Bridge at its southern end, and the on-site 400 feet of stream reach lies completely within the saltwater wedge associated with Commencement Bay's tidal fluctuations. This project complements the neighboring restoration areas including the Milgard mitigation project and the NRDA Trustees Jordan Project. Non-native invasive species were removed from this site and replaced with native plants. Where possible with the least disturbance to native vegetation, small off-channel "fingers" were excavated into the existing bank to allow water inundation during periods of high freshwater flows or tidal surges. This site provides habitat for out-migrating juvenile salmonids that pause here while acclimatizing to saltwater.

Place of Circling Waters (NRDA site)

The Place of Circling Waters is a NRDA mitigation site located along Hylebos Creek at the foot of Northeast Tacoma, this off-channel habitat was created and upland areas were preserved to benefit local Coho, Chinook, and Chum salmonid species. Amphibians and bird species will also benefit from the wetland enhancement. Under an agreement with the Port of Tacoma, NRDA constructed the site and will monitor and maintain as required by the agreement. Additional information regarding this project including current monitoring results can be found here: Place of Circling Waters Monitoring Report, Year 1.

Hylebos Creek Estuarine Restoration Site

The Hylebos Creek Estuarine Restoration Project is a 6.7-acre site located adjacent to Hylebos Creek near Commencement Bay. Historically the site supported tidal wetlands; however, by 1996 the site had been isolated from Hylebos Creek by a fabricated berm, was dominated by non-native species, and contained several structures and a significant amount of debris.

The Restoration Project has converted this property into a functioning estuarine marsh featuring intertidal channels and forested upland. The re-established estuarine habitats have replaced a limited resource within the Hylebos Creek Watershed and have restored natural habitat-forming processes for the benefit of Chinook salmon, steelhead, bull trout, and other native fish and wildlife species. Wildlands **Wildlands** has implemented an ongoing adaptive monitoring and management program to ensure the future success of the Restoration Project.

10.0 JOE'S CREEK WATERSHED

10.1 OVERVIEW

The Joe's Creek Watershed covers 434 acres making it the smallest watershed in Tacoma. It contains primarily single and multiple-family residential land uses with some open space and undeveloped land. Only two percent of this Tacoma watershed is commercial. The watershed borders unincorporated Pierce County and the City of Federal Way (Federal Way) to the north and the Northeast Tacoma Watershed to the south. While named the Joe's Creek Watershed, only the eastern portion of the watershed drains to Joe's Creek while the western portion drains just south of Dumas Bay from Dash Point State Park (Figure 3-13).

Joe's Creek is the main freshwater creek in this area. Joe's Creek itself is located in Federal Way, though it receives stormwater discharges from the City of Tacoma. The City is working closely with Federal Way to address nutrient concerns in this watershed.

10.2 STORMWATER CONVEYANCE

Joe's Creek Watershed in Tacoma is divided into three distinct sub-basins. Sub-basin JC01 is the northern most sub-basin draining an area of approximately 243 acres. The land-use in this basin is residential with small pockets of open space steep sloped areas bordering Dash Point State Park. Stormwater from this basin discharges to several gulches leading to fresh water creeks in Dash Point State Park prior to discharging into the Puget Sound just south of Dumas Bay.

The JC02 Sub-basin covers 97 acres and is the only sub-basin that discharges directly to Joe's Creek. Single-family residence is the predominant land-use in this sub-basin. While not showing on the City's watershed boundary maps, the northern pond from the North Shore Golf Course in Northeast Tacoma discharges to headwaters of Joe's Creek. The additional drainage area includes residential areas discharging to this pond. These boundaries are being re-evaluated and will be updated accordingly in 2020. Based on a study conducted by Herrera for the City of Federal Way evaluating stormwater and groundwater inputs into Joe's Creek, this sub-basin could potentially double in size (Herrera 2018).

The JC03 sub-basin covers 93 acres and while the predominant land-use is residential, this sub-basin contains the only pocket of commercial land-use in the Joe's Creek Watershed. The City is in the process of requesting GIS information from the City of Federal Way to determine how the water flows through this stormwater conveyance system. It appears that the discharge from the area combines with flows from Joe's Creek and ultimately discharges to Dumas Bay.

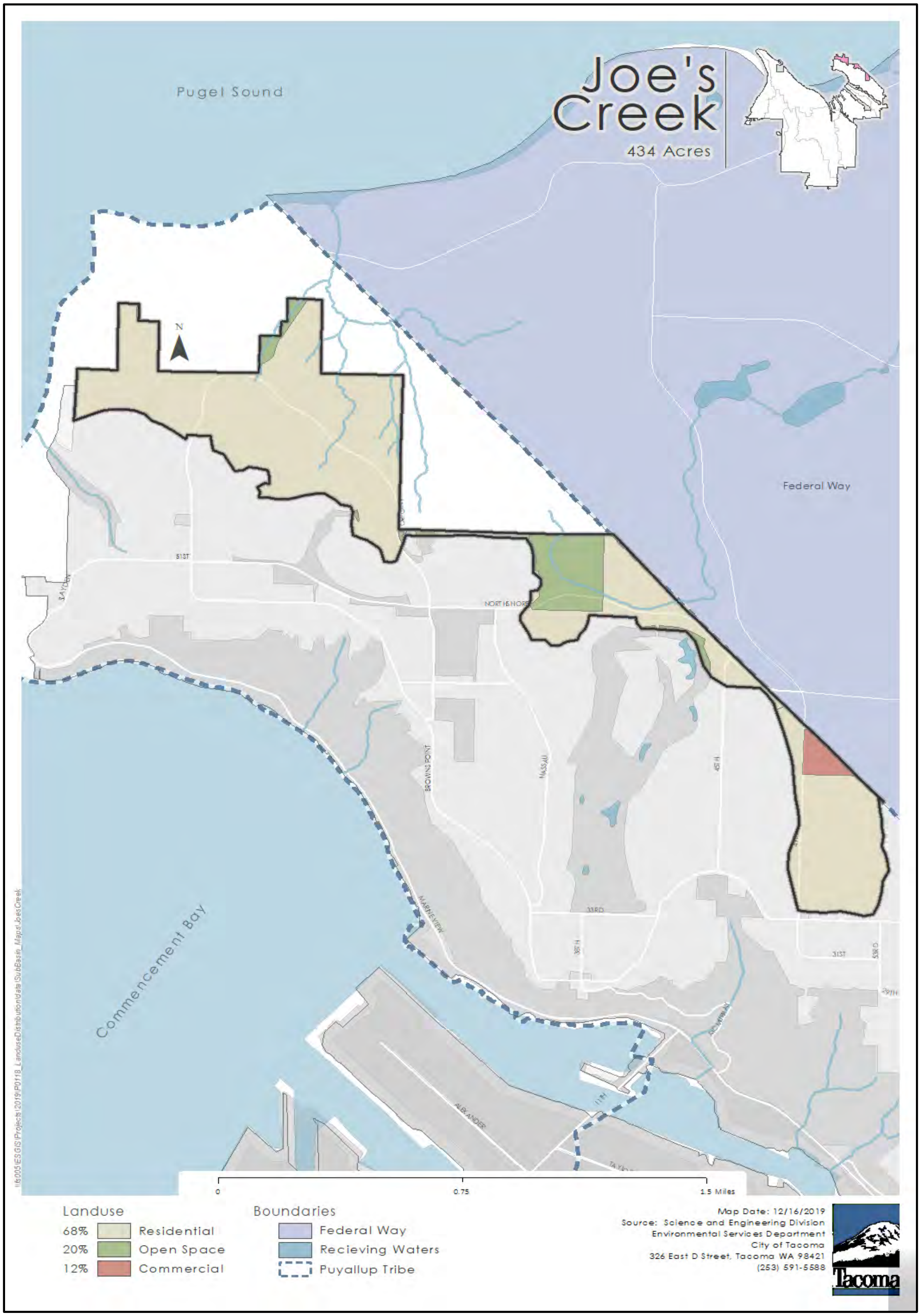

Figure 10-1 City of Tacoma Joe's Creek Watershed Land Use Map

10.3 RECEIVING WATERS

Joe's Creek

Joe's creek is a highly modified urban stream that flows north from its origins in the City of Tacoma and through Federal Way for approximately 0.75 miles to Lake Lorene. Lake Lorene discharges over a distance of approximately 700 feet into Lake Jean. These lakes are located in Federal Way and known as the Twin Lakes. Lake Jean discharges into Lower Joe's Creek, which flows north for approximately 1.1 miles to Dumas Bay in the Puget Sound.

The lower part of the creek is used by salmonid species. While this use is moderate, the lowermost portion of the creek provides the largest and best quality reach of salmonids spawning and rearing habitat in the southwest portion of King County. This habitat is threatened by loss and degradation of riparian conditions, excessive sedimentation and trash deposits where it discharges into the Puget Sound in Dumas Bay

The Dumas Bay shoreline located in Federal Way is surrounded by a mix of single-family medium- and high-density homes. Two City of Federal Way properties are on the bay: Dumas Bay Park and Dumas Bay Center. Three streams drain into the urban 40-acre bay, including Joe's Creek.

City Investigations and Action

<u>Joe's Creek Watershed Nutrient Reduction Project:</u>

The City of Federal Way launched a nutrient reduction project for Joe's Creek in 2016 due to presence of high nutrient levels and harmful algae blooms in the Twin Lakes (Lake Lorene and Lake Jeane). This project consisted of identifying problematic nutrient sources in the Upper Joe's Creek Watershed, implementing corrective actions, developing a nutrient budget to help control for future uses and implementing a public outreach program around these issues.

Federal Way contracted with an environmental consultant and researchers from the University of Washington and collaborated with the City of Tacoma to address the nutrient concerns. Nine locations were monitored through this project, though only two locations represented drainage from the City of Tacoma (JC-1 and JC-2). While JC-2 location was identified as a potential source of nutrient concentrations to the lake, the study's findings were inconclusive due to lack of flow to sample at other locations. The JC-2 Location is located at the headwaters of Joe's Creek and receives inputs from the northern pond at the North Shore Golf Course.

In response to Federal Way's findings, the City conducted the following actions to reduce nutrient concentration discharging to Joes' Creek:

1. Conducted and inspection and performed necessary maintenance of City assets
2. Conducted a source tracing investigation in the identified drainage area which included confirming drainage for both stormwater and sanitary collection systems

11.0 TIDEFLATS WATERSHED

11.1 OVERVIEW

This watershed covers 2,112 acres and is the most highly industrialized area of the City. The majority of Tacoma's heavy industrial facilities are located here along the Sitcum, Blair and Hylebos Waterways. The Tideflats Watershed is bordered by the Lower Puyallup Watershed on the south and west, Foss Waterway Watershed to the west, Northeast Tacoma Watershed to the northeast, and the City of Fife to south (Figure 3-14). Significant navigable waterways in this watershed include the Middle Waterway, Sitcum, and Blair Waterways which allow deep-water berthing by shipping vessels, and the Puyallup River. Wapato Creek discharges into the head of the Blair Waterway. Although the Thea Foss and Hylebos Waterways are proximal to the Tideflats waterways, they are connected to neighboring watershed drainage basins and are discussed in other sections.

The Tideflats is zoned for Port Maritime and Industrial uses which are princiopally dominated by Port of Tacoma operations, but also include other businesses. The Port of Tacoma supports 24-hour operations to accommodate regional and international shipping and distribution schedules, raw materials processing and manufacturing, transport of raw materials, transport of finished products, and freight mobility infrastructure. The entire area is served by road and rail corridors designed for large, heavy truck and rail loads.

Tacoma is currently working on a Tideflats Subarea Plan as a component of the One Tacoma Comprehensive Plan. Steering Committee and Advisory Group have been established. Many local jurisdictions, neighborhood groups, business representatives, labor, environmental groups, economic representatives and transportation groups are being consulted in the development of this plan. The three funding partners, the Port of Tacoma, Puyallup Tribe of Indians and City of Tacoma, will be hiring a consultant to facilitate the two-year process to complete the plan.

11.1.1 Commencement Bay/Tideflats History

The delta area where the Puyallup River meets Commencement Bay changed significantly when the European settlement of the area began (Figure 3-1). Based on significant research included in the Cumulative Impact Study, the delta/tideflat area was developed over a period of nearly 100 years. The lower reaches of the Puyallup River were historically straightened with levees due to extensive flooding and the historic estuary was filled and dredged to create property for industrial activities and navigable waterways for use by the Port of Tacoma (Puyallup River Watershed Council 2014).

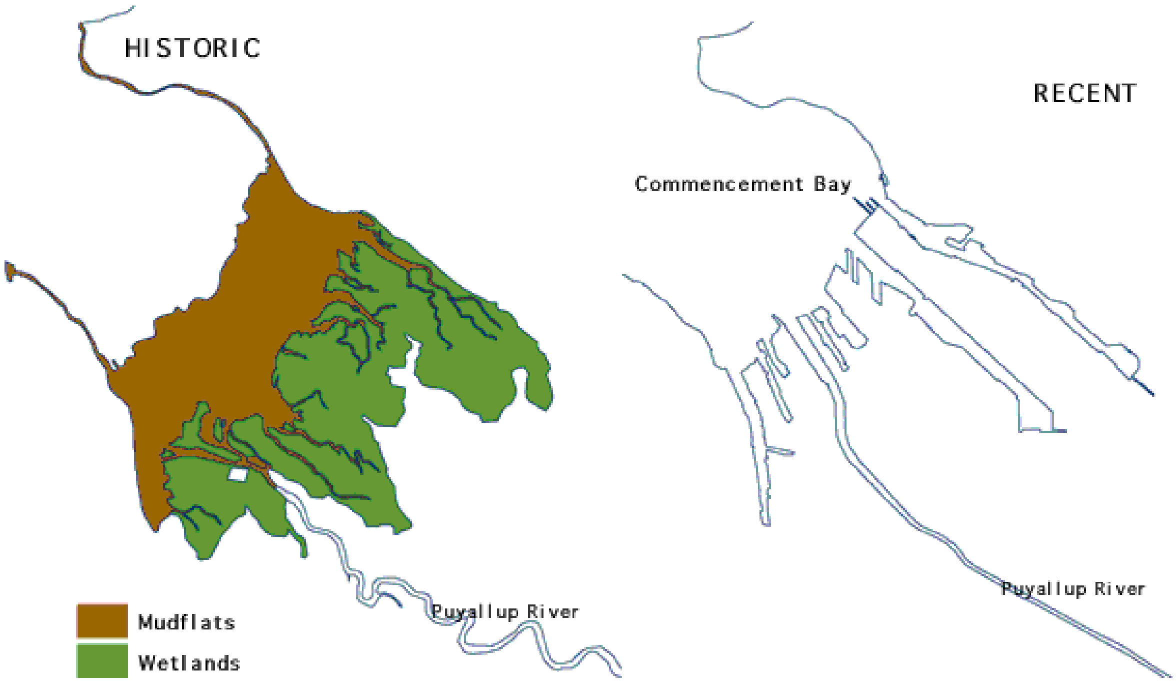

Figure 11-1 Historic and present Puyallup Estuary & Commencement Bay (People for Puget Sound 1997)

The following section discusses the history of Commencement Bay from the development of the first railroad and the creation of the waterways to the present day Superfund designation and subsequent clean up and restoration efforts.

Period I – Pre-1877: The railroad was the first development to occur in the salt marsh of Commencement Bay at the mouth of the river. The Northern Pacific Railroad which traversed salt marsh from the City of Puyallup to Tacoma (site of the Thea Foss Waterway) was completed in 1874. An estimated 10 acres of salt marsh and mudflat was filled for construction of the railroad.

Period II – 1877 to 1894: Lumber was becoming a major industry and large quantities of sawdust were generated and possibly used as fill for wharves or simply disposed of in the Bay (Sanborn, 1885-96). Wharves and piers first appeared on the western side of Commencement Bay along the Tacoma waterfront (in the Thea Foss and North Tacoma Watersheds). The railroad became further established during this period. Piers and warehouses were built for the storage and transfer of cargo and freight between shipping vessels and trains.

Construction of the St. Paul and Tacoma Lumber wharf occurred during this time. The wharf was about 300 feet long and was built seaward from "Boot Island" (an irregularly shaped marsh island just above mean high water line adjacent to the Puyallup River mouth). No record of the fill types and quantities used for the construction of the mill are available. Additionally, several log storage ponds were excavated in the mudflats adjacent to the mill through dredging of the intertidal habitat.

Period III – 1894 to 1907: During this period, the Federal Government initiated plans to dredge several waterways on the west side of Commencement Bay. The first project began in 1902 in what was then known as City Waterway (now Thea Foss Waterway). Approximately 3.1 million cubic yards of material were removed from 97.5 acres of intertidal area. Most of the dredged material was apparently side cast onto the adjacent lands and created developable uplands.

In 1905 dredging started on the Puyallup River to excavate the channel. The Federal Government's progress was hindered by floods in 1909 which caused excessive sedimentation of the river bed (U.S. Board, 1910 and 1925). Prior to the flooding, 1.7 million cubic yards of material were removed from 41.9 acres of mudflats and sidecast on either side of the waterway. Congress directed that no further work be done on the Puyallup River until local interests diverted the river from the waterway or devised another plan to prevent sedimentation.

Work also started on the Middle Waterway during this period. Approximately 810,000 cubic yards of material were excavated and deposited by sidecasting. During this same period a shallow basin was dredged between the Middle Waterway and Puyallup River to use as a log storage pond. In the 1930's, this was excavated and became the St. Paul Waterway. Approximately 50 acres of intertidal mudflat were removed and sidecast to create a log boom storage area.

Additional effort were made during this time period to dredge and even relocate the Puyallup River. This channel relocation effort likely altered the direction of flow of sedimentation resulting in filling additional intertidal areas. Construction of South 11th Street also began during this period, further impacting the mudflats with fill.

<u>Period IV – 1907 to 1917:</u> During this period, shoreline development began to shift to the east side of Commencement Bay. In 1910-1913 the Port of Tacoma became involved in dredging the Milwaukee Slip. This waterway was primarily used for berthing vessels at piers belonging to the Chicago, Milwaukee and St. Paul Railway.

A few years later, the Port of Tacoma began dredging the Hylebos Waterway through which the Hylebos River entered the Bay. A navigable channel was initially created from the Bay to South 11th Street. Approximately 0.9 million cubic yards of material was excavated and deposited mainly on the west side of the channel, an area which was formerly intertidal mudflat. Eventually the channel extended to Lincoln Avenue which displaced an additional 0.5 million cubic yards of mudflat/creek bed and widened the pre-existing Hylebos Creek. This waterway was primarily used by vessels in the lumber trade.

Around 1916, serious efforts were made to construct dikes to reduce tidal influence on the delta, thus "reclaiming" the salt/brackish marsh to agricultural use. The Hylebos diking commission commenced work on a one and a half mile long dike on Lincoln Avenue. Tide gates and associated ditches were installed in order to convert about 1,800 acres of previously "unusable land".

Tide gates were probably located in culverts and served only the larger of the delta channels such as the Wapato and a drainage feature between the Puyallup River and Wapato Creek. Lateral freshwater movement into the expansive delta was severely reduced by the installation of dikes along the Puyallup River upstream as far as "Puyallup City". These dikes eliminated the regular flooding events that occurred in the delta. Thus, freshwater movement became more confined to existing drainage courses and only surface inundation during storm events perpetuated some of the deridritic patterns normally associated with a large delta.

<u>Period V – 1917 to 1927:</u> About this time and extending into the next Historic Period, the Port of Tacoma undertook terminal developments on tideflats between the Milwaukee Slip and the former mouth of Wapato Creek. Initially the Wapato Waterway (later known as the Blair Waterway) was dredged from the Bay to South 11th Street. The new side castings were deposited on the surrounding area to create piers, wharves and other buildable land mass. During these years only the Wapato side was developed, while the Sitcum Waterway was untouched for many years. Sufficient filling had occurred on the Wapato side to create two piers with an intervening slip width of 256 feet.

Period VI – 1927 to 1941: During these years the Port of Tacoma primarily extended existing waterways. Both the Hylebos and Wapato Waterways experienced additional dredging to extend, widen, and/or deepen their channels. In 1937, the Hylebos was extended from Lincoln Avenue to the current upper end. Dredged material was removed and sidecast on the west side. Simultaneously, work was being done to deepen and widen the entire channel. Subsequently, the upper end of the channel was excavated to create a turning basin and connecting channel.

The Wapato Waterway was simultaneously extended between South 11th Street and Lincoln Avenue, and Sitcum and Taylor Avenue. Material dredged during this project were deposited on adjacent lands.

Around 1940 about 3.1 million cubic yards of material were excavated from the Sitcum Waterway and placed in the area bound by South 11th Street, Lincoln Avenue, Milwaukee Way, and Tacoma Road. The area encompasses about 286 acres. It is not known how much of this area was filled during this activity, but Corps photographs dating from 1946 show the area maintaining some marsh character.

Period VII – 1941 - 1991: This final Historic Period describing the history of the port saw the deepening of the existing channels throughout the tideflats area. In 1955 the Blair (formerly Wapato) Waterway was dredged by the Port of Tacoma from South 11th Street to Lincoln Avenue in order to deepen the channel. The dredged material was deposited on a tract of land south of Lincoln Avenue and west of Tacoma Road.

From 1957 to 1977 the east side of the Sitcum Waterway was gradually filled and developed with industrial uses. In 1979 the Sitcum Waterway was deepened by the Federal Government. Approximately 1.72 million cubic yards of material were removed to adjacent areas that had previously been filled. In addition, because of the various berms and tide gates throughout the Tideflat area, additional siltation and “self-filling” continued to occur South of 11th St.

The Blair Waterway was similarly deepened during this time period by the Corps. Removal of 2.5 million cubic yards of organic silt and peat occurred and these materials were deposited on several sites south of Lincoln Avenue. Additional dredging projects have occurred over time in this waterway to maintain and even increase depths to accommodate larger ships that are currently being used.

11.2 Stormwater Conveyance

Stormwater is conveyed through the watershed primarily by both public and private underground conveyance systems as well as through some stormwater ditch systems including Wapato Creek and the Lincoln Avenue Ditch (Figure 3-14). The Port of Tacoma, the City and state regulated industries have NPDES Stormwater Permits regulating their stormwater systems. Because of the interconnected stormwater systems throughout this watershed, the City of Tacoma and Port negotiated an Inter-Local Agreement to describe the individual and coordinated stormwater management activities both parties are doing to protect the water quality of Commencement Bay.

The collection system throughout this area is generally quite flat and the pipes are often oversized to compensate for tidal inundation. Tide gates are present on many of the marine outfalls.

The watershed is divided into six sub-basins, with some sub-basins having more than one marine outfall. Stormwater from this watershed discharges into the Middle, Sitcum, and Blair Waterways , and the Puyallup River. In addition, there are some private discharge points in Wapato Creek (Figure 3-14).

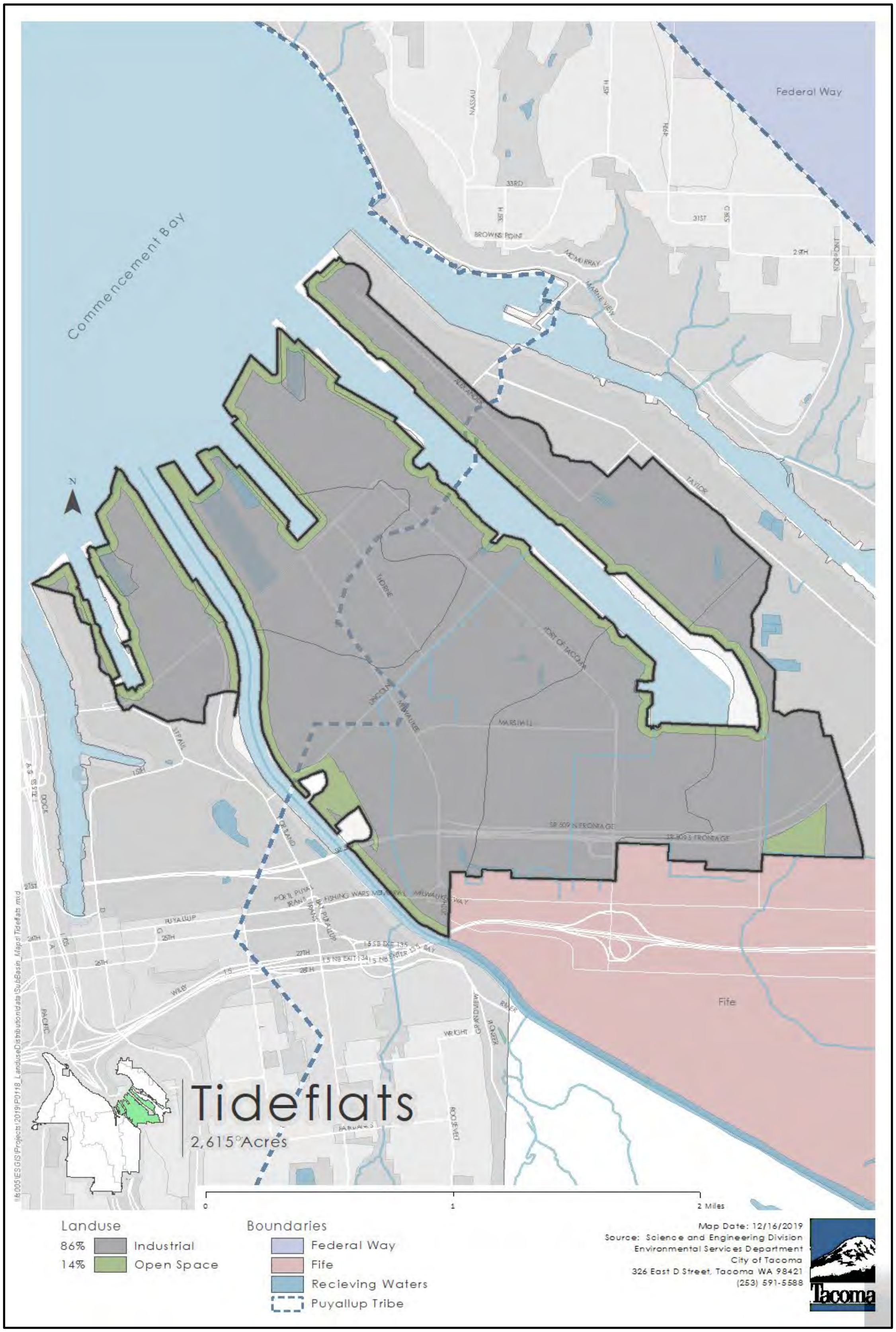

Figure 11-2 City of Tacoma Tideflats Watershed Land Use Map

Tideflats Watershed Sub-basins

TF-01 is the western-most of the Tideflat subbasins and includes a municipal discharge point to the head of the Middle Waterway. The drainage area includes a portion of East 11th St. between approximately East F Street and Portland Avenue, as well as a portion of Portland Avenue between approximately East 9th St and East 15th St. A small area of this subbasin discharges directly to the Puyallup River at East 11th St. and there are several small public ditches and inlets east of East Portland Avenue and north of East 11th St. that tie to a private system.

TF-02 is located north of Lincoln Avenue with two public outfalls to the Sitcum Waterway located on the east and west sides of the head of that waterway. The western outfall discharges water from Milwaukee Way while the eastern outfall discharges stormwater from the Thorne Rd. area, East 11th Street from the Sitcum Waterway to Port of Tacoma Rd. and a small portion of Port of Tacoma Rd.

TF-03 is the largest of the Tideflats subbasins and is located south and east of TF-02. The Lincoln Avenue ditch is located in this subbasin. This combination piped and ditched system discharges near Port of Tacoma Road into a private conveyance, which then discharges to the Blair Waterway.

TF-04 is located at the south end of the sub-basin. City of Tacoma storm pipes in this area discharge along Port of Tacoma road into a private system which then discharges into the head of the Blair Waterway.

TF-05 is also located at the south end of the sub-basin. Wapato Creek is within TF-05. The public drainage system in this limited to a portion along Alexander Avenue east of the Blair Waterway, and a small section on East Alexander Avenue at the far south end of the sub-basin. The private system in this sub-basin includes a combination of ditches and buried pipes. Note that Wapato Creek is identified as a drainage ditch, and there are several private discharge points to the creek. There are three private discharges to the head of the Blair Waterway as well as one toward the northern end of this sub-basin that drains only Port properties.

TF-06 is located on the peninsula between the Blair and Hylebos Waterways. There are four public discharge points to the east side of the Blair Waterway in addition to several private discharge points.

11.3 RECEIVING WATERS

The Tideflats Watershed is part of the Puyallup-White River Water Resource Inventory Area (WRIA 10) and is located in the South Central Puget Sound action area for Puget Sound Recovery. In Commencement Bay and the waterways, average tidal fluctuations vary from 0 feet MLLW to 11 feet MLLW. Extreme tides, which generally occur in June and December, range from approximately –4.0 feet MLLW to 14.5 feet MLLW.

Overview and History

It is important to highlight that all of this land was once Native American territory. A significant portion of the waterways and uplands within the Tideflats falls within the boundaries of the reservation lands of the Puyallup Tribe of Indians who were the original inhabitants of this region. The Puyallup River estuary where the Tideflats now sits was also an intersectional area for many other tribes. Following the Medicine Creek Treaty of 1854 and subsequent negotiations, the modern reservation land boundaries were established along with the right of taking fish "at all usual and accustomed grounds and stations." The rights of hunting and gathering on their ancestral lands were defended by the Tribe through the Fishing Wars of 1960's and 1970's and finally protected by the Boldt Decision of 1974 that specified the Tribe's fishing right to harvest 50% of each salmon run both on and off assigned reservation lands and the right to co-manage the fisheries resources along with the Washington State Department of Fish and Wildlife.
As discussed in detail in Section 3.1.5, the waterways included in this watershed, including the Blair, Sitcum and Middle waterways, were created within the intertidal delta estuary at the mouth of the Puyallup River starting in the late 1880's. Over the course of about 100 years, the area was filled, through a combination of deepening the channels within the waterways and placing those dredged materials on adjacent lands; ongoing siltation from the Puyallup River; and placement of additional fill from elsewhere. The former meandering Puyallup River was channelized through the Tideflats and Wapato Creek. The Port of Tacoma was developed on the filled tidal marshes to support the shipping docks of the Northern Pacific Railroad, and continued with the expansion of other industries.

As a result of this industrial use, the Commencement Bay Nearshore/Tideflats site was identified by the Environmental Protection Agency (EPA) as a Superfund site requiring remediation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Within the Tideflats Watershed area, the Middle and Sitcum Waterways were identified as cleanup sites. Sediments in these waterways have undergone remediation under the oversight of EPA with work completed in the Middle Waterway in 2004 and in the Sitcum Waterway in 1994. Sediments were actively remediated with a combination of dredging and capping at various locations within the waterways. Through this action, two of the smaller waterways, the Milwaukee and St. Paul Waterways, were transitioned to nearshore fill sites. This transition included the construction of containment berms across the ends of the waterways and filling behind with contaminated sediments from other waterways. These contaminated sediments were then capped over to match adjacent elevations, creating additional upland area. These sites remain under EPA oversight and are monitored routinely by others under Long Term Monitoring Plans to ensure that the remedies remains protective. Nearby habitat restoration sites were constructed as part of these projects to mitigate the loss of these intertidal areas. Industry is now focused in the three remaining waterways in the Tideflats area (Middle, Sitcum, and Blair Waterways) as well as in the Hylebos Waterway located within the Northeast Tacoma Watershed.

Puyallup River

The Puyallup River is about 45 miles long, and is formed by glaciers on the west side of Mt. Rainier. It flows generally northwest, emptying into Commencement Bay in Puget Sound. The glaciers that feed the river continually provide silt and gravel to the river, creating sand and gravel bars. During the summer glacial meltwater dominates the streamflow, turning the Puyallup River turbid.

Historically, the river's mouth at Commencement Bay consisted of an extensive tidal flat and wetland estuary delta and served as a primary camp site of the Puyallup Tribe of Indians. The Puyallup continues to be a significant fishing ground for the Tribe today. Urbanization and an extensive system of flood control structures such as dams, levees, and culverts, have radically altered much of the Puyallup River and its tributaries. The estuary delta at the mouth of the Puyallup River has been almost completely replaced with the facilities of the Port of Tacoma, with less than 5% of the original estuarine habitat remaining. Flood protection structures were built along many rivers in the basin, including extensive levees which were placed in conjunction with a project which straightened the river. These modifications altered the natural character of the river.

The Puyallup River is listed as impaired (303 d list) for fecal coliform and subject to a fecal coliform TMDL (Ecology 2011). Upstream tributaries in other jurisdictions are noted as needing a reduction in fecal coliform bacteria loading. There is a load allocation monitoring point at the Lincoln Avenue Bridge crossing, but Tacoma has not been identified as contributing to any water quality violations in this area.

There is one City-owned outfall to the river in the Tideflats Watershed and several Port-owned outfalls.

Blair Waterway

The Blair Waterway is an industrial and commercial shipping channel, and is dredged periodically to maintain depths for shipping. While not one of the original problem areas identified in the Commencement Bay Nearshore/Tideflats site, a hazardous substance, tributyltin (TBT) was found in the sediments during pre-dredging testing in 2013. Under a settlement agreement with EPA, the Port of Tacoma removed these contaminated sediments during dredging of the waterway as part of expanding the capacity for larger ships. The waterway is currently authorized to a depth of -51 ft MLLW, although plans for additional deepening are under consideration.

There are four City-owned outfalls and at least 19 private and Port-owned outfalls discharging to the Blair Waterway.

Sitcum Waterway

The Sitcum Waterway, an industrial and commercial shipping channel, was identified as one of the areas of contamination as part of the Commencement Bay Superfund site. The shorelines of the bay are urbanized, with heavy industry on former tideflats. The waterway was remediated in 1994.

There are two City-owned outfalls and several Port of Tacoma outfalls which discharge to the Sitcum Waterway.

Middle Waterway

The Middle Waterway contains one of the last remnant mudflats in the tideflats area. The waterway is an industrial and commercial shipping channel and was identified as a remediation site as part of the Commencement Bay Superfund site. The waterway remediation was completed in 2004. Significant habitat restoration has occurred in this waterway, including virtually the entire eastern shoreline of the waterway, around the head of the waterway, and along the southern half of the western shoreline. In the outer portion of the western shoreline, industrial uses remain.

There is one City-owned outfall to the head of the Middle Waterway, as well as several small private outfalls.

Wapato Creek

The Ecology Water Quality Assessment for Wapato Creek includes the listing of a number of parameters for the sediments. The habitat in Wapato Creek, and specifically the instream flow is listed in Category 4C (impaired by a non-pollutant) for inadequate instream flow. In addition, the water in the creek is listed as Category 5 for bacteria and dissolved oxygen based on data received from the Puyallup Tribe of Indians indicating that a Total Maximum Daily Load (TMDL) or other approved water quality improvement project is required for the water bodies. Wapato Creek was also listed as Category 2 for benzene.

Soils and Hydrogeology

The majority of the area of the Tideflats Watershed was historically a combination of intertidal mudflats and tidal marsh as referenced in the Commencement Bay Cumulative Impact Study – Historic Review of Special Aquatic Sites, US Army Corps of Engineers, May 4, 1991 (copy in Tideflats, Resources, Historic Information)

Local historical biological experts and evaluation of the earliest photographs and maps strongly suggest that in 1877 the area bound by mean lower low water (MLLW) and mean higher high water (MHHW) was totally intertidal mudflat. According to maps, this area encompassed approximately 1,829 acres extending approximately to the current location of Interstate 5.

The Pierce County soil survey (1939) identifies a "tidal marsh" as lands with zero to one percent slopes occurring on "low-lying wet saline marshy coastal areas traversed by winding tidal sloughs and covered by saline water during high tide. Tidal marsh supports a growth of salt-tolerant grass and plants and is of no agricultural value."

Puget silt loam dominates the Hylebos Waterway and Wapato Creek uplands. Some areas are underlain by Puget fine sandy loam. All three series are classified as hydric soils according to Soil Conservation Service.

ESA-Listed Fish Species Critical Habitat

Based on review of the Washington Department of Fish and Wildlife SalmonScape database, the Tideflats Watershed area falls into several ESA Listing Units[6] including:

- Fall/Winter Chum and Pink Odd Year ESA Listing Unit listed as Not Warranted, Accessible
- Coho ESA Listing Unit listed as Species of Concern, Accessible
- Winter/Summer Steelhead DPS Listing Unit listed as Threatened Accessible

A complete list of ESA listed species for WRIA 10 is included in the Thea Foss Waterway Watershed Section 5.4.

Habitat Restoration Sites

A number of habitat mitigation and restoration sites have been constructed throughout the Tideflats area by a combination of efforts by different parties including the City of Tacoma, Port of Tacoma, Simpson Tacoma Kraft, Puyallup Tribe of Indians and other private parties[7]

There is one designated Open Space site within the Tideflats Watershed, the Rhone-Poulenc site. This is an intertidal site located on the western shoreline of the Blair Waterway.

11.4 STORMWATER ACTIVITIES

Maintenance Activities

Streets within the Port area is swept monthly by the City as part of regular maintenance. Other activities including business inspections, source evaluations etc. are performed on an as-needed basis in accordance with the terms of the City-Port Inter-Local Agreement.

Regional Treatment Facilities

A number of treatment facilities have been installed by the Port of Tacoma throughout the Tideflats area. There are no City-owned regional treatment facilities located within the Tideflats Watershed.

[6] **ESA Listing Units** map NOAA Fisheries Evolutionary Significant Units (ESUs) for salmon, and USFWS Distinct Population Segments for Steelhead trout. (additional information is available on-line at http://apps.wdfw.wa.gov/salmonscape/map.html)

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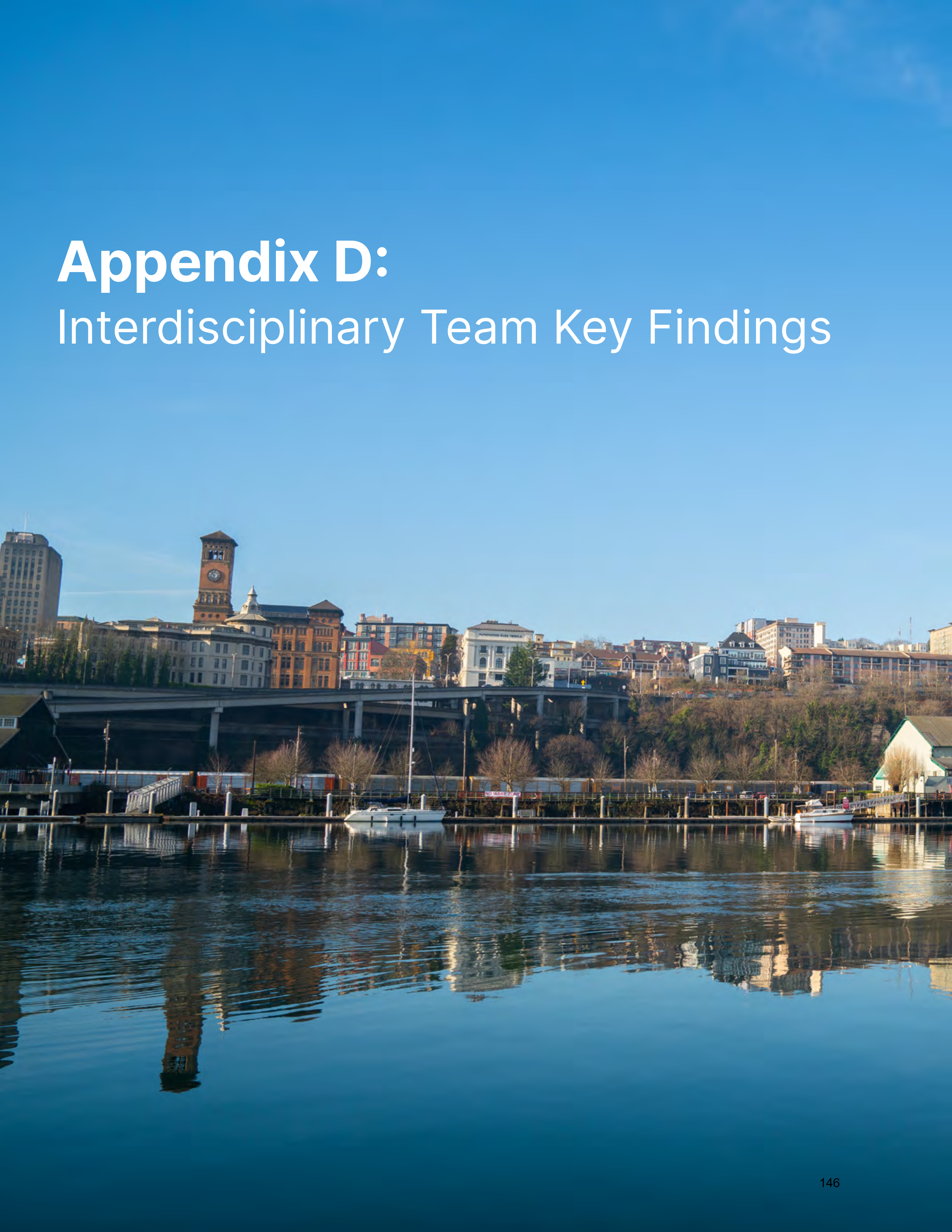
Appendix D:
Interdisciplinary Team Key Findings



Appendix D. Interdisciplinary Team Key Findings

Introduction

The Environmental Programs Group (EPG) is developing a watershed management plan now called the Urban Watershed Protection Plan (UWP Plan) to prioritize stormwater management activities to accommodate future growth and align with the vision of protecting and restoring natural systems throughout the watersheds.

How we choose to address stormwater can also impact community well-being and quality of life by addressing many other issues including property flooding, street improvements, urban tree canopy, blight and dumping, walkability, heat island effects, access to natural areas, and more. The actions we take individually and in coordination across departments affect the health of our watersheds and the ability to provide the ecosystem services we need to support our wellbeing.

In the past, Environmental Services stormwater staff has worked with other City departments in various capacities to meet NPDES stormwater management program requirements. Under the 2018-2023 NPDES Phase I Stormwater Permit, the City is required to formally convene an interdisciplinary team of staff to inform stormwater planning actions. We recognize the need to collaborate with an interdisciplinary team to develop a watershed-based approach to meet the diverse needs of our neighborhoods. By working together closely and aligning what we do across departments, we will have a better chance of achieving our goals.

Initial conversations were held with a variety of staff selected to take part in the interdisciplinary team. The purposes of the conversations were to:

1) Get an updated understanding of the current plans, programs, and key projects in other departments that relate to stormwater.

2) Share where the stormwater management program is headed and next steps in developing Tacoma's first-ever Citywide Watershed Management Plan.

3) Identify key areas where the work of other departments and stormwater management and watershed plans and programs should be informing each other.

The ultimate goal of the interdisciplinary team coordination is to be more strategic in how we operate and invest in stormwater infrastructure to address future development, housing needs, climate impacts, community priorities, and equitable service delivery.

Staff that indicated an interest during initial interviews were also invited to participate on a Core Review Team to inform the development of the Watershed Prioritization Tool:

Desiree Radice	ES Open Space Management
Karla Kluge	Critical Areas Preservation Ordinance and Permitting Regulations
Vanessa Simpson	GIS Data Analysis
Mike Carey	Urban Forestry Program and Management Plan
Karen Bartlett	Asset Management and Criticality Analysis
Mieke Hoppin	Stormwater Manual BMP Design Requirements
Steve Atkinson	Long-range Planning
John Sunich	ES Environmental Compliance and Business Inspections
Hugh Messer	Storm System Operation and Maintenance
Scott Hallenberg	TPU- Wellhead Protection Program

The following summary of comments from the interdisciplinary team initial staff interviews will help direct the next steps in development of the Watershed Prioritization Tool model and the UWP Plan.

Watershed Prioritization Mapping Tool

Long-range Planning Coordination:

Based on model outputs – can we determine where we need modify development/zoning requirements?

Recommend showing capital projects on interactive map. People really get excited to see projects in their neighborhood. We don't have a cross-departmental SOP on how to develop data to be on the same interactive map, but maybe could look into it. What is ES proposing for 60-year capital planning?

How will you monitor/assess watershed action success?

Need a communications plan to make the watershed plan accessible to community members. Consider interactive map where stakeholders can provide comments on the map in their watershed area, similar to One Tacoma Interactive Map. What are special places in their watershed? Can also see where the comments come from – are we missing the boat on engaging in other neighborhoods?

Can tool compare separate land use, sensitive area maps – relationships between different maps, overlaying them? Including Equity Map showing access to opportunity.

Urban Forestry Coordination:

Have Citywide GIS data on tree size. Where large trees are, the priority is tree preservation, where smaller trees or no trees, the focus is on tree planting.

We are currently working on a tree planting prioritization map, which will include overlays such as urban heat, existing tree canopy, tree height, vulnerable populations (based on health indicators), etc. We are trying to determine where trees will have the best bang for their buck (preservation or new trees). It would be great to include a layer for stormwater as well (quality and quantity) to help with this prioritization.

Urban Forestry currently uses the Equity Index for advertising incentive program; also low opportunity neighborhoods get first selection for trees in these programs. We don't do City-lead planting projects, due to issues with long-term maintenance/risk to neighbors. But Metro Parks has facilities and rights of way with space for trees – we give them trees for ROW adjacent to Parks. PCD has their own prioritization map for green infrastructure – we collaborate with them on urban trees program.

We should identify which watershed/water quality data layers we'd like to see included in the tree prioritization tool? Or put tree layers in the watershed prioritization tool?

Could we provide them with key areas for their tree modeling efforts now? Their tree model could feed into our watershed plan layers also.

ES Asset Management Coordination

Asset Management sometimes, but rarely, prioritizes maintenance projects to fix confirmed flooding issues involving property damage (like S. 26th and Pacific Ave intersection.) Would watershed prioritization tool identify those areas that need fixes?

Grant prioritization process – needs help. We scramble each year to scope out projects to submit, but they may not be the top need in the City, we don't know. Capital group has found cases where the neighborhood hasn't really wanted the grant project in that location – and argued against – Ecology doesn't want to continue funding projects that don't have neighborhood backing. In the past, Karen and Dana/Jessica looked at potential grant project list for site feasibility, but not prioritized concerning Citywide need, best benefit to environment, or best cost-benefit. Leah Chrisman is doing a GIS analysis project to identify potential locations for regional treatment. Need to add in the waterbodies that need protection the most to that analysis.

Use InfoMaster model (Theresa and Bonnie run it) to plan for capital projects and 6-yr CIP plan – how can watershed plan tool outputs inform InfoMaster model?

They would like a map of potential sites for treatment from Watershed Prioritization tool – can be added to pipe jobs list.

Stormwater rates are not currently designed to pay for expanded water quality retrofits program. The 100-yr rehab plan only talks about replacing existing assets. Budget analysis only considers pipe replacement for spend sheets, not stormwater extensions, or new regional treatment. Can the model identify what is the most cost-effective way to provide treatment (e.g. street sweeping vs. street trees vs. rain gardens vs. other types of maintenance retrofits?)

Vanessa (GIS) has 2018 Lidar data (from TPU) impervious data layers – currently on shared drive, going to put it on a shared server. Not split out by PGIS/Non-PGIS, though. Buildings are pulled out, but working on distinguishing between driveway/sidewalk – have to do it by hand. Looking at maybe having a consultant do it.

ES was awarded an Ecology grant for line cleaning and street sweeping to start mid-2021 through mid-2023 – Bonnie is hoping that the watershed prioritization tool can help inform which areas to focus on for this project. Need enhanced maintenance plan to Ecology for locations before next spring 2021. For grant application, used land use and The Foss stormwater monitoring data.

Will watershed prioritization be being granular enough to look at street blocks and identifying a proposed project site that Asset Mgmt could implement at the scale of a public works project level?

Is there a way that rates could fund the watershed planning wish list of projects? Currently, only have CIP task in budget with money enough to match grants to get money for projects – overspending this pot over the past few grant cycles. Concerned about long-term maintenance costs of prioritized retrofit projects. Concerned about CIP staffing availability to generate designs and bid out the potential WQ projects the model comes up with.

NPDES Stormwater Permit Coordination:

How could model be helpful for identifying CBAP catch basin assessment/maintenance prioritization or IDDE prioritization areas?

Open Space Coordination:

Metro Parks has a goal for a 10-minute walk (within ¾ of a mile) to a green space from every place in the City. Also looking at school properties for that goal. Metro Parks will be possibly taking over or helping manage any City Open Space that fulfills that goal. Not sure of the specifics yet.

Could the Watershed Prioritization tool help determine if more Open Space properties are needed, or somehow quantifying the benefits of existing open spaces. For example, compare how permeable pavement would help water quality/quantity control goal vs. managing 2 acres of open space. If open space became available in a priority watershed area, it could justify why we need to protect it or manage.

Critical Area Protection Coordination:

Could we use prioritization model to identify where development should and should not intensify (upzoning vs. downzoning.) Where are the critical areas in relation to the stormwater system and are they feeding them? Are there certain areas in town where we need stricter development protections?

Could the watershed planning support development policy like: this zoning allows 20 units, but if you can't accomplish using low impact development to protect nearby critical areas, then you won't be able to build to full density of 20 units. Can't do that now just based on the anti-degradation requirement in the CAPO code. It would save CAPO staff time and management time to not have to fight this battle for each development.

ES Environmental Compliance Coordination:

Could the tool help prioritize EC work towards the pollutant hotspots? If we could shift this work to the businesses that need follow-up that would make a big difference. If we had a priority area to focus on this would help. If we could show the best bang for our buck. Compliance depends on the business, so might be a challenge to show water quality benefit if don't get compliance as easily.

Prioritization mapping questions:

- Can we reduce inspections or focus more on the follow-up, rather than just identifying problem areas and moving on.
- There may need to be an analysis of a pollutant generator site list. Which ones had a number of repeat follow-ups?
- Are there businesses not being good players based on past inspection history? Where?
- Flooding complaints locations? Private & public.
- Can we rate the pollutant concern? Potential pollution or chronic vs. acute. We just go there and they happen to be out of compliance but don't have the big history that a chronic facility would have. At least two levels/criteria to help evaluate inspection priorities.

Public Works Streets Coordination:

Streets Initiative Maintenance priority based on current street condition and what funding is available. It is equally distributed between council districts, but focusing on areas of lower opportunity within each district.

For transportation grants, TIB grant requirements include criteria that include equity, environmental benefit, as well as condition of pavement, etc. Could watershed prioritization tool help support grant proposals?

PW evaluates site by site on their list of street jobs, to see where they might incorporate GSI options. But GSI not called out as a priority for their projects.

PW/Capital Projects map – Erik Sloan is in charge of regular updates – but he doesn't get consistent updates on active projects from project managers, workflow is not great. He is working with IT to come up with a better solution for mapping updates from multiple project managers. Could Watershed mapping coordinate here?

Multi-modal Transportation Coordination:

6-Year Transportation Improvement Program (TIP) – project prioritization criteria:

The TIP lists planned transportation projects for the remaining year and the ensuing six years. The program includes roadways, bridges, non-motorized facilities, sidewalks and other capital related transportation projects. The program is based upon anticipated revenues versus desirable projects. There are always more projects than available revenues. Comprehensive Plan Tie-In questions are a requirement of new projects when added. They are yes/no questions. If folks respond yes, they have to explain how. Prioritization questions include:

- Mixed- Use Centers - Is the project located within a mixed-use center or provides connections between two or more centers?
- Housing Affordability - Does the project have a positive impact on the number, location, and quality of housing opportunities for families and individuals throughout the City?
- Multimodal Transportation - Does the project address multiple modes of transportation to safely and efficiently move people and goods by accommodating and encouraging the use of transit, high-occupancy vehicles, bicycles and/or walking?
- Level of Service - Will the project improve the level of service of a facility or meet the adopted LOS within the next six years?
- Facility Preservation - Would the project preserve an existing capital facility, avoiding greater expense in future years?
- Essential Public Facilities - If this project is defined as an Essential Public Facility, has the siting and planning occurred in compliance with RCW 36.70A.200 and consistent with the Generalized Land Use Element policies pertaining to "Siting Essential Public Facilities"?
- Environmental Protection - Does this project directly respond to the climate change, conserve/preserve natural resources including critical areas and shorelines, and/or protect or improve air or water quality?
- Open Space - Does the project acquire, develop and improve the optimum variety and number of recreation and open space facilities consistent with the changing needs of the community?
- Active Living - Is the project designed to accommodate, facilitate and/or promote active living and physical activity, such as walking, bicycling, taking "safe routes to school", and other recreational and sports activity?
- Economic Development - Will the project make a significant positive impact on the local economy and/or tax base?
- Municipal Art Program - Does the project qualify for the Municipal Art Program (TMC 1.28)?
- Arts and Culture - Does this project strengthen the City's arts and cultural environment and attract more individuals to downtown Tacoma, mixed-use centers or business districts?
- Historic Preservation - Will the project enhance and protect a historic building, historic site or archaeological site?
- Citizen Participation - Did community members, neighborhood and business district organizations, the general public, and pertinent governmental entities participate in the planning, development and approval of this project?

Transportation Master Plan – funding prioritization criteria:

The TMP includes a project prioritization matrix that aligns with the TMP's policy priorities. All of the projects were evaluated based on the following criteria: Location (whether the project is on a TMP; Identified priority network); Multimodal benefit ; Equity; Safety; **Health & Environment (i.e. Significant active transportation facilities; facilities with Air Quality benefits (ITS, roundabouts);** Maintenance/system preservation benefits; Cost to the City; Congestion management; Project horizon; Primary mode served/rank on the modal hierarchy; and Whether or not the project is in a growth center.

Multi-modal transportation projects focus on transit priority streets. They don't do the planning, but can incorporate a list of streets or target watershed areas, if we develop the list.

Watershed Plan Implementation and Monitoring

Long-range Planning Coordination:

Could include in the watershed plan report how the various related Environmental Services programs relate to each other: Open Space, Forestry, Climate Action Plan, Stormwater Management Program, Green Infrastructure Policy, Watershed Planning.

Anticipating new Growth Management Act requirements for reviewing transportation projects for impacts on salmon – capital planning for salmon enhancements. Shoreline code is focused on restoration – beyond maintaining no net loss of habitat value. Could the Watershed Plan describe no net loss, but also what we are doing more?

Shoreline Master Plan requires creation of a shoreline enhancement/restoration project site list, but with no resources to do this in long-range planning. Can this be included in the watershed plan action list? Identify critical areas/shoreline areas for projects.

Next major Comp Plan update in 2023 – heightened emphasis of green stormwater infrastructure/low impact development to protect wetland buffers. Comp Plan/codes – allow the use of wetland mitigation banks and in lieu of stormwater banks. Long-range planning doesn't have the resources to set them up, but maybe part of the Watershed Plan actions? Could we look into inter-jurisdictional banks at some point in the future?

Comp Plan big update starting in 2022 – adopt by June 2023. We envisioned general policies related to watershed health and sub-basins. Look at each watershed and characterize each watershed and what comp plan goals are for the area and what actions are needed to achieve goals. Looking at Tree canopy, stormwater, open space, co-benefits, community needs. Need to add a layer in the comp plan to identify targets of what success would be and how we would measure that success. Also having a joint team that looks at the policies and actively engage to help meet these goals. Council wants to have more accountability for follow through on the comp plan policies. Council is looking at creating a program to assist with coordination between capital planning and long-range planning. One possible project could be Portland Ave Corridor in conjunction with transit. Other is looking at small geographic areas such as Proctor business district.

Comp Plan Ch. 4 Watershed-related policies and goals are all well written to provide the framework for ES Watershed Management Plan. Suggest ES focus on where the watershed planning can support or direct the Functional Plans implementation. That is how we could frame any Watershed Planning updates to Planning Commission – this is how Ch. 4 is being implemented.

Tacoma at Home Initiative to increase affordable housing options – 1 to 3 years until complete adoption. Longer-term goal of project…do we want to change the City's zoning approach as a whole? Stormwater would want to coordinate with this longer-term plan and future policy changes. This would start in the next year. Trying to think about this when conducting changes to zoning that could aid in increasing density.

Port Tideflats Subarea Plan - They will be starting with establishing the baseline for environmental impacts and what infrastructure is there, known issues of the storm system, etc.

Transportation Coordination:

GSI can help provide buffers from the roadway and increase walkability.

Neighborhood and Community Services Coordination:

Adopt a Spots and Neighborhood litter patrol program address pollutant source control.

ES Operations and Maintenance Coordination:

Consider FTEs of ground maintenance folks, if we would need to hire additional staff to maintain proposed facilities or new retrofits.

Most of these increased site maintenance activities are driven by complaint – not necessarily the most need.

Could we increase the number of trees in regional holding ponds? – 1. Space is available and 2. We don't have anyone on maintenance for trees so this becomes problematic. Maybe put in easy to maintain trees. Also – trees need to be watered for the first three years. Leaves falling in ponds does not seem too big of a maintenance problem.

Might want to add personnel hours to clean garbage out of the regional facilities.

Consider planting trees in the planter strips to deter encampments.

TPU Coordination:

TPU Upper Watershed/Power Dam management - They really don't collect much lower river data in lower Nisqually. So don't have any nexus to be involved with this conversation about Watershed Planning within City limits.

TPU Wellhead Protection program – They have maps of targeted wellhead protection areas they could share. Also significant concern about stormwater infiltration policies and proposed GSI/infiltration project locations and pretreatment required to protect groundwater quality.

Stakeholder Engagement

Neighborhood and Community Services Coordination:

Dome District – Creating a BIA in the dome district to help with clean up. Lots of garbage due potentially the transient population moving through there. Trash pickup? Security? Banners? Sweeping? Keegan will send us the contact for the dome district in case we would like to coordinate.

Critical Areas Preservation Coordination:

Discouraged from doing public meetings – their program is so limited in what they can offer for properties – don't have the partnership with other departments that could address homelessness, park use, complaints about trees, etc. It's limited to what types of activities they can do – trees, native plants. No other uses. Can only use it as habitat preservation – but public can enter it, but no intensive uses. Could be a trail, planting, bird watching.

CAPO has no real public engagement except complaint calls. No outward facing communications on positive aspects of critical areas. They would love to have a webpage, tie into stormwater efforts, open space stuff, urban forestry. But Karla and Shannon don't have time.

Urban Forestry:

Suggested if we will be changing regulations or development standards – need to go to Master Builders Association. Also recommended Hilltop Action Coalition virtual meetings – host is engaged and interested in environmental justice issues, lots of people attend. But try to avoid technical presentations in order to keep audience engaged.

Operation and Maintenance Coordination:

They are evaluating the street sweeping program using the equity toolkit/equitable service delivery to underserved areas.

Multi-modal Transportation Coordination:

Transportation Commission, Bicycle Pedestrian Technical Advisory Group (both meet monthly) – Facebook/Twitter accounts for active transportation. Developing a Vision Zero Action Plan (eliminate all traffic-related fatalities/serious injuries by 2035.) This Plan has a stakeholder committee – BIPOC, disabilities represented on core team. Also will be working with neighborhood councils, schools, parks. Maybe surveys, virtual open houses, maybe use ambassadors. First stakeholder meeting in September – March 2021 (complete plan).

Amy Anderson/Jennifer coordinated on Larchmont project outreach, went to school, and neighborhood council.

Public Works Streets Coordination:

Street ops staff attend trade job fairs, not project related, but more generally reaching out about PW jobs. Generally an afterthought to attend any public events. Prop 1 (Streets Initiative) last big outreach effort - was back in 2013. Hard to drum up interest and get people to attend public meetings. So they go out to Safe Streets groups and Neighborhood councils. For Streets Initiative (maintenance jobs), their goal is visiting them with updates once a year (not achieving that). Safe streets meetings, they will be invited to attend a meeting, if there is a neighbor concern. Operations will attend neighborhood council meeting ahead of a bigger chip seal project, to set expectations.

Neighborhood council – sometimes use City liaison to bring messages to staff, and responses to questions back from staff to group through City liaison.

Found it helpful to do some quick outreach through Safe Streets Groups (members are more localized to the streets where projects are located, on Facebook with each other). Neighborhood council members may not be as plugged into the neighborhoods as Safe Streets Groups. Darren Pen is mobilizer for the Safe Streets groups (Erik has Darren's contact information.)

Site Development Permit Review Coordination:

Equity in the application of stormwater requirements – smaller one-off in-fill lots. Argue that they can't make it pencil out. Rather than just giving the developers exceptions, need to consider environmental justice for the benefit to the neighborhood. They are looking for a platform to include that messaging (maybe CED), maybe use WA Stormwater Center EJ Forum

TPU Upper Watershed and Dam Management:

Past and current TPU engagement with Tribes:

Monthly meetings with all technical stakeholders with all tribes and federal agencies with updates – one meeting for each dam each month. Agency reps are generally the same. Ecology, Army Corps, WDFW (not same local biologist of project manager).

Nisqually Dam – Nisqually Tribe (engaged), Squaxin (not a FERC signatory though, more just to inform)

Cushman Dam– actively Skokomish Tribe – sometimes have outside meeting with tribe – Mattsen's group

Wynoochee Dam - Quinault Tribe – no standing meeting, not a lot of FERC requirements. But do temperature monitoring to see that they are releasing cold water as needed to keep downstream temperatures lower.

Cowlitz Dam – Cowlitz and Yakima tribes (not as engaged as of yet) – may be more interested in the future with new improvements.

Keith/Jeromy – Coordination with Puyallup Tribe about Steam Plant decommissioning

Appendix E:
Community Engagement Summary

INTRODUCTION

This document summarizes activities and feedback collected from Phase One of Tacoma's **Urban Waters Protection Plan (UWPP)**[1]. Phase One engagement strategies and tactics were designed to reach city-wide audiences to learn about community experiences and priorities across Tacoma's nine sub-watersheds and inform future stormwater investments**.** This summary includes public engagement efforts and feedback collected between May 2021 and October 2021 through the following key methods:

- Interactive online open house
- Online and printed survey
- Social media campaign
- Presentations at external stakeholder meetings
- Online workshops
- Tabling events
- Watershed Council meetings

Engagement Overview

Community Engagement Goals

The overarching goal of the UWPP is to implement strategic stormwater management activities to **protect people, property, and habitats** from stormwater flooding and pollution throughout the watershed and prioritize solutions that **align with community needs** and accommodate future growth. The City of Tacoma ("the City") recognizes the importance of partnering with key stakeholders and community members to develop a UWPP to meet the **diverse needs** of Tacoma's sub-watersheds and the neighborhoods within them. The City is also committed to putting **equity considerations at the center of the UWPP** development by focusing engagement efforts on reaching overburdened and underserved communities within the City of Tacoma.

The Tacoma Watershed Public Engagement Plan (See **Appendix A: Tacoma Watershed Public Engagement Plan**) provides more detail around engagement goals, priorities, and intended outcomes.

Community Engagement Activities

To engage a representation of the public across different audiences, the City used two complementary outreach approaches: 1) inform and 2) consult and involve. These are described below.

[1] The title "Urban Waters Protection Plan (UWPP)," formerly referred to as the Watershed Management Plan (WMP), was selected based on feedback from community workshop participants.

INFORM

Educate members of the group about the rationale for the project or decision, how it fits with City goals and policies, issues being considered, and where input is needed.

Social media and outreach campaign

The social media and outreach campaign kicked off in August of 2021 and consisted of the following activities:

- Tacoma Sustainability Facebook Page post
- Environmental Services Facebook campaign for Puget Sound Starts Here (September)
  - Included Facebook event post for community workshops and watershed and stormwater management related content
- Tacoma Report news brief (September)
- Media News Release (September)
- Email invitations to stakeholder groups with summary information, collateral, and example social media posts to distribute to their networks. See **Appendix B: Outreach Collateral** for promotional template language examples.

Housed at www.tacomaurbanwatersheds.com, the online open house interactive webpage was published in September 2021 to serve as a central hub of information about the Tacoma Urban Waters Protection Plan. It contained a project overview page, information about existing stormwater programs and solutions available to Tacoma residents, and resources to learn more about the UWPP process and how stormwater issues impact people and the environment. Visitors were able to participate in an interactive survey, provide feedback, register for the two community workshops, and sign up to receive UWPP updates from the City. The page was available in English and Spanish.

Stakeholder meetings and events

The City collaborated with organizers of existing stakeholder meetings and community events to: 1) present on the UWPP process and project goals, 2) inform participants of upcoming engagement opportunities such as the online open house, survey, and workshops, and 3) distribute informative project collateral. Key audiences included City commissions, neighborhood councils, safe streets groups, and advocacy groups and partners. The City also reached out via email to a list of groups considered to have critical perspectives for shaping this planning effort, including community groups that represent overburdened and underrepresented communities and individuals.

CONSULT + INVOLVE

Gather information and ask for feedback from groups to better inform the City's work on the project. Work directly and consistently with groups to ensure their concerns are understood and considered in the City's planning process

Stakeholder interviews and discussions

The City conducted interviews and participated in discussions with several key stakeholders and partners to better understand how the UWPP process and priorities align with ongoing efforts focused on watershed health and stormwater from Tribes, agencies, community groups, and other stakeholders throughout Tacoma.

	Public survey The online open house website hosted an interactive survey that allowed visitors to geolocate specific sites or addresses on a map of Tacoma and submit associated stormwater concerns, ideas, and comments related to that site. Entries were added in real time via pin drop to the map for all visitors to view. The map included Tacoma's Equity Index that shows differences in the amount of opportunity between different areas of Tacoma based on 29 indicators related to health, wealth, and environmental conditions. The survey also contained questions related to stormwater and watershed characteristics, priority ranking, and overall satisfaction.
	Online workshops The City hosted two virtual community workshops via Zoom on these dates: • Saturday, September 25th, 1-2:30pm • Tuesday, September 28th, 5-6:30pm The interactive workshops informed participants of the UWPPP timeline, goals, intended outcomes, and progress and gathered community input and feedback about their watershed- and stormwater-related issues, concerns, and priorities within their communities. Participants at both workshops were offered real time Spanish translation. All participants received a $50 dollar gift card for their participation once the workshops ended.

Centering Equity

The City centered **equity** in the planning process and strived to provide **accessible opportunities for communities to participate**. Key outreach materials, including an informative one-pager and the online open house, were translated into Spanish and community workshops offered simultaneous spoken Spanish translation (See **Appendix B: Outreach Collateral**). All virtual events were accessible by phone as well as by computer.

The City conducted outreach to community organizations representing BIPOC, low-income, and non-English-speaking residents to **increase participation from historically unrepresented communities.** To incentivize participation from members of these organizations, the City offered $50 gift cards for workshop participation. Additionally, the City strategically boosted promotion of workshop events on Facebook, paying for targeted advertisement within Tacoma's low opportunity zip codes.

Community and stakeholder feedback gathered from these engagement efforts will be used to inform the development of a new watershed prioritization tool that will address community needs and watershed health by prioritizing the most effective stormwater actions and projects at critical locations across sub-watersheds.

ENGAGEMENT OUTCOMES

Through the platforms and methods of engagement below, the City's engagement activities reached **over 10,700 people.**[2] Note that these totals represent total interactions and may double count individuals that engaged across multiple platforms.

[2] Estimates for number of people reached through meetings, events, and group interviews and discussions are approximate.

METHOD	# REACHED
Stakeholder meetings	190
Public events (collateral distributed)	170
Social media posts	9,921
Online open house	310
Stakeholder interviews and discussions	46
Workshops	24
Survey responses	115
Total	**10,776**

Social Media Campaign

The table below shows insights for promotion of UWPP engagement opportunities across multiple City hosted Facebook pages in September and October. Overall, the Facebook posts reached nearly ten thousand people, **317** of whom directly engaged with the post content.

PLATFORM	POST REACH	ENGAGEMENTS[3]
Tacoma ES Facebook Page	3,616	213
Tacoma Sustainability Page	1,062	48
Facebook Event: Workshop #1 Post	3,418	27
Facebook Event: Workshop #1 Post	1,825	29
Total	**9,921**	**317**

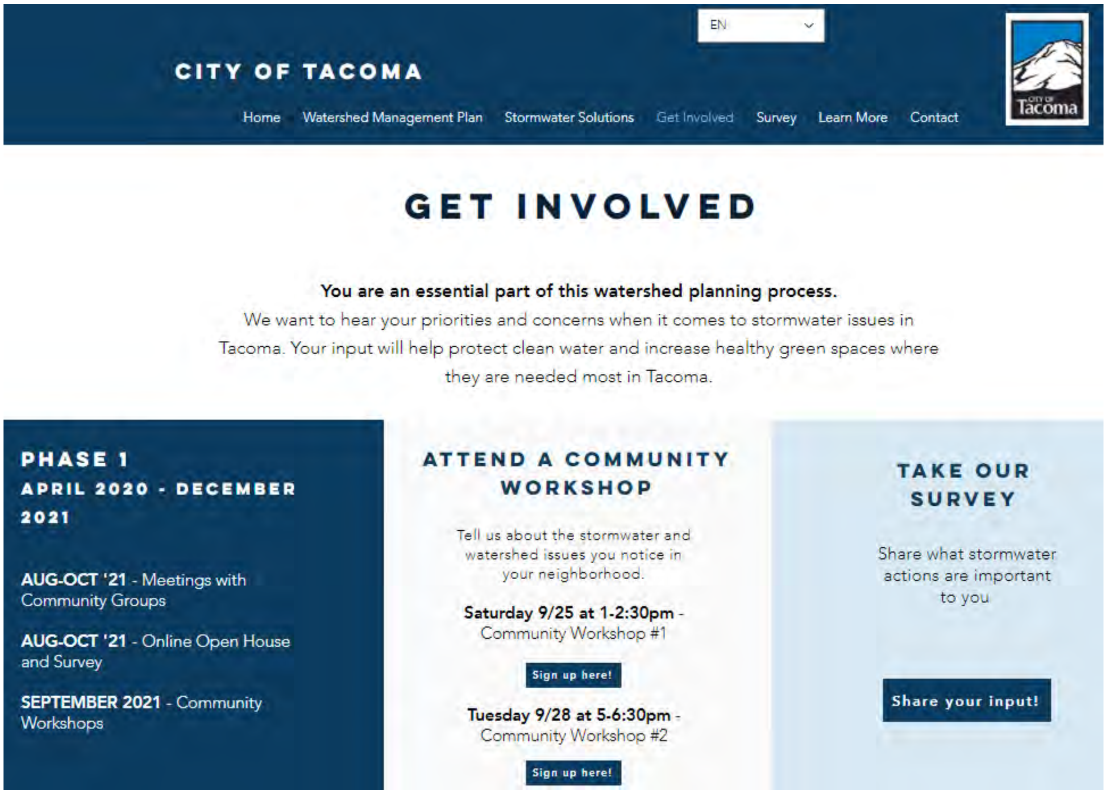
[3] Engagements – Reactions (likes), clicks on links, shares, and comments.

UWPP promotional post on the Tacoma Environmental Services Facebook Page.

Online Open House

From September 1, 2021, to October 29, 2021, the Online Open House had **310 unique visitors.** Other site analytics indicate:

- 541 total site sessions (includes repeat visitors)
- Average session duration was roughly 3 minutes
- Site sessions peaked on September 13th with 63 visitors
- Not including the Home Page, the most heavily trafficked tab on the website was the Survey tab
- The top three traffic sources include direct link, facebook.com, and cityoftacoma.org



Get involved page onTacomaurbanwatersheds.com

Stakeholder Meetings and Events

The City informed stakeholder groups about the UWPP and opportunities for engagement by attending scheduled meetings and giving presentations and tabling at local events. Initial outreach to stakeholders was often conducted through email communication and typically included the following attachments (See **Appendix B: Outreach Collateral**):

- Informative two-pager with links and a QR code to the online open house, survey, and workshop registration page
- Where applicable, Spanish-language one-pager with links and a QR code to the online open house, survey, and workshop registration page

The table below lists external stakeholder meetings attended and groups engaged at multiple local events and meetings. The main distribution points for the printed collateral were two local events (the Broadway Farmers Market and Green Tacoma Day volunteer event) and the UPS campus bulletin boards, where the City distributed **65 postcards** and **105 utility bill inserts** with links and a QR code to the online open house, survey, and workshop registration page.

AUDIENCE	GROUP AND ENGAGEMENT ACTIVITY
Advocates & Partners	**Email outreach**
	• Green Tacoma Day volunteers • Open Space Site Stewards

	• Stream Team volunteers • Tahoma Audubon Society • Swan Creek Clean-up Group • Tacoma Environews Listserv community
Community Groups & Critical Perspectives	**Meetings attended** • Hilltop Action Coalition Weekly Meeting • Hilltop Summer Splash and Block Party event • Stewardship Day event at Greater Christ Temple • Green Tacoma Day volunteer event at Greater Christ Temple • Swan Creek Clean-up Event • TPCHD East Tacoma Collaborative • TPCHD South End Community of Focus • Salishan Community Meeting **Email outreach** • APCC • Korean Women's Association • Black Collective • Tacoma Housing Authority • Salishan Community • Centro Latino • Latinos Unidos South Sound • VT Radio
Implementation Partners	**Meetings attended** • Puyallup River Watershed Council Meeting • Chamber Clover Watershed Council Meeting • Neighboring Jurisdictions Stormwater Staff/NPDES Phase II South Sound Coordinators Group • Puyallup White River Local Integrating Organization Ecosystem Recovery Plan work group **Email outreach** • UWT/UPS/ Bates Tech/Clover Park Tech • Metro Parks • Citizens for a Healthy Bay
General Public	**Meetings attended** • Dometop Neighborhood Alliance Meeting • Neighborhood Council Meetings (Eastside, West End, North End, Central, South End) • Safe Street Group Meetings (Spring Hill, Lincoln, Pac-Yak, Fern Hill, Hillsdale, Alling Park, Larchmont, Shaska-Stafford-Sheri-Yak) **Tabling at event** • Broadway Farmers Market patrons

Stakeholder Interviews

This table summarizes key notes from interviews and discussions with stakeholders including Tribal groups and several implementation partners. See **Appendix C: Stakeholder interviews and Discussion Notes** for more detail.

AUDIENCE	GROUP INTERVIEWED	KEY NOTES
Governments	Puyallup Tribe Fisheries Staff	• How to align stormwater management efforts with Tribal priorities • Water Quality in Commencement Bay and Puget Sound nearshore priority areas • Unhoused encampment cleanup is a challenge • Continue to update Tribe Fisheries during watershed planning process
	Puyallup Tribe Sustainability Work Group	• Cleanup of unhoused encampments in First Creek, Styrofoam ban, electrifying Tribal fleet, and various cleanup events are priorities • Protecting the land is important because Tribes do not have the option to leave if its polluted or too expensive • Affordable housing within reservation boundaries
Implementation Partners	Port of Tacoma	• Include non-City owned stormwater treatment devices in prioritization tool • Include data on habitat mitigation sites, remediation/cleanup sites and nearshore confined disposal areas in the Tideflats • Include Port staff in beta testing of prioritization tool
	Puget Sound Partnership	• Standardized naming conventions in prioritization tool to facilitate regional use • Coordinate with other regional efforts and partners • Attend Action Agenda update meetings
	Puyallup River Watershed Council	• Need to balance streamflow preservation for fish and increased demand for municipal drinking water • Recommends integrating multi-benefit approaches like those promoted through the Pierce Conversation District Strategic Plan, which advocates for land use and development considerations in all watershed planning
	Chamber Clover Watershed Council	• Low Impact Development/green stormwater strategies preferred over end-of-pipe treatment • Preventing stormwater flow in receiving waters, salmon habitat, water quantity, streamflow support, and recharge are top priorities • Need maintenance for fish passage and other restoration projects • Prioritize water quality improvements on existing developments

	Pierce County Stormwater Planning Division	• Watershed and stormwater planning priorities, alignments and related projects • Watershed planning tools & standards
	Tacoma Tree Foundation	• Business, Multi-family and Property Manager engagement efforts around tree maintenance and green infrastructure just getting started with a business survey • Looking for participants for a pilot free tree and landscaping retrofit design program • Focus on the Tacoma Mall Subarea

Public Survey

The survey was available through the online open house website and distributed via paper copies at stakeholder engagement meetings and tabling events. Overall, there were **115 respondents** to the survey. See **Appendix D: Public Survey** for a list of survey questions.

Demographics Overview

In general, the UWPP engagement efforts were somewhat representative of the Tacoma residents. The groups most significantly underrepresented were the Latinx/Hispanic and Spanish-speaking communities. Renters in Tacoma were also underrepresented.

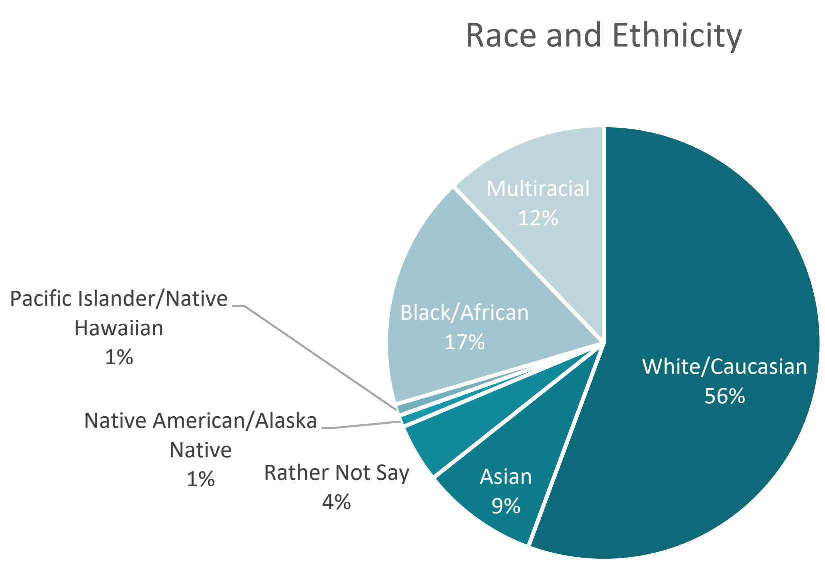
Foss Waterway, Flett Creek, and North Tacoma were the most represented watersheds in both the survey and workshop efforts. Survey respondents represented Tacoma's moderate, low, and very low opportunity zones[4] fairly evenly, while respondents from high and very high opportunity zones constituted a much smaller proportion. Foss Waterway, Fleet Creek, Lower Puyallup watershed participants predominantly represented Tacoma's moderate, low, and very low opportunity zones. North Tacoma participants represented Tacoma residents in the high or very opportunity zones.

Race/Ethnicity

Over half (56%) of all respondents identify as White/Caucasian. The next most common race/ethnicity selected was Black/African at 17 percent.

[4] Tacoma's Equity Index Map shows differences in the amount of opportunity between different areas of Tacoma based on 29 indicators about the health, wealth and environmental conditions in our community such as jobs, schools, clean air, and public safety.

Race / Ethnicity	Flett Creek	Foss Water-way	Leach Creek	Lower Puyallup	North Tacoma	North-east Tacoma	Western Slopes	Not indicated	Total	% of Total
White / Caucasian	13	25	1	5	10	1	1	8	64	56%
Asian	3	4	0	0	0	0		3	10	9%
Native American / Alaska Native	0	0	0	1	0	0	0	0	1	1%
Pacific Islander / Native Hawaiian	0	1	0	0	0	0	0	0	1	1%
Black / African	1	17	0	0	1	0	0	1	20	17%
Multiracial	4	6	0	0	0	0	1	3	14	12%
Rather Not Say	0	1	0	0	3	0	1	0	5	4%
Total	**21**	**54**	**1**	**6**	**14**	**1**	**3**	**15**	**115**	**100%**[5]



"Multiracial" responses included individuals who made the following survey selections:

- Latino/Latinx/Hispanic, Native American/Alaska Native, other
- Asian, Black/African
- Middle Eastern/North African, Pacific/Islander/Native/ Hawaiian
- Native American/Alaska Native, other

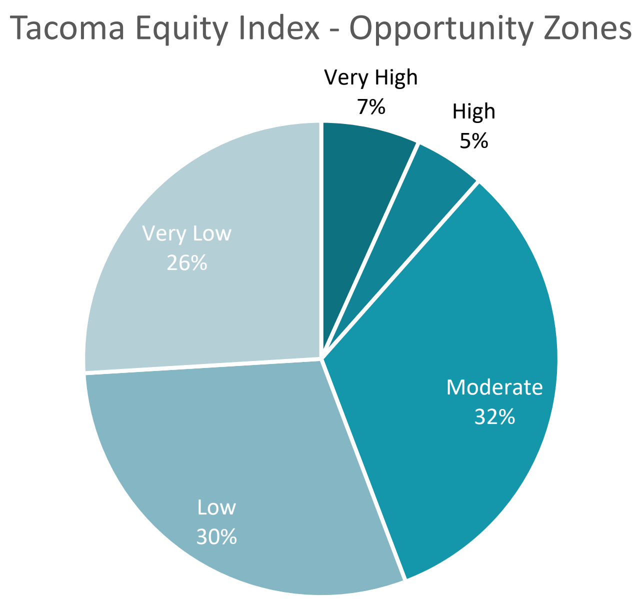
[5] Percentages may not equal one hundred due to rounding.

- Native American/Alaska Native, White/Caucasian
- Pacific Islander/Native Hawaiian
- Latino/Latinx/Hispanic, White/Caucasian
- Asian, White/Caucasian
- Latino/Latinx/Hispanic, Native/American Alaska/Native, White/Caucasian
- Black/African, Latino/Latinx/Hispanic
- Latino/Latinx/Hispanic, Native American/Alaska Native
- Asian, other
- Black/African, Pacific Islander/Native Hawaiian, other
- Native American/Alaska Native, White/Caucasian, other

Tacoma's Opportunity Zones

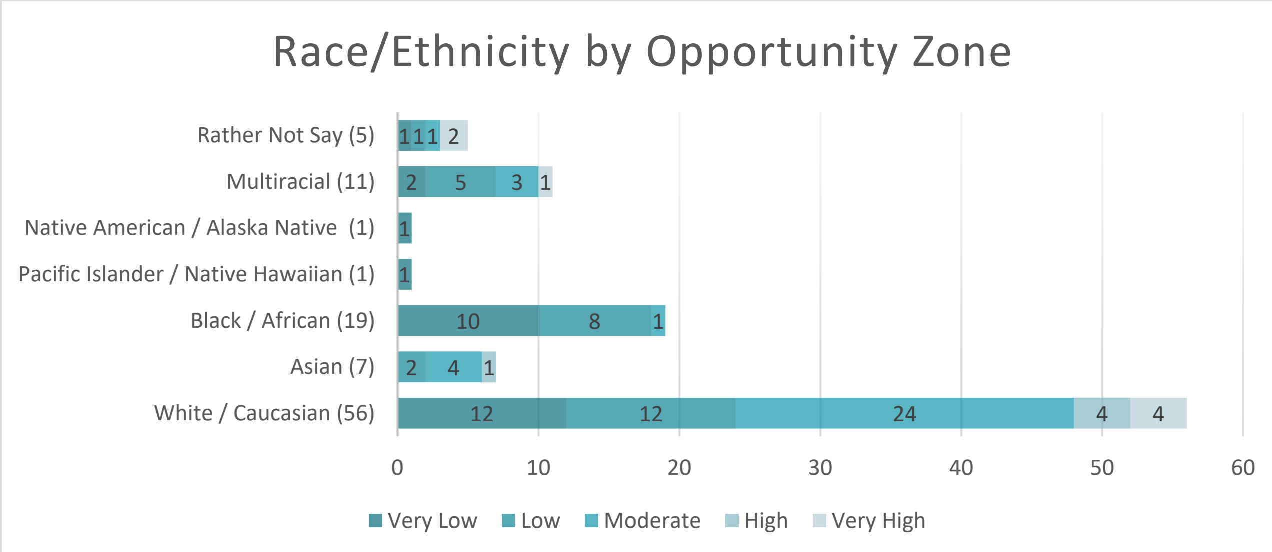
Of all survey respondents, 33 percent reside in **moderate opportunity** neighborhoods. Those that live in Foss Waterway, Flett Creek, and Lower Puyallup reside primarily in low or very low equity areas, while those residing in North Tacoma and Northeast Tacoma score very high or high on the equity index. Overall, more than half (56%) of respondents live in low or very low equity areas according to Tacoma's Equity Index Opportunity Zones

Opportunity Zone	Flett Creek	Foss Water-way	Leach Creek	Lower Puyallup	North Tacoma	Northeast Tacoma	Western Slopes	Total	% of total
Very High	0	0	0	0	5	1	1	7	7%
High	0	1	0	0	4	0	0	5	5%
Moderate	10	19	0	1	2	0	2	34	33%
Low	14	13	0	1	3	0	0	31	30%
Very Low	1	21	1	4	0	0	0	27	26%
Total	**25**	**54**	**1**	**6**	**14**	**1**	**3**	**104**	**100%**



Of respondents that live in very low opportunity areas, more than half (52%) are from the Black, Indigenous, People of Color (BIPOC) communities (includes multiracial). Similarly, 54 percent of low opportunity zone residents are BIPOC or multiracial. Conversely, those that live in moderate, high, or very high opportunity areas are majority White/Caucasian.

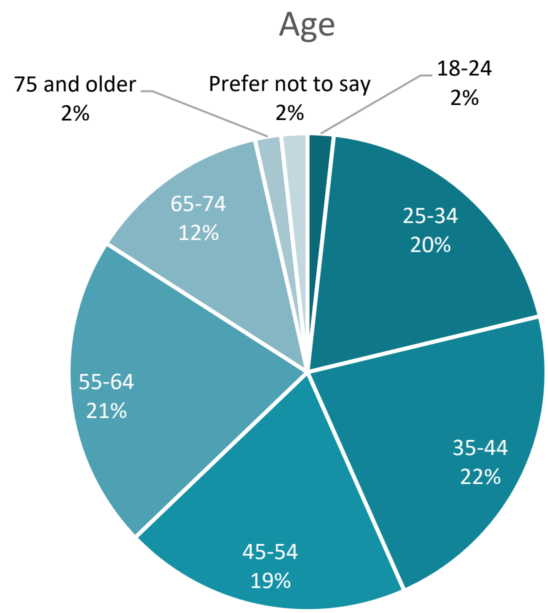
Opportunity Zone	White / Caucasian	Asian	Black / African	Pacific Islander / Native Hawaiian	Native American / Alaska Native	Multi-racial	Rather Not Say	Total	% of total
Very High	4	0	0	0	0	1	2	7	7%
High	4	1	0	0	0	0	0	5	5%
Moderate	24	4	1	0	0	3	1	33	33%
Low	12	2	8	0	0	5	1	28	28%
Very Low	12	0	10	1	1	2	1	27	27%
Total	**56**	**7**	**19**	**1**	**1**	**11**	**5**	**100**	**100%**



Age

The majority of respondents are between the ages of 35-44. The most underrepresented ages are respondents 18-24 years old (2%) and those 75 or older (2%).

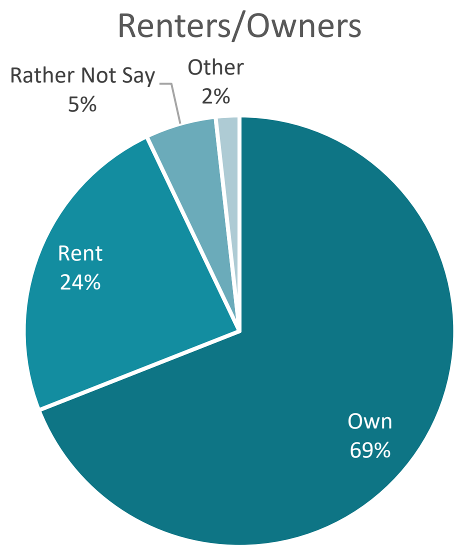
Age	Flett Creek	Foss Water-way	Leach Creek	Lower Puyallup	North Tacoma	North-east Tacoma	Western Slopes	Not indicated	Total	% of total
18-24	0	0	0	0	0	1	0	1	2	2%
25-34	1	12	1	2	3	0	1	2	22	19%
35-44	4	11	0	4	4	0	1	1	25	22%
45-54	4	11	0	0	2	0	0	5	22	19%
55-64	5	10	0	0	3	0	1	5	24	21%
65-74	4	9	0	0	0	0	0	1	14	12%
75+	2	0	0	0	0	0	0	0	2	2%
Prefer not to say	0	0	0	0	2	0	0	0	2	2%
Total	**20**	**53**	**1**	**6**	**14**	**1**	**3**	**15**	**113**	**100%**



Renter/Owner

The majority of respondents own their home (69%).

Rent / Own	Flett Creek	Foss Water-way	Leach Creek	Lower Puyallup	North Tacoma	North-east Tacoma	Western Slopes	Not indicated	Total	% of total
Own	21	31	0	5	9	0	2	10	78	69%
Rent	0	17	1	1	4	0	1	3	27	24%
Rather Not Say	0	3	0	0	1	0	0	2	6	5%
Other	0	1	0	0	0	1	0	0	2	2%
Total	**21**	**52**	**1**	**6**	**14**	**1**	**3**	**15**	**113**	**100%**



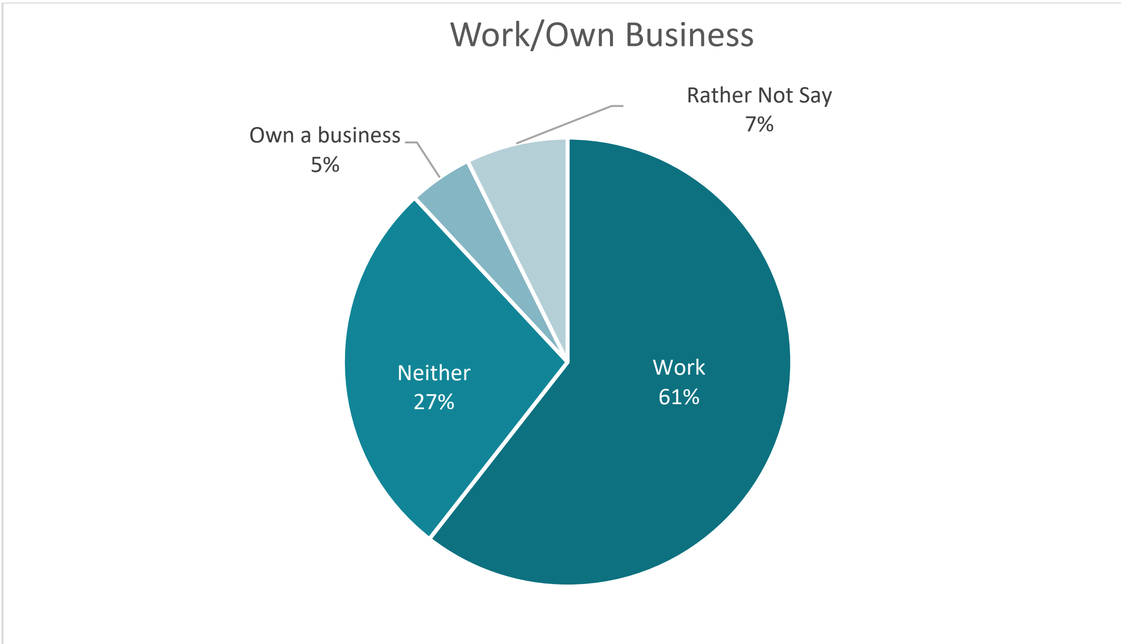
"Other" responses included:

- Live with parents
- I live on a boat that I own, but I rent a slip at Foss Harbor Marina.

Work/Own Business

Over three-fifths (61%) of respondents work in Tacoma while 27 percent neither work nor own a business.

Work/ Own Business	Flett Creek	Foss Water-way	Leach Creek	Lower Puyallup	North Tacoma	North-east Tacoma	Western Slopes	Not indicated	Total	% of total
Work	11	32	1	1	11	1	2	7	66	61%
Neither	9	12	0	4	1	0	1	3	30	27%
Own a business	1	2	0	0	1	0	0	1	5	5%
Rather Not Say	0	5	0	0	0	0	0	3	8	7%
Total	**21**	**51**	**1**	**5**	**14**	**1**	**3**	**14**	**109**	**100%**



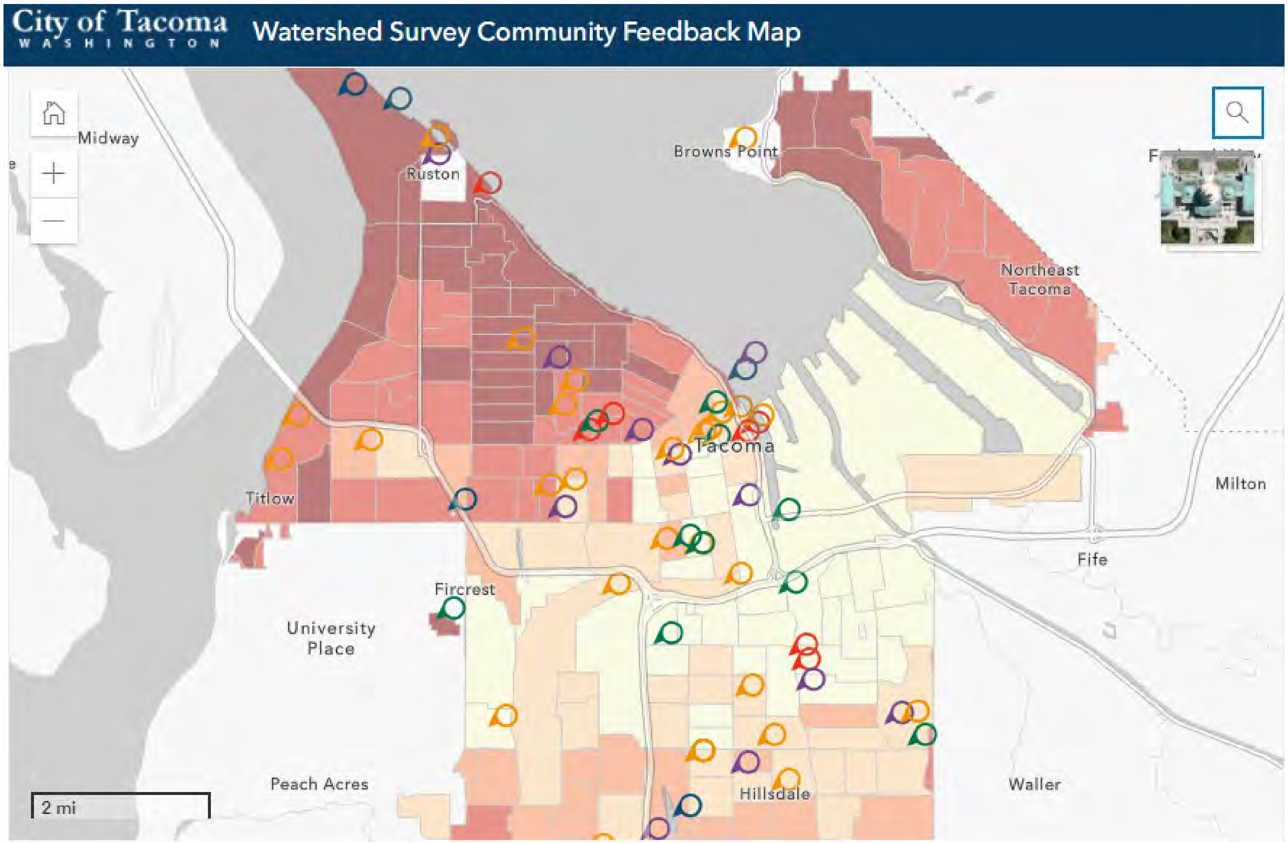
Language

The overwhelming majority of respondents (99%) speak English as their primary language. Spanish speakers, who make up 6.9 percent of Tacoma's population are not represented in the survey. Additional languages indicated spoken at home include Italian, Korean, Spanish, English/Cambodian, Turkish, Chinese, ASL - American Sign Language, Philippines, Tagalog, and Esperanto.

Language	Flett Creek	Foss Water-way	Leach Creek	Lower Puyallup	North Tacoma	North-east Tacoma	Western Slopes	Not indicated	Total	% of total
English	19	45	1	6	13	1	3	11	99	99%
Cambodian	0	0	0	0	0	0	0	1	1	1%
Total	**19**	**45**	**1**	**6**	**13**	**1**	**3**	**12**	**100**	**100%**

Site Identification Map

The survey prompted participants to provide information on specific sites of interest or concern to them throughout Tacoma. Participants were able to drop a pin on an interactive map, select a topic area from a dropdown menu (litter/pollution, improvement idea, flooding, fishing/swimming, or other), and add optional notes about the site. A total of **64 survey respondents** participated in the interactive map survey question.



Identified sites by survey respondents on Tacoma's Watershed Community Feedback Map.

Survey respondents identified more sites in Tacoma's low (36%) and very low (25%) opportunity zones than in other zones. Half of respondents (50%) provided "other" comments while 17 percent identified sites with litter/pollution issues and 16 percent had site improvement ideas. Additional respondent comments are found in **Appendix E: Tacoma's Watershed Community Feedback Map - Additional comments.**

Watershed/ Opportunity Zone	Other Comment	Litter/ Pollution	Improvement Idea	Flooding	Fishing/ Swimming	Total	%
VERY HIGH	**2**	**1**	**1**	**1**	**2**	**7**	**11%**
North Tacoma	2		1	1	2	6	9%
Leach Creek		1				1	2%
HIGH	**5**	**1**	**1**	**1**	**1**	**9**	**14%**
North Tacoma	2	1		1		4	6%
Western Slopes	2					2	3%
Flett Creek	1		1			2	3%
Leach Creek					1	1	2%
MODERATE	**5**	**3**		**1**		**9**	**14%**
North Tacoma	1	1		1		3	5%
Foss Waterway	2	1				3	5%

Flett Creek	1	1				2	3%
Western Slopes	1					1	2%
LOW	**15**	**1**	**5**	**2**		**23**	**36%**
Foss Waterway	6		2	2		10	16%
Flett Creek	6		1			7	11%
North Tacoma	2		1			3	5%
Lower Puyallup	1	1	1			3	5%
VERY LOW	**5**	**5**	**3**	**3**		**16**	**25%**
Foss Waterway	3	4	2	2		11	17%
Flett Creek	1	1	1	1		4	6%
North Tacoma	1					1	2%
Total	**32 *(50%)***	**11 *(17%)***	**10 *(16%)***	**8 *(13%)***	**3 *(5%)***	**64 *(100%)***	**100%**

Continued Involvement

Most respondents (68%) would like to stay involved in the UWPP process and want resources around healthy watershed solutions. Respondents are most interested in learning how the city can help folks **clean up trash** in their neighborhood.

STAY INVOLVED	TOTAL
Clean up trash	55
No thanks	38
Receive emails	37
Build a rain garden	28
Replace my lawn	27
Free trees	26
Keep litter leaves out of storm drains	24
Care for a local habitat area	21
Replace pavement with planted areas	17
Mark storm drains	16
Clean up dog waste	16
Total	**119**

How participants heard about survey

The half of all respondents (50%) heard about the survey through social media outlets like Facebook and 35 percent heard about it through the Safe Streets Group.

SOURCE	TOTAL	% OF TOTAL
Other	53	51%
Safe Streets Group	37	35%
Tacoma EnviroNews Email	5	5%
Watershed Council	5	5%
Tacoma Tree Foundation	2	2%

Citizens for a Healthy Bay	1	1%
Neighborhood Council	2	2%
Total	**105**	**100%**

“Other” write-in responses included:

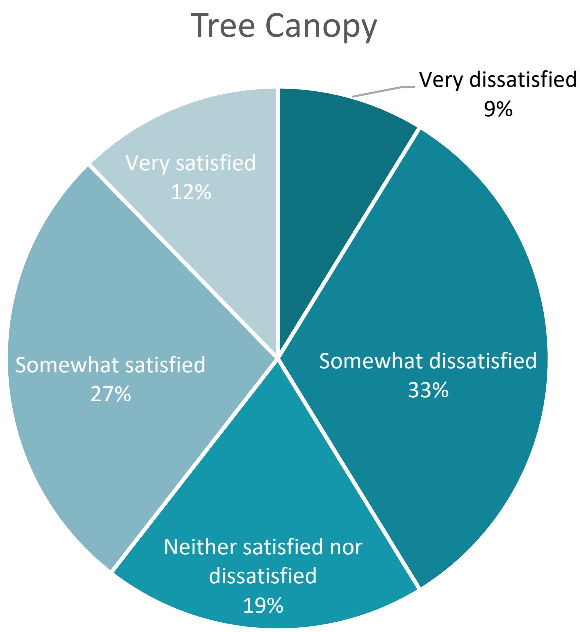
- Hilltop Summer Splash
- Shauna Hansen
- Email from other residents (and the South Tacoma Business District)
- Google Alert "City of Tacoma"
- Social media
- Email from City of Tacoma staff
- Salishan association
- Center for Urban Waters (CUW)
- Facebook (Tacoma Sustainability page, Tacoma Environmental Services page, Central Tacoma Neighborhood page)
- Clover Park Tech – instructor recommendation
- BPTAG
- Green Tacoma Day - Greater Christ Temple

Watershed Characteristic Satisfaction

The survey prompted respondent to rank their satisfaction levels for various watershed characteristics or features.

Tree Canopy

Roughly one third of respondents (32%) are **somewhat dissatisfied** with their neighborhood’s tree canopy, particularly those who reside in Flett Creek, Foss waterway, and Western slopes. Over a quarter (27%) of overall respondents are somewhat satisfied with their neighborhood tree canopy, with North Tacoma, Northeast Tacoma, and Lower Puyallup representing the highest rates of satisfaction.



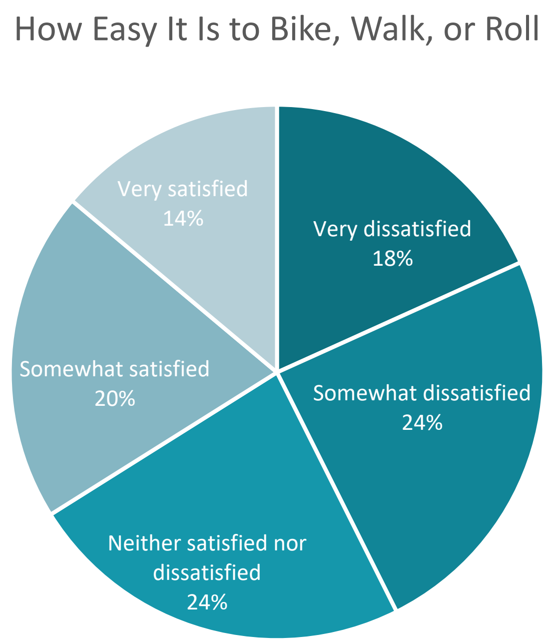
Level of Satisfaction	Flett Creek	Foss Water-way	Leach Creek	Lower Puyallup	North Tacoma	Northeast Tacoma	Western Slopes	Not indicated	Total	% of total
Very dissatisfied	3	1	0	1	2	0	1	2	10	9%
Somewhat dissatisfied	7	18	0	1	4	0	2	5	37	32%
Neither satisfied nor dissatisfied	4	14	0	1	0	0	0	3	22	19%
Somewhat satisfied	4	13	1	2	6	1	0	4	31	27%
Very satisfied	4	6	0	1	2	0	0	1	14	12%
Total	**22**	**52**	**1**	**6**	**14**	**1**	**3**	**15**	**114**	**100%**

How Easy It Is to Bike, Walk, or Roll

One fourth (24%) of respondents are **somewhat dissatisfied** with how easy it is to bike, walk, or roll in their neighborhood, particularly those who reside in Flett Creek, Lower Puyallup, and Northeast Tacoma. Another quarter (23%) is neutral, or **neither satisfied nor dissatisfied.** North Tacoma watershed saw the highest rates of very dissatisfied respondents relative to other watersheds.

Level of Satisfaction	Flett Creek	Foss Water-way	Leach Creek	Lower Puyallup	North Tacoma	Northeast Tacoma	Western Slopes	Not indicated	Total	% of total
Very dissatisfied	2	8	0	1	5	0	1	4	21	18%

Somewhat dissatisfied	8	9	0	2	4	1	1	3	28	24%
Neither satisfied nor dissatisfied	6	14	0	1	2	0	1	3	27	23%
Somewhat satisfied	4	12	0	1	2	0	0	4	23	20%
Very satisfied	2	10	1	1	1	0	0	1	16	14%
Total	**22**	**53**	**1**	**6**	**14**	**1**	**3**	**15**	**115**	**100%**

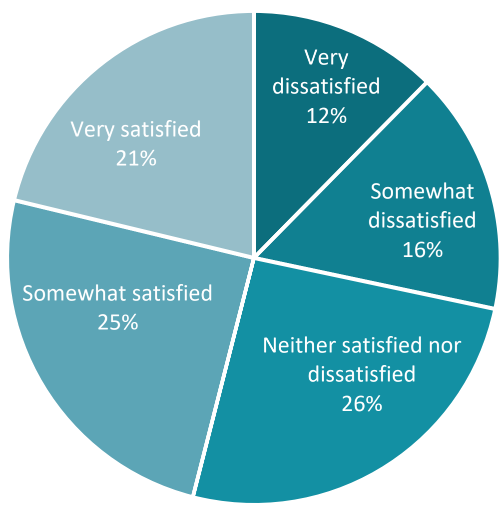


Amount of Flooding

Over a quarter (26%) of respondents are generally **neither satisfied nor dissatisfied** with the amount of flooding in their neighborhoods, while another quarter is somewhat satisfied (25%). Foss Waterway had the highest rate of somewhat and very dissatisfied residents compared to other watersheds.

Level of Satisfaction	Flett Creek	Foss Water-way	Leach Creek	Lower Puyallup	North Tacoma	Northeast Tacoma	Western Slopes	Not indicated	Total	% of total
Very dissatisfied	2	6	0	1	0	0	1	4	14	12%
Somewhat dissatisfied	3	11	0	1	2	0	0	1	18	16%

Neither satisfied nor dissatisfied	8	14	0	1	3	0	1	2	29	26%
Somewhat satisfied	3	12	1	0	6	1	0	5	28	25%
Very satisfied	5	10	0	3	3	0	1	2	24	21%
Total	**21**	**53**	**1**	**6**	**14**	**1**	**3**	**14**	**113**	**100%**



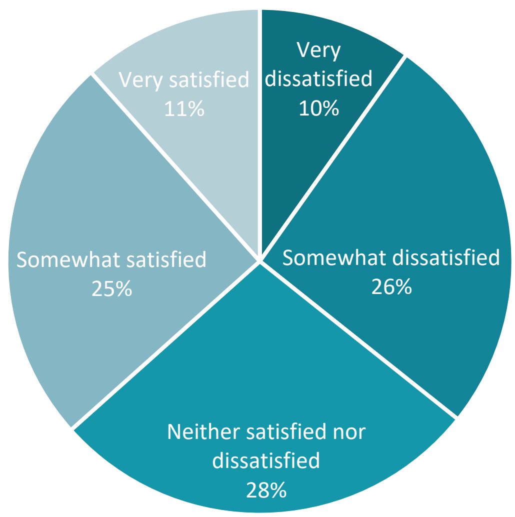
Cleanliness of Streams, Ponds, Lakes, and Beaches

Over one quarter (28%) of respondents are **neither satisfied nor dissatisfied** with the cleanliness of streams, ponds, lakes, and beaches in their neighborhood, followed closely by respondents who are **somewhat dissatisfied** (26%). Respondents residing in Lower Puyallup and North Tacoma had the highest rates of dissatisfaction (somewhat dissatisfied and very dissatisfied) compared to other watersheds.

Level of Satisfaction	Flett Creek	Foss Water-way	Leach Creek	Lower Puyallup	North Tacoma	North-east Tacoma	Western Slopes	Not indicated	Total	% of total
Very dissatisfied	3	2	0	1	0	0	1	4	11	10%
Somewhat dissatisfied	5	9	1	3	7	0	1	3	29	26%
Neither satisfied nor dissatisfied	5	18	0	1	3	0	0	4	31	28%

Somewhat satisfied	7	12	0	1	3	1	1	3	28	25%
Very satisfied	1	10	0	0	1	0	0	1	13	12%
Total	**21**	**51**	**1**	**6**	**14**	**1**	**3**	**15**	**112**	**100%**

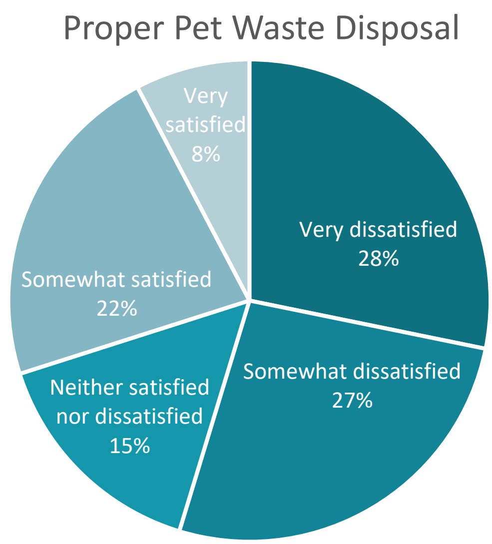
Cleanliness of Streams, Ponds, Lakes, and Beaches



Proper Pet Waste Disposal

Over half of all respondents are **very dissatisfied** (28%) or **somewhat dissatisfied** (26%) with proper pet waste disposal in their neighborhoods. while the respondents form Northeast Tacoma is somewhat satisfied. Compared to other watersheds, the highest rate of satisfaction are in the North Tacoma watershed.

Level of Satisfaction	Flett Creek	Foss Water-way	Leach Creek	Lower Puyallup	North Tacoma	North-east Tacoma	Western Slopes	Not indicated	Total	% of total
Very dissatisfied	7	15	0	3	1	0	2	5	33	28%
Somewhat dissatisfied	6	15	1	0	6	0	0	3	31	26%
Neither satisfied nor dissatisfied	5	9	0	1	1	0	1	1	18	15%
Somewhat satisfied	3	12	0	2	4	1	0	4	26	22%
Very satisfied	2	3	0	0	2	0	0	2	9	8%
Total	**23**	**54**	**1**	**6**	**14**	**1**	**3**	**15**	**117**	**100%**



Watershed Characteristics Importance

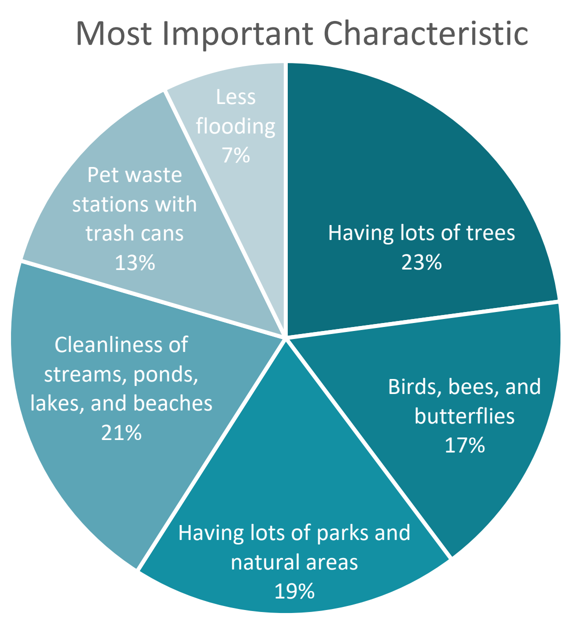
When asked to identify all watershed characteristics important to them, the majority of respondents identified **cleanliness of streams, ponds, lakes and beaches** (87%) and **having lots of trees** (80%) as the two most important amenities in their neighborhoods. Less flooding was the least important characteristic (47%).

Characteristic	Flett Creek	Foss Water-way	Leach Creek	Lower Puyallup	North Tacoma	North-east Tacoma	Western Slopes	N/A *	Total	% of total
Having lots of trees	19	41	1	5	12	1	3	13	95	80%
Cleanliness of streams, ponds, lakes, and beaches	22	46	0	5	12	1	3	14	103	87%
Birds, bees, and butterflies	20	37	1	5	12	1	2	13	91	76%
Having lots of parks and natural areas	16	38	1	5	13	1	3	13	90	76%
Pet waste stations with trash cans	18	44	0	5	9	0	2	11	89	75%
Less flooding	8	31	0	3	4	0	1	9	56	47%
Other	1	0	0	0	0	0	0	0	1	1%
Total	**25**	**54**	**1**	**6**	**14**	**1**	**3**	**15**	**119**	**-**

*Not indicated

When asked to identify the most important neighborhood characteristic of the list they identified, nearly one quarter (24%) of respondents identified **having lots as trees.**

Characteristic	Flett Creek	Foss Water-way	Leach Creek	Lower Puyall up	North Tacoma	North-east Tacoma	Western Slopes	N/A	Total	% of total
Having lots of trees	6	6	0	1	3	1	1	1	19	23%
Cleanliness of streams, ponds, lakes, and beaches	2	6	0	3	2	0	0	4	17	20%
Having lots of parks and natural areas	2	8	0	0	5	0	0	1	16	19%
Birds, bees, and butterflies	1	7	1	2	1	0	0	2	14	17%
Pet waste stations with trash cans	1	3	0	0	2	0	2	3	11	13%
Less flooding	4	1	0	0	0	0	0	1	6	7%
Other	0	0	0	0	0	0	0	0	0	0%
Total	**16**	**31**	**1**	**6**	**13**	**1**	**3**	**12**	**83**	**100%**



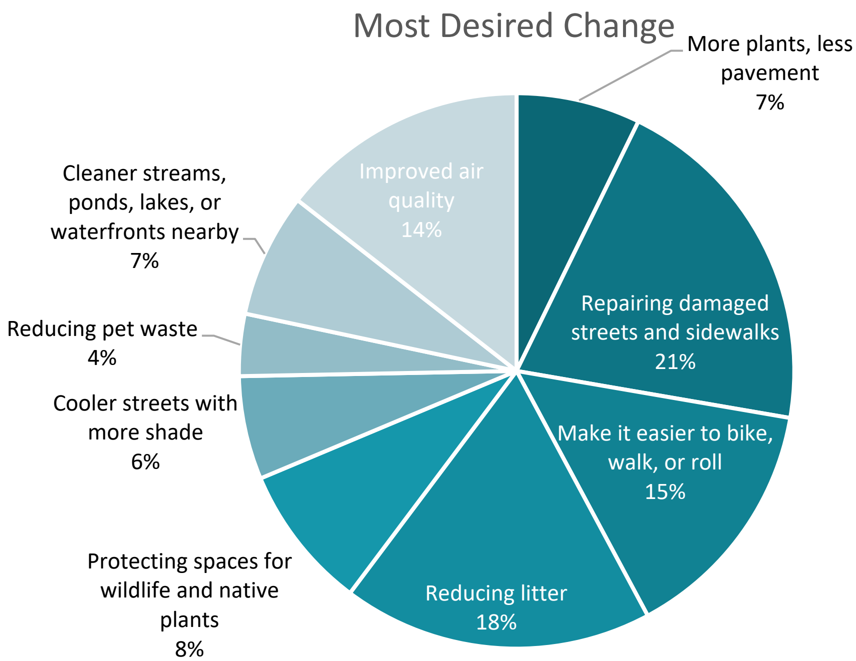
Desired Watershed Changes

The survey asked respondents to identify what watershed characteristics or features they would most want to change. Multiple responses were allowed. Overall, respondents wanted the following changes to be made in their neighborhoods: **repair damaged streets and sidewalks** (87%), **reduce litter** (77%), and **improve air quality** (66%).

Characteristic	Flett Creek	Foss Water-way	Leach Creek	Lower Puyallup	North Tacoma	North-east Tacoma	Western Slopes	N/A	Total	%
Reducing flooding	7	19	0	2	2	0	1	7	38	32%
More plants, less pavement	12	24	1	4	10	1	2	10	64	54%
Repairing damaged streets and sidewalks	21	43	1	6	13	1	3	14	102	86%
Make it easier to bike, walk, or roll	14	21	0	3	12	1	1	9	61	51%
Reducing litter	19	42	1	6	9	0	3	12	92	77%
Protecting spaces for wildlife and native plants	18	24	1	5	10	0	1	11	70	59%
Cooler streets with more shade	14	28	0	4	10	1	1	11	69	58%
More access to nearby natural areas	4	21	1	2	7	1	0	11	47	39%
Reducing pet waste	10	23	0	4	6	0	1	10	54	45%
Cleaner streams, ponds, lakes, or waterfronts nearby	12	19	0	6	11	1	1	11	61	51%
Improved air quality	14	33	1	4	9	1	1	12	75	63%
Total	**25**	**54**	**1**	**6**	**14**	**1**	**3**	**15**	**119**	**-**

Of their selections, respondents were asked to identify their top priority. One fifth (20%) of respondents identified **repairing damaged streets and sidewalks** and another 18 percent identified **reduced litter** as their top priority for desired watershed changes.

Characteristic	Flett Creek	Foss Water-way	Leach Creek	Lower Puyallup	North Tacoma	North-east Tacoma	Western Slopes	N/A	Total	% of total
Reducing flooding	0	0	0	0	2	0	0	0	0	0%
More plants, less pavement	1	2	0	0	2	0	0	1	6	7%
Repairing damaged streets and sidewalks	3	8	0	0	3	0	0	3	17	21%
Make it easier to bike, walk, or roll	3	7	0	0	2	0	0	0	12	14%
Reducing litter	4	6	0	2	0	0	0	1	15	18%
Protecting spaces for wildlife and native plants	1	1	0	1	1	0	0	3	7	8%
Cooler streets with more shade	2	1	0	0	1	0	1	0	5	6%
More access to nearby natural areas	0	0	0	0	0	0	0	0	0	0%
Reducing pet waste	1	0	0	0	0	0	1	1	3	4%
Cleaner streams, ponds, lakes, or waterfronts nearby	0	2	0	1	1	0	0	2	6	7%
Improved air quality	3	2	1	1	2	0	1	2	12	14%
Total	**18**	**29**	**1**	**5**	**14**	**0**	**3**	**13**	**83**	**100%**



Community Workshops

Two iterations of the same virtual community workshop were held on a Saturday afternoon and Tuesday evening to increase access for community members with various work schedules. The workshops were both held on Zoom and accessible through phone or computer. One participant indicted they required live Spanish translation during the workshop. The table below shows the final registration and participation count for each workshop.

WORKSHOP DAY/DATE	REGISTRANTS	PARTICAPANTS	RATE
Saturday, September 25th	23	10	43%
Tuesday, September 28th	21	14	67%
Total	**44**	**24**	**54%**

Participant Information

The registration form for both workshops prompted participants to identify how they learned about the workshop Most participants indicated that they heard about the workshop through an "other" source. Because this was an optional question not all registrants responded. Responses are listed in descending order from highest to lowest.

SOURCE	RESPONSES
Other	15
Tacoma Enivronews Email	4
Watershed Council	4
Safe Streets Group	3

Neighborhood Council	2
Hilltop Action Coalition	2
Citizens for a Healthy Bay	2
Tacoma Tree Foundation	1
Pierce Conservation District	1
Tacoma Pierce County Health Department	1
Business District	0

"Other" responses included:

- Consejo
- Staff
- Tacoma community Facebook group (3)
- I serve as the Chair of Human Rights Commission and on the board of the Hilltop Action Coalition
- Facebook (4)

Using a map, workshop participants were asked to identify the watershed they live or work in using the Zoom poll feature. Of the participants who joined the two workshops, 39 percent indicated they reside in Foss Waterway and 22 percent indicated Flett Creek and North Tacoma. All in-workshop poll questions were optional.

WATERSHED	RESPONSES	%
Foss Waterway	7	39%
Flett Creek	4	22%
North Tacoma	4	22%
Leach Creek	1	6%
Western Slopes	1	6%
Joe's Creek	1	6%
Northeast Tacoma	0	0%
Lower Puyallup	0	0%
Tideflats	0	0%
Total	**18**	**100%**

Workshop participants were asked to identify when stormwater runoff becomes a problem in their experience. They were prompted to select all options that applied. **Polluting salmon, orcas, and other marine creatures** and **polluting groundwater** were most were identified as the biggest problems.

WHEN IS STORMWATER A PROBLEM	Responses
Polluting salmon, orcas, and other marine creatures	15
Polluting groundwater	11
Ponding water on sidewalks or trails interferes with walking, biking, or rolling	10
Eroding slopes	10

Ponding water on the streets, parking lots, or alleys interferes with driving	7
Polluting swimming beaches	6
Sewer back-ups	5
Flooding my house or garage	4
It is not a problem	0

Workshop participants were asked to identify which proposed plan name most resonates with them. Half (50%) of respondents chose "Urban Waters Protection Plan."

PROPOSED PLAN NAME	Responses	%
Urban Waters Protection Plan	8	50%
Protect Our Waters Plan	6	38%
Stormwater Action Prioritization Plan	1	6%
One Tacoma Watershed Plan	1	6%
Total	**16**	**100%**

Tacoma's Vision for Healthy Neighborhoods and Watersheds

As part of the virtual workshops, participants joined small discussion groups led by project team facilitators. Using the web-based interactive MURAL Board platform, participants were asked to participate in an exercise to describe their vision for healthy Tacoma neighborhood and watersheds. Images of workshop MURAL Boards are found in **Appendix F: Workshop MURAL Boards**. The tables below include direct feedback to the following guiding questions and recurring themes represented across responses to each question

- *What does a healthy neighborhood mean to you?*
- *What does a healthy watershed mean to you?*

WHAT DOES A HEALTHY NEIGHBORHOOD MEAN TO YOU?	
Theme	**Feedback**
• Clean green spaces • Accessible public transit • Walkable neighborhoods • Access to healthy food • Biodiversity and wildlife health	• Us humans taking responsibility for our part in the larger ecosystem. Neighborhood = ALL of us • Clean neighborhood parks • Equal access to safe outdoor spaces • Thriving community • Trees • Thriving People • Love, work, play in the same area • Lots of trees and shade • Housing • Food security • Diversity of class/race • Accessible healthy food options

	• Adequate public transit options • Walkability • Walkable/rollable • Open space • Resources • Clean, green space, safe, birds • Maintained water cleanliness • Enough tree coverage (shade) • gardeners not using pesticides • our tax dollars should be protecting our water as • Clean neighborhood parks • Adopted our Storm Drains • Open green space and mature trees • Maintained spaces - rain gardens and other facilities that clean water • Urban wildlife diversity • Unmaintained spaces, too: native plants • Eco-Industry / Greenzones • Needs to be incorporated into City budgets - grants for lower income areas to implement these solutions • Better regulated heavy industry • LID - natural solutions to cleaning water • Amendment to consider new zoning - protect groundwater aquifer • Better public transportation • Better promotion of existing opportunities/grants - cross advertising

WHAT DOES A HEALTHY WATERSHED MEAN TO YOU?	
Theme	**Feedback**
• Healthy ecosystems and biodiversity • Clean water to drink and flow to the Puget Sound • Thriving green spaces • The City regulates human impact and development	• Increased monitoring of indicator species • Thriving water, soil and air • Minimizing harmful human impact. A thriving ecosystem • Healthy ecosystem • Sustained greenspaces • Natural cycles are present • Groundwater is captured locally • Lush tree canopy • Biodiversity • Food for bees and pollinators • Rainwater education • Thriving life • Direct runoff from human activities are a concern for health - damaging for people and marine life • healthy land for us and land animals and marine life • should have healthy features related to wastewater; protection of native species; minimize destruction and avoid repairing

	• Open green space and mature trees • Urban wildlife diversity • Buy-in from the neighborhood • Need education to prevent further destruction; focus on preservation • City to make clear priorities and commitment around healthy watersheds; often get shifted down as a priority • No pollution in public water sources • Clean, unpolluted water • No pollution in the Sound • The ability to drink tap water safely • Our community will eventually be able to undo so much pollution that has affected our wildlife as well as preserve future wildlife both on land and water • Lack of wildlife • No polluted runoff from the roads

The visual below represents words and phrases used in the feedback listed above to describe both healthy neighborhoods and healthy watersheds. The more frequently a word was used in the feedback, the larger it appears in the visual.

The tables below include direct feedback to the following guiding questions and recurring themes heard for each question:

- *What makes a neighborhood unhealthy?*
- *What makes a watershed unhealthy?*

WHAT MAKES A NEIGHBORHOOD UNHEALTHY?	
Theme	**Feedback**
• Pollutants and toxins in waterways from human activities	• A lack of affordable grocery stores and safe outdoor spaces • Humans harming the delicate balance of nature either through greed, ignorance, or both

• Too much pavement, not enough green spaces • Unregulated development and industry practices • Not enough public education about human impacts and solutions	• Paving over green spaces • No near local farmer markets • No green spaces • Lack of green space • Human waste • Lack of trees • Light pollution • Noise pollution • Not enough traffic calming • No front porches • Limited transit connections • Lack of adequate resources/info • Lack adequate housing • Lack of proper drainage • Litter • Not enough housing • Poor water quality • Not being able to safely drink tap water • Illegal to collect and reuse rainwater • Using herbicides and pesticides • Air pollution • Paved planting strips

WHAT MAKES A WATERSHED UNHEALTHY?	
Theme	**Feedback**
• Pollutants and toxins in waterways from human activities • Too much pavement, not enough green spaces • Unregulated development and industry practices • Not enough public education about human impacts and solutions	• Pet waste • Not enough data collection • contaminants – arsenic and legacy pollution • A lack of education, and a lack of concern • Industrial waste, litter, human and pet waste, oil • Contamination • Water pollution • Animal waste • Lack of biodiversity • Dripping cars • Nothing for the bees to eat • Chemical from car washing • Limited walkability • Too much pavement • Not enough trees • Pollution • Dog poop • Too much impermeable pavement • garbage and recycling being directly where rainwater doesn't help the situation • Pavement • Over-construction • Too much pavement • Poorly regulation industry • Uncontained Petro-chemicals / toxins • Use of herbicides, pesticides, synthetic fertilizers • Lack of open green space and mature trees • Improper use of land; building too close; construction around riparian areas • Having healthy areas inaccessible for vulnerable peoples

Participants were also asked to think about the connections and relationships they see between healthy neighborhood and healthy watersheds. The table below includes direct feedback from participants. Recurring and heavily emphasized themes from the input are as follows:

- Clean, accessible, and safe water and green spaces
- Environmental justice and equity considerations built into housing and development planning
- Wildlife and biodiversity health balanced with human growth and activities

CONNECTIONS BETWEEN HEALTHY NEIGHBORHOODS AND HEALTHY WATERSHEDS
Feedback
• Everyone has affordable housing • Clean green space • Clean public space • Clean – no pollution on ground • Clean unpolluted water • Education – provide access to healthy spaces will help with health of watersheds – transportation to get to these spaces is needed • Equity: bus fare is used for work transportation; difficult to spend it on recreation • Green spaces are located in higher economic areas; easier access; not aware of lack of healthy/green spaces in lower socio-economic spaces • Push for more affordable housing; concerned about for-profit development – leadership needs to stand up and say no • Environmental justice: $ for redevelopment is tied to prop values; hard to get to occur to low-income areas • GMA pushed by transit and driving building production – need more synergy between different agencies • Housing • Thriving life • Biodiversity / local food • Greenspace/tree canopy • Proper disposal of pet/human waste • Mobility through the neighborhood & watershed • Education and regulation. Helping people and businesses see our species as just one part of a larger whole • More green spaces connected to longer lifespan • Equitable balance between all residents, both human and animal • Continuous feedback

Watershed Characteristics Ranking and Barrier Discussion

Using MURAL board, participants were asked to rank their top three watershed characteristics based on importance or concern.

WATERSHED CHARACTERISTICS/ISSUES	
Cleanliness of streams, ponds, lakes, and beaches	9
Birds, bees, and butterflies	9
Protection of natural habitat areas	8
More plants, less pavement	8
Lots of trees	7
Pet waste stations with trash cans	7
Air quality	6
Reduced litter	4
How easy it is to bike, walk, or roll	4
Access to nearby parks and natural areas	4

Amount of Flooding	2

Participants provided input on barriers, needs, and potential solutions to improving the top-ranked watershed characteristics. The table below provides direct feedback as well repeated themes associated with each characteristic or issue.

WHAT ARE BARRIERS AROUND IMPROVING THE TOP CHARACTERISTICS/ISSUES THAT YOU HAVE NOTICED OR DEALT WITH?		
Characteristic/ Issue	**Theme**	**Feedback**
Cleanliness of streams, ponds, lakes, and beaches	• Lack of funding • Need solutions to big litter problem	• People believing there is actually a problem • People don't think they should pick up trash that "isn't theirs" • Illegal dumping • Rain barrels • Funding • Garbage and trash into the waters • Time to clean it • Cost of waste services (garbage collection)
Birds, bees, and butterflies	• High costs associated with planting pollinator plants	• People believing there is actually a problem • Money to plant what attract these • Costs • Pesticides • Improper landscaping • Feral cats are destructive to bird population – need to spay/neuter • More native and pollinator friendly flora • More bat habitat
Protection of natural habitat areas	• Increase protection from new development • Increase native flora	• Costs • Over-landscaping – need to let spaces go native, rather than putting in lawns • Human destruction • Increase community involvement • Storm drain program is strong example • New development and encroachment • New development needs have dog parks
More plants, less pavement	• Address public's perceived barriers	• Existing pavement • Perceived effort to maintain • Accessibility for wheelchairs/strollers • Perceived costs of maintenance (trees) • Mess from falling fruit left on ground • Cost of staffing • Lawns are fancy

Lots of trees	• Increased regulatory and permitting solutions to protect trees and green spaces from development	• Costs • Over-development • Need to increase community involvement • Resources to protect trees – free tree maintenance • Consider other solutions before felling mature trees • Need permits to cut down trees but not 100% of the time – in certain areas like wetlands and other protected areas you need a permit • Conflicts with underground sewer pipes – need to choose solution to save trees • Very few trees on waterfront, possibly because people in expensive condos don't want to lose their view • City has strong program for tree planting • Tree maintenance and property damage • Permitting barriers for rain gardens - need strong permitting standards
Pet waste stations with trash cans	• Increase maintenance of full trash cans and empty bag dispensers	• Bag dispensers are often empty • Trash cans often full • Not enough signage to discourage people from leaving pet waste • Need to increase community involvement • Incentives
Air Quality		• People believing there is actually a problem • Electronic vehicle costs
Access to nearby parks and natural areas	• Increase maintenance of green spaces, including invasive species control and help for unhoused individuals	• Urban sprawl limiting options to access natural areas • Trail to the mountain isn't built yet • Overcrowding • Lack of shade/places to escape the heat or other elements • Unkept greenspaces • Uneven distribution of parks/facilities • Pre-WW2 neighborhoods not built near parks – use school space as Ersatz Park, but not the same • Valuation of green spaces includes benefits to human mental and physical health • Invasive species • Lack of needle collection bins • knotweed/blackberries/ivy • Not enough restrooms at parks • Danger or perceived danger from unhoused folks in greenspaces
How easy it is to bike, walk, or roll	• Prioritize bike safety in road design	• Locations are far away • Conflicting interests • Perception of poverty/anti-bike sentiment • Nowhere to go within reasonable distance

	• Increase dense urban centers for better walkability/bikeability	• Nowhere safe to leave a bike • Vehicles dominating space • No sidewalks • Hills • Unsafe roads • Bikes lanes that do not connect • Hard to cross streets

Post-Workshop Feedback

One participant representing the Chambers-Clover Creek watershed followed up via email to provide additional feedback on the workshop. The feedback describes concern that the lack of effective coordination among various City, regional, and state stakeholders with different priorities will impact ability of the UWPP to improve to aquatic systems and address nonpoint pollution:

> My assessment of the watershed management planning process was that the goal of *"…the City is striving to ensure Tacoma's WMP (watershed management plan) will reflect and incorporate the goals and priorities from a wide group of community stakeholders, City departments, and partner organizations throughout the Puyallup-White River and Chambers-Clover Creek Watersheds."* while lofty will not be attained.
>
> We Chambers-Clover Creek watershed stakeholders can't even agree amongst ourselves that our watershed's wetlands, streams, and lakes are shallow aquifer groundwater discharge diminished/deprived, nonpoint nutrient polluted groundwater discharge fed and sediment fouled to the extend that they are unfit habitats for Coho salmon and our indigenous and immigrant people, much less agree on what to do about our watershed's impaired condition

KEY TAKEAWAYS

Key takeaways are largely gleaned from survey responses and community workshop feedback.

- Tacoma residents are generally concerned with the impact that human activities and continued development has on Tacoma's natural spaces and receiving waters like the Puget Sound. Both the survey and the workshop revealed that cleanliness of streams, ponds, lakes and beaches the most important priority for residents. Workshop participants found stormwater most problematic for its negative impact on marine life and groundwater quality.
- Generally, residents were most concerned about ecosystem impacts, including reduced biodiversity, lack of mature tree canopy, and degraded marine life. The most commonly cited link between healthy watersheds and healthy neighborhood were thriving wildlife and ecosystems. Residents felt that these elements possess an intrinsic value and also provide aesthetic, recreational, and mental health value.
- Residents stressed the importance around perseveration of green and natural spaces and strongly emphasized the need to slow the pace of development and the associated impacts. They advocated for stronger regulations around new development to both preserve natural spaces and to ensure Tacoma's neighborhoods are affordable for all residents.

- Many residents expressed significant concern about litter and improper pet waste management, stressing the need for stronger actions from the City including building more dog parks, installing more dog waste stations, and emptying trash cans more often.
- Improved walkability and bikability was important for some residents, but it did not emerge as a top priority. However, improving road-related infrastructure (sidewalks and streets) did appear to be the most desirable neighborhood change amongst surveyed residents.
- Flooding does not appear to be a top priority or area of concern among participants.
- While watershed priorities varied between Tacoma's different watersheds and opportunity zones, the most sites of concern or in need of improvement were identified in Tacoma's low and very low opportunity zones. Similarly, the highest levels of dissatisfaction were from residents of watersheds in predominantly moderate, low, or very low opportunity zones including Foss Waterway, Lower Puyallup, and to a lesser extent Flett Creek. This suggests a need to prioritize these areas for further engagement and implementation of solutions.

RECOMMENDATIONS

The following recommendations are geared towards increasing engagement with underrepresented groups including the Latinx/Hispanic and Spanish-speaking communities:

- Transcreate the survey into Spanish.
- Hire or partner with Spanish speaking outreach staff to provide in-language outreach to the Latinx/Hispanic community.
- Identify additional Lantinx/Hispanic and Spanish-speaking community groups and organizations to help identify existing events, meetings, and opportunities to engage the community.
- Identify and partner with trusted community advocates to share and promote watershed planning information and engagement opportunities.
- Identify and partner with popular and trusted media outlets utilized by the Latinx/Hispanic community in Tacoma (e.g., local TV and radio)
- Reimburse participants for participation in focus groups.
- Identify prevalent "Asian and Pacific Island Languages," which represent 7.5 percent of languages spoken in Tacoma, and transcreate project collateral.

APPENDIX A: TACOMA WATERSHED PUBLIC ENAGAGEMENT PLAN

Overview of Public Engagement Plan

Background

The City of Tacoma's (City) Environmental Services Department (ES) is a regional leader in stormwater management including pollution source control inspections, green stormwater infrastructure projects, and stormwater quality monitoring. This work supports healthy neighborhoods and a thriving Puget Sound, resulting in a more livable Tacoma for everybody. The City recognizes the importance of partnering with key stakeholders and community members to develop a Watershed Management Plan (WMP)[6] that meets the diverse needs of Tacoma's sub-watersheds and the neighborhoods within them. As a part of this work, ES plans to implement an equitable engagement plan in accordance with Resolution 40622.

All stormwater in the City drains to two regional watersheds: the Puyallup-White River Watershed and the Chambers-Clover Creek Watershed. Within Tacoma, these watersheds are divided into nine sub-watersheds draining to local receiving waters, each with a unique history, challenges, and opportunities for improvement. These sub-watersheds are as follows: North Tacoma; Foss Waterway; Lower Puyallup; Tideflats; Northeast Tacoma; Western Slopes; Leach Creek; Flett Creek; and Joe's Creek. The WMP will capture the distinct challenges and opportunities facing the neighborhoods within the sub-watersheds as each neighborhood has different levels of stormwater system service, access to opportunity, and community needs as well as different threats to the water quality of local waterways, and different opportunities for watershed improvements.

The WMP will describe the most effective stormwater actions and projects at the most important locations across sub-watersheds, prioritizing solutions that simultaneously address community needs and watershed health. It will provide a flexible framework that can be updated over time to reflect new pollution hotspots, community priorities, future development and housing needs, and anticipated climate change impacts. The WMP will also set standards for tracking and reporting progress toward the City's stormwater management priorities (see goals listed in the key messages) and will aim to align watershed priorities with the projects, programs, and policies of other City departments as well as across jurisdictional boundaries with neighboring municipalities in the watersheds. Much of this work will be done through the development of a new watershed prioritization tool, which will combine existing regional data layers with stormwater performance estimates and a decision support framework. Development of this tool, especially the decision support framework, will be informed by input from stakeholders and community members.

The overarching goal of the WMP is to prioritize stormwater management activities to protect and restore natural systems throughout the watershed that align with community needs and accommodate future growth. Due to the broad-scale nature of watershed planning, the city is striving to ensure Tacoma's WMP will reflect and incorporate the goals and priorities from a wide group of community stakeholders, City

[6] The City of Tacoma will solicit public input on the final name for the Watershed Management Plan during Phase One of this public engagement effort. This document uses general title of Watershed Management Plan (WMP) throughout but title will be updated the reference once a final name has been selected through public engagement process.

departments, and partner organizations throughout the Puyallup-White River and Chambers-Clover Creek Watersheds. We will especially be seeking input from overburdened community groups living in Tacoma. Overburdened communities are defined by the EPA as:

> **minority, low-income, tribal, or indigenous populations** or geographic locations in Washington State that potentially experience **disproportionate environmental harms and risks**. This disproportionality can be as a result of **greater vulnerability to environmental hazards**, **lack of opportunity for public participation**, or other factors. Increased vulnerability may be attributable to an **accumulation of negative or lack of positive environmental, health, economic, or social conditions** within these populations or places. The term describes situations where multiple factors, including both environmental and socio-economic stressors, may act cumulatively to affect health and the environment and contribute to **persistent environmental health disparities.**

Thus, community engagement is essential in developing and implementing a successful WMP. This Public Engagement Plan (PEP) **provides a strategic framework for engaging with key partners, stakeholders, and the public in the watershed management planning process**. The PEP outlines the goals and objectives of public engagement, community demographics, key messages, and strategic engagement strategies to engage and communicate with a diversity of audiences and partners. The Key Engagement Strategies section of the PEP is divided into two Phases. Phase One will focus on city-wide strategies and tactics that identify community priorities across the sub-watersheds to help determine future stormwater investments. Phase Two will provide a template to be completed at a later date that will focus on strategies and tactics to support neighborhood-specific outreach during options analysis. Cascadia Consulting Group (CCG) will work with the City to implement this PEP.

Equitable Public Engagement

The Watershed Planning team is committed to leading the department toward increased community involvement with historically underserved groups and putting equity at the center of program development and service delivery, including the development of the WMP. Community members, especially historically marginalized groups in Tacoma, have explicitly expressed the need for active, transparent, early, and thorough participation during City-led public engagement processes. Tacoma City Council has acknowledged the disparate impacts of systematic racism by passing Resolution No. 40622 in June 2020. This resolution affirms the City Council's dedication and commitment to comprehensive and sustained transformation of all institutions, systems, policies, practices, and contracts impacted by systemic racism. With the resolution, the City is launching a comprehensive transformation process that will establish new practices based on community and expert opinion as well as past reform efforts, centering the voices of those most impacted by systemic racism. Each department has developed a Racial Equity Action Plan (REAP) which calls out measurable steps toward achieving Citywide equity goals including "Purposeful Community Outreach and Engagement" and "Equitable Service Delivery."

The WMP Public Engagement Plan is being developed within this context and to meet the anti-racist transformation goals of the City. The WMP engagement process will build on pertinent feedback already shared from previous community surveys related to stormwater and watershed management as summarized in Appendix A.

The City will be engaging the public at key project milestones to:

- Identify community priorities and preferences,
- Gather input on proposed stormwater actions and projects to ensure that community needs, goals, and preferences are reflected, and
- Understand how community input shapes the final product.

We will do this by using a series of outreach tools that will be designed to reach diverse community members using best practices that center key engagement themes of access and transparency, equity, community support, trust, and relationship-building. These materials include but are not limited to an online open house, flyers, community workshops, briefings at external stakeholder meetings, e-newsletters, and direct outreach to key stakeholders. ES customer communication tools include billing inserts, environews listserv, EnviroTalk quarterly magazine to single family residents, and TV Tacoma programming (Urban Green, Tacoma Report, etc.)

The PEP is a living document intended to guide the project team through the engagement process.

Project team

Project Managers:	Shauna Hansen (City of Tacoma), Christian Nilsen (Geosyntec)
Additional City Staff:	Laura Nokes (Watershed Plan Project Manager), Merita Trohimovich (Stormwater Management Program), Desiree Radice (Open Space Management Program), Mike Carey (Urban Forestry Management Program), Teresa Peterson (Wastewater Comprehensive Plan)
Outreach support:	Gretchen Muller (CCG), Signe Lindquist (CCG)

Key Messages

MESSAGING FOR EXTERNAL AUDIENCES:

Why should I participate in this process?

- This is an ongoing opportunity to **tell us about stormwater and watershed issues that you notice in your area of town**. Your input will help us hone in on which broadly identified community and environmental health priorities we've heard from previous community feedback are most critical to your neighborhood.
- By participating, you have an opportunity to help **guide the development of the City's stormwater actions and project investments** on the ground.
- We would like to learn more about how you see watershed planning overlapping with the goals and priorities of you and your family, so that we can work together to build community health, economic recovery, and stormwater management solutions.
- The WMP is not just a guidance document; by participating, **you have influence over solutions for the whole Tacoma community,** including millions of dollars of public investments in stormwater solutions, incentive programs for individual actions, and business assistance opportunities over the next 5-10 years.
- We are also in a time where we are addressing **multiple global issues** such as climate change, racial injustice, and the economic recovery from the COVID-19 pandemic. Given the City's limited resources and many pressing community needs, your input helps us invest stormwater dollars to support the community's shared priorities (such as providing cooler, shadier, walkable streets and access to nearby nature) as well as clean water and healthy habitat in our lakes, streams, and Puget Sound to result in **win-win strategies**.

How will my input be used?

- Public input will be an **essential part of the watershed planning process**. We will listen to everybody's input including the public, City staff, City leaders, and partners throughout the planning process.
- This public engagement strategy **will inform a WMP** that is part of an ongoing, iterative planning process that will evolve and grow over time. Actions or issues that cannot be addressed through this planning process will be communicated to relevant City departments and decision-makers for further consideration.
- Input received during WMP development **will help the City to better align watershed priorities** with the programs, plans, and policies of other City departments. The City will use your input to **identify potential co-benefits of stormwater and watershed management actions** that also address the key community needs identified by you and your neighbors during the WMP public engagement process. Co-benefits may include community cohesion, positive mental health impacts, walkability, shade, lower temperatures, less urban flooding, cleaner streets, water conservation, more swimmable beaches, urban wildlife, and access to nearby nature and medicinal plants.

What is the WMP?

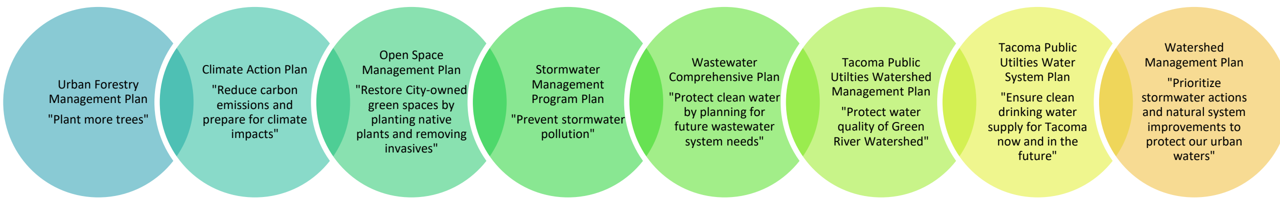
- A **WMP is a plan that identifies issues and threats to clean water and healthy habitat** and develops a framework to address them within a specific watershed. It **prioritizes stormwater management activities to align with community needs** and accommodate future growth while protecting and restoring natural systems throughout the watershed.
- The WMP will **provide a flexible framework that can be updated over time to respond to new pollution hotspots, community priorities, future development and housing needs, and anticipated climate change impacts**. The WMP will also set standards for tracking and reporting progress toward the City's stormwater management priorities listed in Tacoma's Stormwater Management Program Plan as well as priorities identified through this watershed planning process.
- This is the City's first WMP. We are **using this opportunity to better align watershed priorities with the programs and policies of other City departments.** Additionally, we are looking to identify opportunities to collaborate with internal departments as well as outside partners (such as neighboring jurisdictions and community groups) on stormwater management projects and programs. This plan will help us achieve our goal to support healthy neighborhoods and a thriving Puget Sound, leaving a better Tacoma for all.

What are the WMP goals and priorities?

- **Clean Water and Healthy Ecosystems**: Strategically select stormwater management investments to minimize impacts of stormwater runoff on critical urban waters[7] to protect and restore clean water and ecosystem function.
- **Healthy Neighborhoods**: Focus on stormwater solutions that will address needs identified by the community and eliminate disparities in stormwater service and access to green space caused by historic lack of investment.
- **Resilient Community**: Invest now in stormwater system improvements to meet the future needs of population growth, affordable housing, and climate change.
- **Equity and Environmental Justice:** Commit to transparent and clear communication. Listen to and prioritize community needs.
- **Fiscal Responsibility (or Smart Government Spending)**: Choose cost-effective stormwater management actions to achieve the greatest environmental and community benefits.

[7] Urban waters include our streams, lakes, wetlands, bays, and the Puget Sound.

How does the WMP compare to Tacoma's other environmental protection plans?



Where am I in the watershed?

- The City will be conducting a participatory mapping exercise that will allow residents to comment on different areas throughout Tacoma, addressing the following questions:
  - Where are pollution or stormwater concerns on your street/in your neighborhood?
  - Are there any impacts to natural areas next to your home or business?
  - What do you value about your place in the watershed?
  - Where are flooding/overflow issues?
  - Where do we need more trees?

- The following functionalities will be built into the participatory map:
  - Name of sub-watersheds (and main receiving water).
  - Main water bodies and green spaces in each of 9 sub-watershed basins.
  - Descriptions of common water quality threats in each of the 9 sub-watershed basins.

MESSAGING FOR INTERNAL AUDIENCES:

How does the WMP address the City Council community priorities (Equity Index indicators)?

- The table below describes community priorities that we identified through brainstorming exercises with the Equity Toolkit Analysis team. These will be used as a basis for further conversations with City staff and partner organizations.

Livability Social Determinant Category	**Economy Social Determinant Category**	**Education Social Determinant Category**	**Accessibility Social Determinant Category**	**Environmental Health Indicators**
Nuisance/Neighborhood Quality Index	Employment Index	Highest Educational Attainment	Parks & Open Space	NOx- Diesel Emissions (Annual Tons/Km2)
Median Home Value for Owner Occupied Units	Unemployment Rate	*Choose an Indicator.*	Transportation Access	Ozone Concentration

Urban Tree Canopy	*Choose an Indicator.*	*Choose an Indicator.*	Road Condition	PM2.5 Concentration
Life Expectancy	*Choose an Indicator.*	*Choose an Indicator.*	*Choose an Indicator.*	Populations Near Heavy Traffic Roadways

Livability:

- Reduce nuisance due to flooding issues.
- Adding green infrastructure to neighborhoods could increase home values but also need to support green jobs and affordable housing to combat gentrification.
- Improve urban tree canopy by adding trees for stormwater management.
- Addressing homeless encampment garbage near streams and holding ponds helps keep neighborhoods and receiving waters cleaner. We are offering purple bags and temporary garbage service at encampments to collect and properly dispose of garbage.
- Crime: Getting communities involved greening their neighborhood through planting trees, building rain gardens, and other natural landscaping projects could help reduce the crime rate as well as improve stormwater quality.

Economy:

- Helping to make business districts more attractive with stormwater projects that include art/trees/green infrastructure could help businesses in this area and increase employment.
- Need to plan stormwater green infrastructure projects with parking and business customer impacts in mind.
- We can invest in MWBE contractors and consultants to design and build green infrastructure projects.

Education:

- Studies show that students do better or perform better if they live in or go to school in green environments.
- Teaching kids about clean water, stormwater, rain gardens, and impact of actions on water quality.
- Opportunities for planting rain gardens at schools get students more excited about science and builds interest in STEM fields within young age groups.

Accessibility

- Maintenance of Passive Open Space areas for access to “nearby nature” is paid for by stormwater rates.
- Road condition can be improved through permeable pavement street projects.
- Encouraging multi-modal transit reduces pollution in street runoff that is toxic to fish (e.g. tire chemicals).

Environmental Health

- Air quality is improved and the heat island effect is reduced where trees are planted as part of a stormwater management project or where trees are protected in passive open space properties illustrating the important co-benefits of stormwater management investments.

Goals and Objectives

Vision: Develop a PEP that engages the Tacoma community (including overburdened communities) for the WMP so that it reflects the goals, needs and priorities of Tacoma's most impacted community groups.		
Goal A	**Educate, empower, and energize the community members in Tacoma** to cultivate a shared understanding of stormwater and watersheds.	
	Objective 1:	Equip community members with a baseline level of knowledge of concepts and terms about stormwater, water quality and watersheds. Build awareness about what stormwater rates pay for.
	Objective 2:	Build awareness around community co-benefits of stormwater management and stormwater rate investments, the watershed planning process, and how they support community wellbeing, social justice, and environmental health.
	Objective 3:	Identify opportunities for community members to participate in building greener and more resilient neighborhoods through activities on their properties such as depave, rain gardens, downspout disconnects, planting trees, planting native plants, building healthy soils, and identifying potential projects for partnerships.
Goal B	**Gather community perspectives and feedback** on the biggest priorities for watershed health in various areas of the City to inform WMP development and guide decision-making.	
	Objective 1:	Reduce barriers to participation and use relevant, in-language messaging to meet different audiences across ages, industries, cultures, and locations.
	Objective 2:	Ensure multiple opportunities to provide input that are accessible and equitable to community members across demographic indicators such as gender, age, race, ethnicity, income, and geographic location.
	Objective 3:	Identify implementation partners for Phase Two to serve as trusted community messengers and provide specific feedback on priority actions located in their neighborhood.
Goal C	**Build community-wide support** for advancing stormwater management priorities and implementing the most effective stormwater actions and projects at the most important locations.	
	Objective 1:	Learn what types of actions and projects the community feels are most likely to succeed and things they would like to have a role in.
	Objective 2:	Build support for and identify new actions and projects to include in the WMP that help achieve community goals.
Goal D	**Clearly communicate the overall engagement process and existing community feedback gathered to date** to demonstrate the long-term, comprehensive engagement approach and **provide context for engaging later in the process.**	
	Objective 1:	Ensure the residents of Tacoma are aware of where and when public input is available and have access to information and resources to participate.
	Objective 2:	Be transparent about how community input is being used and how input will guide the WMP process.
Goal E	**Gather public participation regarding the Stormwater Management Program Plan development, update, and implementation**.	
	Objective 1	Communicate to a wider audience what the SWMP is and how people can be involved.
	Objective 2:	Educate community members on pollution reporting options.
	Objective 3:	Identify potential partners/allies to share information to their social networks about Tacoma's SWMP.

Public outreach

Key Engagement Themes:

- **Education & Awareness –** ensure the community has access to information and resources to participate and provide input.
- **Access & Transparency –** the community knows when and how they can participate in the stormwater management process.
- **Equity –** intentional efforts are taken to engage historically underrepresented communities in a meaningful way.
- **Support –** the community feels respected and heard.
- **Trust –** the community understands how their input and participation shapes the final product.
- **Build relationships –** for ongoing assistance with watershed goals/actions.

Anticipated Concerns:

- The COVID-19 pandemic has significantly altered our ability to interact with the public.
- Technology and accessibility will limit who is able to participate.
- Historic inequitable City policies and practices including redlining, underinvestment in public improvements and infrastructure in the South and Eastside, and the lack of broadly accessible engagement opportunities will influence who is willing to hear our message and participate in the process.
- There are many parallel City and County-led engagement efforts around environmental topics that compete for engagement attention and time this year.
- Many community members do not understand what we mean by “watershed management.”
- Many community members do not understand what stormwater utility rates are paying for and do not want to pay because they do not see the value (watershed planning is funded by stormwater utility rates).

Crosswalk of engagement themes and goals

Goal	Key Engagement Themes
Educate, empower, and energize the residents of Tacoma to cultivate a shared understanding of stormwater management.	**Access & Transparency:** The community knows when and how they can participate in the WMP process. **Education & Awareness:** Ensure the community has access to information and resources to participate and provide input. **Equity:** Intentional efforts are taken to engage historically underrepresented communities in a meaningful way.
Gather community preferences and feedback that is representative of the makeup of the City of Tacoma to inform WMP development and guide decision-making.	**Access & Transparency:** The community knows when and how they can participate in the WMP process. **Equity:** Intentional efforts are taken to engage historically underrepresented communities in a meaningful way. **Support:** The community feels respected and heard.
Build community-wide buy-in for the WMP process and implementation strategies.	**Equity:** Intentional efforts are taken to engage historically underrepresented communities in a meaningful way. **Support:** The community feels respected and heard. **Trust:** The community understands how their input and participation shapes the final product.
Clearly communicate the overall engagement process and results to date, to demonstrate the long term, comprehensive engagement approach and **provide context for engaging later in the process.**	**Access & Transparency:** The community knows when and how they can participate in the WMP process. **Support:** The community feels respected and heard. **Trust:** the community understands how their input and participation shapes the final product.
Gather public participation related to the Stormwater Management Program (SWMP) development and updates.	**Access & Transparency:** The community knows when and how they can participate in the SWMP process. **Education & Awareness:** Ensure the community has access to information and resources to participate and provide meaningful input. **Support:** The community feels respected and heard. **Trust:** The community understands how their input and participation shapes the final product.

Key Audiences and Partners

Tacoma Community Context

The City of Tacoma is a growing, thriving, and diverse city that is rising to meet the challenge of ensuring a sustainable, vibrant community for all its residents. The City hopes to engage residents of all backgrounds with relevant messaging and messengers. Specifically, the goal is participation across diverse socio-economic, geographic, occupational, racial, and ethnic backgrounds representative of demographics in Tacoma. We will check in throughout the project to examine our progress towards this goal and can adjust outreach strategies as needed to ensure that we are on track to meet it.

If the proposed outreach strategies do not result in these levels of responsiveness, the team will consult with community members to reassess strategies and identify additional outreach strategies and efforts needed to meet the desired response rates.

According to the U.S. Census Bureau[8], the City of Tacoma has an estimated population of approximately 217,834 persons in 2019. Other recent demographics[9] are summarized as follows, based on 2018 5-year estimates:

Age	
Under 5 years	5.8%
5-19 years	18.6%
20-44 years	39.1%
45-64 years	23.3%
65 and over	13%
Residents' Place of Birth	
U.S.	87.3%
Born outside the U.S.*	12.7%
• **Asia***	~46.4%
• **Europe***	~17.3%
• **Latin America***	~26.6%
• **Africa**	~5.8%
***Regardless of citizenship status**	
Housing Types	
Own	52.0%
Rent	48.0%

Race[10]	
White alone	63.7%
American Indian and Alaska Native	1.8%
Asian alone	6.2%
Black or African American alone	11.5%
Native Hawaiian and Other Pacific Islander	1.0%
Other race alone	5.3%
Two or more races	10.4%
Hispanic or Latino of any race[11]	12.8%

Languages Spoken	
English only	81.2%
Asian and Pacific Island languages	7.5%
Other Indo-European languages	3.4%
Spanish	6.9%
Other	1%

[8] The linked summary page is reflective of 2018 demographic information.
[9] The information in these tables reflects 2019 data taken from individual US Census Bureau tables.
[10] Race categories reflect US Census Bureau labels. Find more information about category definitions here. These categories add up to 99.9%, with the final 0.1% being attributed to the Census' rounding practices.
[11] The US Census Bureau denotes "Hispanic or Latino of any race" as a separate category, as people who identify as Hispanic or Latino are also counted under one of the other race categories. Feedback from members of Latinos Unidos South Sound from a June 2021 Climate Justice Plan community workshop noted that census data is likely an underestimation for Tacoma. This racial group is one of the youngest and fastest growing minority groups in Tacoma and more likely nearer to 20% of current population.

Tacoma Neighborhood Breakdown

	South End	***West End***	***Eastside-ENACT***	***South Tacoma***	***North End***	***Central***	***NE Tacoma***	***New Tacoma***
Population								
Total	39.75k	29.73k	28.87k	24.70k	24.54k	20.55k	16.85k	13.70k
Race[12]								
White	50.6%	73.5%	41.7%	50.9%	85.3%	60.6%	63.6%	58.7%
Hispanic	11.5%	6.6%	19.5%	11.9%	5.5%	10.8%	8.2%	13.4%
Black	10.4%	7.8%	12.0%	18.0%	1.6%	14.3%	5.8%	10.4%
Asian	14.3%	6.2%	13.7%	6.6%	3.3%	4.8%	14.0%	8.4%
Mixed	9.6%	5.0%	8.1%	9.9%	4.0%	7.7%	6.6%	7.5%
Other	3.6%	0.9%	5.0%	2.8%	0.3%	1.9%	1.9%	1.6%
Place of birth								
U.S.	79.8%	87.8%	77.9%	84.2%	93.9%	89.9%	81.5%	83.0%
Outside of U.S.	20.2%	12.2%	22.1%	15.8%	6.1%	10.1%	18.5%	17.0%
Asia	65.1%	39.0%	47.5%	38.1%	36.9%	34.8%	55.0%	33.5%
Europe	12.4%	39.4%	12.5%	20.2%	32.1%	16.1%	21.6%	9.3%
Latin America	17.9%	15.3%	37.5%	36.7%	30.9%	41.3%	19.1%	54.6%
Africa	3.1%	4.9%	1.5%	2.7%	0.0%	7.4%	2.7%	1.7%
Age								
Under 5	6.8%	5.0%	8.0%	7.8%	4.71%	7.9%	6.0%	2.6%
5-19	19.0%	14.4%	20.4%	16.4%	17.2%	16.7%	19.2%	9.4%
20-44	53.2%	30.0%	39.0%	42.7%	38.2%	39.4%	38.5%	52.1%
45-64	27.3%	27.7%	22.1%	23.1%	27.5%	24.7%	30.9%	24.4%
65+	12.3%	22.9%	10.5%	10.0%	12.4%	11.2%	12.3%	11.5%
Equity rating (as shown by the Tacoma Equity Map)								
Rating	Moderate to very low	Very high to high	Moderate to very low	Moderate to very low	Very high to high	High to very low	Very high to high (N side) to very low (S side)	Very low

[12] Several race categories were combined for brevity and clarity by the Statistical Atlas into mutually exclusive and exhaustive categories. They are defined as follows: **White:** non-Hispanic whites; **Hispanic:** Hispanics, excluding black and Asian Hispanics; **Black:** blacks, including Hispanic blacks; **Asian:** Asians, including Hispanic Asians; **Mixed:** non-Hispanic mixed race people; **Other:** American Indians and other groups not otherwise categorized. Though US Census does not recognize neighborhoods, the Statistical Atlas take Census demographic data and breaks it down by neighborhood and individual blocks. For more information on the Statistical Atlas and their data mapping methods, please visit their site here.

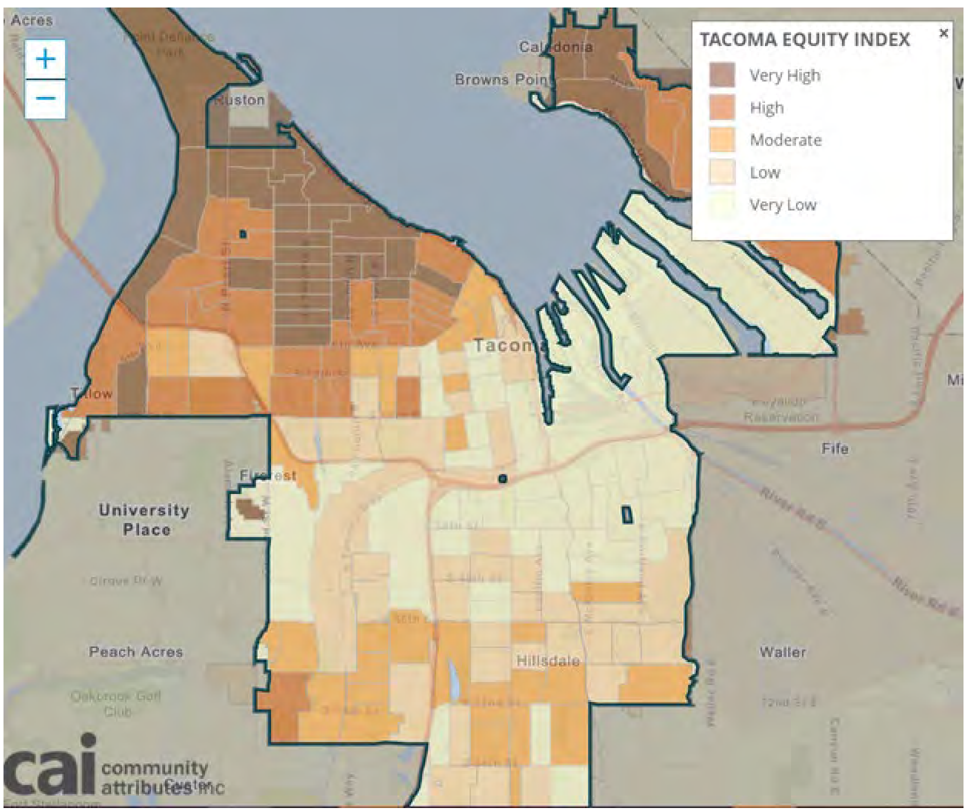
Language needs

Project materials and information may be provided in non-English languages. The project team will monitor the communities that we work with to determine whether a translation need is apparent.

Outreach collateral may be translated into any of the six most widely used languages in Tacoma: Spanish, Korean, Russian, Khmer, Tagalog and Vietnamese. Materials in other languages can be made available upon request, and the team may also choose to utilize auto translate services for the survey and other materials published online.

Equity Index Map

Below is a map that shows the Tacoma Equity Index based on the different census tracts. Using data from the US Census Bureau, the Tacoma Equity Index looks at 29 indicators in livability, accessibility, economy, education, and environmental health to determine what areas of Tacoma are less likely have access to adequate community services. Darker areas are areas that have more opportunity and lighter areas are those with less opportunity.



Key Audiences

The following list includes key audiences to engage regarding the watershed prioritization development process. This list will serve as a guide during outreach.

Levels of Engagement

1) Inform	2) Consult	3) Involve	4) Collaborate
Educate members of the group about the rationale for the project or decision; how it fits with City goals and policies; issues being considered; areas of choice or where input is needed.	Gather information and ask for feedback from groups to better inform the City's work on the project.	Work directly and consistently with groups to ensure their concerns are understood and considered in the City's planning process.	Create a partnership to work along with groups and give them meaningful ownership over developing and implementing the planning process or project.
Activities			
• Project website • Social Media • Emails/ newsletters/ mailings • Open houses/ community meetings • Presentations • Factsheets	• Online survey/ polls • Public comment	• Interactive workshops • Community forums	• Advisory committees • MOUs with community-based organizations

Internal Audiences

Audience & Description	Groups	Engagement Goal
City Leadership ***City leaders who make decisions that drive investment and policy***	• City Council • City Manager • ES Upper Management	**Consult** and update for decision-making. **Strategies**: Present status updates to Infrastructure, Planning and Sustainability (IPS) Council Subcommittee. IPS Subcommittee to recommend final plan approval by City Council through Council Resolution.
Interdisciplinary Core Team ***City staff who are responsible for programs that could benefit from watershed planning collaboration or provide valuable perspectives to the WMP***	• Department heads and staff, specifically: • ES Open Space Management • Critical Areas Preservation Ordinance and Permitting Regulations • GIS Data Analysis • Urban Forestry Program and Management Plan • Asset Management and Criticality Analysis	**Consult** and **collaborate** to gather feedback on potential strategies, align with priorities and processes, and identify opportunities for mutual support.

	• NPDES Phase I Permit Manager and Stormwater Manual Design Requirements • Long-range Planning • ES Environmental Compliance and Business Inspections • Storm System Operation and Maintenance • TPU- Wellhead Protection Program	**Strategies**: Workshops with key members (early 2021). Additional consultation of small groups throughout tool development.
Guides and Analysts ***City commission/committee members whose support and direction are important for community engagement, watershed strategy development, and implementation***	• Environmental Services Commission • Sustainable Tacoma Commission • Commission on Immigrant and Refugee Affairs • Mayor's Youth Commission of Tacoma • Tacoma Area Commission on Disabilities • Transportation Commission/Bicycle Pedestrian Tech Advisory Group	**Inform** and **involve,** as appropriate, to gather feedback on engagement opportunities and strategies. **Strategies**: Offer to present a monthly meeting agenda if commission members are interested.

External Audiences

Audience & Description	Groups	Engagement Goal
Governments	• Puyallup Tribe Fisheries • Puyallup Tribe Sustainability Work Group • Puyallup Tribe Land Use Planning • Muckleshoot Tribe Fisheries	**Consult** to gather feedback on potential strategies, align with priorities and processes, and receive expert advice and traditional place-based knowledges. **Strategies**: Initial group meeting followed by additional email/meeting correspondence on issues of tribal interest. Tribal Staff will determine whether to bring before their Tribal Council.
Advocates/Partners ***Very supportive of watershed action and willing to put in effort to support watershed protection and restoration efforts***	• 350 Tacoma • Sunrise Tacoma • First Creek Neighbors • Wapato Creek Neighbors • Leach Creek Neighbors • Swan Creek Cleanup Group	**Inform** and **consult** with to gather feedback in developing strategies and getting the word out on engagement opportunities.

	• Swan Creek Food Forest • Tahoma Audubon Society • Stewardship Partners • Stream Team Volunteers • Pet Waste Station Sponsors • Adopt a drain sponsors • Adopt a spot sponsors • LitterFree253 volunteers • Green Tacoma Day volunteers • Open Space Site Stewards • Tacoma CREATES Science Community Organizations	Strategies: Introductory email to invite to participate in online open house and survey. Follow-up option to sign up for regular e-newsletter check-ins throughout the process.
Community Groups and Critical Perspectives ***Groups frequently not reached during public processes but critical to reach***	• TPCHD East Tacoma Collaborative • TPCHD South End Community of Focus • Centro Latino • Latinos Unidos South Sound • VT Radio • Juan Hour Show (radio) • Hilltop Action Coalition • APCC • Korean Women's Association • Lincoln Business District • Black Collective • Tacoma Urban League • NAACP Education and Outreach • Black Star Farmers: Black and Indigenous protest farm • Black Women's Caucus of WA state, Tacoma Chapter • Commission on African American Affairs • Pierce Co. Community Engagement Task Force (Tamar Jackson) – quality of life, equity, neighborhood improvements (food, housing, employment) • Tacoma Housing Authority • Summer school students (Envirochallenger classes)	**Inform** and **consult** or **involve** and update for watershed WMP development and foster participation. Strategies: Ask to attend external stakeholder meetings and present a brief overview if they indicate interest. Follow up email to invite to workshop and participate in online open house and survey. Follow-up option to sign up for regular e-newsletter check-ins throughout the process.
Businesses and Property developers ***Business operations affected by stormwater management decisions***	• Businesses • Tacoma Chamber of Commerce • Tacoma Downtown Business Improvement District • Tacoma Downtown Alliance • Business Districts • Master Builders' Association • Metropolitan Development Council	**Inform** and **consult** to gather feedback. Strategies: Ask to attend external stakeholder meetings and present a brief overview if they indicate interest.

	• NW Eco Building Guild for business organizations	Follow-up email to invite to participate in online open house and survey. Follow-up option to sign up for regular e-newsletter check-ins throughout the process.
Implementation Partners ***Conduct operations that affect the success of public engagement and watershed strategy implementation***	• Port of Tacoma • UWT/UPS/TCC/Bates Tech/Clover Park Tech • Pierce County Planning Staff • WA Stormwater Center Staff (help with getting out communications to other municipalities) • Puyallup River Watershed Council • Puyallup White River LIO Ecosystem Recovery Plan work group • Chamber Clover Watershed Council • Neighboring Jurisdictions Stormwater Staff/NPDES Phase II South Sound Coordinators Group • Pierce Conservation District Water Quality Program • Puyallup Watershed Initiative • Citizens for a Healthy Bay • Tacoma Pierce County Health Department • Metro Parks • Tacoma Public Schools • Environmental Services EnviroChallenger Classroom Educators (Internal contacts with schools) • Tacoma Public Utility Environmental Educators (Internal contacts with schools) • Washington Environmental Council (Orcas Love Rain Gardens Program Partner) • The Nature Conservancy (Residential Stormwater Community of Interest Partner) • Trust for Public Lands (Green Schoolyards Program Partner) • Puyallup Tribe Sustainability Group (help with getting out communications to tribal members) • Regulatory agencies: WA Department of Ecology, WA Department of Fish and Wildlife, EPA, etc.	**Inform** and **involve** in identifying new strategies. **Strategies**: Introductory email to invite to workshop and participate in online open house and survey. Regularly attend external stakeholder meetings for Watershed Councils and Phase II South Sound Coordinators group and present during partner updates. Follow-up option to sign up for regular e-newsletter check-ins throughout the process.

General Public ***Watershed implementation affects day-to-day lives***	• ES Customers • Neighborhood Councils • Safe Streets leaders • Individual residents • 311 Stormwater Complaint Callers • Healthy Homes Healthy Neighborhoods Contacts	**Inform** throughout the process and **consult** on strategies and opportunities. **Strategies:** Introductory email to invite to participate in online open house and survey. Ask Neighborhood Councils and Safe Streets groups to attend their external stakeholder meetings and present a brief overview, if they indicate interest. Follow-up option to sign up for regular e-newsletter check-ins throughout the process.

Puyallup river watershed council and the chambers clover watershed council

The Puyallup River and Chambers Clove watershed councils are standing organizations of community members facilitated by Pierce County Watershed Planning staff. These councils have been involved with the development of Pierce County basin plans and have action plans and annual work plans prioritizing actions in support of watershed health in WRIA 10 and WRIA 12 drainage basins.

Each watershed council has its own mission statement:

> *The mission of the Chambers-Clover Creek Watershed Council is to promote the protection and enhancement of the Chambers-Clover Creek Watershed. The council is committed to improving the health of the watershed by working to improve fish habitat, water quality and foster a sense of stewardship among watershed residents.*

> *The Puyallup River Watershed Council's mission is to restore, protect and enhance the environmental, economic and cultural health of our watershed, from Mount Rainier to Commencement Bay. We are citizens and representatives of businesses, governments and other groups collaborating to achieve clean water, healthy habitats and thriving communities.*

The watershed councils engage with interested community members through public education and outreach activities (such as Salmon Homecoming Celebration and Annual Watershed Forums) in addition to email listservs, Facebook, and quarterly newsletters. They also fund watershed small grant programs to support community engagement and volunteer activities led by community members.

Phase One: Key Engagement Strategies

Successful engagement requires tailored approaches to meet the variety of needs and priorities of key audiences and partners. We acknowledge that individuals and organizations within the key audience groups will vary in their understanding of watersheds, stormwater and water quality, and their level of support for planning. To that end, we will strategically use several core engagement strategies to connect with audiences around their priorities and concerns by meeting audiences where they are at.

Our approach is designed to engage a representation of the public across different audiences by reaching out to groups who are critical to implementing watershed and stormwater management strategies, will be most affected by watershed management actions, and/or are typically harder-to-reach populations.

Virtual and Remote Engagement

During the COVID-19 pandemic, virtual and remote engagement will be the primary means of engaging the broader community. Below are proposed strategies for virtual and remote engagement to reach key audiences and partners.

Community workshops

City staff will work to recruit community members for two virtual workshops. Both workshops will aim to include representatives from organizations that are listed in the "Implementation Partners", "Guides and Analysts" (City Commissioners) audience groups, and representatives from historically underrepresented and overburdened communities that are listed in the "Community Groups and Critical Perspectives" audience group.

Cascadia will design and facilitate two 1-2-hour community workshops focused on providing background about Tacoma's watersheds and reviewing community feedback (as previously submitted to the City) about community priorities in Tacoma. Depending on participant availability, we may offer two iterations of each meeting with different time options for those with alternative schedules. These workshops will ask for additional input on location-specific watershed concerns, values, and priorities and the plan title. Workshop participants from the Community Groups and Critical Perspectives key audiences may be reimbursed with gift cards for their participation per the City gift card reimbursement policy and procedures, once they become available.

Anticipated work products include:

- Workshop agendas and planning documents
- Workshop materials such as discussion guides, presentations, etc.
    - Provided translated materials, if necessary
- Two virtually hosted public workshops for community members
- Brief summaries of each workshop, with a focus on key input to the WMP
- Send direct, physical materials to key stakeholder groups, translated if necessary

Community workshops provide an opportunity to specifically gather critical voices to participate in the engagement process. Creating a space for representatives of key audiences who have not typically engaged in the WMP process ensures that we are hearing from all members of the community. Community workshops are a great method to build meaningful, long-term relationships around watershed planning and stormwater management decisions.

Potential Communication tools include:

- Direct email invitation
- Environews listserv
- Utility bill inserts
- Watershed Council distribution lists
- Handouts to restoration site stewards or other stewardship volunteer events

External stakeholder meetings

We will collaborate with organizers of existing community events to inform residents of the WMP process, project goals, and upcoming opportunities to take part in the WMP process. By working with other City departments, City commissions, neighborhood councils, and advocacy and community groups, we can reach their networks to create targeted opportunities to participate in the WMP process.

Essential activities include:

- City staff will request if there is interest for a watershed management presentation at community meetings and if so, provide a brief overview of planning efforts and direct them to the online open house and survey. Additionally, the Community Groups and Critical Perspectives audience will also be invited to attend the second workshop.

Key audiences for this effort will include:

- **Businesses and Property developers whose** *operations are affected by stormwater management decisions, as recommended by the City Community and Economic Development Department.*
- **Guides and Analysts –**City commissions that indicate interest.
- **Community Groups and Critical Perspectives –** Residents that indicate interest.
- **Implementation Partners –** Watershed Councils and Phase II NPDES Permit Coordinators.
- **General Public –** Neighborhood Councils, Safe Streets Groups.

Online open house & survey

The online open house is a digital alternative to an in-person event to gather community input. The online open house platform will provide the opportunity to maintain a regularly updated platform for all to:

- Learn about the current progress of the WMP,
- Understand how each of the City's programs contribute to environmental protection in Tacoma,
- Engage with project materials/learn about opportunities for community involvement, and
- Provide feedback.

An online format also offers the opportunity to integrate into current **webpages** and increased accessibility and flexibility, as participants can engage over a longer time period.

Components for implementation of an online open house and one survey will primarily include:

- Maintaining the **Watershed Planning - City of Tacoma** website to provide up to date information on WMP status and project materials.
    - Develop translated materials of site contents.
    - Link to online open house and survey.
    - Link to comment map.
- Developing online survey to gather community feedback on draft WMP priorities.
- Developing online open house using Wix.

Additional opportunities, as budget allows, to provide the broader Tacoma community opportunities to provide feedback and engage during the WMP project could also include:

- Hosting an open house for members of the public to speak with project staff to learn about the project.
- Holding one-on-one phone meetings or conference calls and/or support presentations and focus groups with key staff to do deeper dives into strategies and measures.
- Sending direct, physical materials to key stakeholder groups, translated if necessary.
- Using alt-text for all online images.
- Ensuring information is available both online and through non-digital avenues, such as mobile displays, handouts, and posters.

To host the Online Open House, we suggest using Wix. Wix is an easily customizable website building platform that supports embedded SurveyMonkey surveys as well as its own polling application, has multilingual capabilities, and is accessible via mobile devices.

Communication tools include:

- Direct email invitation
- Environews listserv
- Utility bill inserts
- Watershed Council distribution lists
- Handouts to restoration site stewards or at other stewardship volunteer events

Outreach collateral

Cascadia will develop key communications and outreach collateral with project messaging to support the wide variety of engagement strategies and key audiences. The following materials will be provided to anyone participating in outreach and will all be available online. The graphics for these materials will include visuals that represent and speak to racially and ethnically diverse community members.

Notification options include:

- Modify existing factsheets to create a two-page factsheet about the WMP goals, planning process, and ways to participate in the process.
- PowerPoint for community events and briefings.

- One-page talking points hand out.
- Half-page handout for distribution (via email or hard copy at open space restoration events)
- Project website kept up to date on latest events and activities.
- Create an e-newsletter template for City staff to populate with content to keep interested parties up to date on new participation opportunities.
- Project inbox to directly answer questions.
- Create an online advertisement.
- Include translations text blocks in identified languages on all materials.

Roles

Cascadia	City of Tacoma
• Prepare for, attend, and present at 2 public workshops. Include facilitation training for staff if needed for break-out rooms. • Prepare and publish an online open house. • Develop outreach collateral materials. • Develop and deploy 1 survey. • Provide on-call engagement advice and support, particularly related to equitable engagement strategies. • Summarize data received in the survey and the workshops into a report which will guide the prioritization tool. • Manage overall project timeline and provide information needed to keep Public Engagement WMP on track.	• Review all public engagement materials. • Attend 2 public workshops. • Update City websites with upcoming engagement opportunities. • Prepare for, attend, and present at 2 watershed council meetings. • Prepare for, present and take notes at external stakeholder meetings. • Promote through ES and City communications channels. • Serve as the point of contact.

Budget and Timeline

Budget

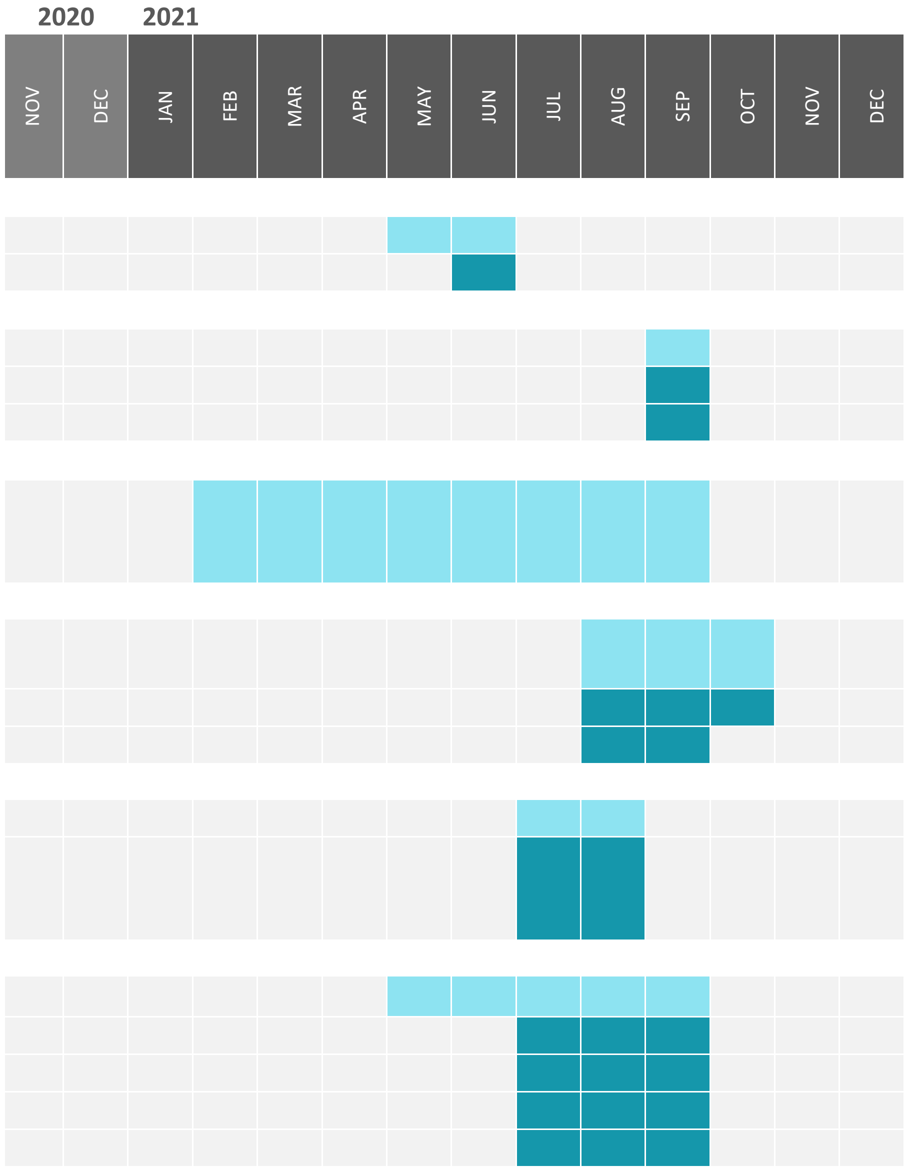
The table below describes how the public engagement budget will be spent and key assumptions about the responsibilities of City staff and the consultant team.

Engagement Approach	Frequency	Budget
Public Engagement WMP development	1	$1,480
Online survey, online open house, and online/printed outreach collateral	1 *Consultant team to develop an online survey and open house, a two-page factsheet, a one-page talking points handout, a half-page handout for restoration events, a utility bill insert, a newsletter template, a PowerPoint template, and draft email template(s) for community outreach.*	$20,290
Events and external stakeholder meetings	TBD *City leads planning and implementation of all briefings.*	*Negligible*
Public workshops	1 *Consultant team leads development of workshop agendas, facilitation of 2 virtual meetings (including planning, logistics, note-taking, and follow-up), and a summary of feedback received through the workshops.*	$6,944
	***Total**	$28,714

*** Please note that the total budget for consultant team engagement support is $33,850. Budget not included above is allocated to support project team coordination.**

Timeline

✦ denotes an internal presentation.
✧ denotes an external meeting or presentation.



Public Engagement Plan
Public Engagement Plan

Community workshops
1st community workshop
2nd community workshop

Events and external stakeholder meetings (ongoing)

Online open house and survey
Online open house
Survey

Outreach collateral
Factsheet, handouts, utility bill insert, and newsletter/PPT templates.

Engagement Support
Website updates
Email updates
Newsletters
Social media

Phase Two: Key Engagement Strategies

Phase Two of the WMP process will focus on prioritizing projects throughout the city. Public engagement efforts will focus on strategies and tactics to support neighborhood-specific outreach during options analysis and each project will complete the template as seen in Appendix B.

Appendix A. Community Feedback Survey Data

Find existing data from community feedback opportunities here.

Appendix B. Phase Two Public Involvement Plan Template

BACKGROUND

This section is intended to provide a 3-4 paragraph description of the project, including the project location and goals, project phase, and associated timeline.

KEY MESSAGES

Complete this section with key messages related to the overall Watershed Management Planning process and project specifics. This section is intended to help ensure that everyone on the project team and outside of the project team use consistent messaging when communicating about the project.

PROJECT TEAM

Add all key members of the project team. Examples are provided below.

Project Manager:
Communications Lead:

Outreach Support

Additional City Staff:

<table>
<tr><td colspan="2">PUBLIC OUTREACH
Complete this section with the public engagement objectives for each of the three project phases: Options Analysis; Design; and Construction. Examples for public outreach objectives by phase are listed below. It is also important to identify and list anticipated concerns for each project phase. Examples are also listed below.</td></tr>
<tr><td>Objectives</td><td>Options Analysis

Notify community members and nearby neighbors of project and solicit feedback
Provide multiple opportunities for community input on design options
Share regular updates about project at key project milestones
Communicate equitably and gather feedback from all project stakeholders

Design

Involve adjacent businesses, area residents, members of the community and other affected stakeholders to inform the planning/design process, and reduce impacts as much as is reasonable and feasible
Engage the nearby neighborhood and surrounding communities by maintaining communication channels, listening, and responding quickly to public questions and concerns
Communicate equitably and gather feedback from all project stakeholders

Construction

Notify community members and nearby stakeholders of project and solicit pre-construction feedback
Inform members of the community, area residents, nearby businesses and other affected stakeholders of upcoming construction project timeline and expected impacts
Engage the surrounding neighborhoods and communities by maintaining open and accessible communication channels, listening and responding to questions and concerns, and providing multiple avenues for input
</td></tr>
<tr><td>Anticipated Concerns</td><td>Options Analysis

Lack of support for options and/or overall lack of support for project
Overall project delays and expense

Design

Quality of life impacts: Changes to local community character, neighborhood development/gentrification
Project delays and expense

Construction

Project delays and expense
</td></tr>
</table>

Media & Stakeholders	• **Stakeholders:** *Examples could include: Adjacent businesses, residents, and property owners/managers in vicinity of project* • **Media:** *List local media sources here.*
Outreach Budget and Assumptions	**Budget:** $200,000 **Budget Assumptions:** • Outreach budget for options analysis, design, and construction • Includes direct expenses for printing materials, renting event venues, etc. • Can include budget for subconsultants (as needed)
Public Project Contact	**EMAIL:**
	PHONE:

BUDGET

Total Funds **$**

Funding Programs

PLANNED MAJOR OUTREACH ACTIVITIES

Please complete this table with a detailed list of public engagement outreach activities and include when those activities will take place and the justification for those activities. Please refer to Engagement Strategies Phase One on p. X for a list of potential activities.

When	What	Why	Complete
			☐
			☐

SCHEDULE & MAJOR MILESTONES

Options Analysis
Timeline Details

Design
Timeline Details

Construction
Timeline Details

Webpage: *Add project website here.*

BACKGROUND

Add project background here.

PROJECT BENEFITS

Add project benefits here.

Insert project area map here.

TABLE 2: STAKEHOLDER CHECKLIST

Incorporated? (Y or N)	**Audiences to Consider**	**Examples** (full list will be developed over project life)
	Adjacent property owners and tenants, including businesses and residents	
	Typical users of project area	
	District Councils	
	Community groups and neighborhood organizations	
	Cultural and religious organizations	
	Tribes	
	Chambers of commerce and local business organizations	
	City of Tacoma Departments	
	Other agencies	
	Adjacent municipalities	
	Universities and institutions	
	Public facilities	
	Schools and childcare facilities	
	Hospitals/Medical Facilities	
	Social service organizations and facilities (including those serving people with disabilities)	
	CBOs	
	City of Tacoma Advisory Boards	
	Event Centers	
	Media Outlets	
	Populations that may need targeted outreach to due to cultural barriers, language differences, etc.	

GUIDING QUESTIONS

Please provide responses to the below questions.

1. **What are the goals of the project?**

2. **What racial or social inequities currently exist in the project area?**

3. **How do the project goals address or consider the existing racial or social inequities? How will the project increase or decrease racial or social equity?**

4. **How will you address the project's impacts (including unintended consequences) on racial or social equity?**

DEMOGRAPHIC DATA AND LANGUAGE NEEDS

Projects are required to provide materials and information in non-English languages if 5% or more of the population in that project area speaks a given language. For any project, materials in other languages are available upon request.

TRANSLATIONS THRESHOLD

2010 US Census Bureau Language Map data

Census Tract #	%Speak Spanish	% Speak Vietnamese	% Speak Russian	% Speak African Languages	% Speak Chinese	% Speak Korean

2010 - 2014 American Community Survey 5 Year Average provided by the United States Census Bureau

Census Tract #	Total Population	% Speak Spanish	% Speak Vietnamese	% Speak Russian	% Speak African Languages	% Speak Chinese	% Speak Korean	% English less than very well	% Other Languages Spoken

2010 US Census Bureau Language Map

Recommendations:

- *Provide recommendations here based on census data.*

INCLUSIVE ENGAGEMENT ELEMENTS

Examples are provided below.

Events

- The project team will coordinate with other City projects, performing public outreach in the area to share project information at existing outreach events and outlets.
- The project team will share project information with the community at local events where people in the area are already gathering (i.e. festivals, drop-ins at coffee shops, pop-ups, etc.) Include multi-lingual interpretation upon request.
- The project team will host in-person walk and talk events, along with one online survey to include stakeholders with limited availability/access to attend in-person events, respectively

Mailings

- Include translated text on mailings
- Send translated mailings and ensure they reach populations of those speaking languages other than English

Web

- Include all translated materials on project webpage
- Web content will be formatted to work with popular screen readers for blind audiences
- Project webpage will contain translated text. Additional project materials in other languages can be provided upon request.

Print Materials

- Easy to understand graphics and written materials will be created to promote accessibility for all audiences

Construction outreach

- Partner with Community Based Organizations, schools, healthcare facilities, organizations and housing developments within the neighborhood to help share information with the community.

APPENDIX B: OUTREACH COLLATERAL

2-Pager (front and back)

GET INVOLVED!

We want to hear your priorities and concerns when it comes to stormwater issues in Tacoma. Your input will help protect clean water and increase healthy green spaces where they are needed most in Tacoma.

ATTEND A COMMUNITY WORKSHOP

Tell us about the stormwater and watershed issues you notice in your neighborhood. Sign up here: TacomaUrbanWatersheds.com/get-involved-1

TAKE OUR SURVEY

Share which stormwater actions are important to you at: TacomaUrbanWatersheds.com/survey

LEARN MORE

Learn more about potential stormwater solutions here: TacomaUrbanWatersheds.com

Help shape Tacoma's future

WATERSHED PLAN PHASE 1
April 2020 through December 2021

- Community Workshops
- Online Survey & Virtual Open House
- Meetings with Community Groups

SEP OCT NOV DEC

TACOMA'S WATERSHED MANAGEMENT GOALS

IDENTIFY
Identify Tacoma's priority streams, lakes, and shorelines that need protection from stormwater runoff.

INCORPORATE
Incorporate information about neighborhood priorities.

PARTNER
Partner with neighborhoods to take effective stormwater actions where they are most needed.

Contact Us: Shauna Hansen
SHansen2@cityoftacoma.org
www.cityoftacoma.org/healthywatersheds
/TacomaES
@tacomaenviroservices

1-Pager (English and Spanish)

HEALTHY WATERSHEDS MAKE HEALTHY NEIGHBORHOODS

Partnering on stormwater management in Tacoma

GREEN SPACE • REDUCED FLOODING • CLEAN WATER • CLIMATE RESILIENCE • HEALTHY HABITATS

As Tacoma faces the challenges of responding to climate change and achieving equitable outcomes for all, what we do with stormwater can make a difference for our health, safety, quality of life, environment, and our future.

Tacoma's Environmental Services Department is creating a Watershed Management Plan to identify and implement the most effective stormwater actions to protect our waterways, improve our neighborhoods, and provide healthy green spaces where they are needed most in Tacoma.

STORMWATER

Rainwater travels over roofs, lawns, driveways and streets – washing pollutants like litter, pet waste, yard chemicals, car oil and tire dust into local streams, lakes or the Puget Sound.

GET INVOLVED!

We want to hear your priorities and concerns when it comes to stormwater issues in Tacoma. Your input will help protect clean water and increase healthy green spaces where they are needed most in Tacoma.

ATTEND A COMMUNITY WORKSHOP

Tell us about the stormwater and watershed issues you notice in your neighborhood. Sign up here: TacomaUrbanWatersheds.com/get-involved-1

TAKE OUR SURVEY

Share which stormwater actions are important to you at: TacomaUrbanWatersheds.com/survey

LEARN MORE

Learn more about potential stormwater solutions here: TacomaUrbanWatersheds.com

Contact Us: Shauna Hansen
SHansen2@cityoftacoma.org

www.cityoftacoma.org/healthywatersheds

/TacomaES
@tacomaenviroservices

LAS CUENCAS HIDROGRAFICAS SALUDABLES HACEN VECINDARIOS SALUDABLES

Colaborando para la gestión de aguas pluviales en Tacoma

ESPACIOS VERDES • REDUCCIÓN DE INUNDACIONES • AGUA LIMPIA
RESILIENCIA CLIMÁTICA • HABITATS SALUDABLES

A medida que Tacoma se enfrenta a los desafíos de responder al cambio climático y de lograr resultados equitativos para todos, lo que hacemos con las aguas pluviales puede hacer una diferencia para nuestra salud, seguridad, calidad de la vida, el medio ambiente, y nuestro futuro.

El Departamento de Servicios Ambientales de Tacoma está creando un Plan de Manejo de Cuencas Hidrográficas para identificar e implementar las acciones de aguas pluviales más efectivas para proteger nuestras vías fluviales, mejorar nuestros vecindarios, y proporcionar espacios verdes saludables donde más se necesitan en Tacoma.

AGUAS PLUVIALES

El agua de lluvia viaja sobre techos, jardines, cocheras y calles – lavando contaminantes como basura, residuos de mascotas, productos químicos de jardín, aceite de automóvil, y polvo de neumáticos en arroyos locales, lagos o el Puget Sound.

En Tacoma, SI TOCA EL SUELO, TOCA AL SOUND

¡INVOLÚCRATE!

Queremos escuchar sus prioridades y preocupaciones de los problemas de aguas pluviales en Tacoma. Su aporte ayudara proteger el agua limpia y aumentar la salud de espacios verdes donde son los más necesarios en Tacoma.

ASISTA A UN TALLER COMUNITARIO

Cuéntanos sobre los problemas de aguas pluviales y cuencas hidrográficas que tienes en su vecindario. Regístrate aquí: TacomaUrbanWatersheds.com/get-involved-1

TOMA NUESTRA ENCUESTRA

Comparta qué acciones de aguas pluviales son importantes para usted en: TacomaUrbanWatersheds.com/survey

APRENDA MÁS

Aprenda más sobre las soluciones potenciales de aguas pluviales aquí: TacomaUrbanWatersheds.com

Contáctenos: Shauna Hansen SHansen2@cityoftacoma.org | www.cityoftacoma.org/healthywatersheds | /TacomaES @tacomaenviroservices

Postcard Mailer (front and back)

Utility Bill Insert (front and back)

Promotional Language Templates

E-newsletter:

We want to hear from you! During September there are a couple of different ways for community members in Tacoma to contribute to the Urban Watershed Management Plan developed by Tacoma's Environmental Services Department. Their mission is to support healthy neighborhoods and a thriving Puget Sound and they are currently developing Tacoma's first Urban Watershed Management Plan to help prioritize stormwater solutions to protect our streams, wetlands, lakes, and shoreline habitats from pollutants carried in stormwater and they need your input! When rainwater hits hard surfaces like roofs, sidewalks, driveways, and parking lots, it becomes stormwater runoff and washes pollutants like litter, pet waste, and car oil into our local waterways and Puget Sound. So in Tacoma: If it Hits the Ground, it Hits the Sound.

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Visit www.Tacomaurbanwatersheds.com to learn more, complete the survey and register for the workshops and please tell your neighbors!

Tacoma Healthy Watersheds Virtual Community Workshop #1
Date: Saturday Sept 25th, 1-2:30 pm
Registration link:
https://us02web.zoom.us/meeting/register/tZwrcu-rrz4sGtx3--9HjskF1fsGZyQtjkOD

Tacoma Healthy Watersheds Virtual Community Workshop #2
Date: Tuesday Sept 28th, 5-6:30 pm
Registration link:
https://us02web.zoom.us/meeting/register/tZwocuChrTwtH9K984qLdO5sFs4433F-VMpU

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Learn more and take the healthy watersheds neighborhood survey at www.Tacomaurbanwatersheds.com!

Post 2:

Help us meet the needs in your neighborhood while contributing to the City's new Urban Watershed Plan. How should the City prioritize stormwater solutions to build community health and economic recovery while protecting Tacoma's most important streams, wetlands, lakes and shoreline habitats from pollutants carried in stormwater? We want to hear from you!
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Post 3:

We want to hear from you! Improve your neighborhood and guide which stormwater investments Tacoma over the next 5-10 years. Tacoma's new Urban Watershed Plan will keep our local waterways clean and healthy and benefit your block at the same time!
There's still time to complete the watershed neighborhood survey between now and Oct. 15 or register to participate in a virtual community workshop on Saturday Sept. 25 or Tuesday Sept. 28 at www.Tacomaurbanwatersheds.com

Instagram:

Post 1: (IMAGE  **)**

Healthy Watersheds = Healthy Neighborhoods

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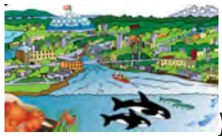
Post 2: (IMAGE  **)**

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#Tacomaurbanwatersheds

Post 3: (IMAGE  **)**

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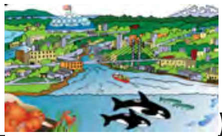
Post 1: (IMAGE )

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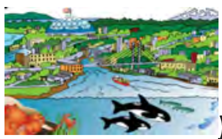
Post 2: (IMAGE )

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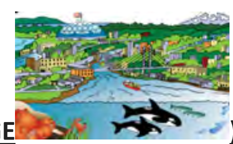
Post 3: (IMAGE )

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Give your input and receive $40 for your time in attending the workshop.

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#Tacomaurbanwatersheds

APPENDIX C: STAKEHOLDER INTERVIEW AND DISCUSSION NOTES

Puyallup Tribe Fisheries Staff - Oct. 5, 2020

- Is watershed prioritization tool required for NPDES Phase I Permit compliance?
    - No, but we plan to use the tool to be proactive in where we are putting in structural stormwater controls like street sweeping, pipe cleaning, source control activities and stormwater treatment retrofits.
- What is the tool based on?
    - The Nature Conservancy Puget Sound pollution hot spot mapping tool, but we will be adding in Tacoma specific data based on local stormwater outfall monitoring data. Could use Puyallup Tribe Shellfish department data or Fisheries department data. Just let them know where we need data, and they can sort through and give us what they have.
- Tribal Fisheries staff and Tribal Council are also very concerned about sanitary sewer overflows that occur during big storm events. Can the watershed model address SSOs?
    - Maybe could address in the Wastewater Comprehensive Planning?
- If the prioritization tool looks at prioritizing business inspections on tribal properties, we will coordinate with joint inspections with tribal staff – often have gotten positive compliance with many businesses without having to enforce.
- In terms of other tribal groups that might be interested stakeholders in the watershed plan development: Tribal Fisheries Commission members and Tribal Fishermen have a lot of interest in water quality. Periodic membership meetings – we could do a fact sheet to distribute to their membership or survey to ask questions.
- Tribal Fisheries staff work focuses on water quality in Commencement Bay and Puget Sound nearshore areas. Mason Gulch and Puget Creek have limited benefit to fisheries due to amount of development. So many degraded streams in Tacoma – not of habitat benefit.
- Puyallup Tribe has helped out with development of many basin plans and modeling done by Pierce County.
- Curious if the prioritization model results will align with what Tribal experience has shown are the priority needs throughout the watershed.
- Recommend we coordinate with South Puget Sound Salmon Enhancement Grant projects or planning efforts where we can.
- Tribe is also dealing with a lot of encampment cleanups, mostly reactionary. Hard to prevent new encampments developing. Mentioned City purple bag pilot program.
- Suggest we continue to meet during watershed plan development when we hit milestones for feedback and we will try to stay in touch every few months.

Puyallup Tribe Sustainability Group - Feb. 23, 2021

- Tribe environmental goals are closely tied to practicing their treaty rights and teaching their children. Try to connect sustainability communications and messaging in the tribal newsletter with tribal teachings to connect with tribal members.
- First Creek is a tribal council priority area – clean-up from homeless encampments
- Watershed locations have tribal names – could watersheds/waterbody signage reflect tribal names?

- Would like to include tribal youth in events and activities to be training up as future stewards of the watershed
- Currently focused on Styrofoam ban, electrifying tribal fleet vehicles, Earth Day cleanup events to "give back to our Mother" on Earth Day. Also interested in organizing habitat restoration plantings on tribal properties (working with Tribal Fisheries staff to identify locations), but concerned about safety of young people participating if may be drug paraphernalia, human waste, or unsafe persons present on site. Potential cleanup sites include Swan Creek Park, Canoe Landing Site, Ceremonial Grounds to get ready for "First Fish" ceremony, Tribal Cultural Center.
- If there are events that the City would like tribal members to participate in, we could send the invite to the Tribal Sustainability email.
- Importance and challenges of taking care of the land and water in Tacoma – committed to it: if it gets ruined by pollution, tribal members don't have the option to leave – if they move off reservation, they don't receive services. Already being priced out of properties within reservation boundaries.

West End Neighborhood Council – Mar.17, 2021

1) What's your favorite thing about your watershed?
   - Wildlife
   - Titlow Park
2) What are some needs or challenges where you live in the watershed?
   - Weed killer used on planter strip
   - Too much litter
   - Street runoff from vehicles
   - Not enough waste collection receptacles
   - Dog waste
   - Leaky cars
   - Need more holding ponds
   - Lots of new apartments

Chambers Clover Watershed Council – May 19, 2021

1) How does Tacoma watershed and stormwater planning tie into CCWC goals and priorities?
   - Pointed out that they are very interested in Low Impact development as part of strategy 3 even more than end of pipe solutions – so we should probably call GSI and source control actions out separately in our priority actions list.
   - Priorities for this watershed are salmon habitat, water quantity, streamflow support. Favor projects that support recharge. Hard to have fish if there is not enough water.
   - Consider hiring a full-time maintenance crew to care for project fish ladders, make sure fish blockages like downed tree limbs are moved, evaluate scouring if it looks like there is too much runoff going in during storm events? Who is there to maintain restoration projects once they have been built? Also what if encampment is destroying plants, fires, etc.
   - Asked about a hotline to call if neighbors on stream see anything to report. As part of our outreach, we should probably let people know when to call Tacoma First 311 with watershed issues and what types of receiving water issues we want to know about. Similar to water pollution hotline guidance. CCWC offered to publish our hotline on their website.

- Another concern is existing development that was built prior to NPDES permit regulations. Both with water quality and quantity control are substandard. Should focus projects in these older existing developments.
- CCWC ultimate goal – no more untreated stormwater released into receiving waters.

2) What related projects and initiatives are you working on in/near Tacoma? How can our watershed plan support your work?
   - Restoration Priorities – Wapato lake, Leach Creek, Puget Creek, Titlow Estuary, Nearshore habitat up to Point Defiance. Nearshore habitat is for the whole watershed and they are using Point Defiance as an example. Especially in regards to roads and rails removal: get those opened up and get estuary functioning on some of those. Example: Titlow Lagoon.
   - Monitoring priorities – This is for areas that generally look pretty good habitat-wise but might be impacted by water quality and sedimentation due to stormwater e.g. Snake Lake.
3) How do you want to have more ongoing input during Tacoma's plan development? During action implementation?
   - The council members would like to be updated and participate in:
     i. Advertise/participate in stakeholder workshops and online watershed priorities survey (Summer 2021)
     ii. Review beta version of Watershed Prioritization Model (Summer 2022)
     iii. Review draft Watershed Priority Action List (Winter 2023)
   - Also potential updates monthly during partner updates.
4) Additional thoughts: Sometimes in the urban areas, it's hard to know which waterbody you are near, so it's important to show people which watershed they are contributing to.

Puyallup River Watershed Council – May 27, 2021

1) How does Tacoma watershed and stormwater planning tie into CCWC goals and priorities?
   - How much water is needed for native fish populations. Home in Tacoma project going on and increase the density of middle housing options in single family home neighborhoods. Increased demand on water going to drinking water vs. supporting stream flows. Pierce County is approving water injections into aquifers to support stream flows? How are we going to protect groundwater quality from stormwater pollutants? Where does this water come from? Health Department regulates the Tacoma groundwater protection district – groundwater quality is a concern. At the same time how are you are going to preserve healthy Puget Sound for native fish and wildlife populations?
     i. Watershed plan will identify key areas in the city where protecting and preserving natural areas.
     ii. Watershed plan will identify where in the city to do more stormwater infiltration (including pretreatment) to protect and enhance groundwater supplies. For example, we are currently doing a feasibility study for potential regional infiltration facilities in the south Tacoma channel area (would support Flett creek flows)
     iii. While our plan is mainly looking at stormwater management solutions, some of those solutions will include protecting/enhancing critical area habitat.
   - Pierce Conservation District Strategic Plan – advocates for land use & development tie in with watershed planning. Also, PCD promotes different green infrastructure related programs like "Lawns to lettuce", edible plants in rain gardens, community gardens – way to convert

pavement to green infrastructure. Highly recommends multi-benefit approaches that looks at what is important to the community (maybe more important to them/make a better connection with them than stormwater management). Their Harvest Pierce Co. program did a GIS analysis of 400 city vacant properties to identify good ones for new community gardens, but having trouble move forward on it – he will send us that list of properties.

- Additional efforts sponsored by PRWC: Ecosystem Recovery Plan team is planning a Watershed Gathering for September 2021 – we should participate. Salmon Homecoming (may be virtual again this year – Oct .2 save the date.) Puyallup Watershed Symposium will be virtual again this year in December.
- Sumner is just starting their watershed planning efforts, so they are interested in what we are doing.

2) How do you want to have more ongoing input during Tacoma's plan development? During action implementation?

- The council members would like to be updated and participate in:
  - i. Advertise/participate in stakeholder workshops and online watershed priorities survey (Summer 2021)
  - ii. Review beta version of Watershed Prioritization Model (Summer 2022)
  - iii. Review draft Watershed Priority Action List (Winter 2023)
- Look out for the invite to the watershed planning workshops/survey. Coordinate with actions in the Ecosystem Recovery Plan. Coming back and sharing the beta version of the tool.

Additional thoughts in the chat:

- Just wanted to note the TPU Water can switch over to the South Tacoma Groundwater Protection District supply during the summer - that helps flows in the Green River but also speaks to the importance of Regional Protection Facilities in Tacoma to protect that supply.
- RE: regional water quality retrofits - have you considered a 'stormwater park' to improve water quality in Swan Creek, possibly connected to the new Pipeline Trail?
- Make sure you participate in PRWC Watershed Gathering event

Puget Sound Partnership - Sept. 10, 2021

- Likes that the prioritization tool will be open source for regional use. May need to create common naming protocols so all jurisdictions will use same attributes in data layers. There is a small amount of funding allocated to Local Integrating Organizations annually for their own projects. Maybe could be used for GIS data dictionary? Suggest to PWR-LIO to see if other LIOs would support it.
- How can PSP support our efforts by scaling up or distributing to other jurisdictions? Talk to Ecology about supporting these types of efforts?
- Aligns with regional funding proposition for Stormwater Investment Plan if we are looking watershed-wide vs within City limits.
- Good to be coordinating with the Puyallup White River Watershed Local Integrating Organization (PWR-LIO) efforts around the Ecosystems Recovery Plan. Consider reaching out to Lead Entity for WRIA 10/12 (Lisa Spurrier) also – they don't usually fund stormwater actions, but do call them out in the Salmon Recovery Plan.

- Recommend we attend the 2022-26 Action Agenda Update topical workshops coming up at the end of the year. Also, there is NEP primary funding for the Action agenda – updates come through the LIO.
- Ecology Puget Sound Characterization Model is more designed based on river, creek systems than on stormwater conveyance systems
- Maybe Tacoma's BMP effectiveness module could help with comparing water quality benefits of different NTA funding proposals?

Port of Tacoma - Sept. 20, 2021

- They would like to ensure that the non-City owned stormwater treatment devices (the Port has a lot) are included in the watershed prioritization model as baseline conditions in the Tideflats watershed.
- Include in the watershed model special data on habitat mitigation sites, remediation/cleanup sites and nearshore confined disposal areas in the Tideflats.
- Could use NPDES Industrial Permit holder copper/lead limits to adjust pollutant-loading numbers in the Port.
- Identify where the City and Port MS4 stormwater systems connect to same receiving waters.
- The Watershed Planning Report should acknowledge both City and Port as NPDES permit holders. They would like to review the chapter on the Tideflats subarea.
- The Port has staff focused on modeling air quality, remediation projects, transportation planning, facilities planning, maximizing productive space in the Port.
- Port is working with Puyallup Tribe staff in multiple areas – development project reviews, cultural resources review, water quality projects. They have standing meetings with Tribe in addition to project specific meetings.
- They would like to be included in the team doing beta testing on watershed model and reviewing the draft priority action list.
- They also coordinate with Drainage District #23 about maintenance of the ditch running through the Port.

West End Neighborhood Council – Mar.17, 2021

1. What's your favorite thing about your watershed?
    - Wildlife
    - Titlow Park
2. What are some needs or challenges where you live in the watershed?
    - Weed killer used on planter strip
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    - Need more holding ponds
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APPENDIX D: PUBLIC SURVEY

TACOMA HEALTHY WATERSHEDS

COMMUNITY SURVEY

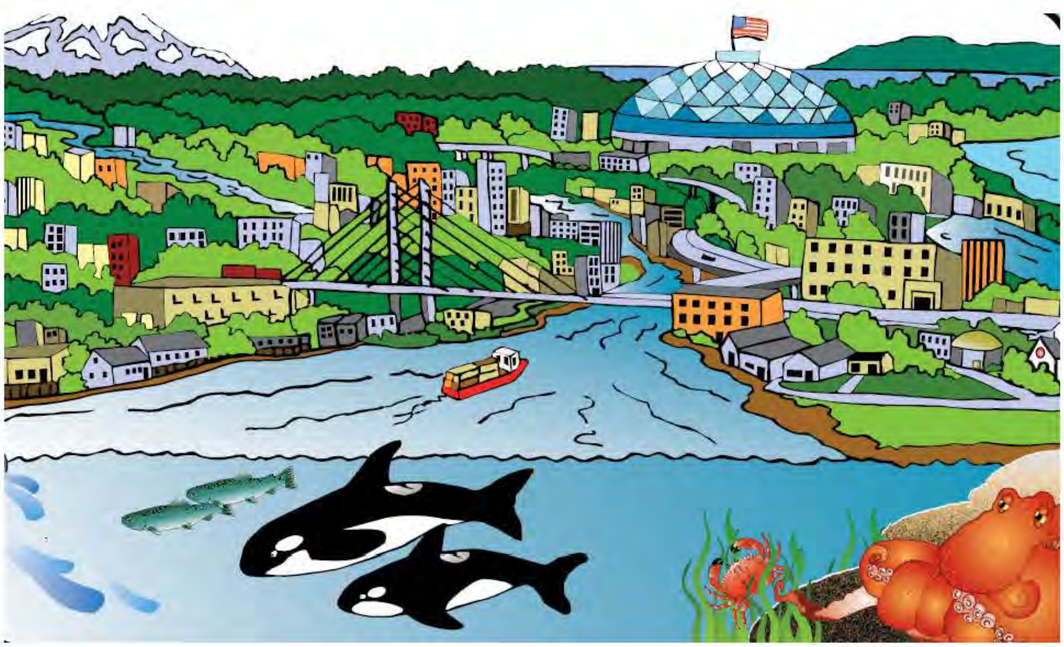
DID YOU KNOW? Most of Tacoma's **stormwater** (rainwater that travels over our streets, yards, and driveways and picks up pollutants such as oil and pet waste) flows directly into our waterways without being cleaned. In other words: If it hits the ground, it hits the Sound.

Tacoma's Environmental Services Department is creating a Watershed Management Plan to help us select the most effective stormwater actions to protect our waterways, improve our neighborhoods and provide healthy green spaces where they are needed most in Tacoma.

We've heard community feedback highlighting community priorities like ***litter, green spaces, more trees, clean air and water, and safe routes to walk, bike and roll***. Please take a few minutes to share which priorities are most important in your neighborhood.

Your participation in this survey is optional and voluntary.

This survey should take about 5 minutes to complete. Thank you for participating.



TACOMA HEALTHY WATERSHEDS

COMMUNITY SURVEY

TELL US ABOUT YOUR NEIGHBORHOOD

SATISFACTION WITH CURRENT NEIGHBORHOOD

1. How satisfied or dissatisfied are you with...

Amount of tree canopy

a. Very satisfied
b. Somewhat satisfied
c. Neither satisfied nor dissatisfied
d. Somewhat dissatisfied
e. Very dissatisfied

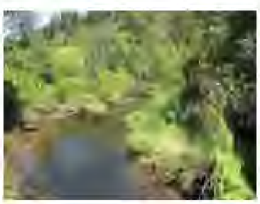
Urban Mobility: bike, walk, or roll

a. Very satisfied
b. Somewhat satisfied
c. Neither satisfied nor dissatisfied
d. Somewhat dissatisfied
e. Very dissatisfied

Amount of flooding

a. Very satisfied
b. Somewhat satisfied
c. Neither satisfied nor dissatisfied
d. Somewhat dissatisfied
e. Very dissatisfied

Cleanliness of streams, ponds, lakes, and beaches



a. Very satisfied
b. Somewhat satisfied
c. Neither satisfied nor dissatisfied
d. Somewhat dissatisfied
e. Very dissatisfied

Amount of litter and/or pet waste

a. Very satisfied
b. Somewhat satisfied
c. Neither satisfied nor dissatisfied
d. Somewhat dissatisfied
e. Very dissatisfied

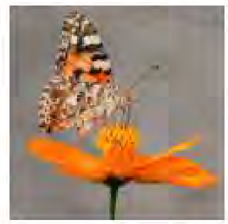
TACOMA HEALTHY WATERSHEDS
COMMUNITY SURVEY

IMPORTANCE OF AMENITIES

2. Please check the box next to each image that is important to you. **(Select all that apply)**

☐ Having lots of trees

☐ Birds, bees, and butterflies

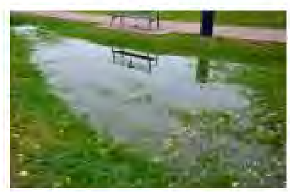


☐ Having lots of parks and natural areas

☐ Cleanliness of streams, ponds, lakes, and beaches

☐ Pet waste stations with trash cans

☐ Less flooding



☐ None of the above

3. Of these, circle which one is the most important?

TACOMA HEALTHY WATERSHEDS
COMMUNITY SURVEY

NEIGHBORHOOD IMPROVEMENTS

4. What do you want more of in your neighborhood? (Select all that apply)

☐ Reducing flooding

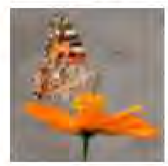
☐ More plants, less pavement

☐ Repairing damaged streets and sidewalks

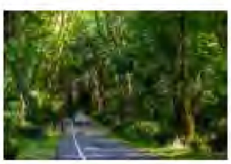
☐ Make it easier to bike, walk, or roll

☐ Reducing litter

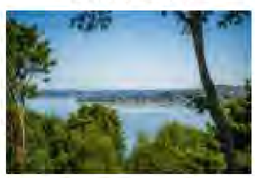
☐ Protecting spaces for wildlife and native plants



☐ Cooler streets with more shade

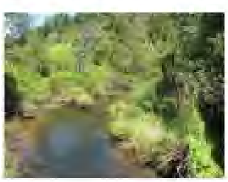


☐ More access to nearby natural areas

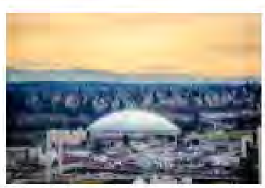


☐ reducing pet waste

☐ Cleaner streams, ponds, lakes, or waterfronts nearby



☐ Improved air quality



5. Of these, circle which one is the most important?

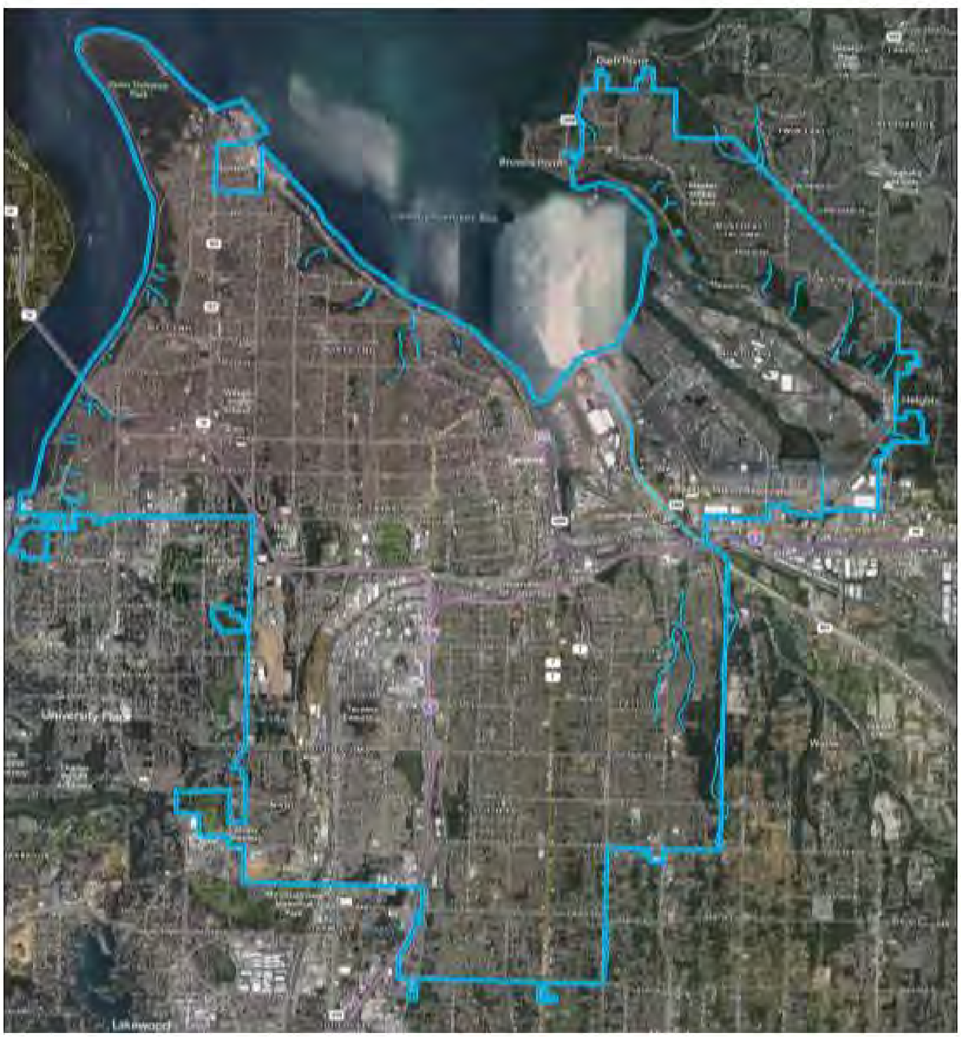
TACOMA HEALTHY WATERSHEDS

COMMUNITY SURVEY

MAPPING WHAT'S IMPORTANT TO YOU

6. **We want to learn more about where you notice stormwater issues and what natural areas around Tacoma are most important to you.** Mark a location on the map and add a comment about that place. For example, m**ark any places** where:
    - You like to fish, harvest plants, or recreate (ex: walk, swim, etc.).
    - You have noticed flooding.
    - You have an idea for improving the street such as: adding sidewalks or planting trees.
    - There is pollution or litter* (be specific about what type of trash or pollution you see).

** For issues that require a quick response, including spills or dumping that could wash down the street or storm drain and pollute nearby waterways, please call the City of Tacoma reporting hotline at **311** or visit www.cityoftaocma.org/TacomaFirst to report it.*



TACOMA HEALTHY WATERSHEDS

COMMUNITY SURVEY

DEMOGRAPHIC INFORMATION

The following questions help us understand the profile of survey participants and supports our effort to make this process as comprehensive and inclusive as possible. These questions are optional.

7. **Race/Ethnicity** (check all that apply)

	Asian
	Black/African
	Latino/Latinx/Hispanic
	Middle Eastern/North African
	Native American/Alaska Native
	Pacific Islander/Native Hawaiian
	White/Caucasian
	Rather Not Say

8. Please list any specific race, ethnic, and national groups, and tribal/band affiliations with which you identify (optional): ______________________________________

9. Age

	17 and under
	18 – 24
	25 - 34
	35 - 44
	45 – 54
	55 – 64
	65 – 74
	75 and over
	Rather Not Say

TACOMA HEALTHY WATERSHEDS
COMMUNITY SURVEY

10. Do you rent or own the place where you live?

	Own
	Rent
	Rather Not Say
	Prefer to self-describe:

11. Do you work or own a business in Tacoma?

	Work
	Own a business
	Neither
	Rather Not Say

12. Primary language spoken at home: ______________________________________

13. Additional language(s) spoken at home: ______________________________________

TACOMA HEALTHY WATERSHEDS

COMMUNITY SURVEY

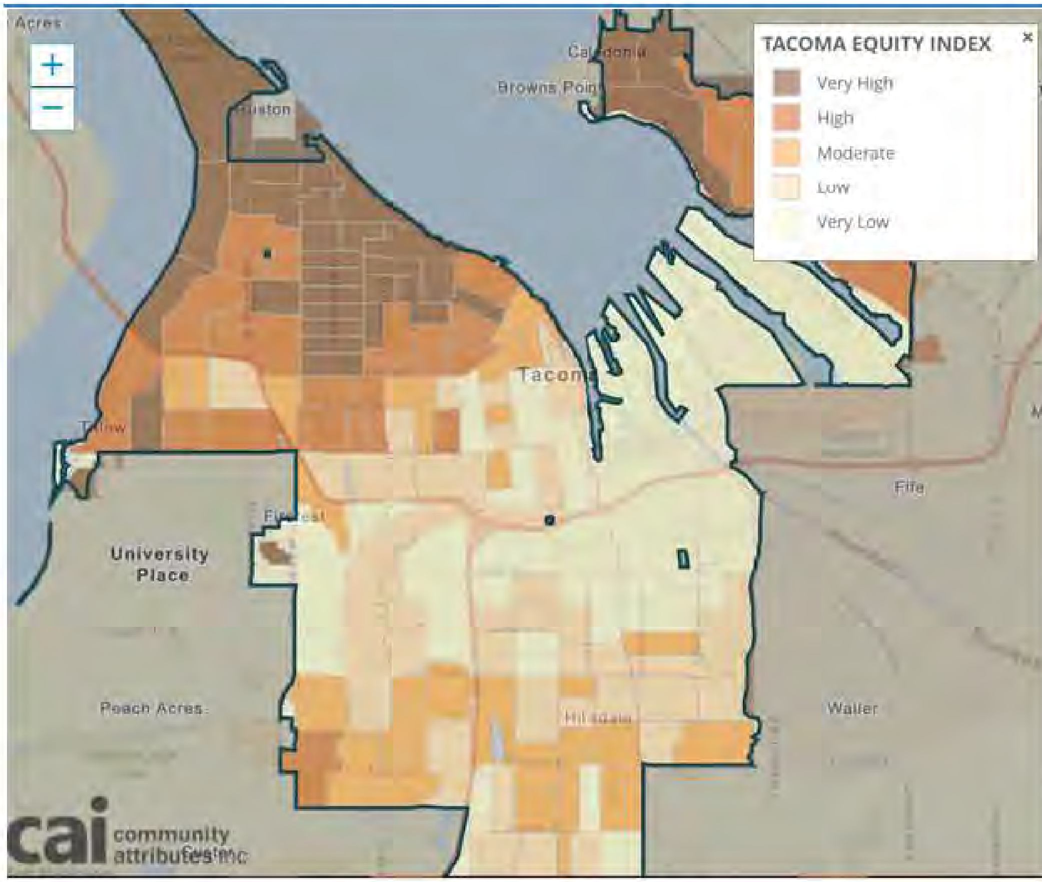
Tacoma's Equity Index Map – Learning about Opportunity Zones

Tacoma's Equity Index Map shows differences in the amount of **opportunity between different areas of Tacoma based on 29 indicators about the health, wealth, and environmental conditions in our community** (such as jobs, schools, clean air, and public safety.)

This map is used to make decisions about government spending on community programs, projects, and services to improve access to opportunity where it is needed most.

The darker colors show areas with higher opportunity while the lighter colors show areas with lower opportunity.

14. Circle your neighborhood block area on the map below:



TACOMA HEALTHY WATERSHEDS

COMMUNITY SURVEY

STAYING INVOLVED

15. Please contact me so I can get more involved in making healthy neighborhoods and healthy watersheds. I would like to learn how the City can help me…

1. ☐ …**clean up trash** in my neighborhood
2. ☐ …**mark storm drains/catch basins** with "no dumping" in my neighborhood
3. ☐ …**keep litter and leaves out of the storm drain** near me
4. ☐ …**clean up dog waste** in my neighborhood
5. ☐ …**volunteer to care for a local natural area**
6. ☐ …**get free street trees or low-cost trees** for my yard
7. ☐ …**build a rain garden** in my yard
8. ☐ …**replace my lawn with pollinator plants**
9. ☐ …**replace pavement with plants** on/near my property
10. ☐ …**receive email updates** about Tacoma's Watershed Plan

16. Please provide your email address and/or phone number so we can contact you about the items you marked above.____

Your input is critical to help the City prioritize future stormwater management, habitat restoration, and urban forestry programs in Tacoma's urban watersheds.

Thank you for helping us support healthy neighborhoods and a healthy environment for all.

APPENDIX E: TACOMA'S WATERSHED COMMUNITY FEEDBACK MAP - ADDITIONAL COMMENTS

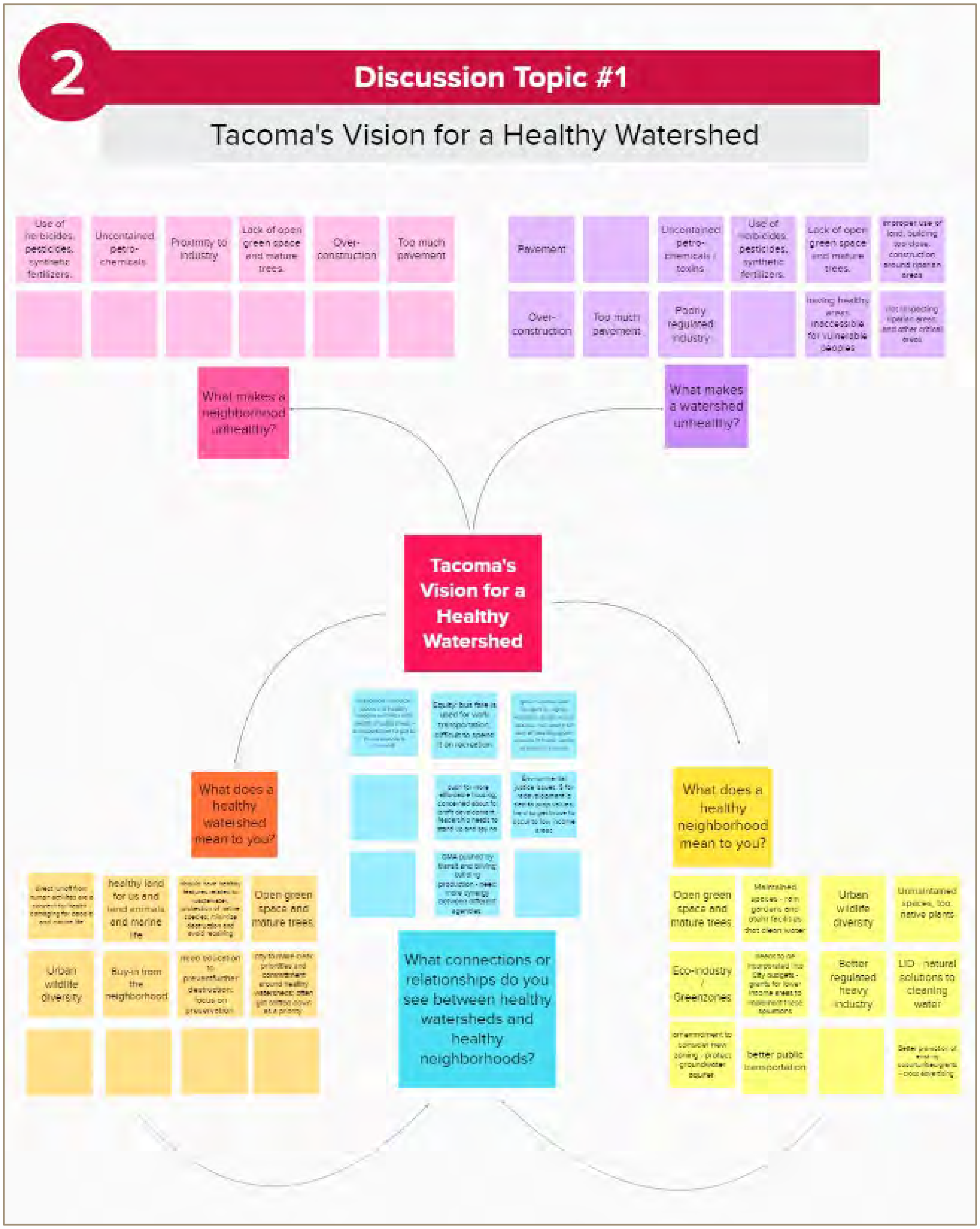
Watershed/ Opportunity Zone	Other Comment	Litter/ Pollution	Improvement Idea	Flooding	Fishing/ Swimming
VERY HIGH					
North Tacoma	Reduce pollution Improve drainage		Turning it into a park	Stormwater/groundwater not properly handled. Ditches overflow, ice in winter, water on roadways	Access to the beach and forest
Leach Creek		Litter			
HIGH					
North Tacoma	Address litter from unhoused encampments Address litter from unhoused encampments	Pet waste, litter		Street flooding at the corners	
Western Slopes	More trees				
Flett Creek			Adding sidewalks and fixing damaged streets		
Leach Creek					Walking, biking
MODERATE					
North Tacoma		Litter: cigarette butts, broken glass, food packaging			
Foss Waterway	Improve roads and sidewalks	More garbage cans			
Flett Creek	Polluted water well	The city has continually allowed an encampment of people to chop cars here, endangering the headwaters of Flett Creek			
Western Slopes	Address pet waste				

LOW					
Foss Waterway	Reduce litter Increase trees and shade Improve bikability		Most of the block has uneven sidewalks on S. 11th Street near SeaMar Park Ave S and 61st Street would like more trees	Flooding is bad near Pac Ave & A Street	
Flett Creek	Regulate paper mill. Replace lawns with native grass		Make it safer and easier to cross highways on foot or by bike		
North Tacoma			Add protected bike lanes on 6th Avenue!		
Lower Puyallup		Lots of litter, sometimes illegal dumping	The pipeline trail is multi-use and unsafe for pedestrians sometimes due to speeding bikers, ATVs, motorbikes. Also, there is a lot of trash and unscooped dog waste.		
VERY LOW					
Foss Waterway	Must consider biking and walking when replacing pavement More trees thoughtfully planted in areas where they can thrive Reduce litter	School bus and City bus stop on 25th. People and kids waiting for bus, and people in cars waiting at the stops drop or throw trash out of their cars. Neighbors, and we, pick it up. Some renters are not as invested in the neighborhood as home owners	Please work hard on the Trail To The Mountain to activate this Tacoma Rail line and reduce litter, homeless encampments, and add amenities to walk/bike/roll 'J' Street needs street repaired	Street flooding at bottom of railroad tracks on E 46th & E Street flooding on the corner, lack of stormwater infrastructure	

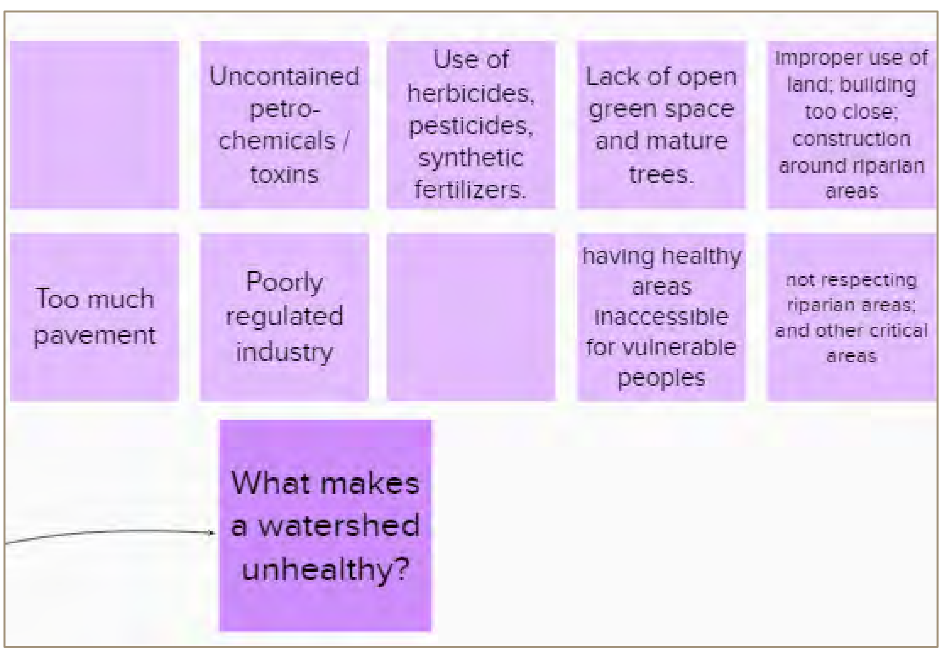
		Litter and human waste related to homeless encampments Lots of trash due to littering from streets, highways Paper survey has a circle drawn over the i-5 + hwy 16 interchange area, Tacoma Mall area, and the neighborhoods east of the mall. Note “here is litter here”	between 16th to 21st Street		
Flett Creek	Groundwater contamination	84th between Alaska + Hosmer on the N side, w bound traffic	Add to Fernhill trees and planting to help reduce calm traffic	Flooding on EG btw S. 84th-86th. Sidewalks, trees, so much trash - fast food, etc. I don't want trees blocking my view of Mt. Rainier	
North Tacoma	Remove pavement and plant more trees				

APPENDIX F: WORKSHOP MURAL BOARDS

Discussion Topic #1



CLOSE-UPS OF DISCUSSION TOPIC #1



education - provide access to healthy spaces will help with health of watersheds - transportation to get to these spaces is needed

Equity: bus fare is used for work transportation; difficult to spend it on recreation

green spaces are located in higher econimic areas; easier access; not aware of lack of healthy/green spaces in lower socio economic spaces

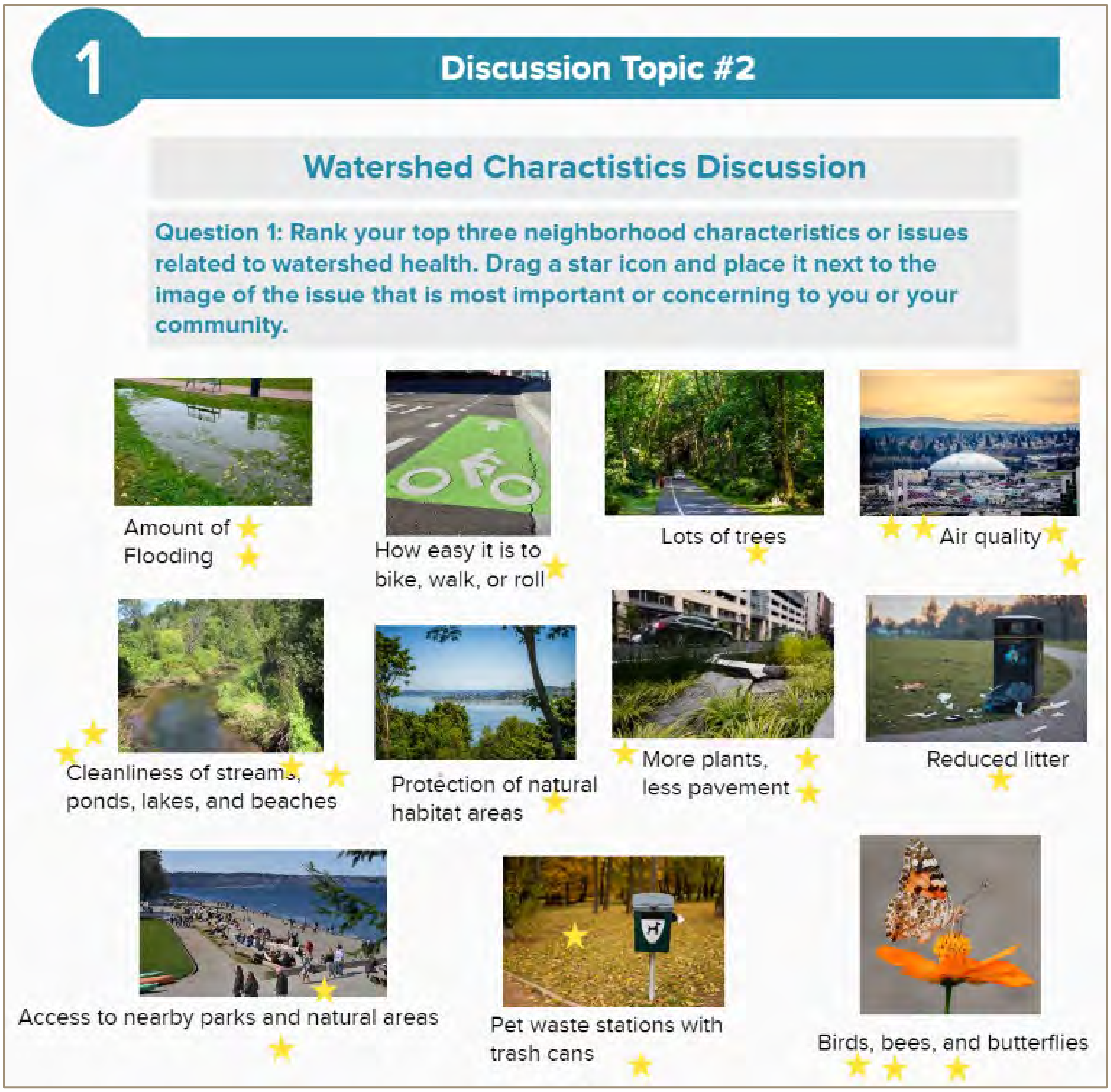
push for more affordable housing; concerned about for profit development - leadership needs to stand up and say no

Environmental justice issues: $ for redevelopment is tied to prop values; hard to get those to occur to low income areas

GMA pushed by transit and driving building production - need more synergy between different agencies

What connections or relationships do you see between healthy watersheds and healthy neighborhoods?

Discussion Topic #2




Question 2: Are there any barriers around improving these issues that you have noticed or dealt with?
Clean Streams ponds, lakes and beaches
People believing there is actually a problem
People don't think they should pick up trash that "isn't theirs"
Illegal dumping
garbage and trash into the waters
Funding
Rain barrels
Time to clean it
Cost of waste services (garbage collection)
Air Quality
People believing there is actually a problem
Electric vehicle costs

Spanish Translation

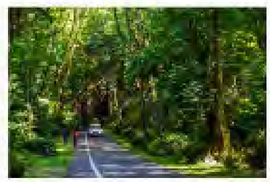
5 Tema de Discusión #2

Discusión de las Características de la Cuenca Hidrográfica

Pregunta 1: Clasifique las tres características principales de su vecindario o problemas relacionados con la salud de la cuenca hidrográfica. Arrastre una estrella y colóquela junto a la imagen del problema que es más importante o que le preocupa más a usted o a su comunidad.

Cantidad de Inundaciones

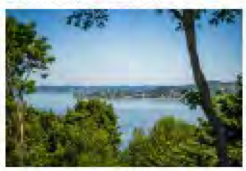
Qué tan fácil es andar en bicicleta, caminar o rodar



Muchos arboles

Calidad del aire

Limpieza de arroyos, estanques, lagos y playas



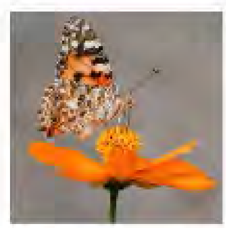
Protección de áreas de hábitat natural

Más plantas, menos pavimento

Reducir Basura

Acceso a parques y áreas naturales cercanas

Estaciones de desechos de mascotas con botes de basura



Aves, abejas y mariposas

Appendix F:
Monitoring and Spatial Data Review Summary

FINAL MEMORANDUM

Date:	8 December 2021
To:	Laura Nokes, City of Tacoma
From:	Sarah Welsh, Christian Nilsen, and Daniel Pankani, Geosyntec Consultants
Subject:	Tacoma Watershed Prioritization Planning Project – Monitoring and Spatial Data Review Summary

1. SUMMARY

This memorandum describes data to be included in the watershed prioritization tool for the Tacoma Watershed Prioritization Planning Project. As detailed below, Geosyntec has compiled spatial data, receiving water data, and metrological data from several sources. This list will be kept updated through development, and the final tool may use other data than is included in this memo. Data used in the final tool will be documented in the final tool technical report.

2. CITY-OWNED SPATIAL DATA

2.1 Vector Data

Where available, vector data has been ingested through the City's ArcGIS Data Hub and associated Representational State Transfer (REST) application programming interface (API) available at https://geohub.cityoftacoma.org/. The list below is organized by services directory from the REST API.

2.1.1 General Data

General data consists of boundaries and land uses used by several City agencies. General data to be used in the tool are:

- Districts
  - Tacoma City Limits
  - Neighborhood Council Districts
  - Neighborhood Business Districts
- Land Use Designations
- Puyallup Tribe Boundary
- Other
  - Zoning Layer (for future development)

- South Tacoma Groundwater Protection District
- Mixed Use Center Layer (Dart) – Regional Growth Centers (where Tacoma should concentrate growth & transportation projects).
- Shoreline Layer – WE also have high tide line elevation that could be our shoreline value.

2.1.2 DART Data

The Tacoma DART (Development Assistance & Review Team) Map is used for members of the public to find and utilize data that is helpful in project planning and permitting. It consolidates many of the City's data layers. The following data layers are expected to be incorporated.

DARTequity2020

- Accessibility Index
- Economy Index
- Education Index
- Environmental Exposures
- Environmental Health Index
- Environmental Effects
- Equity/Opportunity Overall Index 2020
- Livability Index
- Race 2020 Percentage (Point)

- DART Infrastructure
  - Curb Ramps (Public)
  - Sidewalks
  - Pavement Restoration Index (2015)
  - Pavement Type (2015)
  - Pavement Condition Index (2015)
  - Street Cut Moratoriums
  - Street Names (centerline) for context.
- DART Environmental
  - Biodiversity Corridors
  - FEMA Flood Hazard Areas
  - Puyallup Levee Overtopping
  - Fish Bearing Streams
    - Salmon Scape: WDFW Salmonscape
  - Habitat Sites (Port of Tacoma)
  - NPDES Sensitive Sites
  - Wetlands Inventory
  - Critical Areas (public datasets only)

        - Aquifer Recharge Areas
        - Waterbodies
        - Streams
        - Landslide Hazard Areas

Also discussed: WDFW Priority Habitats and Species List https://wdfw.wa.gov/species-habitats/at-risk/phs/maps

2.1.3 Environmental Services Surface Water Network

Environmental services data contains information on the surface water network, local stormwater facilities and regional stormwater facilities. The following data layers are expected to be incorporated.

- Surfacewater Map Labels
    - Manhole Labels
    - Pipe Diameter & Material
    - Pipe SAP ID
- Active Public
    - Conveyances
        - Surfacewater Flow Direction
        - Surfacewater CB Lead
        - Surfacewater Main
        - Surfacewater Trunk Main
        - Surfacewater Ditch (Open Drain)
    - Structures
        - Surfacewater Facilities
            - Local Surfacewater Facility
            - Regional Surfacewater Facility
        - Surfacewater Manhole
        - Surfacewater Discharge Point
        - Surfacewater Inlet
        - Misc Surfacewater Structure
    - Surfacewater Facility Outlines
        - Local SW Facility Outline
        - Regional SW Facility Outline

2.2 Raster Data

Relevant raster data that is not available publicly has been provided by the City of Tacoma. Raster data layers are summarized in Table 1.

Table 1. City provided raster data

Layer Name	Description	File name	Nominal Scale
Urban Tree Canopy	Lidar derived tree cover classified by height above ground.	CanopyClasses	1 m
Urban Heat Index	Citywide urban heat measurements (July 2018). Contains morning, afternoon, and evening layers.	Urban_Heat_tac_am, Urban_Heat_tac_af, Urban_Heat_tac_pm	10 m
Building Footprints	Lidar derived building footprint areas	building_footprints	0.3 m
Top of Surface Elevation	Lidar derived digital surface model.	lidar_dsm	0.5 m
Bare Earth Elevation	Lidar derived digital elevation model.	Lidar_dtm	0.5 m
Land Cover	Six-class land dover categories (2017)	TacomaWA_LCAllClass_2017	1 m

3. RECEIVING WATER DATA

Receiving water data include those data that are relevant for assessing the condition of waterways that receive stormwater data. Compiled data sources are described in Table 2.

Table 2. Receiving water data

Name	Description	Source	Reference
Foss Waterway Monitoring	Foss Waterway Source Monitoring Sediment Sample Results	City of Tacoma	Tacoma, 2021
S8.D Outfall Data	Phase I Stormwater Permit S8.D Outfall Data 2009-2013	Ecology	Ecology, 2015
City of Tacoma Municipal Stormwater Permit Data	City of Tacoma stormwater data.	Ecology	Ecology, 2019

4. OTHER SPATIAL DATA

The following spatial data has been assembled be used to evaluate rainfall-runoff behavior and to evaluate pollutant loading relationships. Compiled data are summarized in Table 3.

Table 3. Other spatial data

Name	Description	Data Provider	Reference
Slope Categories	Categorized slopes (flat, moderate, steep).	USGS	USGS, 2020
Slope	Continuous slope	USGS	USGS, 2020
Soils	Hydrologic Soils Groups	Stormwater Heatmap, USDA, Oak Ridge National Laboratory	Nilsen et al., 2021
Age of Imperviousness	Detected change to impervious land cover derived from remote sensing	European Commission, Joint Research Centre (JRC)	Pesaresi et al., 2015.

Other spatial data acquired (or soon to be acquired) include:

- latest sub-foot aerial imagery from the City of Tacoma
- stormwater capital projects in various stages of development
- streets capital projects
- streets right-of-way
- watershed and subcatchment delineations
- Delineations of catchments draining to BMPs
- 2017 Lidar data
- Urban Forestry
- Urban Heat Island Data

5. METEOROLOGIC DATA

Meteorologic data will be used for rainfall-runoff modeling of historic and future climate change scenarios. Meteorologic data compiled for this effort consists of the following:

5.1 Precipitation

The University of Washington Climate Impacts Group has developed downscaled projections of climate change scenarios for Puget Sound. For this effort, the Geophysical Fluid Dynamics Lab’s Climate Model version 3 (GFDL-CM3) Representation Concentration Pathway 8.5 (RCP 8.5) has been selected. The RCP 8.5 is considered a ‘high-emissions’ scenario.

5.2 Potential Evapotranspiration

Remote-sensed potential evapotranspiration estimates are available from NASA’s Moderate Resolution Imaging Spectroradiometer (MODIS) program. Data are available for the period 2001-2020. Consistent with Ecology modeling guidance, evapotranspiration data will be calculated on an average monthly basis.

6. REFERENCES

Florczyk, Aneta J., Christina Corbane, Daniele Ehrlich, Sergio Freire, Thomas Kemper, Luca Maffenini, Michele Melchiorri et al. "GHSL data package 2019." *Luxembourg, EUR* 29788, no. 10.2760 (2019): 290498.

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Washington State Department of Ecology, 2019. “WQ_ENV_MunicipalStormwaterPermitAreas” Information Technology Services Office, GIS Unit, Adam Oestreich, Spatial Database Administrator

Zhang, Kun, Gaofeng Zhu, Jinzhu Ma, Yuting Yang, Shasha Shang, and Chunjie Gu. "Parameter analysis and estimates for the MODIS evapotranspiration algorithm and multiscale verification." *Water Resources Research* 55, no. 3 (2019): 2211-2231.

* * * *

Appendix G:
Technical Methods and Approach Document

Final TECHNICAL METHODS AND APPROACH DOCUMENT

City of Tacoma Watershed Planning Project

Prepared for

City of Tacoma
747 Market St
Tacoma, WA 98402

Prepared by

Geosyntec Consultants, Inc.
520 Pike Street, Suite 2600
Seattle, Washington, 98102

Project Number: PNW0448

Revised August 2022

TABLE OF CONTENTS

1. INTRODUCTION

This technical memorandum describes the technical basis and assumptions to be used for the Best Management Practice (BMP) Performance Module of the Tacoma Watershed Planning Project tool.

1.1 Features Addressed

The following features, a subset of those previously identified in the project Development Roadmap, will be addressed by the BMP performance module. This Technical Memorandum describes the methodology the tool will use to perform calculations and aggregate information for these features. Features to be addressed are:

Calculate current pollutant loading based on Tacoma-specific water quality and hydrology (FEAT5).

Model pollutant loading based on future development conditions and climate change predicted storm events (FEAT6)

Model existing BMP impacts on pollutant loading and hydrology (FEAT7)

FEAT8 Model potential BMP impacts on pollutant loading and hydrology (FEAT8)

FEAT9 Calculate cumulative volume and pollutant load reductions from BMPs (FEAT9)

2. COMPONENTS

2.1 Chemicals of Concern

Eight chemicals of concern (COCs) have been selected for this study as summarized in Table 1. Chemicals of Concern below.

Table 1. Chemicals of Concern

Parameter	Group	EIM Parameter CAS
Bis(2-ethylhexyl)phthalate- Water - Total	Phthalate	117-81-7
Copper - Water - Total	Metal	7440-50-8
Phenanthrene - Water - Total	LPAH	85-01-8
Pyrene - Water - Total	HPAH	129-00-0
Total Nitrogen - Water - Total	Nutrient	NA
Total Phosphorus - Water - Total	Nutrient	7723-14-0
Total Suspended Solids - Water - Total	Conventional	NA
Zinc - Water - Total	Metal	7440-66-6

2.2 BMPs

Best management practices (BMPs) to be evaluated include both structural and non-structural BMPs. These are described below.

Structural BMPs refer to BMPs that capture stormwater and improve water quality or hydrology. Facility type names shown in Table 2 conform with the names used in their asset management database.

Table 2. Structural BMP Definitions

Facility Type	Description
Filterra/Vegetated box	Manufactured devices with high rate filtration media that support plants.
Media Filter	Manufactured devices with high-rate filtration media consisting of a variety of inert and sorptive media types and configurations (e.g., cartridge filters, upflow filters, membrane filters, vertical bed filters).
Oil-water Separator	Manufactured devices including oil/water separators and baffle chambers designed for removing floatables and coarse solids.
Pervious Pavement	Full-depth pervious concrete, porous asphalt, paving stones or bricks, reinforced turf rings, and other permeable surface

Facility Type	Description
	designed to replace traditional pavement.
Pond/wet vault	Surface wet pond with a permanent pool of water, may include underground wet vaults.
Bioretention	Shallow, vegetated basins with a variety of planting/filtration media and often including underdrains.
Sand Filter	Filter bed with granular media, typically sand.
Swale	Shallow, vegetated channel, also called bioswale or vegetated swale.
Swirl Separator	Manufactured devices providing gravitational settling using swirl concentrators, screens, and baffles. Also referred to as hydrodynamic separators (HDS).
Dry Extended Detention Basin/Tank	Dry extended detention including grass-lined and concrete lined basins that are designed to empty after a storm.
Trench[1]	Filter bed with granular media, typically sand. Full infiltration
Vault	Concrete-lined basins that drain after a storm.
Notes: 1. Equivalent to Infiltration Trench, this terminology is used in the City's asset management database.	

In addition to the structural BMPs shown in Table 2, non-structural BMPs will be included as described in Section 6 of this document.

3. HYDROLOGIC SIMULATION

Continuous hydrologic simulation will be performed for historic and future climate scenarios. The results of these simulations will be used to calculate inflow to BMPs as well as annual runoff rates.

3.1 Data Sources

3.1.1 Precipitation

The tool will use a region-wide, simulated precipitation dataset developed by the University of Washington Climate Impacts Group (Mauger et al., 2018). This dataset contains modeled hourly precipitation using the Geophysical Fluid Dynamics Laboratory (GFDL) Climate Model version 3 (CM3) and the Representative Concentration Pathways (RCP) 8.5 scenario. This is the regional climate model dataset that was used by King County for their most recent update of intensity-duration-frequency curves for design of stormwater facilities.

The GFDL model was chosen by CIG due to its ability to accurately model winter storm drivers, important for stormwater applications. Combined with the higher emissions scenario, this modeling scenario represents the upper end of expected future climate changes effects.

CIG downscaled climate model results using a statistical-dynamical approach to capture the expected changes in extreme events as well as the different drivers of rainfall that affect the Puget Sound Region. Regional simulations were performed using the Weather Research and Forecasting community mesoscale model. This resulted in hourly rainfall predictions at an approximately 12 km grid size across Puget Sound. Predictions were bias-corrected on a quantile-mapping basis (individual mean bias corrections for precipitation in each quantile range) using the historic (1970-2005) WRF data. Four runoff scenarios/epochs will be developed as shown in Table 3.

Table 3. Historic and Future Climate Precipitation Scenarios

Scenario	Begin	End
Historic	January 1, 1970	December 31, 1999
2030s	January 1, 2000	December 31, 2039
2050s	January 1, 2040	December 31, 2069
2080s	January 1, 2070	December 31, 2099

3.1.2 Potential Evapotranspiration

Evapotranspiration includes evaporation directly from soil layers and vegetation as well as transpiration through plants. For runoff calculations, evapotranspiration is used to account for direct loss of water from stored water and loss of water from transpiration.

For this modeling effort, monthly values of potential evapotranspiration (PET) from the TerraClimate long-term monthly dataset. PET values were calculated for the study area for the period 1970-2000 as shown in Table 4.

Table 4. Terra Climate Monthly Potential Evapotranspiration, Tacoma, Washington

Month	Monthly PET *(mm)*	Monthly PET *(in)*
Jan	185	7.3
Feb	278	11.0
Mar	496	19.5
Apr	720	28.4
May	1000	39.4
Jun	1148	45.2
Jul	1334	52.5
Aug	1198	47.2
Sep	795	31.3
Oct	425	16.7
Nov	233	9.2
Dec	163	6.4

3.1.3 Hydrologic Response Units

Modeling will be performed on discretized landscape units based on common soils, land cover, and slope characteristics known as hydrologic response units (HRUs). The HRU approach provides a computationally efficient method of pre-computing hydrologic response for later use. Results for a particular watershed can be calculated by summing or averaging the results for individual HRUs.

Each combination of parameters was modeled in separate batched simulations. HRUs were designated by a three-digit number according to the following convention:

- First digit: Hydrologic Soil Group Number (0 = A/B, 1 = C, 2 = Saturated)
- Second digit: Land cover (0=Forest, 1=Pasture, 2=Lawn, 5=Impervious)
- Third Digit: Slope (0=Flat, 1=Mod, 2=Steep)

For example, a site with Type C soils, with forested land cover, on a moderate slope would be represented by 101. This schema allowed for HRUs to be stored as an eight-bit unsigned integer on a raster image, minimizing storage size.

3.1.4 HSPF Parameters

A set of regional HSPF regional calibration factors for the Puget Lowlands Ecoregion were developed the USGS in the 1990s (Dinicola, 1990) and updated by Clear Creek Solutions for use within WWHM (Department of Ecology, 2014). These parameters, referred to as the 'default parameters' by Ecology will be used in this study. Parameters are provided in Appendix A

4. HYDROLOGIC PERFORMANCE

4.1 Long-Term Volume Capture Performance

Hydrologic performance refers to: (1) the long-term volume captured and retained by a BMP (i.e., lost to infiltration, ET, harvesting, diversion, or another pathway), (2) long-term volume captured and treated by a BMP, and (3) long-term volume bypassed or overflowing (not captured). To complete the water balance, the sum of these three pathways equals the total inflow volume to the BMP.

The approach uses long-term capture nomographs to determine the estimated hydrologic performance. A nomograph is a chart that relates BMP design attributes like volume, drawdown time, and design flowrate, with pre-computed values for long-term hydrologic performance. Each point on these charts is the result of a continuous simulation model run for 20-30 years.

The Modeling Engine supports two primary BMP sizing and design paradigms:

- Volume-based nomographs. The capture efficiency is a function of the normalized BMP storage volume and the drawdown time for the stored water to be fully drained or otherwise treated.
- Flow-based nomographs. The capture efficiency is a function of the flow-through capacity for providing treatment and the time of concentration of the tributary area.

The modeling approach allows for separate sets of nomographs to be consulted for any given climate scenario depending on the sizing paradigm for a given facility type. These nomographs are created by running batches of long-term continuous simulations for BMPs with various storage volumes and drawdown times (for volume-based BMPs) or various flow rates and watershed time of concentration (Tc) values (for flow-based BMPs).

This methodology for determining long-term percent capture was previously used for the Puget Sound Partnership BMP Performance tool (Nilsen and Koryto, 2017). It was first developed and technically vetted for the National Cooperative Highway Research Program (Taylor et. al, 2016).

This approach is intended to facilitate the rapid estimation of long-term volume capture performance of structural stormwater BMP facilities, it is not intended to assess adequacy of design or to perform detailed BMP sizing.

4.1.1 Nomograph Preparation

4.1.1.1 Volume-Based Nomographs

Volume-based nomographs encode three pieces of information about the BMP facility:

1. Ratio of the volume capacity provided by the BMP design to the Design Capture Volume (DCV) for the tributary area. This value is a unitless ratio. The equation for the DCV of the tributary area is:

$$V_{dc} = \sum A_n \cdot Q_{91,n}$$

Where: V_{dc} = Design Capture Volume *(ft^3)*
A_n = Watershed area comprised of a particular HRU *(ft^2)*
$Q_{91,n}$ = 91st percentile, 24-hour runoff depth for a particular HRU *(ft)*

The ratio is the actual volume of the BMP divided by the DCV of the tributary area. So, if a BMP is designed exactly to the DCV then it would have a ratio of 1.0, and a BMP sized to smaller than the DCV would have a ratio of less than 1.

2. Drawdown time of the facility. This is computed differently for different types of BMPs. In general, this is computed as the volume divided by the relevant discharge rate. The units for this value are hours.
3. Long-term capture efficiency resulting from many years of continuous simulation for a given facility relative size and drawdown time.

The three dimensions of data can be represented in a nomograph plot as shown below in Figure 1.

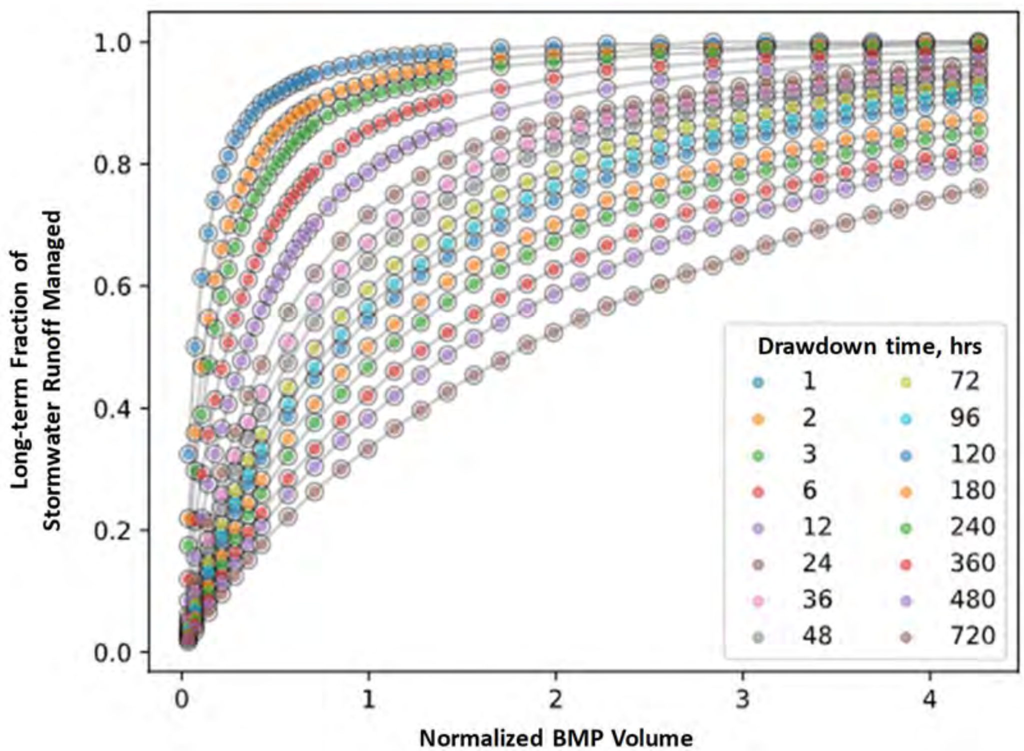

Figure 1. Example of a capture efficiency nomograph for a volume-based BMP with a constant drawdown time.

The process for nomograph development for each climate scenario includes:

1. Define a representative unit tributary area (typically one acre). Determine the DCV produced from this tributary area for each impervious HRU.
2. Produce a continuous timeseries of discharge from this area over a long-term period.
3. Perform batch simulations consisting of relevant combinations of BMP volume and drawdown time, representing the range of expected values (one simulation for each combination of HRU, drawdown time, and BMP volume). Produce a continuous timeseries of BMP storage and discharge using the same long-term period as in Step 2.
4. Extract the long-term capture efficiency from each run. Load these results into a standard data table to support lookups and interpolation.

Flow-Based Nomographs This nomograph type encodes two pieces of information about facilities designed with a flow-based sizing approach:

1. Effective design intensity of the facility. This value relates the treatment rate provided by the facility to the effective area of the tributary area it is meant to treat. The units for this value are inches per hour. The equation for the design intensity is:

$$I_d = \frac{\sum(A_n \cdot q_{91,n})}{\sum \mathrm{A_n}}$$

Where: I_d = Design intensity *(in/hr)*
$q_{91,n}$ = 91st percentile discharge for a particular HRU *(in/hr)*
A_n = Watershed area comprised of a particular HRU *(ft^2)*

2. Long-term capture efficiency resulting from continuous simulation for a given facility design intensity and its adjacent land surface Tc.

The three dimensions of data can be represented in a nomograph plot as shown below in Figure 2.

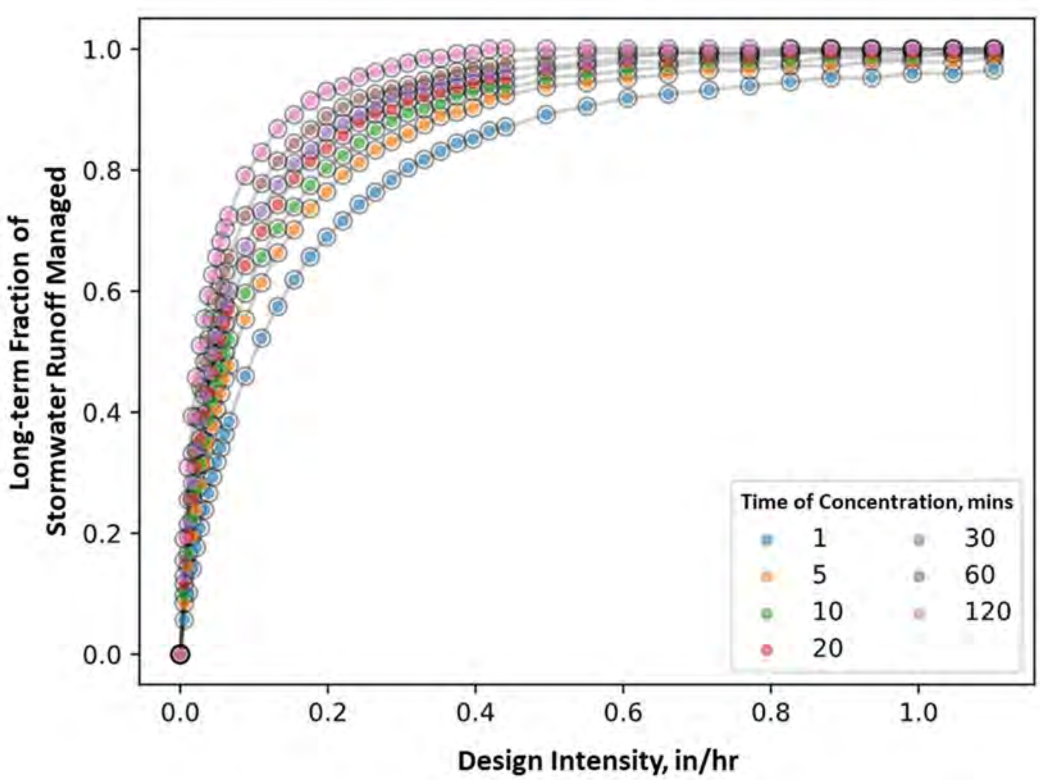

Figure 2. Capture efficiency nomograph for a flow-based BMP.

4.1.2 Nomograph Solution Approaches

The nomograph solution approach relies on the definition of distinct 'compartments' within a BMP. Each facility may be composed of one or two compartments, and the volume managed by each compartment is either counted as 'treated/detained' and discharged downstream or it is counted as infiltrated and is eliminated from the water balance.

This compartment-based approach allows the Modeling Engine to calculate BMP capture for a wide variety of facility configurations. **Table 5** shows the modeled BMP types mapped to their respective treatment solution approaches. The table indicates whether the facility has one or two-compartments and which nomograph type is being used to calculate wet-weather volume capture performance.

Table 5. Structural facility types & solution approach table

Modeled BMP Name	Pseudocode Mapping to Tacoma Asset Management Type	No. of Compartments	Volume-based Compartments	Flow-based Compartments
Bioretention with raised underdrain	FACILITYTYPE == "Bioretention" AND INFILTRATED ≠ "FULL"	2	Infiltration & Treatment	--

Modeled BMP Name	Pseudocode Mapping to Tacoma Asset Management Type	No. of Compartments	Volume-based Compartments	Flow-based Compartments
Dry Extended Detention Basin/Tank	FACILITYTYPE == "Tank" AND FLOWCONTROL ≠ true	2	Infiltration & Treatment/Detention	--
Flow Duration Control Tank	FACILITYTYPE == "Tank" AND FLOWCONTROL == true	2	Infiltration & Treatment/Detention	--
Bioretention with no Underdrain	FACILITYTYPE == "Bioretention" AND INFILTRATED == "FULL"	1	Infiltration	--
Infiltration Basin/Trench	FACILITYTYPE == "Trench"	1	Infiltration	--
Permeable Pavement	FACILITYTYPE == "Pervious Pavement"	1	Infiltration	--
Sand Filter	FACILITYTYPE == "Sand Filter"	1	Treatment	--
Filterra /Vegetated box	FACILITYTYPE == "Vegetated Box"	1	--	Treatment
Media Filter	FACILITYTYPE == "Media Filter"	1	--	Treatment
Oil-water Separator	FACILITYTYPE == "Oil Water Separator"	1	--	Treatment
Hydrodynamic Separator	FACILITYTYPE == "Swirl Separator"	1	--	Treatment
Vegetated Swale	FACILITYTYPE == "Swale"	2	Infiltration[1]	Treatment
Wet Pond	FACILITYTYPE == "Pond"	1	Treatment	--

1 Vegetated Swales and Filter Strips perform 'incidental infiltration' due to their un-lined design. This is discussed further in the 'hybrid flow and infiltration' discussion below.

Single-Compartment Volume-Based Nomograph Traversal. This is the simplest case for volume-based facilities, such as an infiltration basin, lined bioretention, bioretention with no underdrain, permeable pavement, and several other types. For a single compartment BMP, the normalized BMP volume is determined as the ratio of the facility's total volume to the DCV of the tributary area. BMP input parameters are structured so that the drawdown time can be inferred from available design information such as facility depth, total volume, and underlying infiltration rate so that the correct curve can be chosen from the nomograph.

Figure 3 illustrates an example solution for an infiltration facility with a six-hour draw-down time whose total volume is equal to the DCV of the tributary area. In this case, the modeling module would estimate that the facility achieves approximately 85% of long-term runoff volume infiltration.

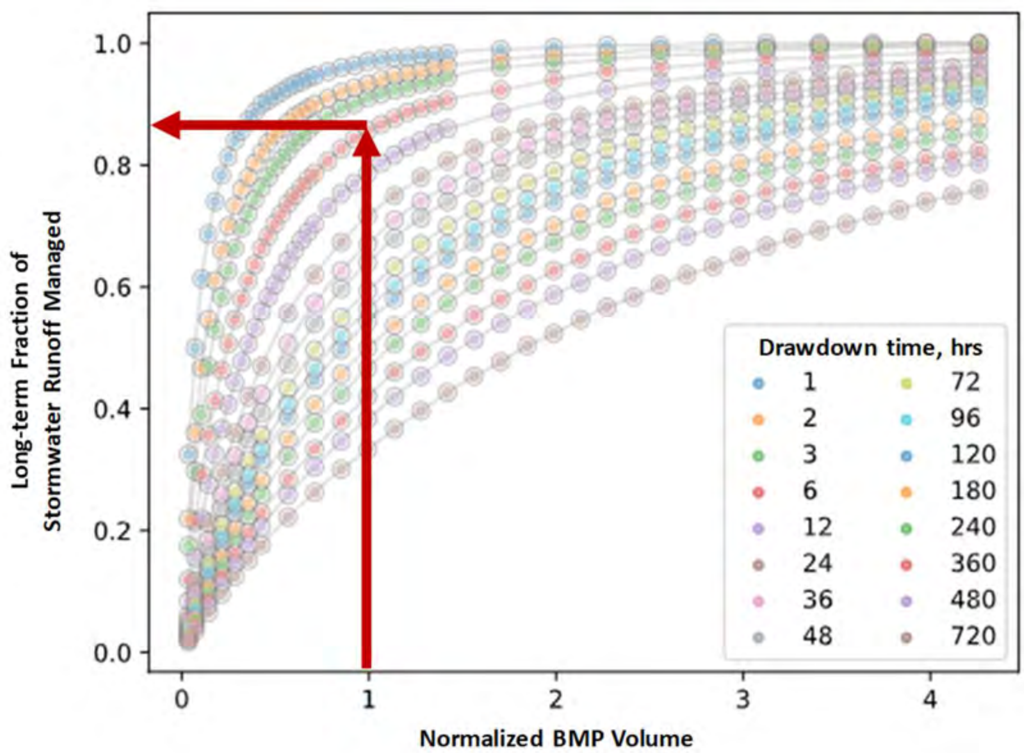

Figure 3. Single compartment volume-based nomograph solution example

Two-Compartment Volume-Based Nomograph Traversal. This type of BMP solution is used for volume-based facilities that are capable of both infiltration and treatment of inflowing stormwater. Common examples of this type of BMP include bioretention facilities with a raised underdrain and extended dry detention facilities. These facility types may perform volume infiltration via infiltration into the native soil and may discharge treated flow via elevated underdrains or outlet structures.

The first nomograph traversal is for the infiltration compartment since these facilities fill from the bottom and infiltration typically begins to occur before treated discharge. The following figure illustrates the traversal process for a two-compartment facility in which each compartment is sized to be 50% of the design volume. In this case, the drawdown time is 24 hours for the infiltration compartment and 3 hours for the treatment compartment. The following steps demonstrate the traversal process which is illustrated below in **Figure 4**.

Determine the infiltration capture performance by traversing 0.5 units along the x-axis and locate the correct trace for the 24-hour drawdown time of the infiltration compartment. The value is approximately 48% of long-term capture. This is shown in brown in the figure below.

Translate horizontally to the trace for the next compartment which draws down in 3 hours. The second compartment trace is shown in green in the figure below.

Follow the green 3-hour drawdown trace up the nomograph for 0.5 units of x-axis distance.

In this example, about 83% of long-term capture is achieved by both compartments working in concert. Infiltration accounts for 48% (from step 1), treatment accounts for 35% (83% - 48%), and 17% is bypassed (100% - 83%).

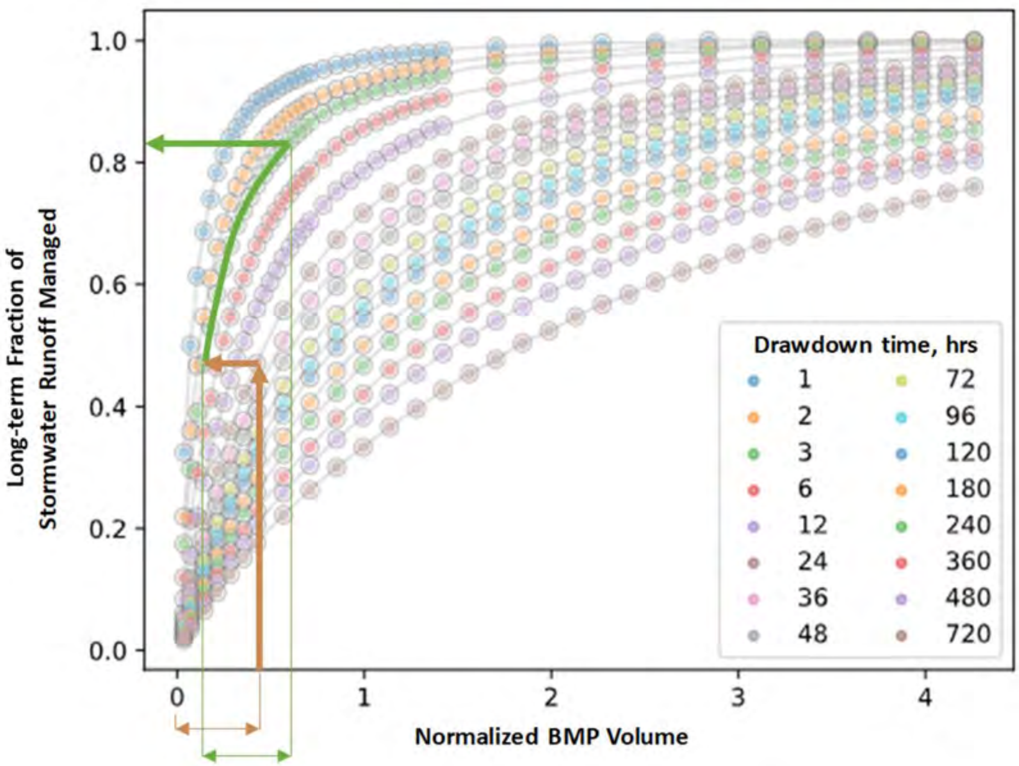

Figure 4: Two-compartment nomograph traversal. In this case both compartments have the same volume capture capacity (0.5 Design Volumes) but they have different drawdown times.

For some BMP types, such as extended detention with permeable bottoms, there is not a defined infiltration compartment. Instead, infiltration occurs simultaneously with treatment. For these BMPs, the facility is divided into two parallel compartments with equal drawdown time. The volume in each compartment is prorated based on the ratio of the discharge rate from each compartment. For example, a hypothetical detention basin with a DCV ratio of 1.0 has a treated surface discharge rate of 0.35 cfs and an infiltration discharge rate of 0.15 cfs. The basin is divided into two parallel compartments, a treatment compartment with a DCV ratio of 0.7 and 0.35 cfs discharge rate and a infiltration compartment with a DCV ratio of 0.3 and 0.15 cfs discharge rate. Each compartment is analyzed individually (in parallel) and then the results are summed.

Single-Compartment Flow-Based Nomograph Traversal. This is the simplest case for flow-based BMPs. It is based on the flow rate of the facility. This nomograph is useful for modeling facilities such as an HDS unit or a proprietary flow-through biofilter since these facilities do not perform stormwater volume infiltration. In the example nomograph below (Figure 5) a facility with a design treatment intensity of 0.2 inches per hour is expected to manage 83% of long-term runoff.

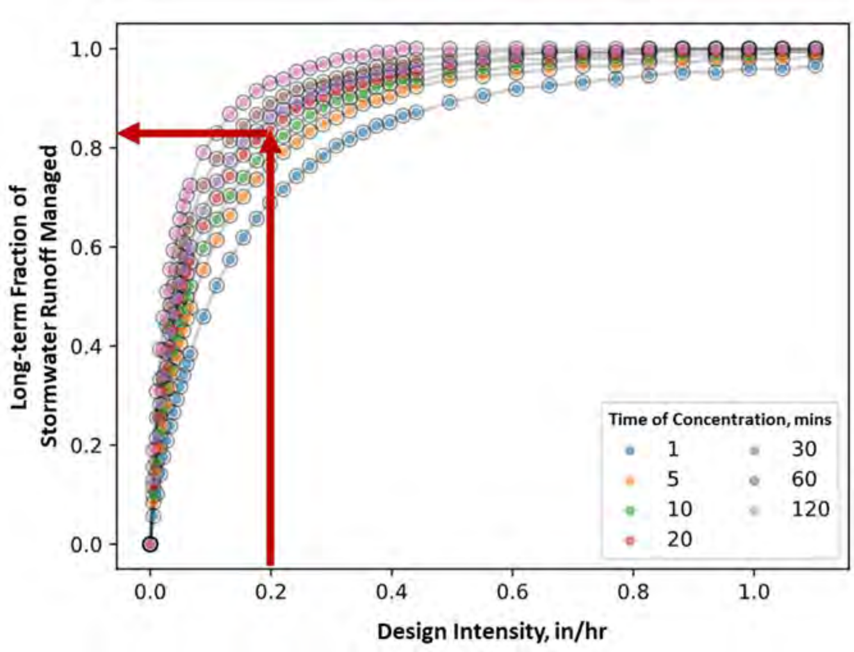

Figure 5. Single compartment flow-based nomograph solution

Hybrid Flow-Based Nomograph Traversal. This volume capture solution applies only to facilities that are both unlined and flow-based facilities like a typical vegetated swale. These facilities are often sized and designed as flow-based facilities, but they may provide incidental volume reduction via infiltration depending on underlying soil conditions. For these facilities, the nomograph solution for capture is:

1. Consult the relevant flow-based nomograph to compute the total long-term capture volume.
2. Utilize the facility volume, depth, and underlying soil group to estimate the total storage volume and drawdown time for the facility.
3. Consult the relevant volume-based nomograph to calculate the long-term retained volume.
4. Calculate the treated and discharged volume as the difference between the total long-term capture volume and the retained volume.

This approach helps ensure that the overall long-term volume capture is consistent with the flow-based nomograph traversal result but allows for a portion of the capture volume to be counted as infiltration to better represent the incidental infiltration performance of these facilities.

Nested BMPs. The nomograph solution supports regional BMPs that receive discharge from BMPs in their upstream catchments. This means that upstream facilities that achieve long-term volume capture and attenuation will affect the potential volume capture performance of downstream facilities since that volume, or a portion of that volume, was removed from the system. It should be noted that in practice BMPs are typically only nested once, such as in a distributed

BMP upstream of a centralized BMP, and more deeply nested facility configurations are uncommon.

This approach implements a corrective algorithm to track and correct the impacts of upstream infiltration and detention when applying nomograph traversal capture solutions in nested BMP configurations. This effectively treats upstream BMPs similarly to the first compartment in a two compartment BMP, described above. Therefore, the downstream BMP traverses the nomograph curve further to the right, where the slopes are lower (somewhat less capture per unit of volume provided). Comparisons between this algorithm and an explicit continuous simulation analysis in EPA SWMM 5.1 are within 5% of long-term capture efficiency, long-term volume infiltration performance, and long-term treatment performance for equivalent BMP configurations.

4.2 Simplified Treatment Volume Capture Performance

The approach allows for a simplified method to model catchments with many treatment facilities for which individual facility delineations are not available, or to model facilities where specific design parameters are unknown. The user can enter the fractions of the site treated by given types of BMP and enter the long-term fraction of runoff volume retained and treated by the facility. This method requires the user to delineate the overall site treated area, but uses the user-entered values for percent of volume treated and retained rather than nomographs.

5. WATER QUALITY PERFORMANCE

5.1 Statistical Analysis Approach

Water quality performance estimates will be derived from the International Stormwater BMP Database (http://bmpdatabase.org/), version 2021 or later. Analysis will be based on the distribution of paired influent and effluent water quality concentrations for individual events by BMP category as reported in the database. This approach follows a similar study performed for the Puget Sound Partnership, evaluating the performance of water quality BMPs (Nilsen and Koryto 2017). Analysis steps are described below.

5.1.1 Data Sufficiency

In order to be used in this study, a minimum of 20 paired results must be reported with at least three distinct studies.

5.1.2 Paired difference test

For each BMP-pollutant combination, a parried difference test will be performed to test whether influent and effluent data represent statistically distinct populations. The Wilcoxon signed-ranked test, which is a non-parametric hypothesis test will be used. Only relationships that show a statistically distinct difference between influent and effluent will be used.

5.1.3 Monotonicity test

Next, data will be tested for monotonicity (e.g. a nondecreasing function) using the non-parametric Spearman's Rho test. Only monotonic relationships will be used.

5.1.4 Regression

Finally, a regression relationship between influent and effluent concentrations will be developed using the non-parametric Kendall-Theil Robust Line regression. This approach was chosen to handle data outliers better than other regression methods, such as ordinary least-squares regression.

5.2 Influent - Effluent performance curves

The pollutant load entering a BMP is estimated by calculating the product of the average annual influent volume and the mean COC concentration in the watershed. The BMP pollutant load reduction is calculated by the sum of:

1. **Infiltration** - The load reduced by infiltration is calculated as the watershed pollutant concentration multiplied by the volume lost to infiltration by the facility.
2. **Treatment** - The load reduced by treatment is calculated as the product of the volume treated and the reduction in concentration achieved by the facility between the influent and treated effluent.

To calculate the concentration reduction for treated water, this approach uses as input a set of influent-versus-effluent concentration curves. These define the best estimate of average effluent quality based on the average influent quality. These curves were developed based on monitoring studies in the International Stormwater BMP Database (http://bmpdatabase.org/), as prepared for the San Diego WQE (2018). An example plot representing the functional relationship between influent and effluent TSS concentration for several BMP types is shown below in Figure 6.

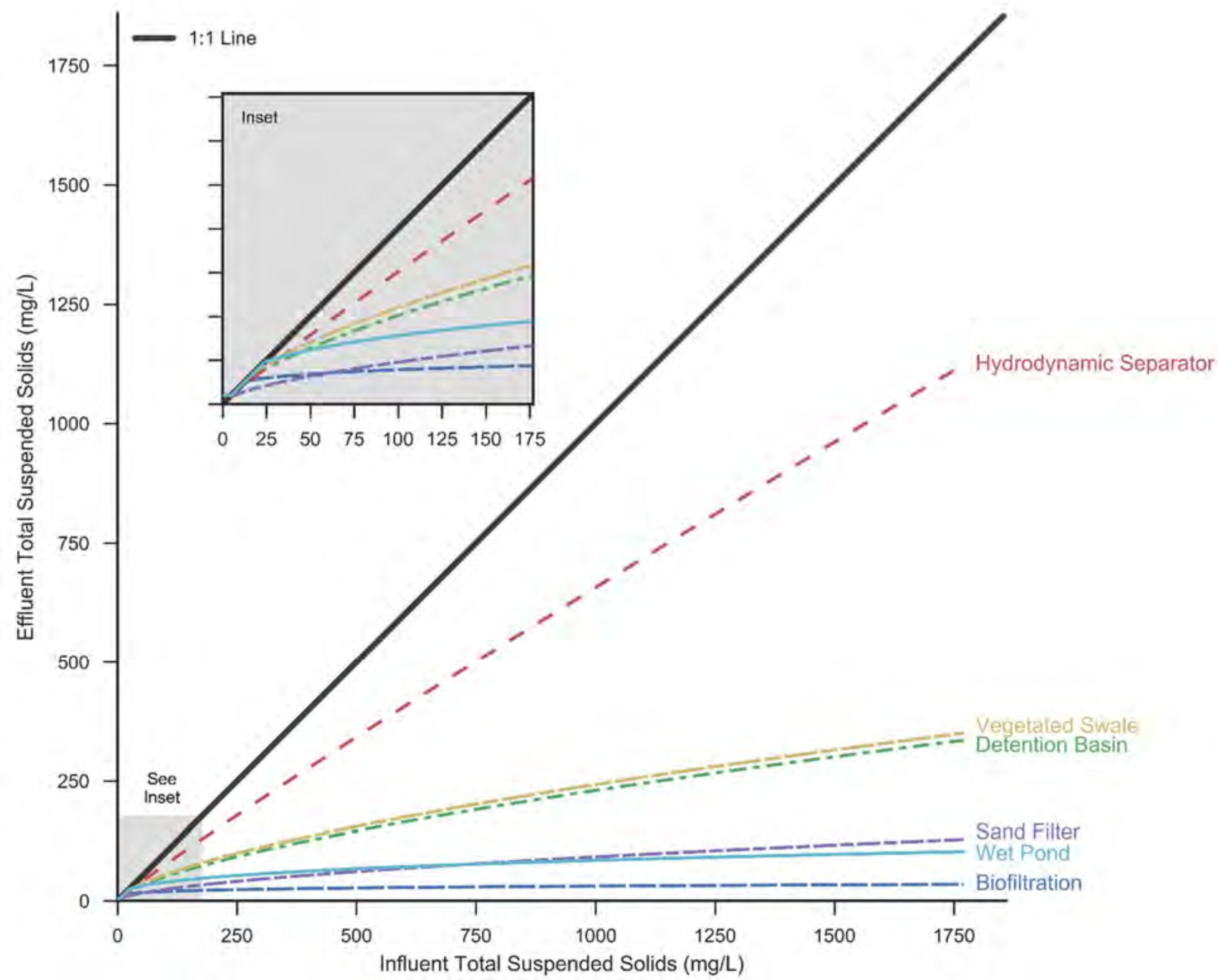

Figure 6. Influent vs effluent curve for TSS removal by BMP type

The load reduction mechanism(s) for each of BMP types are listed below in Table 6.

Table 6. Load reduction calculation approach for BMP types

Water Quality BMP Types	Eliminates Load (Infiltrated / diverted)	Treatment & Discharge Influent-Effluent Curve
Rain Garden with no Underdrain	Infiltration	No treatment assumed (infiltration only)
Infiltration Basin/Trench	Infiltration	No treatment assumed (infiltration only)
Drywell	Infiltration	No treatment assumed (infiltration only)
Permeable Pavement	Infiltration	No treatment assumed (infiltration only)
Underground Infiltration	Infiltration	No treatment assumed (infiltration only)
Cisterns for Harvest and Use	Infiltration	No treatment assumed (infiltration only)
Rain Garden (bioretention with raised underdrain)	Infiltration	Biofiltration/Bioretention
Dry Extended Detention Basin/Tank	Infiltration	Detention Basin
Flow Duration Control Basin/Tank	Infiltration	Detention Basin
Vegetated Swale	Infiltration	Vegetated Swale
Rain Garden with Underdrain and Liner	No infiltration assumed	Biofiltration/Bioretention
Filterra /Vegetated box	No infiltration assumed	High Rate Biofiltration
Media Filter	No infiltration assumed	High Rate Media Filter
Other Proprietary Biotreatment	No infiltration assumed	High Rate Biofiltration
Oil-water Separator	No infiltration assumed	Oil-water separator
Sand Filters	No infiltration assumed	Sand Filter
Hydrodynamic Separator	No infiltration assumed	Hydrodynamic Separator
Wet Pond	No infiltration assumed	Wet Pond/Wetland Basin

The overall load reduction is calculated as the sum of the load removed via infiltration and the load removed via treatment. The load downstream of a BMP is calculated as the influent load minus these two components of load reduction. The effluent concentration is calculated as the load divided by the effluent volume. Bypass volume is assumed to be untreated and is assigned the contributing catchment concentration.

6. PERFORMANCE OF SOURCE CONTROL BMPS

6.1 Street Sweeping

6.1.1 Performance Data

Tacoma performs enhanced street sweeping across the city using regenerative air machines. Currently, all areas of the city are swept at least twice a year, with more frequent sweeping occurring for major arterials and business districts (City of Tacoma 2017).

Tacoma has been monitoring sweeping performance in the Thea Foss watershed since 2012. A summary of monitoring results is shown in Table 7. For most COCs, the trend in removal efficiencies are relatively steady, although values fluctuate from year-to-year.

Table 7. Summary of Reduction in COC Concentrations for Street Sweeping in the Thea Foss Watershed, 2012-2021

COC	2012	2013	2014	2015	2016	2017*	2018*	2019*	2020†	2021†	Mean Value (Tool Default)	Trend
Bis(2EH)phthalate	47%	50%	53%	55%	55%	34%	37%	42%	35%	36%	**44%**	
Indeno(1,2,3-c,d)pyrene	66%	64%	67%	68%	67%	50%	49%	49%	39%	33%	**55%**	
Phenanthrene	65%	68%	70%	70%	71%	51%	50%	51%	41%	41%	**58%**	
Pyrene	61%	69%	71%	73%	73%	54%	54%	54%	44%	43%	**60%**	
TSS	18%	20%	21%	22%	24%	18%	18%	18%	27%	26%	**21%**	
Zinc	19%	23%	27%	29%	32%	29%	30%	30%	36%	36%	**29%**	

* includes enhanced sweeping for outfalls 243, and 245

† includes enhanced sweeping for outfalls 243, 245, and 254

6.1.2 Tool assumptions

To calculate pollutant removal attributable to street sweeping, the tool will employ the following assumptions.

- Default removal for each COC will be set at the mean value as shown in Table 7.
- Pollutant reduction will be calculated prior to influent concentrations draining to BMPs.
- Street sweeping will be assumed to apply evenly to an entire watershed.
- The default value will be able to be adjusted for each watershed independently by users.

6.2 Storm Line Cleaning

Similar to Street Sweeping, Anchor QEA (2012) evaluated performance of basin-wide storm-line cleaning.

Table 8. Summary of Storm Line Cleaning Monitoring in the Thea Foss Watershed, 2012-2021

COC	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Mean Value (Tool Default)	Trend
Bis(2EH)phthalate	40%	52%	54%	57%	58%	56%	54%	54%	54%	55%	56%	**54%**	
Indeno(1,2,3-c,d)pyrene	76%	78%	79%	81%	80%	79%	76%	75%	74%	74%	74%	**77%**	
Phenanthrene	72%	73%	75%	77%	77%	77%	75%	74%	74%	74%	74%	**75%**	
Pyrene	77%	79%	81%	83%	83%	82%	80%	79%	79%	79%	79%	**80%**	
TSS	21%	21%	25%	28%	30%	32%	30%	30%	29%	30%	31%	**28%**	
Zinc	20%	22%	26%	28%	30%	32%	32%	33%	34%	36%	37%	**30%**	

6.2.1 Tool assumptions

To calculate pollutant removal attributable to line cleaning, the tool will employ the following assumptions.

- Default removal for each COC will be set at the mean value as shown in Table 8.
- Pollutant reduction will occur after to effluent concentrations discharging from BMPs.
- Storm line cleaning will be assumed to apply evenly to an entire watershed.
- The default value will be able to be adjusted for each watershed independently by users.

7. REFERENCES

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APPENDIX A

HSPF IMPLND and PERLND Factors

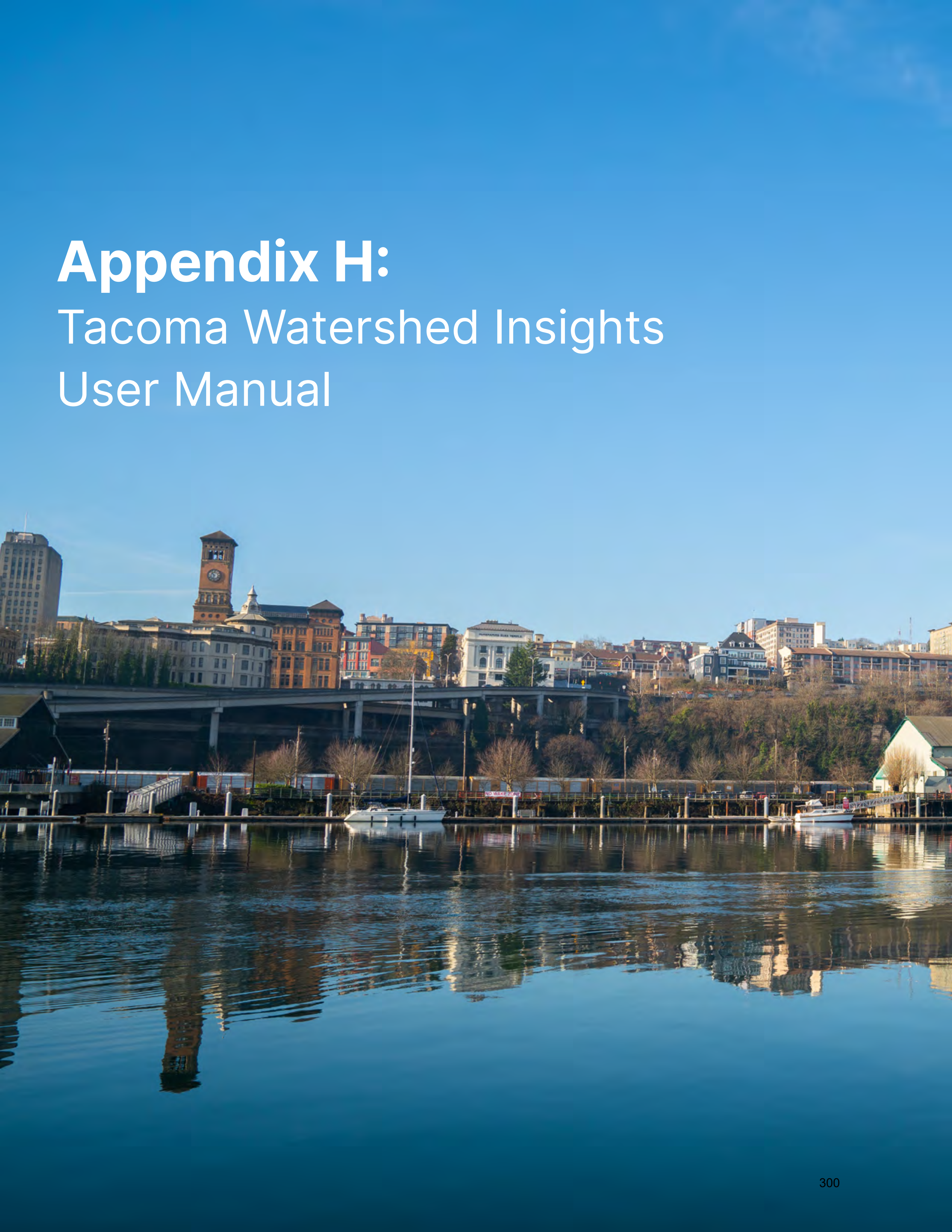
Table A-1 HSPF PERLND Factors

HRU	Soil	Land Cover		Slope	LZSN	INFILT	LSUR	SLSUR	KVARY	AGWRC	INFEXP	INFILD	BASETP	AGWETP	CEPSC	UZSN	NSUR	INTFW	IRC	LZETP	IWAT	RETSC
000	A/B	Forest		Flat	5	2	400	0.05	0.3	0.996	2	2	0	0	0.2	0.5	0.35	0	0.7	0.7	NA	NA
001	A/B	Forest		Mod	5	2	400	0.1	0.3	0.996	2	2	0	0	0.2	0.5	0.35	0	0.7	0.7	NA	NA
002	A/B	Forest		Steep	5	2	400	0.15	0.3	0.996	2	2	0	0	0.2	0.5	0.35	0	0.7	0.7	NA	NA
010	A/B	Pasture		Flat	5	1.5	400	0.05	0.3	0.996	2	2	0	0	0.15	0.5	0.3	0	0.7	0.4	NA	NA
011	A/B	Pasture		Mod	5	1.5	400	0.1	0.3	0.996	2	2	0	0	0.15	0.5	0.3	0	0.7	0.4	NA	NA
012	A/B	Pasture		Steep	5	1.5	400	0.15	0.3	0.996	2	2	0	0	0.15	0.5	0.3	0	0.7	0.4	NA	NA
020	A/B	Lawn		Flat	5	0.8	400	0.05	0.3	0.996	2	2	0	0	0.1	0.5	0.25	0	0.7	0.25	NA	NA
021	A/B	Lawn		Mod	5	0.8	400	0.1	0.3	0.996	2	2	0	0	0.1	0.5	0.25	0	0.7	0.25	NA	NA
022	A/B	Lawn		Steep	5	0.8	400	0.15	0.3	0.996	2	2	0	0	0.1	0.5	0.25	0	0.7	0.25	NA	NA
100	C	Forest		Flat	4.5	0.08	400	0.05	0.5	0.996	2	2	0	0	0.2	0.5	0.35	6	0.5	0.7	NA	NA
101	C	Forest		Mod	4.5	0.08	400	0.1	0.5	0.996	2	2	0	0	0.2	0.5	0.35	6	0.5	0.7	NA	NA
102	C	Forest		Steep	4.5	0.08	400	0.15	0.5	0.996	2	2	0	0	0.2	0.3	0.35	6	0.3	0.7	NA	NA
110	C	Pasture		Flat	4.5	0.06	400	0.05	0.5	0.996	2	2	0	0	0.15	0.4	0.3	6	0.5	0.4	NA	NA
111	C	Pasture		Mod	4.5	0.06	400	0.1	0.5	0.996	2	2	0	0	0.15	0.4	0.3	6	0.5	0.4	NA	NA
112	C	Pasture		Steep	4.5	0.06	400	0.15	0.5	0.996	2	2	0	0	0.15	0.25	0.3	6	0.3	0.4	NA	NA
120	C	Lawn		Flat	4.5	0.03	400	0.05	0.5	0.996	2	2	0	0	0.1	0.25	0.25	6	0.5	0.25	NA	NA
121	C	Lawn		Mod	4.5	0.03	400	0.1	0.5	0.996	2	2	0	0	0.1	0.25	0.25	6	0.5	0.25	NA	NA
122	C	Lawn		Steep	4.5	0.03	400	0.15	0.5	0.996	2	2	0	0	0.1	0.15	0.25	6	0.3	0.25	NA	NA
200	SAT	Forest		Flat	4	2	100	0.001	0.5	0.996	10	2	0	0.7	0.2	3	0.5	1	0.7	0.8	NA	NA
201	SAT	Forest		Mod	4	2	100	0.01	0.5	0.996	10	2	0	0.7	0.2	3	0.5	1	0.7	0.8	NA	NA
202	SAT	Forest		Steep	4	2	100	0.1	0.5	0.996	10	2	0	0.7	0.2	3	0.5	1	0.7	0.8	NA	NA
210	SAT	Pasture		Flat	4	1.8	100	0.001	0.5	0.996	10	2	0	0.5	0.15	3	0.5	1	0.7	0.6	NA	NA
211	SAT	Pasture		Mod	4	1.8	100	0.01	0.5	0.996	10	2	0	0.5	0.15	3	0.5	1	0.7	0.6	NA	NA
212	SAT	Pasture		Steep	4	1.8	100	0.1	0.5	0.996	10	2	0	0.5	0.15	3	0.5	1	0.7	0.6	NA	NA
220	SAT	Lawn		Flat	4	1	100	0.001	0.5	0.996	10	2	0	0.35	0.1	3	0.5	1	0.7	0.4	NA	NA
221	SAT	Lawn		Mod	4	1	100	0.01	0.5	0.996	10	2	0	0.35	0.1	3	0.5	1	0.7	0.4	NA	NA
222	SAT	Lawn		Steep	4	1	100	0.1	0.5	0.996	10	2	0	0.35	0.1	3	0.5	1	0.7	0.4	NA	NA

Table A-2 HSPF IMPLND Factors

HRU	Land Cover	Slope	LSUR	SLSUR	NSUR	RETSC
250	Impervious	Flat	400	0.01	0.1	0.1
251	Impervious	Moderate	400	0.05	0.1	0.08
252	Impervious	Steep	400	0.1	0.1	0.05

Appendix H:
Tacoma Watershed Insights User Manual



Geosyntec consultants

engineers | scientists | innovators

USER'S MANUAL

City of Tacoma Watershed Planning Project

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City of Tacoma

Prepared by

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August 2023

Contents

1 Introduction

This manual describes how to use the Tacoma Watershed Insights web application. This application lets users track stormwater infrastructure, assess performance, and make informed decisions regarding stormwater and water quality in Tacoma.

1.1 Purpose

The purpose of this manual is to provide a guide for users who want to learn how to navigate and use the Tacoma Watershed Insights web application. The manual covers the following topics:

- How to access and log in to the application
- How to view and explore the map and data layers
- How to use the tools and features of the application
- How to export and share data and reports

This manual is focused on the usability of the web application. It does not provide technical details about the methodology behind calculations or modeling assumptions. For information regarding these aspects, please refer to the Technical Methodology Report [1].

The manual assumes that users have a basic familiarity with web browsers and GIS concepts. The manual also provides links to external resources for further information and learning.

1.2 Key Concepts

Before using the Tacoma Watershed Insights web application, it is helpful to understand some key concepts that are used in the tool. These concepts are also referred to throughout this manual.

[1] *Technical Methods and Approach Document - City of Tacoma Watershed Planning Project.* Geosyntec Consultants, June 2023.

1.2.1 Climate Epochs

Stormwater facility results are calculated based on continuous rainfall-runoff simulation using a regional precipitation data set.[2]

Four scenarios or *climate epochs* have been developed as shown in Table 1.1.

Table 1.1: Climate Epochs

Scenario	Begin	End
1980s (Historic)	January 1, 1970	December 31, 1999
2030s	January 1, 2000	December 31, 2039
2050s	January 1, 2040	December 31, 2069
2080s	January 1, 2070	December 31, 2099

1.2.2 Facility Types

Water quality and hydrology calculations are specific to each facility type. *Facility Type* refers to stormwater facility names used by the City of Tacoma.

Table 1.2: Facility Types contained in the Tacoma Watershed Insights application

Facility Type	Description
Filterra/Vegetated box	Manufactured devices with high-rate filtration media that support plants.
Media Filter	Manufactured devices with high-rate filtration media consisting of a variety of inert and sorptive media types and configurations (e.g., cartridge filters, upflow filters, membrane filters, vertical bed filters).

[2]Salathé, E.P., Hamlet, A.F., Mass, C.F., Lee, S-Y., Stumbaugh, M., Steed, R. 2014. Estimates of Twenty-first Century flood risk in the Pacific Northwest based on regional scale climate model simulations. J. Hydrometeorology 15(5): 1881-1899, https://doi.org/10.1175/JHM-D-13-0137.1

Facility Type	Description
Oil-water Separator	Manufactured devices including oil/water separators and baffle chambers designed for removing floatables and coarse solids.
Pervious Pavement	Full-depth pervious concrete, porous asphalt, paving stones or bricks, reinforced turf rings, and other permeable surface designed to replace traditional pavement.
Pond/wet vault	Surface wet pond with a permanent pool of water, may include underground wet vaults.
Bioretention	Shallow, vegetated basins with a variety of planting/filtration media and often including underdrains.
Sand Filter	Filter bed with granular media, typically sand.
Swale	Shallow, vegetated channel, also called bioswale or vegetated swale.
Swirl Separator	Manufactured devices providing gravitational settling using swirl concentrators, screens, and baffles. Also referred to as hydrodynamic separators (HDS).
Dry Extended Detention Basin/Tank	Dry extended detention including grass-lined and concrete lined basins that are designed to empty after a storm.
Trench	Filter bed with granular media, typically sand. Full infiltration
Vault	Concrete-lined basins that drain after a storm.

1.2.3 Simple vs. Detailed Facilities

In the context of the Tacoma Watershed Insights application, facilities can be modeled as one of two types: Simple and Detailed.

The Tacoma Watershed Insights application models stormwater infrastructure as either Simple or Detailed facilities based on the availability of data and the complexity of the facility's design and operation.

1.2.3.1 Simple Facilities

By default, facilities are initially modeled as Simple Facilities unless detailed information has been entered. The Simple Facility model is used when detailed data about a facility is not available, such as the specific design parameters of the facility or the infiltration area. Simple facilities are assumed to treat or retain 91% of runoff from the effective drainage area.

1.2.3.2 Detailed Facilities

If more detailed data about a facility are available, the application can model the facility as a Detailed Facility. When the Simple Facility switch is turned off, parameters specific to the facility type become editable. Detailed Facilities provide a more accurate and comprehensive model of a facility's performance.

1.2.4 Pollutants

The Tacoma Watershed Insights application models 8 different stormwater pollutants. These are shown below.

Table 1.3: Stormwater Pollutants

Parameter	Group	EIM Parameter CAS
Bis(2-ethylhexyl) phthalate	Phthalate	117-81-7
Copper	Metal	7440-50-8
Phenanthrene	LPAH	85-01-8
Pyrene	HPAH	129-00-0
Total Nitrogen	Nutrient	None
Total Phosphorus	Nutrient	7723-14-0
Total Suspended Solids	Conventional	None
Zinc	Metal	7440-66-6

1.2.5 Subbasins

A Subbasin is a geographical area that drains into a particular receiving water or collection system node. In addition to reporting facility performance, the tool reports metrics on a subbasin level.

The subbasins used in this tool have been developed by the City of Tacoma. They are summarized in Table 1.4. Subbasins are referenced by a unique subbasin code using the subbasin code prefix shown in Table 1.4. For example, the first subbasin that is part of the Flett Creek Basin would be `FL_01`.

Table 1.4: City of Tacoma Subbasins

Basin	Number of Subbasins	Subbasin Code prefix
Flett Creek	10	`FL_`
Foss Waterway	15	`FS_`
Joes Creek	3	`JC_`
Leach Creek	6	`LC_`
Lower Puyallup	6	`LP_`
North Tacoma	11	`NT_`
Northeast Tacoma	6	`NE_`
Tideflats	6	`TF_`
Western Slopes	4	`WS_`

2 System Administration

2.1 Sign Up as a New User

You must register and be approved as a new user before using the site. To sign up, click **Login** in the upper right hand corner of the site. At the login page, click **Register** to be taken to the registration page. After entering the required details, click **Submit** to create your account. An email will be sent to your provided email address for verification.

Before you can access the site, your account must be approved by a User Admin. See the Modifying User Roles section for information on approving new users.

2.2 User Roles

Users can have one of the following roles associated with their account.

Only a User Admin or System Admin may edit user roles.

Table 2.1: Roles and Permissions

Role	Permissions
Public	None
Read-only	Read access to data via site and via token
User/Editor	All of the above, plus • access to scenarios and editing data
User Admin	All of the above, plus • access to user manager • access to application settings
System Admin	All of the above, plus • direct api access

2.3 Managing Users

Only a User Admin or System Admin may edit user roles. To approve new users and to update user roles, follow these steps.

1. Click on your profile avatar in the upper left-hand corner of the screen.
2. Select **Manage Users** from the menu.

You will be taken to the Manage Users page, where you can edit and save user role information.

3 Viewing Results with the Map Explorer

The map explorer module is the main access point for all the spatial resources that can be used to view existing infrastructure and water quality conditions.

3.1 Viewing Layers

By default, the following layers are enabled:

- Stormwater facilities
- Stormwater facility delineations
- Stormwater subbasins

To view other layers select the layer icon on the left-hand menu. A new panel will display with available layers.

Other layers that can be viewed are shown below.

Table 3.1: Map Data Layers

Category	Layer Name
Conveyances	Catchbasin Leads Regional Facility Model: Manholes Surfacewater Inlet Surfacewater Main Surfacewater Trunk
Landcover & Landuse	Land Cover Category Imperviousness Contours Runoff Terrain

Category	Layer Name
Pollutants	Total Copper Concentration Total Nitrogen Concentration Total Suspended Solids Concentration Total Zinc Concentration

3.2 Viewing Facility Overview Information

You can view summary information for a particular BMP by clicking on it from the Map Explorer. The map will zoom to the selected facility and a panel will be displayed showing information on a facility.

3.3 Viewing Facility Details

Click on **View Facility Details** from the Facility Overview Panel to see and edit particular facility attributes. In addition to the overview information displayed on the Map Explorer, you can view water quality parameters, cost analysis parameters, and detailed performance data.

3.4 Exporting Facility Details

To export detailed facility data, click on **Export Results** from the Facility Detail Page. This will export a `.csv` file with all facility attributes and performance results.

3.5 Searching for a Facility

To search for a particular facility, select the search icon on the left-hand toolbar. A panel will appear with search options. You may search by the following categories:

- **altid/node_id** - Refers to the facility id.
- **Facility Type** - Refers to the City designated facility type
- **Facility Type (WQ Modeling)** - Refers to the facility type designation used for water quality modeling

4 Results Viewer

4.1 Using the BMP Facility Results View

The BMP Facility Results View can be used to view a summary of the performance of existing BMP's. To access the viewer, select **WQ Results Viewer** from the dropdown menu at the top menu bar, or from the homepage.

You can view individual BMP results by selecting the **BMP Facility Results View** card or by selecting the icon on the left-hand menu bar. Results are summarized by climate epoch.

4.2 Using the Subbasins Results View

The water quality results viewer can be used to view the conditions of each stormwater subbasin. To access the viewer, select it from the dropdown menu at the top menu bar, or the homepage.

You can view aggregated results by subbasin by selecting the **Subbasin Results View** card or by selecting the icon on the left-hand menu bar. To view a chloropleth map of results, select the parameter to visualize from the menu next to the map.

4.3 Exporting Results

To export results from the Subbasin Results View, click the **Export** button on the table below the map. This will download a CSV file of all results. To export a selection of data, select the rows you want to export on the table, then click **Export**.

5 Editing Facility Data

5.1 Editing Water Quality Parameters

You can edit the parameters used to model facilities in the **Facility Details** view. There are several ways to navigate to this view:

- From the Map Explorer map, click on a facility to open the Facility Overview panel. Then, click on **View Facility Details** to be taken to the detail page.
- From the **Water Quality Results Viewer,** click on a BMP name in the table.

5.2 Updating from Simple to Detailed Facility

By default, most facilities are modeled as simple facilities, meaning only two parameters are used: Captured Percentage, and Retained Percentage. The Simple Facility type should be used when detailed data about a facility are not available (e.g. the facility's infiltration area).

If more detailed data are available, turn off the Simple Facility switch, and parameters specific to the facility type will be editable.

5.3 Editing Facility Type

If a Facility Type needs to be updated, select the Facility Type dropdown menu, and choose the appropriate facility type. Click **Save** to save your edits.

Warning Saving your edits does not recalculate results. To recalculate, click the **Refresh Results** button on the Facility Details Page.

5.4 Editing Life Cost Analysis Parameters

By default, facilities will not have cost parameters unless users provide cost analysis parameters. Facilities without cost data will show the following message under the Lifecycle Cost Analysis Heading:

> *Lifecycle costs are unavailable for this facility. This usually means that the "Cost Analysis Parameters" are incomplete.*

To edit lifecycle cost parameters, select the dropdown menu titled **Cost Analysis Parameters.** There, you can enter the cost analysis parameters directly for a facility. See the Cost Analysis Parameters section for descriptions of parameters.

5.4.1 Cost Estimator Tool

To assist with selection of cost analysis parameters, a cost estimator tool is available; it uses cost curves and methodology developed by King County to provide high-level cost estimates for various facilities. To use this tool, select a BMP to view the BMP facility details page. Next, click on the cost analysis parameters drop down and then click on the **King County Cost Estimator Tool.** This will open a dialog box to select and apply data from King County cost curves.

First, select the appropriate facility type under the **BMP Type** dropdown menu. This will preselect an appropriate BMP Cost Curve used by King County (**KC BMP Variation** in the tool). You can refine or change the selected cost curve under the **KC BMP Variation** menu. Cost curves that match the selected **BMP Type** will be shown in **bold**.

In order to calculate the cost parameters, you must enter a sizing parameter in the next dialog box. Depending on the cost curve selected, the dialog box will display either *area (sqft)* or *each (count).* Here, *area* refers to the footprint area of a facility (e.g. the total area of pervious pavement), or the number of facilities to be installed (e.g. number of UIC wells).

After entering the number denoting the area or number of facilities, the Capital Cost and O&M Costs will be calculated. Click *Apply to BMP Form* to apply the calculated costs to the facility. To calculate the final lifecycle cost, you will need to enter data for the following:

Install Year - The year of installation, denoting what year to apply the capital costs.

Replacement Cost - The cost to replace a facility. This cost is intended to reflect costs related to major replacement of facility components, such as replacement of soil after multiple years of use.

Lifespan Yrs - How long the facility would be operated before replacement would be necessary.

5.4.2 Global Cost Settings

In order to calculate lifecycle costs the same way for every facility, the tool uses four global cost parameters (*discount rate*, *inflation rate*, *planning horizon*, and *cost basis year*). These parameters apply to all facilities analyzed, instead of a particular facility.

To edit these global parameters, select *Settings* under your user profile in the top left portion of the screen. Individual cost parameters can be edited by clicking the edit tool to the left of each parameter name.

6 Using the Prioritization Module

The watershed prioritization module allows users to identify and prioritize areas for actions to meet watershed planning goals related to water quality, habitat, and social equity.

6.1 Selecting Project Type

The *Project Type* dialog denotes what type of project is being considered. The two choices are:

- **Retrofit** - Projects that are intended to improve water quality or hydrology. This choice gives a higher priority to subbasins that have a higher pollutant load, or do not have adequate stormwater infrastructure.
- **Preservation** - Projects that are intended to preserve an area in a subbasin with better water quality or already have adequate stormwater infrastructure.

6.2 Setting Priority Weights

The prioritization tool allows users to weight watershed management goals based on their relative importance. Weights are positive numbers

Weights can be zero or any positive number, and reflect a decision maker or stakeholders preferences. The higher the weight, the more important the criterion. Numerically, this represents a factor of preference. For example if Goal A has a weight of 1 and Goal B has a weight of 2, Goal B will be treated as twice as important as Goal A.

No constraints have been set on the scale of weights, however, it is common practice to set a total number of weighting points (e.g. 10 points) and assign weights so that the sum of weights is equal to this predetermined total.

Priority weights are assigned for each major watershed goal. Goals are comprised of subgoals and numeric metrics as described in Table 6.1:

Table 6.1: Watershed Planning Goals used in the Prioritization Module.

Goals	Sub-goals	Criteria
Goal 1: Improve Water Quality Outcomes (Clean Water Goal)	1.1 Prioritize areas based on pollutant concentrations	Total Nitrogen Concentration, TSS Concentration, Annual Runoff, Imperviousness
	1.2 Improve infrastructure in areas with inadequate stormwater management	Percent of Area Treated, Age of Development
Goal 2: Increase Resilience to Climate Change Impacts (Resilient Community Goal)	2.1 Target areas most vulnerable to and at risk for climate change impacts	Urban Heat Island, Capacity Issues Layer
Goal 3: Preserve and Restore Critical and Sensitive Habitat (Healthy Ecosystems)	3.1 Preserve and Improve Natural Spaces	ES Open Space/Natural Resource Areas, Biodiversity Corridors
Goal 4: Implement Equity and Social Justice (Healthy Neighborhoods; Equity)	4.1 Prioritize areas of overlapping equity needs as identified by other Tacoma programs	Equity Index Score, Livability Index
	4.2 Improve access to safe, high-quality roadway infrastructure (green infrastructure recommendation)	Pavement Condition Index

6.3 Viewing Prioritization Results

After selecting and submitting priority weights, results will be shown on the chloropleth map and in the *Subbasin Prioritization Results* table.

Subbasins with higher priority scores reflect a higher preference for new projects based on user weighting. Clicking on a row will highlight the selected subbasin on the map.

6.4 Downloading Prioritization Results

To understand the breakdown of attributes and weights from the prioritization module, download the results by clicking on the *Export* button. This will download a .CSV file listing subgoals, criteria, weights, direction of criteria (whether a criterion should be minimized or maximized), as well as the criterion-specific results.

7 Using the Scenario Designer

The Scenario Designer is used to create and evaluate potential new facilities or groups of facilities. It can be used to assess the potential performance of a new action, or compare various alternative actions.

7.1 Creating a New Scenario

To create a new scenario, click **Create New Scenario** in the Scenario Designer page. A new window will open with a multi-step form where you can enter information about your scenario. The first step asks for basic information about your scenario. Enter this information, then click **Next.**

7.1.1 Creating a New Delineation.

The next step is to create a new delineation. The new delineation represents the area that drains to a new facility. Enter a name for this new delineation and then click the **edit icon** on the map window.

Use the stormwater upstream trace tool in Tacoma's GIS system (AccessES) to identify the approximate upstream drainage area to the node where you plan to install the new facility. Draw the new delineation on the map. Double-click to complete the delineation. To delete a delineation after it has been completed, click the **delete icon** on the map window.

Once you have finished creating the delineation, click **Next.**

7.1.2 Creating a new facility

The final step is to create a new BMP facility. Under the **Create a BMP** section, add water quality parameters and cost analysis parameters. See the section on Editing Facility Data for instructions.

Use the map to indicate the location for the new facility. Click the **Edit Icon** in the map window and then click on your desired location on the map. Save your location by clicking on the **Accept Edits** icon. Then click **Next** under the **Create a BMP** form.

The new scenario will be summarized on the next screen. If everything looks good, click **Create Scenario** to save your scenario. On the next screen, be sure to click **Calculate Scenario WQ Results** to generate results.

Caution You must click **Calculate Scenario WQ Results** to generate performance results for your scenario.

8 Data Integrations

Facility data, subbasin data, and results can be easily integrated into other tools and applications through the **Data Integration Module.** Navigate to the module by clicking on **Profile** under the user menu in the top left corner of the application. The **Data Integration** panel is displayed below your profile information.

Data integration is performed through a REST API, which uses HTTP methods to read data from the tool.

8.1 Obtaining a read-only token

Each user is assigned a unique read-only token. This token allows the API server to identify and authorize your requests. Your read-only token will be displayed beneath your user profile.

8.2 Token Rotation

It is good practice to change your token at regular intervals, or in the event of your token being compromised. To rotate your token, click the **Rotate Token** button next to your token.

8.3 Making API Calls

All API calls are GET requests and are made in the following format:

> `https://www.tacomawatersheds.com/api/rest/{resource}/ {resource_id}/token/{toke`

In the above URL structure, `{resource}` is the data type you are requesting, `{resource_id}` is the specific ID of the resource (optional and depends on the endpoint), and `{token}` is your unique read-only token.

8.3.1 API Endpoints

This API is organized around several endpoints representing different types of resources: `tmnt_facility`, `tmnt_delineation`, `subbasin`, and `results`. All responses are provided in JSON format unless otherwise specified.

Common Parameters:

- `f`: (optional, default=json, [json, geojson]) Format of response data
- `limit`: (optional, default=1e6) Number of records to return
- `offset`: (optional, default=0) Start from index
- `epoch`: (optional, default=1980s, [all, 1980s, 2030s, 2050s, 2080s]) Climate epoch filter

Get attributes for all treatment facilities:

> `/api/rest/tmnt_facility/token/{token}?f={f}&limit={limit} &offset={offset}`

Get attributes for a specific treatment facility:

> `/api/rest/tmnt_facility/{altid}/token/{token}`

Replace `{altid}` with the specific facility id.

Get attributes for all delineations:

> `/api/rest/tmnt_delineation/token/{token}?f={f}&limit= {limit}&offset={offset}`

Get attributes for a specific delineation:

> `/api/rest/tmnt_delineation/ {altid}/token/{token}?f={f}`

Replace `{altid}` with the specific delineation id.

Get attributes for all subbasins:

> `/api/rest/subbasin/token/{token}?f={f}&limit={limit}& offset={offset}`

Get attributes for a specific subbasin:

> `/api/rest/subbasin/{subbasin_id}/token/{token}`

Replace `{subbasin_id}` with the specific subbasin id.

Get water quality results for a specific subbasin:

> /api/rest/subbasin/wq/{subbasin_id}/token/{token}?epoch={epoch}

Replace `{subbasin_id}` with the specific subbasin id.

Get water quality results for all subbasins:

> /api/rest/subbasin/wq/token/{token}?f={f}&limit={limit}&offset={offset}&epoch={epoch}

Get results:

> /api/rest/results/token/{token}?ntype={ntype}&limit= {limit}&offset={offset}epo

The `ntype` parameter is optional and filters the data by node type (land_surface, tmnt_facility).

8.4 How to connect Excel with Tacoma Watersheds Results

Power Query is a powerful tool within Microsoft Excel that allows you to import data from various external data sources, including RESTful APIs. This tutorial will guide you on how to connect Excel Power Query with the Tacoma Watersheds `results` API.

Before starting, make sure you have your unique read-only token from the Tacoma Watersheds API.

8.4.1 Step 1: Open Power Query

1. Open Excel, and go to the **Data** tab in the Ribbon.
2. Click on **Get Data** in the left corner of the Ribbon.
3. In the dropdown menu, select **From Other Sources**, then **From Web**.

8.4.2 Step 2: Connect to the API

1. A pop-up window will appear prompting you to enter a URL.
2. In this field, enter the following API endpoint URL:

> https://www.tacomawatersheds.com/api/rest/results/token/{token}?ntype={ntype}limit={limit}& offset={offset}&epoch={epoch}

Replace `{token}` with your unique read-only token and fill in the `{ntype}`, `{limit}`, `{offset}`, and `{epoch}` as per your requirements. For example, if you want to get all results for `land_surface` node type and for the `1980s` climate epoch, your URL would be:

> `https://www.tacomawatersheds.com/api/rest/results/token/ your_token?ntype=land_`
>
> Click **OK**

8.4.3 Step 3: Parse the Response

1. A new window named **Power Query Editor** will open, and Excel will show you a preview of the data.
2. If the data appears as a single column of records, click on **List** to convert it to a table. Then click on the button with two arrows on the right side of the header of the column to expand the data into a tabular format.
3. If the data is in nested JSON format, you may need to click on the double-arrow button again to fully expand the data.

8.4.4 Step 4: Load the Data

1. Once you are satisfied with the preview of the data, click on **Close & Load** in the **Home** tab.
2. Excel will create a new worksheet and load the data into a table.

9 Source Code and Deployment

9.1 Source Code Information

Source code is available for the public at the project github repository: github.com/Geosyntec/StormPiper.

The source code is licensed under the Mozilla Public License 2.0 (MPL 2.0).

9.1.1 About the MPL 2.0

The MPL 2.0 is a free and open-source software license that allows the software to be freely used, modified, and shared under specific terms. Key highlights of the MPL 2.0 include:

- **Copyleft:** Modified files must be released under the same license, but linking is allowed without affecting the rest of the project.
- **Distribution:** You can distribute the code in both source and compiled form, provided you include the license file.
- **Attribution:** The original copyright notices must be retained in redistributed code.
- **Warranty Disclaimers and Liability Limitations:** The license includes standard provisions to protect contributors from legal claims.

You can view the full text of the MPL 2.0 license and specific details regarding the StormPiper project in the GitHub repository at:

https://github.com/Geosyntec/StormPiper/blob/main/LICENSE

Please refer to the `LICENSE` file within the repository for the complete terms and conditions governing the use of the StormPiper source code.

9.2 Local Development

9.2.1 Pre-requisites

Ensure you have Git, Python, Conda, and Docker installed on your system.

9.2.2 Getting Started

Follow the steps below to get the app up and running on your system:

9.2.2.1 Clone the Repository

First, clone the StormPiper repository:

```
git clone git@github.com:Geosyntec/StormPiper.git
```

9.2.2.2 Build and Activate a Virtual Environment

Next, create a virtual environment using Conda and activate it:

```
conda create -n stormpiper python=3.11
conda activate stormpiper
```

9.2.2.3 Install the Required Dependencies

Navigate to the StormPiper directory and install the necessary dependencies:

```
cd StormPiper
pip install -r stormpiper/requirements.txt
pip install -r stormpiper/requirements_test.txt
```

9.2.3 Running the Development Server

Run the development server with the following command:

```
uvicorn stormpiper.main:app --reload --port 8000
```

You can access the documentation at `localhost:8000/docs`.

9.2.4 Making Changes and Maintenance

9.2.4.1 Running Tests

Run the tests using:

```
pytest
```

To check test coverage:

```
coverage run --branch -m pytest
coverage report -m
```

9.2.4.2 Code Formatting and Type Checks

Use the provided script to check code formatting and type declarations:

```
bash scripts/lint.sh
```

9.2.5 Docker Deployment

9.2.5.1 Building the Container

Use the following command to build the container. It runs `make clean`, `make stack`, and then `make build`:

```
make develop
```

9.2.5.2 Running the Container

Start the container with:

```
make up
```

You can access the development server at `localhost:8080`.

To silence the logs, run the container in `daemon` mode:

```
make up-d
```

9.2.5.3 Stopping the Container

Stop the container by using:

```
make down
```

9.3 Deployment

Deploying the applicaiton on your own server requires knowledge of Kubernetes. Kubernetes is an open-source container orchestration platform that automates the deployment, scaling, and management of containerized applications. It provides mechanisms for deploying and managing applications across multiple servers, ensuring high availability and scalability.

See the Kubernetes documentation on Google Cloud Plaform for more information.

9.4 Deployment configuration

See the deployment scripts on the github repo for examples on how this applicaiton was deployed: https://github.com/Geosyntec/StormPiper/tree/main/.github/workflows

10 Parameter Definitions

10.1 Facility Parameters

Table 10.1: Facility Input Data

Parameter	Description
area_sqft	The footprint area of the facility in square feet.
captured_pct	The average annual percent of stormwater captured by the facility.
depth_ft	The depth of ponding for the facility in feet.
hsg	Hydrologic Soil Group classification for native infiltration. Valid Options: A B C D
inf_rate_inhr	The infiltration rate at the facility location in inches per hour.
media_filtration_rate_inhr	The media filtration rate at the facility in inches per hour.
retained_pct	The percent of stormwater retained or infiltrated by the facility.
retention_volume_cuft	The design retention volume of the facility in cubic feet.
treatment_rate_cfs	The treatment rate of the facility in cubic feet per second.

Table 10.2: Facility Water Quality Result Parameters

Parameter	Description
DEHP_conc_mg/l_effluent	Mean annual concentration of Bis(2-ethylhexyl) phthalate (DEHP) discharged from a facility (mg/l)
DEHP_conc_mg/l_influent	Mean annual concentration of Bis(2-ethylhexyl) phthalate (DEHP) flowing to a facility (mg/l)
DEHP_load_lbs_inflow	Mean annual load of Bis(2-ethylhexyl) phthalate (DEHP) entering a facility (lbs)
DEHP_load_lbs_removed	Mean annual load of Bis(2-ethylhexyl) phthalate (DEHP) removed by a facility (lbs)
DEHP_load_lbs_total_discharged	Mean annual load of Bis(2-ethylhexyl) phthalate (DEHP) exiting a facility (lbs)
PHE_conc_mg/l_effluent	Mean annual concentration of Phenanthrene discharged from a facility (mg/l)
PHE_conc_mg/l_influent	Mean annual concentration of Phenanthrene flowing to a facility (mg/l)
PHE_load_lbs_inflow	Mean annual load of Phenanthrene entering a facility (lbs)
PHE_load_lbs_removed	Mean annual load of Phenanthrene removed by a facility (lbs)
PHE_load_lbs_total_discharged	Mean annual load of Phenanthrene exiting a facility (lbs)
PYR_conc_mg/l_effluent	Mean annual concentration of Pyrene discharged from a facility (mg/l)
PYR_conc_mg/l_influent	Mean annual concentration of Pyrene flowing to a facility (mg/l)

Parameter	Description
PYR_load_lbs_inflow	Mean annual load of Pyrene entering a facility (lbs)
PYR_load_lbs_removed	Mean annual load of Pyrene removed by a facility (lbs)
PYR_load_lbs_total_discharged	Mean annual load of Pyrene exiting a facility (lbs)
TCu_conc_ug/l_effluent	Mean annual concentration of Total Copper discharged from a facility (ug/l)
TCu_conc_ug/l_influent	Mean annual concentration of Total Copper flowing to a facility (ug/l)
TCu_load_lbs_inflow	Mean annual load of Total Copper entering a facility (lbs)
TCu_load_lbs_removed	Mean annual load of Total Copper removed by a facility (lbs)
TCu_load_lbs_total_discharged	Mean annual load of Total Copper exiting a facility (lbs)
TN_conc_mg/l_effluent	Mean annual concentration of Total Nitrogen discharged from a facility (mg/l)
TN_conc_mg/l_influent	Mean annual concentration of Total Nitrogen flowing to a facility (mg/l)
TN_load_lbs_inflow	Mean annual load of Total Nitrogen entering a facility (lbs)
TN_load_lbs_removed	Mean annual load of Total Nitrogen removed by a facility (lbs)
TN_load_lbs_total_discharged	Mean annual load of Total Nitrogen exiting a facility (lbs)
TP_conc_mg/l_effluent	Mean annual concentration of Total Phosphorus discharged from a facility (mg/l)
TP_conc_mg/l_influent	Mean annual concentration of Total Phosphorus flowing to a facility (mg/l)
TP_load_lbs_inflow	Mean annual load of Total Phosphorus entering a facility (lbs)

Parameter	Description
TP_load_lbs_removed	Mean annual load of Total Phosphorus removed by a facility (lbs)
TP_load_lbs_total_discharged	Mean annual load of Total Phosphorus exiting a facility (lbs)
TSS_conc_mg/l_effluent	Mean annual concentration of Total Suspended Solids discharged from a facility (mg/l)
TSS_conc_mg/l_influent	Mean annual concentration of Total Suspended Solids flowing to a facility (mg/l)
TSS_load_lbs_inflow	Mean annual load of Total Suspended Solids entering a facility (lbs)
TSS_load_lbs_removed	Mean annual load of Total Suspended Solids removed by a facility (lbs)
TSS_load_lbs_total_discharged	Mean annual load of Total Suspended Solids exiting a facility (lbs)
TZn_conc_ug/l_effluent	Mean annual concentration of Total Zinc discharged from a facility (ug/l)
TZn_conc_ug/l_influent	Mean annual concentration of Total Zinc flowing to a facility (ug/l)
TZn_load_lbs_inflow	Mean annual load of Total Zinc entering a facility (lbs)
TZn_load_lbs_removed	Mean annual load of Total Zinc removed by a facility (lbs)
TZn_load_lbs_total_discharged	Mean annual load of Total Zinc exiting a facility (lbs)

Table 10.3: Facility Hydrology Result Parameters

Parameter	Description
bypassed_pct	Percent of mean annual runoff bypassed by a facility

Parameter	Description
design_intensity_inhr	Design storm intensity for a flow-based facility (in/hour)
design_volume_cuft_cumul	design volume for a volume-based facility (cubic feet)
ro_coeff	Design runoff coefficient for a facility
runoff_volume_cuft_bypassed	Mean annual runoff volume bypassed by a facility (cubic feet)
runoff_volume_cuft_captured	Mean annual runoff volume captured by a facility (cubic feet)
runoff_volume_cuft_inflow	Mean annual runoff volume entering a facility (cubic feet)
runoff_volume_cuft_retained	Mean annual runoff volume retained by a facility (cubic feet)
runoff_volume_cuft_total_discharged	Mean annual runoff volume exiting a facility (cubic feet)
runoff_volume_cuft_treated	Mean annual runoff volume treated by a facility (cubic feet)

10.2 Cost Data Parameters

Table 10.4: Global Cost Parameters

Parameter	Description
cost_basis_year	The base year for the cost calculation.
discount_rate	The rate used for discounting future cash flows.
inflation_rate	The rate of inflation considered in the cost calculation.
planning_horizon_yrs	The planning horizon in years for cost calculation.

Table 10.5: Facility Cost Parameters

Parameter	Description
capital_cost	The total capital cost for the facility.
capital_cost_basis_year	The base year for the calculation of the capital cost of the facility.
install_year	The year when a facility was or will be installed.
lifespan_yrs	The expected lifespan of a facility in years.
om_cost_basis_year	The base year for the calculation of the operation and maintenance cost of the facility.
om_cost_per_yr	The operation and maintenance cost of a facility per year.
present_value_capital_cost	The present value of the capital cost of the facility.
present_value_chart_table	The present value chart table related to the facility.
present_value_cost_table	The present value cost table related to the facility.
present_value_om_cost	The present value of the operation and maintenance cost of the facility.
present_value_total_cost	The total present value cost of the facility.
replacement_cost	The cost to replace or perform major upgrade to the facility.

10.3 Subbasin Parameters

Table 10.6: Landcover parameters

Parameter	Description
lc_pasture_pct	Landcover Pasture (pct)

Parameter	Description
lc_grass_pct	Landcover Grass (pct)
lc_water_pct	Landcover Water (pct)
lc_imp_roof_pct	Landcover Impervious-roof (pct)
lc_imp_nonroof_pct	Landcover Impervious-nonRoof (pct)
lc_imp_total_pct	Landcover Impervious-total (pct)

Table 10.7: Land Use parameters

Parameter	Description
lu_resair_pct	Landuse Airport Compatibility Residential (pct)
lu_commcmu_pct	Landuse Crossroads Mixed-Use Center (pct)
lu_rgcd_pct	Landuse Downtown Regional Growth Center (pct)
lu_com_pct	Landuse General Commercial (pct)
lu_indh_pct	Landuse Heavy Industrial (pct)
lu_indl_pct	Landuse Light Industrial (pct)
lu_resl_pct	Landuse Low-Scale Residential (pct)
lu_ins_pct	Landuse Major Institutional Campus (pct)
lu_resm_pct	Landuse Mid-Scale Residential (pct)
lu_resmfhd_pct	Landuse Multi-Family (High Density) (pct)
lu_comn_pct	Landuse Neighborhood Commercial (pct)
lu_comnmu_pct	Landuse Neighborhood Mixed-Use Center (pct)
lu_os_pct	Landuse Parks and Open Space (pct)
lu_shore_pct	Landuse Shoreline (pct)
lu_rgctm_pct	Landuse Tacoma Mall Regional Growth Center (pct)

Table 10.8: Subbasin Parameters

Parameter	Description
area_acres	The total subbasin area in acres.
basicwq_area_acres	The area in acres allocated for basic water quality.
basicwq_area_pct	The percentage of total area allocated for basic water quality.
eff_area_acres	The effective impervious area within a subbasin in acres.
eff_area_pct	The percentage of total area that is effective impervious area.
enhwq_area_acres	The area in acres treated by enhanced water quality facilities.
enhwq_area_pct	The percentage of total subbasin area treated by enhanced water quality facilities.
fc_area_acres	The area in a subbasin in acres treated by flow control facilities.
fc_area_pct	The percentage of total subbasin area treated by flow control facilities.
runoff_depth_inches	Depth of runoff in inches.
runoff_volume_cuft	Volume of runoff in cubic feet.
runoff_volume_cuft_generated	Volume of runoff generated in cubic feet.
runoff_volume_cuft_reduced	Volume of runoff reduced in cubic feet.
runoff_volume_pct_reduced	The percentage of runoff volume reduced.
tmnt_facility_count	Total number of treatment facilities within a subbasin
treated_area_acres	The area in acres that has been treated by stormwater facilities
treated_area_pct	The percentage of total area that has been treated by stormwater facilities

11 Appendix A - Technical Methodology

HDR

HERRERA

DRAFT
TECHNICAL MEMORANDUM

Date: March 11, 2022

To: Carly Greyell, King County Department of Natural Resources and Parks, Water and Land Resources Division

From: Edith Hadler, HDR Engineering, Inc.
John Lenth, Herrera Environmental Consultants, Inc.
Olivia Wright, Herrera Environmental Consultants, Inc.

Subject: Unit Cost Basis for Water Quality Benefits Evaluation (431-TM1)

CONTENTS

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TABLES

ATTACHMENTS

Glossary of Terms

AACE	Association for the Advancement of Cost Engineering
BMP	best management practice
BOE	Basis of Estimate
CCI	Construction Cost Index
County	King County
CSO	combined sewer overflow
DNR	(Washington State) Department of Natural Resources
Ecology	Washington State Department of Ecology
ENR	*Engineering News-Record*
FV	future value
GSI	green stormwater infrastructure
Herrera	Herrera Environmental Consultants, Inc.
LCC	life-cycle cost
LCCA	life-cycle cost analysis
LTCP	Long-Term Control Plan
NPV	net present value
O&M	operations and maintenance
PDF	Portable Document Format
PRISM	Project Reporting and Information System Management
PV	present value
RKI	Robin Kirschbaum Inc.
ROW	right-of-way
SDOT	Seattle Department of Transportation
SF	square foot/feet
SPU	Seattle Public Utilities
SUSTAIN	System for Urban Stormwater Treatment and Analysis Integration Model
TM	technical memorandum
UIC	underground injection control
WQBE	Water Quality Benefits Evaluation
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation
WTD	(King County) Wastewater Treatment Division

Purpose and Background

The King County Wastewater Treatment Division (WTD) is developing the Water Quality Benefits Evaluation (WQBE) toolkit to inform King County (County) decision-making processes regarding selection of cost-effective water quality improvement investments, reducing pollutant load, and improving ecological and human-health outcomes. This toolkit will be applied to a suite of potential projects and programs that could improve water quality and could be implemented in the areas draining to the WTD service area receiving waters. The results of the evaluation of the projects and programs will provide information about the multiple water quality benefits of potential WTD investments within the context of potential regional investments in other areas of the drainage basins. This information will provide technical support for County discussions with stakeholders, regulators, and decision makers related to water quality investments and policies. The toolkit will also be adaptable and designed to respond to the values supported by the region and WTD ratepayers (including those identified by the Regional Engagement effort of the Clean Water Plan) and future strategic planning needs at the division and department levels (including Clean Water Healthy Habitat).

The WQBE toolkit is being developed in two phases over a period extending from 2020 through 2022. During Phase 1 (2020), a preliminary set of models was developed. In Phase 2 (2021–2022), these models are being further calibrated and refined to support County planning efforts (e.g., Clean Water Plan and Combined Sewer Overflow [CSO] Long-Term Control Plan [LTCP] efforts). Implementation of preliminary analyses using the WQBE toolkit will be performed during its development phases; once finalized, the WQBE toolkit will be used to support a wide range of future planning efforts by the County and potentially other municipalities within the County's jurisdictional borders.

To support preliminary model development in Phase 1, the Herrera Environmental Consultants, Inc. (Herrera) team developed a suite of "Actions" comprising structural practices that improve water quality. These Actions provide the unit building blocks ("Unit Actions") that were aggregated and combined to develop water quality "Programs," or groups of Actions that can be implemented to improve water quality over a broad geographic area. Fact Sheets were developed to document the defining characteristics of each Action and Program, including costs, performance, and modeling inputs. Subsequent work in Phase 1 included modeling these Programs to identify the most cost-effective combinations of Actions or "Packages" for reducing pollutant loads or stormwater volumes.

The Herrera team documented the process used to develop Phase 1 Actions and Programs for the WQBE toolkit in a technical memorandum (420-TM1). This document provided guidance for interpreting the Action and Program Fact Sheets, while supporting detailed documentation on the technical basis of the Fact Sheet content is provided as a series of appendices.

This technical memorandum (431-TM1) documents the methodology and approach used to develop cost estimates for the Phase 1 Actions. It specifically provides revised cost assumptions for each Action that were developed for Phase 2 based on lessons learned from Phase 1.

Cost Estimating Methodology and Approach

This section provides an overview of the methodology and approach used to estimate direct construction cost, indirect non-construction cost, project cost, and life-cycle cost (LCC) for each Action.

Overview

The estimating methodology used to generate planning-level cost estimates is based on an order-of-magnitude cost estimate with planning-level, conceptual scope, and limited conceptual design provided by Herrera and Robin Kirschbaum Inc. (RKI) consultants including design assumptions and dimensions. This was augmented by information from the *King County Surface Water Design Manual*, *City of Seattle Stormwater Manual*, Washington State Department of Ecology (Ecology) *Stormwater Management Manual for Western Washington*, and historical agency and proprietary design and detail information from online sources. General and specific assumptions that influence the cost estimates are documented in the cost spreadsheet for each Action.

The Herrera team developed a suite of Actions comprising structural and non-structural practices that improve water quality. These Actions will be modeled in the System for Urban Stormwater Treatment and Analysis Integration Model (SUSTAIN) to identify the most cost-effective combinations of Actions for reducing pollutant loads and/or stormwater volumes.

A "Unit Action" represents a typical vertical profile, areal footprint, and associated design-drainage area for a specific Action being modeled in SUSTAIN. These Unit Actions need to be a representative footprint of an Action defined to be compatible with the SUSTAIN model. Cost optimization is used to determine the collective sizes and/or number of Unit Actions required to achieve a certain pollutant load reduction target. Each Unit Action has an associated total implementation cost.

This cost estimating effort focuses on the capital and operations and maintenance (O&M) costs for the Unit Actions. The programmatic costs associated with executing groups of Unit Actions within a Program will be defined after further development of the SUSTAIN model is completed and is a future scope element.

Planning-level cost estimates were developed for the Unit Actions and variations listed in Table 1.

Table 1. WQBE Actions and Variations.

Action	Description
Green Stormwater Infrastructure (GSI)	
Rain Garden Installation	WQBE_01_Rain Garden Installation on Property
Bioretention Planter	WQBE_02A_Bioretention Planter on Property
	WQBE_02B_Bioretention Planter in ROW
	WQBE_02C_Bioretention Planter with Property Cost
Bioretention Installation	WQBE_03A_Bioretention Underdrain on Property
	WQBE_03Aa_Bioretention Underdrain with Property Cost
	WQBE_03B_Bioretention No Underdrain on Property
	WQBE_03Bb_Bioretention No Underdrain with Property Cost
	WQBE_03C_Bioretention Underdrain in ROW
	WQBE_03D_Bioretention No Underdrain in ROW
Bioswale Installation	WQBE_04A_Bioswale in ROW
	WQBE_04B_Bioswale on Public Property
	WQBE_04C_Bioswale with Property Cost
Media Filter Drains	WQBE_05A_Media Filter Drain Underdrain
	WQBE_05B_Media Filter Drain No Underdrain
Drywell	WQBE_06A_Drywell on Property
	WQBE_06B_Drywell with Bioretention Planter on Property
Deep UIC Wells	WQBE_07A_Deep UIC Well on Property
	WQBE_07B_Deep UIC Well in ROW
	WQBE_07C_Deep UIC Well with Property Cost
	WQBE_07D_Deep UIC Well with Filter in ROW
	WQBE_07E_Deep UIC Well with Bioretention Planter in ROW
Permeable Pavement	WQBE_08A_Pervious Concrete Sidewalk (no sand layer)
	WQBE_08B_Porous Asphalt Driveway (with sand layer)
	WQBE_08C_Permeable Paver Driveway (with sand layer)
	WQBE_08D_Permeable Paver Plaza (no sand layer)
Stormwater Retention/Detention/Infiltration	
Depaving (Removal of Impervious Surfaces)	WQBE_9A_Removal of Impervious Surfaces on Property (wheel strips)
	WQBE_9B_Removal of Impervious Surfaces on Property (no wheel strips)
Stormwater Treatment Wetland	WQBE_20A_ Stormwater Treatment Wetland on Public Property
Detention Vault	WQBE_11A_Detention Vault on Public Property
	WQBE_11B_Detention Vault in ROW
	WQBE_11C_Detention Vault with Property Cost

Table 1 (continued). WQBE Actions and Variations.	
Action	**Description**
Detention Pond	WQBE_12A_Detention Pond on Public Property
	WQBE_12B_Detention Pond with Property Cost
Infiltration Pond	WQBE_13A_Infiltration Pond Till Soil on Public Property
	WQBE_13B_Infiltration Pond Outwash Soil on Public Property
	WQBE_13C_Infiltration Pond Till Soil with Property Cost
	WQBE_13D_Infiltration Pond Outwash Soil with Property Cost
	WQBE_13E_Infiltration Pond Outwash Soil with High Rate Underground Filter on Public Property
Infiltration Vault	WQBE_14A_Infiltration Vault Till Soil on Public Property
	WQBE_14B_Infiltration Vault Outwash Soil on Public Property
	WQBE_14C_Infiltration Vault Till Soil in ROW
	WQBE_14D_Infiltration Vault Outwash Soil in ROW
	WQBE_14E_Infiltration Vault Till Soil with Property Cost
	WQBE_14F_Infiltration Vault Outwash Soil with Property Cost
	WQBE_14G_Infiltration Vault Outwash Soil with High Rate Underground Filter on Public Property
Cistern	WQBE_16_Cistern on Property
Gray Stormwater Treatment	
Wet Pond	WQBE_18A_ Wet Pond on Public Property
	WQBE_18B_ Wet Pond with Property Cost
Wet Vault	WQBE_19A_ Wet Vault on Public Property
	WQBE_19B_ Wet Vault in ROW
	WQBE_19C_ Wet Vault with Property Cost
Stormwater Treatment Wetland	WQBE_20A_ Stormwater Treatment Wetland on Public Property
	WQBE_20B_ Stormwater Treatment Wetland with Property Cost
High Rate Underground Filter System installation	WQBE_21A_High Rate Underground Filter in Urban ROW PCCP
	WQBE_21B_High Rate Underground Filter in Highway ROW PCCP
	WQBE_21C_High Rate Underground Filter in Urban ROW HMA
	WQBE_21D_High Rate Underground Filter in Highway ROW HMA
	WQBE_21E_High Rate Underground Filter on Public Property
	WQBE_21F_High Rate Underground Filter with Property Cost
Regional Vegetated Media	WQBE_22A_Regional Vegetated Media Stormwater Facility on Public Property
	WQBE_22B_Regional Vegetated Media Stormwater Facility with Property Cost

Estimating Basis

Action unit costs were developed from a conceptual design basis combined with accepted design practice and engineering judgment. Differing approaches and assumptions may also meet an acceptable standard of care but may have a significant effect upon cost development. Cost modeling assumptions were developed for each Action to guide the cost development process and maintain consistency with accepted design practices and the WQBE goals. Cost modeling assumption definitions include:

- Design standards (e.g., *King County Surface Water Design Manual*, *City of Seattle Stormwater Manual*, Ecology *Stormwater Management Manual of Western Washington*, etc.)
- Facility assumptions (e.g., treatment media type and depth, drains, piping, location and surface restoration, etc.)
- Facility location and area (e.g., urban roadway, residential property, etc.)

Refer to the Basis of Estimate (BOE) documentation in Attachment A for initial preliminary concept and site assumptions that were used in cost model development. The Unit Action cost estimate spreadsheets contain BOE information for the following:

- Design basis (specific to cost assumptions)
- Planning basis
- Cost basis
- Allowances
- Estimating assumptions
- Contingency
- Management reserve
- Benchmarking

The BOE is considered a “living document” and information provided may be updated when the Unit Action definition or approach undergo changes or are further defined.

Cost Estimate Development

Cost estimates were developed in general conformance with the Association for the Advancement of Cost Engineering (AACE) and King County WTD estimating guidelines. AACE classifies estimates into five class types as outlined in AACE Recommended Practice 18R-97. The cost estimate classification varies, depending upon the project definition and primary estimating characteristics. The estimate classification is distinguished by the degree of project definition and the intended purpose or use of the estimate. The AACE guideline matrix for estimate classification system is provided in Table 2 below.

Table 2. AACE Estimate Class and Characteristics

AACE Estimate	Degree of Project Definition	Typical Estimate Purpose	AACE Expected Accuracy Range
Class 5 (Pre-Class 5)	0% to 2%	Conceptual screening	-50% to +100%
Class 4	1% to 15%	Concept study, order of magnitude, feasibility study	-30% to +50%
Class 3	10% to 40%	Budget, authorization, control	-20% to +30%
Class 2	30% to 70%	Control	-15% to +20%
Class 1	70% to 100%	Check estimate, bid/tender, change order	-10% to +15%

Source: AACE International, 2005.

In addition to the estimate classes listed above, AACE recognizes that special considerations apply when developing costs intended for planning-level screening or long-range strategic planning. These estimates were designated as Class 10 estimates in AACE publication RP111r-20 and were designated as Pre-Class 5 by the CSO Long-Term Control Planning team. Class 5 and Pre-Class 5 (AACE Class 10) estimates are assigned the same accuracy range, contingency, and uncertainty allowances as the AACE Class 5 estimate. The distinguishing feature between an AACE Class 5 estimate and a Pre-Class 5 estimate is that traditionally, a Class 5 estimate is prepared for a near-term project. Pre-Class 5 estimates are prepared to provide planning-level comparisons or conceptual screening for projects that may be constructed 10 years or more in the future.

The WQBE Unit Action cost estimates were designated and prepared as Pre-Class 5 estimates to provide for comparison and screening between different Unit Actions or a suite of Actions. Table 2 lists the allowances and expected accuracy range for the AACE estimate classes. For the purpose of this TM, Pre-Class 5 and Class 5 estimates are assigned the same estimating characteristics and may be used interchangeably.

Cost estimates for the WQBE toolkit were developed in two phases. In Phase 1, Action total project cost estimates were initially developed to support Phase 1 modeling. Phase 2 of the cost estimating was focused on refining the total project and life-cycle costs to reflect a programmatic approach to the Actions. These Unit Action costs provide reasonable estimates of project costs, while also accounting for contingency and uncertainty. Including contingency and other allowances in the project costs includes risk and uncertainty in cost-effectiveness determinations. In both Phases 1 and 2, costs were determined using the WTD cost estimating tool, hereafter called the WTD cost estimate sheet, a Microsoft Excel workbook used to capture, organize, and develop the estimate from project components and assumptions. The WTD cost estimate sheet was selected for use in the WQBE toolkit to provide consistency in how the cost estimates were developed to allow for cost comparisons across the alternatives developed for the CSO LTCP and CSO Water Quality and Optimization programs.

A workshop was conducted following the initial cost development to review the assumptions and methodologies used in developing Phase 1 estimates. Details regarding the workshop as they relate to water quality development are provided in Section 1.2 of Appendix B. A summary of the estimating cost refinements that were identified and implemented with WQBE Phase 2 cost development is listed below. WQBE Phase 2 cost refinements include:

- Revising the estimate class to Pre-Class 5 (AACE Class 10) to capture the long-term planning window associated with WQBE Action development and to be consistent with the CSO LTCP estimate development.
- Revisiting the cost contingency and indeterminates allowance multipliers. The multipliers were evaluated based on specific complexity and assumed project complexity associated with the Actions. Complexity assignments based on Action categories are described within subsequent sections in this TM. Specific contingency factors, uncertainty factors, and complexity factor assignments are detailed within each Action estimate within the Basis of Estimate tab.
- Property costs were initially referenced from appraised land values within the Seattle area. Land costs were revisited to provide land values outside of the Seattle area and that were more reflective of costs within King County.
- The Actions were scaled within the WTD workbook to provide indirect costs that were more reflective of the anticipated cost for a suite of Actions or anticipated Program size.

To remain consistent with the CSO LTCP cost estimate development, the total project cost for each Action was used to update the LCC model workbooks. The LCCs (described in further detail in subsequent sections) were estimated for each Action.

The design basis, developed by Herrera and RKI, was used to develop a cost concept for each Action. The design basis included concept scope and description, preliminary design assumptions, dimensions, and design standards. Refer to Appendix B for details on the design assumptions used for developing the Action cost models. The design basis was used to develop the quantities and estimated construction costs for each Action. Cost allowances were assigned where there was insufficient information to develop quantities within the estimate.

The design basis was augmented using referenced requirements from the following sources:

- *King County Surface Water Design Manual*
- *City of Seattle Stormwater Manual*
- Ecology *Stormwater Management Manual for Western Washington*
- Historical agency and vendor design and detail information

A BOE summary sheet (within the spreadsheet cost estimating tool) was prepared to document key estimating assumptions, design details, estimating factors, and exclusions for each Action. A copy of the BOE summary sheet is provided with the cost spreadsheets in Attachment A.

Total Project Cost Estimates

The WTD cost estimating spreadsheet was used to develop a total project cost for each Action. The total project cost consists of:

- Direct construction cost, which represents the probable cost of construction
- Indirect or non-construction costs, which represent design, permitting, real estate, and other costs associated with the development and administration of a project

Direct Construction Cost

This section describes the methodologies and assumptions used to estimate direct construction costs for the Unit Actions. Direct construction costs represent the costs associated with physical construction of a project and include:

- Subtotal construction costs, which is also called the probable cost of construction bid. The subtotal construction costs include:
  - Contractor overhead and profit and general conditions (included in line-item unit prices)
  - Contractor bonds and insurance (included in line-item unit prices)
  - Contractor mobilization and demobilization (10 percent) based on County experience
- Allowance for indeterminates or design allowance for undefined scope work. The amount is based on a percentage of the subtotal construction costs assigned based on Action type and anticipated complexity as follows:

  - o 15 percent for Green Stormwater Infrastructure (GSI) Actions
  - o 20 percent for Stormwater Retention/Detention/Infiltration and Gray Stormwater Treatment Actions
  - o 25 percent for the Regional Vegetated Media Stormwater Facility (regional facility) Action

- Street use permits: Seattle Department of Transportation (SDOT) street use permit fees for work within Seattle right-of-way (ROW) (varies by Unit Action).

- Project contingency multipliers were assigned based on anticipated project complexity and the level of uncertainty as follows:
  - o 15 percent for GSI Actions
  - o 25 percent for Stormwater Retention/Detention/Infiltration and Gray Stormwater Treatment Actions
  - o 30 percent for the Regional Vegetated Media Stormwater Facility (regional facility) Action

Additional Construction Costs

Additional direct construction costs are included within the WTD cost estimate model and reflect the cost of markups and contingencies in addition to the calculated subtotal of construction costs. These costs include:

- Construction change order allowance (10 percent) based on County experience
- Retail sales tax (10.1 percent) in Seattle
- Outside agency construction (e.g., utility relocations; user-defined, varies by Unit Action)

Year of Construction Cost

Engineering News-Record (ENR) monitors construction costs across the country. The ENR Construction Cost Index (CCI) averages the cost of a set amount of labor and materials over a 20-city average of labor rates and material costs. In addition, ENR has specific CCI average values for the Seattle area.

To maintain estimating consistency between Unit Actions, all costs were escalated to August 2019 dollars using Seattle ENR CCI values. Should a Unit Action be selected for future development, it is recommended that construction costs be adjusted to the projected mid-year of construction.

Indirect Non-Construction Costs

Indirect costs represent "soft costs," which are costs outside of those that are directly part of the construction (or installation), but are required to complete the construction. Examples of indirect costs include design, permitting, real estate procurement, etc. WTD tracked indirect project costs for completed capital improvement projects using its Project Reporting and Information System Management (PRISM) Database. In 2011 WTD updated its WTD cost estimate sheet to incorporate indirect project cost information from the PRISM database. The WTD PRISM cost database information, built into the WTD cost estimating sheet, was used to estimate indirect costs for each Action using the conveyance project type.

WTD gathered indirect project cost data from the PRISM database for 53 projects that were over $1 million in construction cost and from 27 baselined projects that were under $1 million in construction costs. The costs from these referenced key projects were used to develop indirect project costs based on project construction costs. Table 3 depicts how the WTD cost estimate sheet assigns indirect project costs as a percentage of the Action's subtotal of construction cost.

Table 3. WQBE Indirect Costs Assigned Based on Subtotal Construction Cost.

Subtotal Construction Cost Range	Indirect Costs Assigned (%)
$1,000,000–$5,000,000	82.12%
$5,000,000–$10,000,000	68.36%
More than $10,000,000	61.17%

The WTD cost estimate spreadsheet assigns indirect costs based on a percentage of a project's subtotal construction costs. The indirect cost model within the estimate spreadsheet was developed and intended for use on large, capital improvement projects. The projects used to develop the indirect cost model generally had construction cost ranges shown in Table 3 above. Singularly, the subtotal construction cost for each WQBE Action is less than the WTD cost estimate spreadsheet's indirect cost tool was intended to model. However, while the WQBE Action unit costs are discrete, it is anticipated that each Action will be part of a larger project, suite of combined Actions, or installed as part of a Program. Indirect costs for the WQBE Actions were assigned using a scaled subtotal construction cost assuming the total project or Program cost ranges listed below:

- Indirect costs for GSI Actions were based on $20 million to $25 million construction cost. The subtotal cost range was selected as typical for a GSI Program.
- Indirect costs for Stormwater Retention/Detention/Infiltration and Gray Stormwater Treatment Actions were based on $10 million to $15 million subtotal construction cost. The construction cost range was selected as a typical project size for this type of Action.

In addition to project type and estimated construction cost, the following series of project calibrations were selected in the cost model to develop an indirect cost profile:

- Initiatives (art, sustainability): determined that the Actions would not be considered eligible for the initiatives
- Operations support
- Facility inspection used
- In-house legal used
- Modeling used
- Water and Land Resources Division support used

The WTD cost estimate sheet assigned indirect costs as a percentage of the estimated subtotal construction cost based on a developed cost profile from the following nine key PRISM categories:

- Design Engineering
- Construction Management
- Permitting and Licenses
- Operations Support
- Community Relations
- Environmental Planning and Management
- Real Estate: Permitting, Right-of-Way, and Monitoring
- Project Management
- Project Controls

The WTD cost estimate sheet cost model profile assigns indirect costs based on project complexity within the key PRISM categories. There are four complexity levels within the PRISM categories:

- Low complexity indicates a simplified or straightforward cost profile. For example, the Rain Garden Action, which uses a simple, preapproved design with little permitting required, was assigned a low complexity profile.

- Routine complexity indicates typical design or duties without unique issues or concerns. For example, the Detention Vault Action was assumed to require typical design and construction monitoring. While the Action requires permitting, no unique permitting issues were anticipated with this installation. The Detention Vault Action was assigned a routine complexity profile.

- Moderate complexity indicates that there will be elevated costs or concerns associated that are higher than normally found with that type of project. For example, the Stormwater Treatment Wetland Action was assumed to require elevated support for permitting, and environmental planning and management. The Stormwater Treatment Wetland Action was assigned a moderate complexity profile.

- High complexity indicates that the project may have risks associated with it that can require intense support or concerns that may cause significant delivery and schedule delays. For example, a tunnel project that crosses a bay or requires disturbance along the shoreline area may require extensive permitting, have elevated risk associated with the construction, or may require extensive community-relations outreach. The tunnel project may be assigned a high complexity profile. None of the WQBE Phase 2 Actions were considered to have a high complexity profile.

The cost model was established to calculate the indirect cost for each of the key PRISM categories' project complexity with baseline costs set at the "Routine" complexity setting. Indirect costs within each key category were refined (increased or decreased) for each Action by selecting a lower or higher complexity input value. Complexity factors for the WQBE Action units were assigned based on the following:

- Low complexity for GSI Actions

- Routine complexity for Stormwater Retention/Detention/Infiltration and Gray Stormwater Treatment Actions

- Moderate complexity for Regional Vegetated Media (regional) Action

The complexity factors used in developing the cost model for each Action were documented in the BOE assumptions.

Real Estate Costs

The WQBE Actions represent high-level concepts and it is unknown where construction will occur. In determining real estate costs, the following sources were considered:

- WTD appraised land values from the CSO LTCP cost estimates were used to determine property costs from the Seattle area.

- Assessed land costs from areas within King County that were outside of the Seattle area were obtained from the King County Department of Assessments appraised land values.

An average land cost of $54 per square foot (SF) was assigned for acquisition based on an average of Seattle area land costs and assessed land costs in King County outside of the Seattle area. The overall project contingencies are applied to the property costs. Real estate cost assumptions, where used, are documented in the estimate spreadsheet for each Unit Action.

Total Project Costs

Total project costs were estimated for each Unit Action by summing the direct construction costs and indirect non-construction costs using the WTD cost estimating tool. The summary sheet provides a summary of costs for each Unit Action that includes the following information:

- Total direct construction costs, which includes:
  - Estimated probable cost of construction bid (directly estimated using engineered quantities and unit pricing analysis)
  - Additional direct cost
  - Additional construction costs (from PRISM and user-defined allowances)
  - Other capital charges (from PRISM)
- Total indirect non-construction costs (from PRISM and user-defined allowances):
  - Design and construction consulting services
  - Permitting and agency support
  - ROW
  - WTD staff labor
  - Miscellaneous services and materials
  - Non-WTD support
- Total project cost, which includes both direct and indirect construction costs

As detailed under the Cost Estimate Development section, the WQBE estimates were prepared as Pre-Class 5 estimates intended for planning-level screening or alternative comparison for long-range strategic planning. Attachment A contains Portable Document Format (PDF) files of the WTD estimating spreadsheet tool for each of the Unit Actions' cost estimates.

Life-Cycle Cost

A life-cycle cost analysis (LCCA) was prepared using the WTD LCC Model to provide an evaluation of the developed concepts over an established analysis period. The LCCA considers initial capital costs and future costs, such as capital replacement and O&M costs. A 30-year analysis period was selected for the LCCA.

For the WQBE Actions, the LCC was the total project capital cost plus the net present value (NPV) of ongoing capital replacement and O&M over the analysis period of the project. Project LCCs combine capital replacement and O&M costs to allow reasonable comparisons between concepts with high project costs and those with high O&M costs. Project LCCs were estimated by considering:

- Total project cost comprising both direct construction cost and indirect project costs
- Capital replacement cost, which was the cost to replace components during the life-cycle period
- Annual O&M costs, which included labor, chemicals, supplies, and energy costs

The LCCA estimates are to be considered preliminary level (Pre-Class 5) because of the limited information available and the planning-level engineering that has occurred.

Life-Cycle Cost Analysis Assumptions

The following general assumptions were used in the WTD LCC Model:

- Initial capital cost:
    - o Initial capital cost is input into the WTD LCC Model as total project cost and not construction cost. Indirect non-construction cost is estimated using the WTD PRISM database program and cost model and not estimated using standard WTD LCC Model assumptions.
    - o Initial capital cost was assumed to occur in a single year.
    - o If capital costs are incurred over multiple years (large projects), total project cost was entered into the WTD LCC Model as a fraction of the total project cost depending on the number of years for implementation. For example, if a Program is implemented over 10 years, 1/10 of the total project cost will be entered into the WTD LCC Model for each year for 10 years. The first year will be listed as initial capital cost, and subsequent years will be entered as one-time capital replacements.

- Capital replacement cost:
  - Capital replacement is input into the WTD LCC Model as total project cost and not construction cost. Indirect non-construction cost is estimated using the WTD PRISM database program and cost model and not estimated using standard WTD LCC Model assumptions. Indirect non-construction cost (ancillary cost) for capital replacement was manually adjusted to $0 in the WTD LCC Model.
  - If capital replacement (or Program implementation cost) occurs more frequently than every 5 years, annual cost was manually entered into the WTD LCC Model because the WTD LCC Model is not set up for less than 5-year increments.

The following is a general representation of how NPV is calculated within the WTD LCC Model:

$$Project\ Net\ Present\ Value\ (NPV) =$$

$$PV\ (Initial\ Capital\ Costs) + PV(Capital\ Replacment\ Costs) + PV(O\&M\ Costs)$$

In general, future values (FVs) are converted to present values (PVs) by the following equation:

$$PV = FV\frac{FV}{(1+i)^n}$$

Where: i = annual interest rate (provided by County), n = year of expenditure.

- Life-cycle assumptions:
  - Period: 30 years
  - Initial year of operations: 2021
  - Year of analysis: 2019
  - Construction start: 2020
- Cost assumptions:
  - Cost estimate dollar basis year: 2019
  - General conditions markup: 0 percent (general conditions markup was included in the project costs prior to entry into the WTD LCC Model)
  - Construction cost escalation: 3.5 percent
- O&M and general cost escalation:
  - Projects: 3.0 percent

- Programs: 3.5 percent (because it is associated with Program implementation and not necessarily O&M)
- O&M labor rate growth: 3.2 percent
- Direct labor rate as of year of analysis: $47.97
- Washington (retail) sales tax: 10.1 percent
- Project cost contingency allowance: 0 percent (because project costs are entered into the WTD LCC Model and not construction costs)
- WTD labor overhead: 150 percent (this is a County-controlled rate applied to raw labor costs calculated for O&M activities)
- The O&M labor cost formula is listed below:

$$O\&M\ Labor\ Costs\ =$$

$$Labor\ Hours\ per\ Year\ \times Direct\ Labor\ Rate\ \times WTD\ Overhead\ Rate$$

- Financial assumptions:
  - Percent financed of each capital activity:
    - Projects: 60.0 percent
    - Financing interest rate: 5.25 percent
    - Financing maturity: 30 years
    - Financing costs, capitalized: 2.0 percent
- Economic assumptions:
  - Discount rate, WTD (cost of capital): 5.25 percent. The discount rate accounts for both inflation and the time value of money.
  - WTD real discounted rate: 2.18 percent (if O&M escalation is 3.0 percent) or 1.69 percent (if O&M escalation is 3.5 percent).[1]

[1] Real discount rate of 2.18 percent is the default value in the WTD LCC Model; this is estimated based on a WTD financing interest rate of 5.25 percent and 3 percent annual inflation for O&M and general cost escalation. A real discount rate of 1.69 percent is used when O&M and general cost escalation is assumed to be 3.5 percent annual inflation (instead of 3 percent). It was generally assumed 3.5 percent annual O&M and general cost escalation for Programs to be consistent with 3.5 percent annual construction cost

- o Annual growth in electricity consumption: 1.0 percent

Attachment A contains a PDF file of the WTD LCC Model and a Microsoft Excel workbook for each of the Unit Actions' LCC estimate.

Operations and Maintenance Cost

Annual O&M cost was estimated for each Unit Action and generally included the following:

- O&M activities were based on the type of activity provided in the most current version of the Cost and Modeling Assumptions worksheet. Activity sources included:
  - o *King County Surface Water Design Manual*, 2016
  - o *City of Seattle Stormwater Manual*, 2016
  - o Ecology *Stormwater Management Manual for Western Washington*, 2019
  - o Kitsap County *Manchester Stormwater Retrofit Drainage Report*, 2014
- Annual labor hours required by maintenance crews for cleanup after major storm events or for periodic inspections and remediation of materials (grass, plantings, permeable pavement, concrete cracks and joints, etc.) and regular maintenance activities for the specific Unit Action, where applicable.
- Annual material replacement, such as plant replacement, grass seed mix, mulch, etc. for the specific Unit Action, where applicable.
- Annual equipment rentals needed to perform maintenance activities for the specific Action, where applicable. Equipment rates were obtained from EquipmentWatch™ (Rental Rate Blue Book®) adjusted for Seattle pricing.

Capital Replacement Cost

Capital replacement cost (items requiring replacement prior to the 30-year life of the Unit Action) was estimated for each Unit Action and generally assumed the following:

- Complete replacement of vegetation along with soils that had been compacted every 10 years, where applicable
- Complete replacement of access gates every 10 years, where applicable

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escalation because Programs generally do not have an O&M component, and it was generally assumed 3 percent annual O&M and general cost escalation (default value in WTD LCC Model) for projects because they include an O&M component.

- Complete replacement of mechanical equipment (e.g., flow restrictor, access hatch, outlet structure, baffle, etc.) every 20 years, where applicable

Capital replacement costs were estimated for each Unit Action by summing the construction costs of the specific line items assumed for replacement for the specified interval (e.g., 10 years), including mobilization/demobilization, and then converting the construction cost into project cost by multiplying the subtotal by the ratio of total project cost (excluding land acquisition) to total construction cost for the Unit Action (see equation below). Capital replacement is input into the WTD LCC Model as total project cost and not construction cost. The formula for capital replacement cost is shown below:

$$Total\ Capital\ Replacement\ Project\ Cost =$$

$$Total\ Capital\ Replacement\ Construction\ Cost \times \frac{Total\ Project\ Cost\ (excluding\ land\ acquisition)}{Total\ Construction\ Cost}$$

Total Life-Cycle Cost

Total LCC for each Unit Action was estimated using the WTD LCC Model. Costs were entered into the WTD LCC Model for initial capital (project), capital replacement, and O&M. Total LCC is presented as NPV over 30-year life using the WTD discount rate.

COST SOURCES

This section explains the process used to collect cost information for costs in support of the WQBE toolkit (construction, Program, and O&M costs). The costs for each Unit Action were characterized for each unit (see definition at end of document) of an Action, or the footprint of the Unit Action designed specifically for compatibility with the SUSTAIN model. Costs for the Unit Action items are to be considered preliminary, planning-level costs based on limited or generalized engineering design assumptions.

The following sources were used to develop unit prices using cost data representative of the Seattle/King County region and reviewed to gather data to support development of costs for the Unit Actions. All costs reflect owner's anticipated construction costs (construction contractor pricing) in 2019 dollars:

- **Tabula costing tool (Version 3.1.2):** The County developed Tabula to provide planning-level construction cost estimates for conveyance, tunnel, and storage facilities. The County last updated this program in 2010 with costs based on 2008 dollars (King County, 2010).

- **Seattle Public Utilities (SPU) cost estimating guide:** The SPU estimating guide provides unit cost information for typical elements within public works infrastructure projects and for building construction. Costs within this sheet were based on 2017 dollars (SPU, 2017).

- **Washington State Department of Transportation (WSDOT) unit bid analysis:** The WSDOT unit bid analysis database contains a bid history for standard unit bid prices from WSDOT projects. This tool contains cost information for excavation, conveyance, best management practices (BMPs), or other typical roadway construction items. The WSDOT database search can be limited to projects within western Washington or other nearby localities, such as the Olympic Peninsula (WSDOT, 2019).

- **Puget Sound BMP cost database:** The Puget Sound BMP cost database report contains cost information from the Puget Sound region for stormwater treatment and BMP elements (e.g., wet ponds, porous pavement, cisterns, constructed wetlands, etc.). Costs from this database report are based on 2012 dollars.

- **King County TMs and reports:** King County TMs (e.g., Legacy Load Removal and the University GSI projects) and existing reports (e.g., Puget Sound BMP Cost Database, Water Resource Inventory Area [WRIA] 9 reports, and University Green Stormwater Infrastructure with GSI cost benchmarking by CH2M Hill) contain both estimated construction costs and historical maintenance cost data. Construction and other cost data within the reports are based on various dates and any applied escalation or inflationary values should be considered on a case-by-case basis.

- **Internet sources:** Internet websites and online data sources were used to estimate specialty costs associated with the GSI Program costs, such as the RainWise Cistern cost from approved vendors listed on the RainWise website at https://www.kingcounty.gov/services/environment/stewardship/nw-yard-and-garden/rain-barrels.aspx.

  Online sources were also used to estimate O&M costs and specialty item costs such as blue roofs and cisterns. Website and online data sources used are as detailed in the Cost Source column of the Cost Data Summary (Table 4).

- **Contractor and vendor quotes:** Vendor quotes were used to calculate bid costs or to verify reported unit cost data for specialty items, such as proprietary stormwater treatment (i.e., Filterra), odor control, and large-value maintenance equipment purchases. Vendor quotes reflect current market conditions at the time the quote was obtained. Quotes should be adjusted to account for installation costs and labor, shipping and handling, and contractor markup and profit.

- **Estimator and agency historical databases:** VMS, Herrera, King County (WTD), SPU, Washington State Department of Natural Resources (DNR), Kitsap County, and other agencies within the Puget Sound area maintain and may post contractor bid prices for publicly bid projects. Bid costs from these sources were used to fill in data gaps from the other sources or for specialty work (e.g., Maury Island Natural Area Derelict Piling Removal from DNR for creosote pile removal, Manchester Stormwater Retrofit Phase 2 from Kitsap County, RainWise participation and historical participation rates from SPU and WTD, etc.) obtained from other sources. Data obtained from these sources were reviewed to ensure that the quantities and other project parameters were relevant. Costs obtained from these sources were based on various dates and any applied escalation or inflationary values were considered on a case-by-case basis.

- **EquipmentWatch™:** HDR Engineering, Inc. maintains a subscription to EquipmentWatch™, which provides access to Rental Rate Blue Book® pricing. The pricing is kept current by extensive ongoing research. This pricing tool is an industry standard for determining equipment values for both use and rental. The rates can be applied across the country or can be adjusted for a specific region, such as the Seattle area. Additional information on EquipmentWatch™ can be found on its website at <equipmentwatch.com>.

- **RSMeans:** RSMeans, an industry resource used in estimating construction costs, was another source of productivity information that was cross referenced for validation (Gordian, 2018). RSMeans researches data to provide construction costs for materials, labor, transportation costs, and equipment rental rates. The rates can be applied across the country or can be adjusted for a specific region, such as the Seattle area. Additional information on RSMeans can be found on its website at <www.RSMeans.com>.

- **Labor rates:** Craft rates and related benefits were estimated using current prevailing wage rates for King County. These labor rates include base wage rate, all applicable fringe benefits, unemployment insurance, and payroll taxes. Workers' compensation insurance is included separately in each work activity based on risk histories.

Cost Source Data Summary

The cost sources used in development of the Unit Action costs are summarized in Table 4 below. Where appropriate, costs were benchmarked using the County's CSO LTCP unit price estimates to maintain estimating cost consistency between the Programs. The cost estimates and estimating approaches used for the WQBE Phase 1 Actions were evaluated against peer projects and programs. The results are documented within the Program Cost Benchmarking Technical Memorandum (hereafter called the Benchmarking TM), prepared by Lotus Water. A copy of the Benchmarking TM is provided as Attachment B and supplemental analysis to the Benchmarking TM is in Attachment C. WQBE Phase 1 Action direct and indirect cost assumptions were evaluated for appropriateness and for cost sensitivity and the results documented in the Evaluation of Water Quality Benefit (WQBE) Project Cost Sensitivity for SUSTAIN Modeling Technical Memo (hereafter called the WQBE Cost Sensitivity TM). A copy of the WQBE Cost Sensitivity TM is provided as Attachment D.

Table 4. Cost Data Summary.

Action	Cost Source
Rain Garden Installation	• King County University GSI, Puget Sound BMP cost database, WSDOT unit bid analysis, SPU cost estimating guide, Tabula, estimator and historical databases • Equipment rates from RSMeans and personnel costs from Washington State prevailing wage rates • O&M guidelines per *Stormwater Management Manual for Western Washington*, 2019
Bioretention Planter	• King County University GSI, Puget Sound BMP cost database, WSDOT unit bid analysis, SPU cost estimating guide, Tabula, estimator and historical databases • Equipment rates from RSMeans and personnel costs from Washington State prevailing wage rates • O&M guidelines per *Stormwater Management Manual for Western Washington*, 2019
Bioretention	• King County University GSI, Puget Sound BMP cost database, WSDOT unit bid analysis, SPU cost estimating guide, Tabula, estimator and historical databases • Equipment rates from RSMeans and personnel costs from Washington State prevailing wage rates • O&M guidelines per *Stormwater Management Manual for Western Washington*, 2019
Bioswale (treatment)	• Construction costs based on WRIA 9 Reports, WSDOT Unit Bid Analysis, SPU/County and estimator and historical databases • Equipment rates from RSMeans and personnel costs from Washington State prevailing wage rates • O&M guidelines per *Stormwater Management Manual for Western Washington*, 2019
Media Filter Drains	• King County University GSI, Puget Sound BMP cost database, WSDOT unit bid analysis, SPU cost estimating guide, Tabula, estimator and historical databases • O&M guidelines per *Stormwater Management Manual for Western Washington*, 2019
Drywell	• King County University GSI, Puget Sound BMP cost database, WSDOT unit bid analysis, SPU cost estimating guide, Tabula, estimator and historical databases • O&M guidelines per *King County Surface Water Design Manual*, 2016

Table 4 (continued). Cost Data Summary	
Action	**Cost Source**
Deep UIC Wells	• Construction costs based on University GSI report, Puget Sound BMP cost database, and estimator and historical cost database • O&M guidelines per *King County Surface Water Design Manual*, 2016
Permeable Pavement	• Construction costs based on University GSI report and estimator and historical cost database • O&M guidelines per *Stormwater Management Manual for Western Washington*, 2019
	• Construction costs based on University GSI report, Puget Sound BMP cost database, WSDOT unit cost database, and estimator and historical cost database • O&M guidelines per *Stormwater Management Manual for Western Washington*, 2019
Depaving (Removal of Impervious Surface)	• Construction costs based on SPU/County and estimator and historical database • O&M minimal and based on professional judgment
Detention Vault	• Construction costs based on WSDOT Unit Bid Analysis, tabula, SPU cost estimating guide, vendor quotes, SPU/County and estimator and historical databases • Equipment rates from RSMeans and personnel costs from Washington State prevailing wage rates • O&M guidelines per *Stormwater Management Manual for Western Washington*, 2019
Detention Pond	• Construction costs based on WSDOT Unit Bid Analysis, tabula, SPU cost estimating guide, vendor quotes, SPU/County and estimator and historical databases • Equipment rates from RSMeans and personnel costs from Washington State prevailing wage rates • O&M guidelines per *Stormwater Management Manual for Western Washington*, 2019
Infiltration Pond	• King County University GSI, Puget Sound BMP cost database, WSDOT unit bid analysis, SPU cost estimating guide, Tabula, estimator and historical databases • O&M guidelines per *Stormwater Management Manual for Western Washington*, 2019
Infiltration Vault	• Construction costs based on WSDOT Unit Bid Analysis, tabula, SPU cost estimating guide, vendor quotes, SPU/County and estimator and historical databases • O&M guidelines per *Stormwater Management Manual for Western Washington*, 2019
Cistern	• RainWise cost based on average rebate amount per cistern for 60 gal, 250 gal, and 600 gal vendor info from <https://www.700milliongallons.org/rainwise/>. • O&M guidelines per *Stormwater Management Manual for Western Washington*, 2019 and *King County Surface Water Design Manual*, 2016

Table 4 (continued). Cost Data Summary

Action	Cost Source
Wet Pond	• King County University GSI, Puget Sound BMP cost database, WSDOT unit bid analysis, SPU cost estimating guide, Tabula, estimator and historical databases • Equipment rates from RSMeans and personnel costs from Washington State prevailing wage rates • O&M guidelines per *Stormwater Management Manual for Western Washington*, 2019
Wet Vault	• Construction costs based on WSDOT Unit Bid Analysis, tabula, SPU cost estimating guide, vendor quotes, SPU/County and estimator and historical databases • O&M guidelines per *Stormwater Management Manual for Western Washington*, 2019
Stormwater Treatment Wetland	• Construction costs based on Manchester Stormwater Retrofit (Kitsap County), King County University GSI, Puget Sound BMP cost database, WSDOT unit bid analysis, SPU cost estimating guide, Puget Sound BMP Cost Database, SPU/County and estimator and historical databases • Equipment rates from RSMeans and personnel costs from Washington State prevailing wage rates • O&M guidelines per *King County Surface Water Design Manual*, 2016
High Rate Underground Filter System	• Construction cost based on vendor quotes and estimator and historical databases • Equipment rates from EquipmentWatch™ (Blue Book®) and personnel costs from LCC model • O&M guidelines per Kitsap County *Operations and Maintenance Manual: Manchester Stormwater Park*, 2015

Summary of Costs by Unit Action

A summary of the costs for each Unit Action is provided in Table 5. The Unit Action drainage area assumptions are summarized in Table 4 of Appendix B. These cost estimates were designated as Pre-Class 5 estimates and are assigned the AACE expected accuracy range of -50% to +100% (see Table 2). This range can be applied to the total project costs.

Table 5. Costs by Unit Action.

Action	Description	Action Unit	Total Direct Construction Cost (a)	Property Acquisition Cost (b)	Total Indirect Non-Construction Cost (c)	Total Project Cost (d)	O&M Costs (Annual) (e)	Net Present Value 30-year Life-Cycle Cost (2019)
Equations						(a)+(b)+(c)		PV(d)+PV(e)
Green Stormwater Infrastructure (GSI)								
Rain Garden Installation	WQBE 01_Rain Garden Installation on Property	25 SF	$17,000	$0	$7,000	$24,000	$2,800	$82,000
Bioretention Planter Installation	WQBE 02A_Bioretention Planter on Property	25 SF	$29,000	$0	$13,000	$42,000	$2,800	$100,000
	WQBE_02B_Bioretention Planter in ROW	25 SF	$39,000	$0	$17,000	$56,000	$2,800	$114,000
	WQBE_02C_Bioretention Planter with Property Cost	25 SF	$29,000	$1,400	$15,000	$44,000	$2,800	$102,000
Bioretention Installation	WQBE_03A_Bioretention Underdrain on Property	85 SF	$59,000	$0	$26,000	$85,000	$2,800	$175,000
	WQBE_03Aa_Bioretention Underdrain with Property Cost	85 SF	$59,000	$14,000	$42,000	$100,000	$2,800	$190,000
	WQBE_03B_Bioretention No Underdrain on Property	85 SF	$57,000	$0	$25,000	$83,000	$2,800	$173,000
	WQBE_03Bb_Bioretention No Underdrain with Property Cost	85 SF	$57,000	$14,000	$41,000	$98,000	$2,800	$188,000

	WQBE_03C_Bioretention Underdrain in ROW	85 SF	$97,000	$0	$42,000	$139,000	$2,800	$230,000
	WQBE_03D_Bioretention No Underdrain in ROW	85 SF	$94,000	$0	$41,000	$135,000	$2,800	$226,000

Table 5 (continued). Costs by Unit Action.

Action	Description	Action Unit	Total Direct Construction Cost	Property Acquisition	Total Indirect Non-Construction Costs	Total Project Cost	O&M Costs (Annual)	Net Present Value 30-year Life-Cycle Cost (2019)
Bioswale Installation	WQBE_04A_Bioswale in ROW	200 SF	$29,000	$0	$12,000	$41,000	$2,600	$111,000
	WQBE_04B_Bioswale on Public Property	200 SF	$14,000	$0	$6,000	$20,000	$2,600	$89,000
	WQBE_04C_Bioswale with Property Cost	200 SF	$14,000	$40,000	$52,000	$66,000	$2,600	$135,000
Media Filter Drains	WQBE_05A_Media Filter Drain Underdrain	200 SF	$24,000	$0	$10,000	$34,000	$2,300	$116,000
	WQBE_05B_Media Filter Drain No Underdrain	200 SF	$21,000	$0	$9,000	$30,000	$2,300	$113,000
Drywell	WQBE_06_Drywell on Property	1 Each	$11,000	$0	$5,000	$16,000	$1,800	$53,000
	WQBE_06B_Drywell with Bioretention Planter on Property	1 Each	$50,000	$0	$22,000	$72,000	$1,900	$112,000
Deep UIC Well	WQBE_07A_Deep UIC Well on Property	1 Each	$32,000	$0	$14,000	$46,000	$2,000	$86,000
	WQBE_07B_Deep UIC Well in ROW	1 Each	$46,000	$0	$20,000	$66,000	$2,000	$106,000
	WQBE_07C_Deep UIC Well with Property Cost	1 Each	$32,000	$1,400	$16,000	$48,000	$2,000	$88,000
	WQBE_07D_Deep UIC Well with Filter in ROW	1 Each	$142,000	$0	$62,000	$204,000	$4,900	$303,000
	WQBE_07E_Deep UIC Well with Bioretention Planter in ROW	1 Each	$762,000	$0	$333,000	$1,095,000	$6,800	$1,239,000

Table 5 (continued). Costs by Unit Action.								
Action	**Description**	**Action Unit**	**Total Direct Construction Cost**	**Property Acquisition**	**Total Indirect Non-Construction Costs**	**Total Project Cost**	**O&M Costs (Annual)**	**Net Present Value 30-year Life-Cycle Cost (2019)**
	WQBE_07F_Deep UIC Well with Bioretention Planter on Property	1 Each	$650,000	$0	$287,000	$938,000	$6,800	$1,083,000
Permeable Pavement	WQBE_08A_Pervious Concrete Sidewalk (no sand layer)	200 SF	$8,000	$0	$4,000	$12,000	$2,100	$78,000
	WQBE_08B_Porous Asphalt Driveway (with sand layer)	200 SF	$4,000	$0	$2,000	$6,000	$2,200	$60,000
	WQBE_08C_Permeable Paver Driveway (with sand layer)	200 SF	$3,000	$0	$1,000	$4,000	$2,100	$55,000
	WQBE_08D_Permeable Paver Plaza (no sand layer)	200 SF	$3,000	$0	$1,000	$4,000	$2,100	$54,000
Depaving (Removal of Impervious Surfaces)	WQBE_9A_Removal of Impervious Surfaces on Property (wheel strips)	100 SF	$1,000	$0	$1,000	$2,000	$600	$15,000
	WQBE_9B_Removal of Impervious Surfaces on Property (no wheel strips)	100 SF	$1,000	$0	$1,000	$2,000	$600	$15,000
Stormwater Retention/Detention/Infiltration								
Detention Vault	WQBE_11A_Detention Vault on Public Property	1 each	$3,519,000	$0	$2,710,000	$6,229,000	$4,900	$6,352,000
	WQBE_11B_Detention Vault in ROW	1 each	$4,473,000	$0	$3,130,500	$7,603,000	$4,900	$7,727,000
	WQBE_11C_Detention Vault with Property Cost	1 each	$3,519,000	$589,000	$3,446,000	$6,965,000	$4,900	$7,085,000
Detention Pond	WQBE_12A_Detention Pond on Public Property	1 each	$617,000	$0	$484,000	$1,102,000	$9,400	$1,473,000
	WQBE_12B_Detention Pond with Property Cost	1 each	$617,000	$1,073,000	$1,826,000	$2,443,000	$9,400	$2,807,000

Table 5 (continued). Costs by Unit Action.								
Action	**Description**	**Action Unit**	**Total Direct Construction Cost**	**Property Acquisition**	**Total Indirect Non-Construction Costs**	**Total Project Cost**	**O&M Costs (Annual)**	**Net Present Value 30-year Life-Cycle Cost (2019)**
Infiltration Pond	WQBE_13A_Infiltration Pond Till Soil on Public Property	1 each	$395,000	$0	$310,000	$705,000	$5,500	$971,000
	WQBE_13B_Infiltration Pond Outwash Soil on Public Property	1 each	$352,000	$0	$276,000	$629,000	$3,500	$836,000
	WQBE_13C_Infiltration Pond Till Soil with Property Cost	1 each	$395,000	$903,000	$1,439,000	$1,834,000	$5,500	$2,094,000
	WQBE_13D_Infiltration Pond Outwash Soil with Property Cost	1 each	$352,000	$903,000	$1,405,000	$1,758,000	$3,500	$1,959,000
	WQBE_13E_Infiltration Pond Outwash Soil with High Rate Underground Filter System on Public Property	1 each	$424,000	$0	$332,000	$756,000	$6,400	$1,033,000
Infiltration Vault	WQBE_14A_Infiltration Vault Till Soil on Public Property	1 each	$2,577,000	$0	$2,012,000	$4,589,000	$4,900	$4,721,000
	WQBE_14B_Infiltration Vault Outwash Soil on Public Property	1 each	$2,009,000	$0	$1,562,000	$3,572,000	$4,900	$3,709,000
	WQBE_14C_Infiltration Vault Till Soil in ROW	1 each	$3,008,000	$0	$2,245,000	$5,253,000	$4,900	$5,384,000
	WQBE_14D_Infiltration Vault Outwash Soil in ROW	1 each	$2,351,000	$0	$1,769,000	$4,120,000	$4,900	$4,257,000
	WQBE_14E_Infiltration Vault Till Soil with Property Cost	1 each	$2,577,000	$533,000	$2,679,000	$5,256,000	$4,900	$5,385,000
	WQBE_14F_Infiltration Vault Outwash Soil with Property Cost	1 each	$2,009,000	$533,000	$2,229,000	$4,238,000	$4,900	$4,372,000
	WQBE_14G_Infiltration Vault Outwash Soil with High Rate Underground Filter System in ROW	1 Each	$2,368,000	$0	$1,795,000	$4,163,000	$7,800	$4,376,000

Table 5 (continued). Costs by Unit Action.

Action	Description	Action Unit	Total Direct Construction Cost	Property Acquisition	Total Indirect Non-Construction Costs	Total Project Cost	O&M Costs (Annual)	Net Present Value 30-year Life-Cycle Cost (2019)
Cistern	WQBE_16_Cistern on Property	1 each	$18,000	$0	$8,000	$26,000	$2,100	$70,000
Gray Stormwater Treatment								
Wet Pond	WQBE_18A_ Wet Pond on Public Property	553 SF	$383,000	$0	$300,000	$683,000	$2,000	$852,000
	WQBE_18B_ Wet Pond with Property Cost	553 SF	$383,000	$718,000	$1,198,000	$1,581,000	$2,000	$1,745,000
Wet Vault	WQBE_19A_ Wet Vault on Public Property	1 each	$2,852,000	$0	$2,203,000	$5,055,000	$2,900	$5,125,000
	WQBE_19B_ Wet Vault in ROW	1 each	$3,314,000	$0	$2,493,000	$5,806,000	$2,900	$5,874,000
	WQBE_19C_ Wet Vault with Property Cost	1 each	$2,852,000	$538,000	$2,876,000	$5,728,000	$2,900	$5,795,000
Stormwater Treatment Wetland	WQBE_20A_ Stormwater Treatment Wetland on Public Property	503 SF	$360,000	$0	$282,000	$642,000	$2,300	$817,000
	WQBE_20B_ Stormwater Treatment Wetland with Property Cost	503 SF	$360,000	$678,000	$1,130,000	$1,489,000	$2,300	$1,659,000
High Rate Underground Filter System	WQBE_21A_High Rate Underground Filter in Urban ROW PCCP	1 each	$120,000	$0	$75,000	$195,000	$2,900	$254,000
	WQBE_21B_High Rate Underground Filter in Highway ROW PCCP	1 each	$89,000	$0	$56,000	$145,000	$2,900	$204,000
	WQBE_21C_High Rate Underground Filter in Urban ROW HMA	1 each	$86,000	$0	$54,000	$140,000	$2,900	$199,000

Table 5 (continued). Costs by Unit Action.

Action	Description	Action Unit	Total Direct Construction Cost	Property Acquisition	Total Indirect Non-Construction Costs	Total Project Cost	O&M Costs (Annual)	Net Present Value 30-year Life-Cycle Cost (2019)
	WQBE_21D_High Rate Underground Filter in Highway ROW HMA	1 each	$79,000	$0	$50,000	$129,000	$2,900	$188,000
	WQBE 21E_High Rate Underground Filter on Public Property	1 each	$64,000	$0	$42,000	$106,000	$2,900	$165,000
	WQBE 21F_High Rate Underground Filter with Property Cost	1 each	$64,000	$900	$43,000	$107,000	$2,900	$166,000
Regional Vegetated Media	WQBE_22A_Regional Vegetated Media SW Facility on Public Property	5,940 SF	$2,965,000	$0	$3,073,000	$6,038,000	$12,000	$6,562,000
	WQBE_22B_Regional Vegetated Media SW Facility with Property Cost	5,940 SF	$2,965,000	$910,760	$4,259,000	$7,224,000	$12,000	$7,741,000

WQBE Program Terminology

Action: Individual structural and non-structural best management practices (BMPs) or activities to improve water quality (e.g., rain gardens, wet ponds, street sweeping).

Assessment point: Location where a management objective is evaluated during optimization.

Basin: Grouping of catchments and subbasins that represent the primary discharge points and spatial scale for the Tier 2 SUSTAIN optimization.

Basis of Estimate (BOE): Document that details the premise, or basis, from which critical aspects of a project cost estimate were developed including cost and labor estimates, material availability, any assumptions or deviations, any studies or analysis used as a reference, and any other details which impacted the cost estimates.

Catchment: Delineation of drainage areas for the Loading Simulation Program in C++ (LSPC) baseline pollutant loading model and serving as the scale of individual Tier 1 SUSTAIN cost-optimization.

Package: Point on a SUSTAIN cost-effectiveness curve that identifies a specific level of implementation of a Program (e.g., 200 unit rain gardens and 50 unit permeable pavement installations in specified subbasins that represent a cost-effective implementation of a green stormwater infrastructure [GSI] incentive program in the Lake Washington basin).

Programs will be evaluated with the SUSTAIN models by generating a Package of representative Actions optimized for stormwater volume or pollutant load reductions at an assessment point. Previously defined projects could also be incorporated into the SUSTAIN models and included in optimization evaluations as desired.

Program: Group of Unit Actions that could be implemented to improve water quality over a broad geographic area, such as a GSI incentive program in unincorporated areas within the Lake Washington basin or a roadway stormwater treatment program on County-owned roads within the Green/Duwamish basin.

Project: Individual Action or related group of Actions at a specific geographic location for which detailed, spatially explicit characteristics are defined (e.g., a rain garden installation on a specified property or within a small defined area).

Subbasin: Grouping of catchments for which SUSTAIN model output will be reported to inform causal model inputs.

Unit Action: Representative vertical profile, areal footprint, and associated design-drainage area for an Action being modeled in SUSTAIN. Cost-benefit optimization is used to determine the collective sizes and/or number of Unit Actions required to achieve a certain pollutant load reduction target. Each Unit Action has an associated cost that is scalable during optimization to estimate total implementation costs.

Unit: Representative footprint of an Action defined so as to be compatible with the SUSTAIN model.

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ATTACHMENT A

Cost Estimates and Life-Cycle Cost Analysis

ATTACHMENT B

Program Cost Benchmarking TM

ATTACHMENT C

Supplemental Analysis for the Program Cost Benchmarking TM

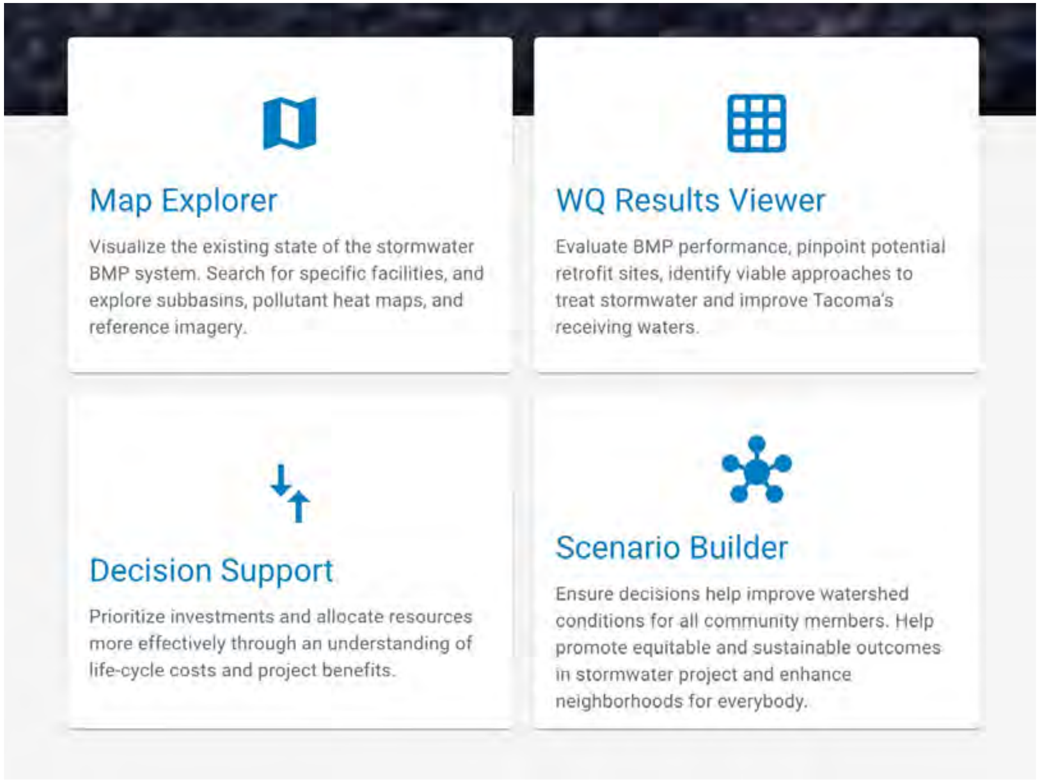
ATTACHMENT D

Evaluation of WQBE Project Cost Sensitivity for SUSTAIN Modeling TM

13 Appendix C - Workshop Slides

Tacoma Watershed Insights

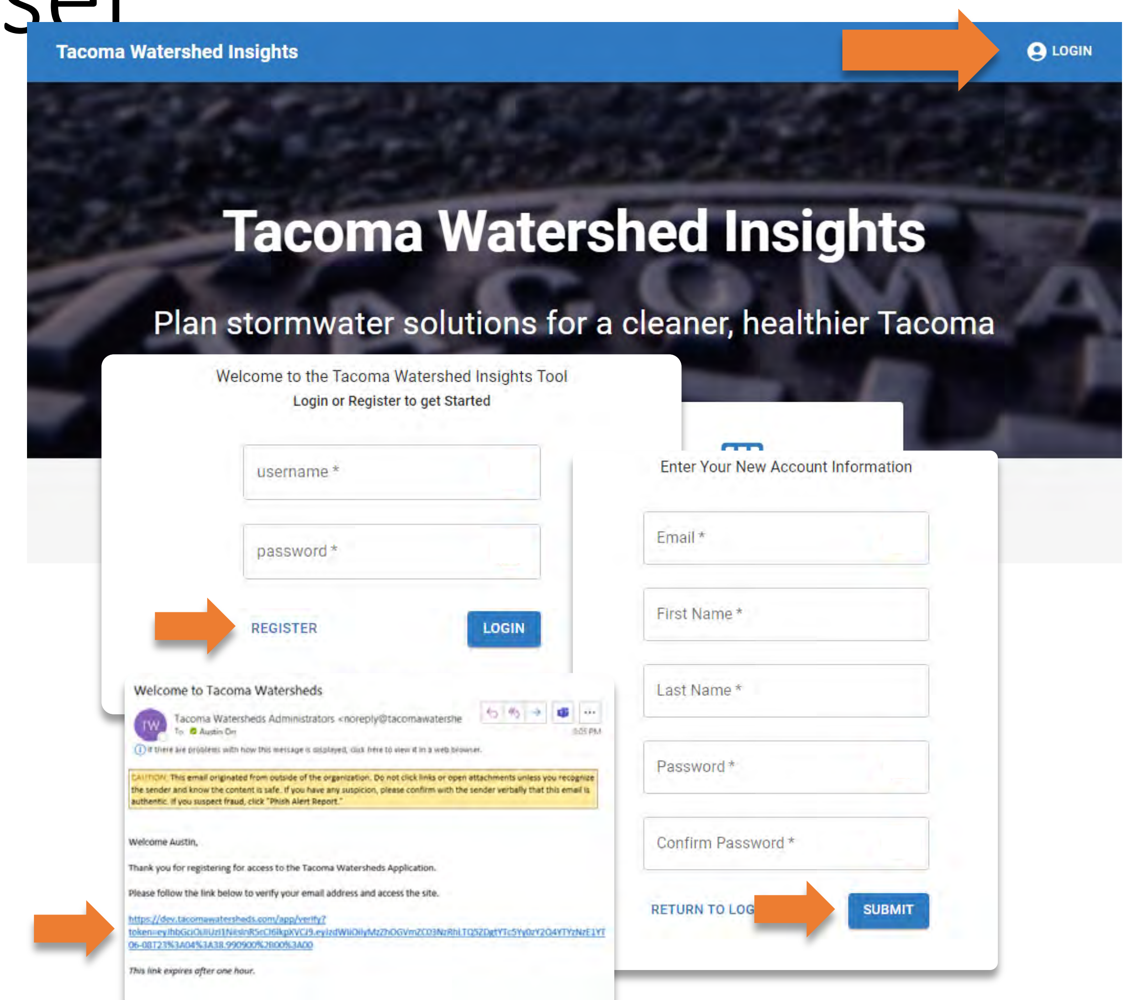
Main Components



System Administration

Enroll New User

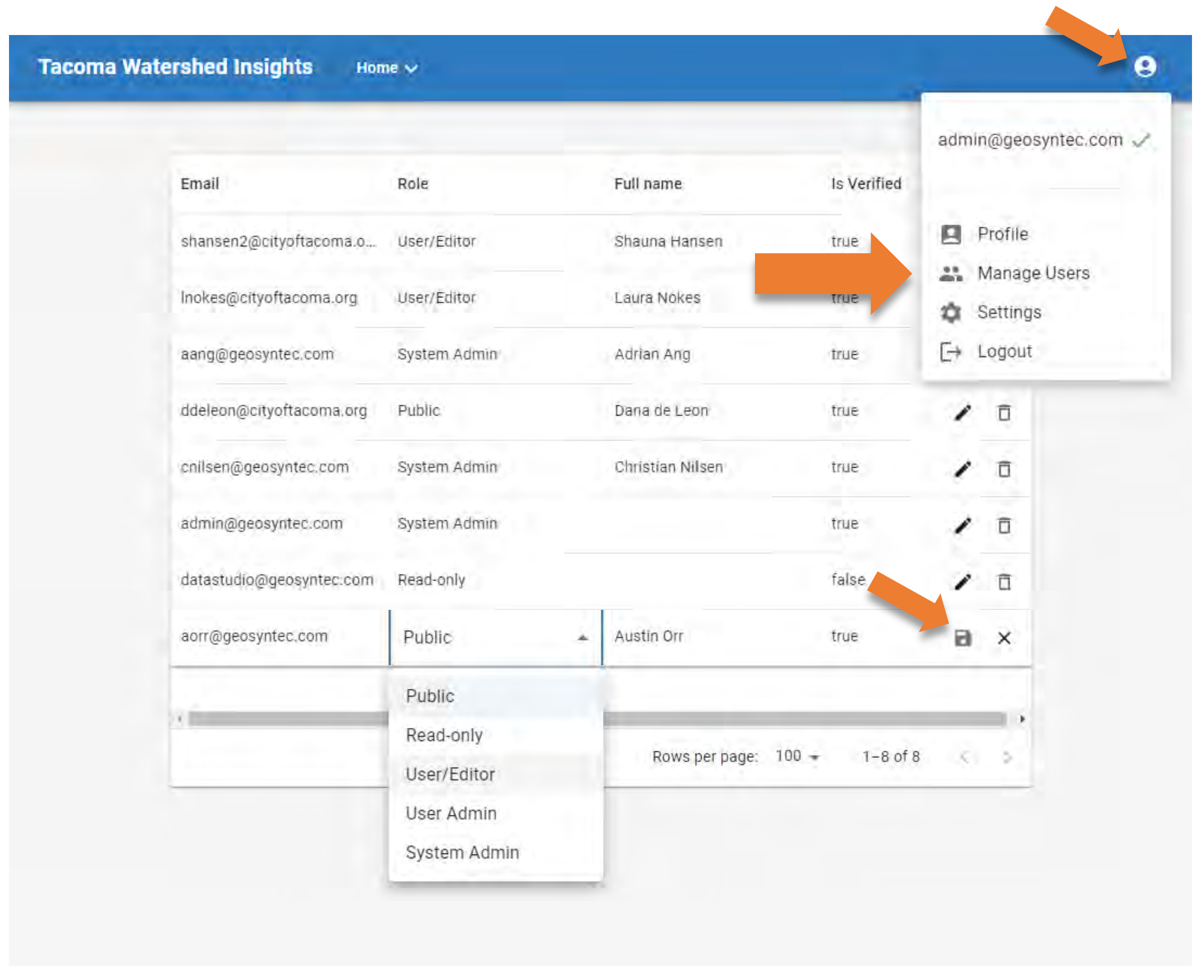
- Navigate to site
- Click Login
- Click Register
- Click Submit
- Check Email & Click through Verification



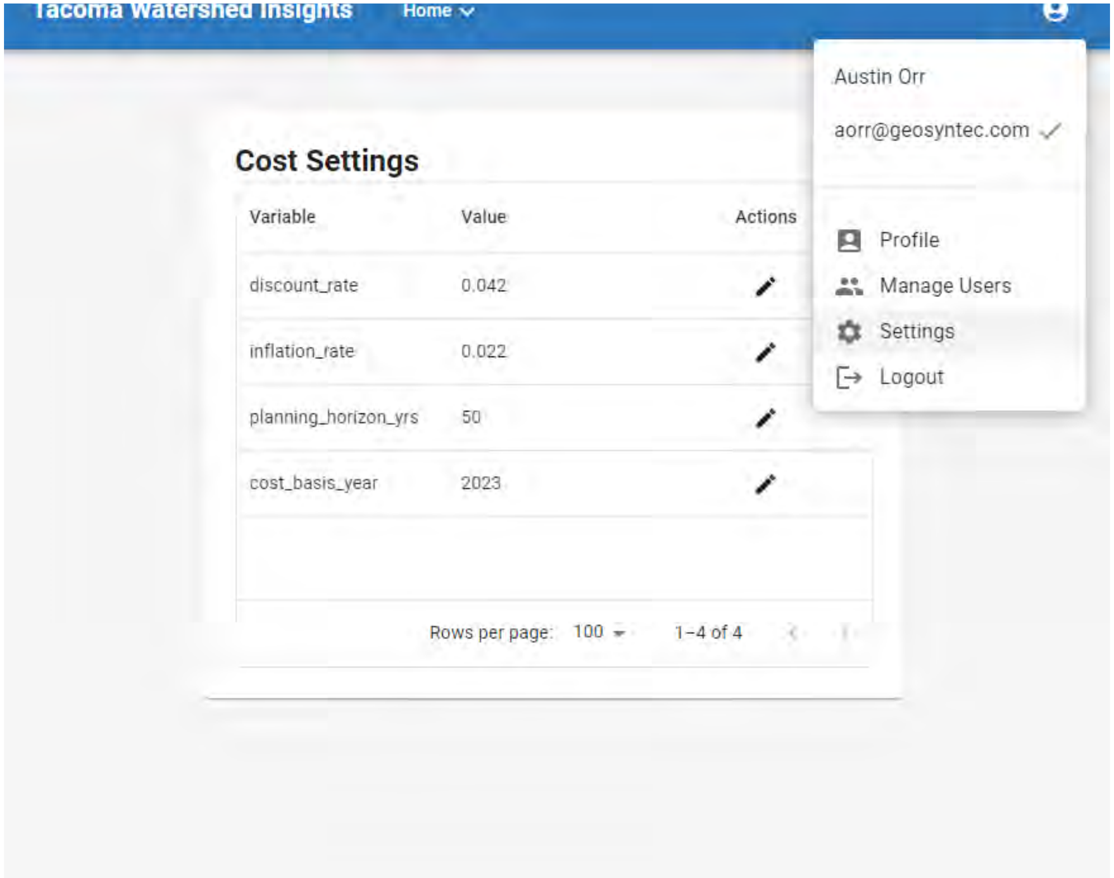
Modify User Roles

Role	Permission
Public	None
Read-only	Read access to data via site and via token
User/Editor	All of the above + access to scenarios and editing data
User Admin	All of the above + access to user manager + access to application settings
System Admin	All of the above + direct api access

- Ask a User Admin to change your role
- Click on Profile
- Click Manage Users
- Click the pen to edit
- Select Role
- Save or cancel



Cost Module Settings

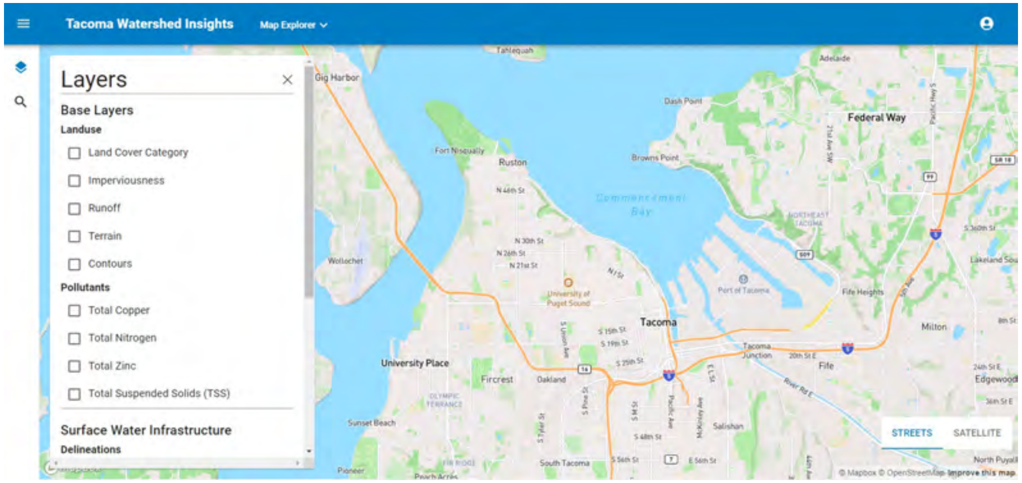


Modify Global Settings

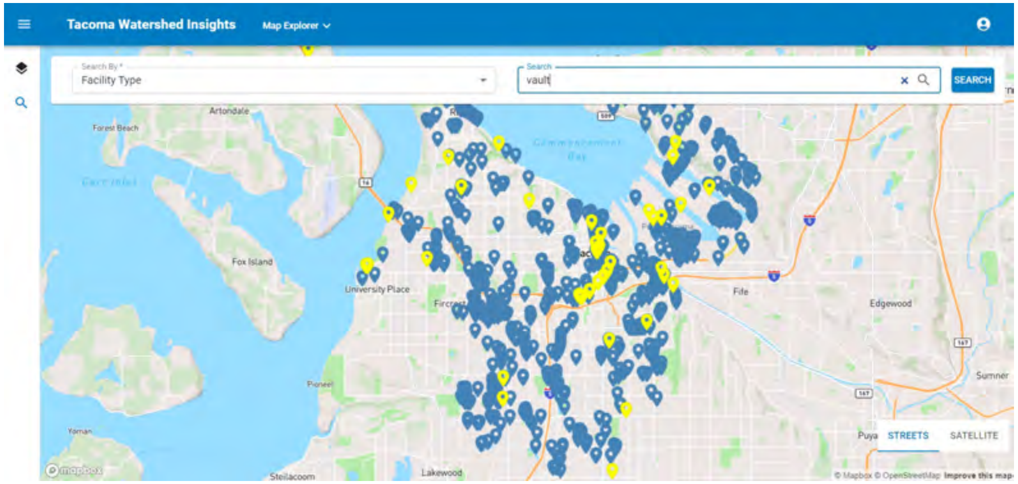
Map Explorer

Visualize Existing Infrastructure and Conditions

- Available Layers:
  - Pollutant heat maps
  - Landuse/Terrain
  - Stormwater subbasins
  - Stormwater BMPs
  - Stormwater pipes

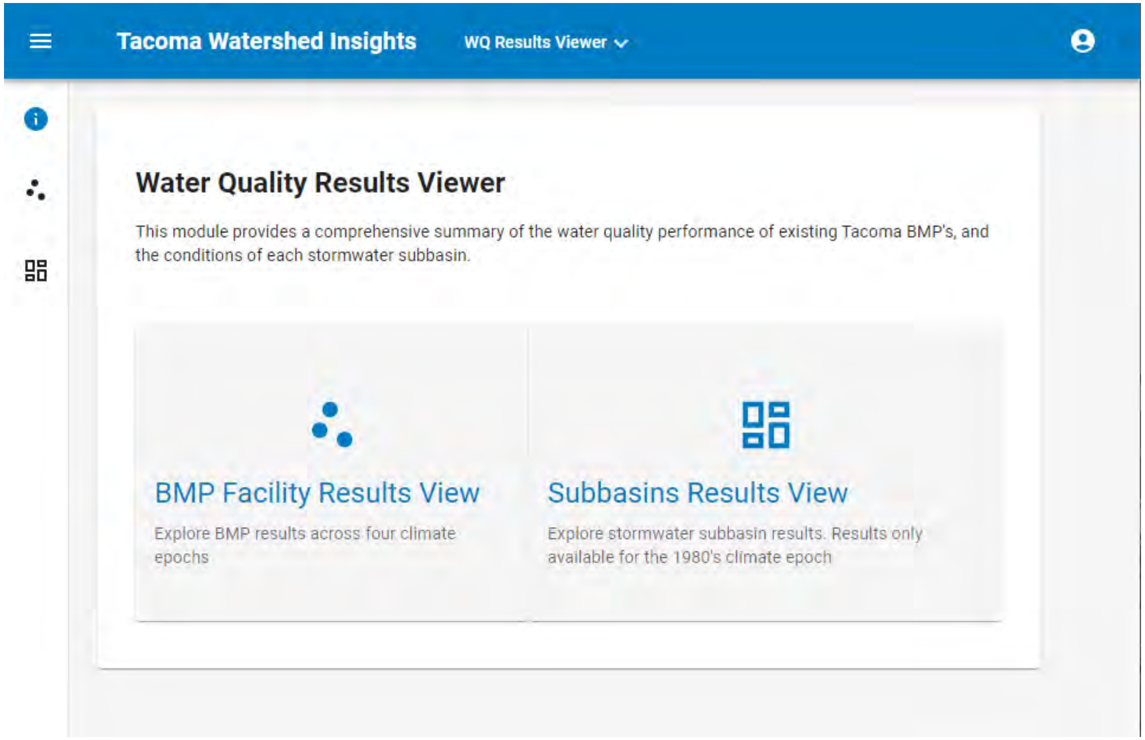


Search by Facility Type



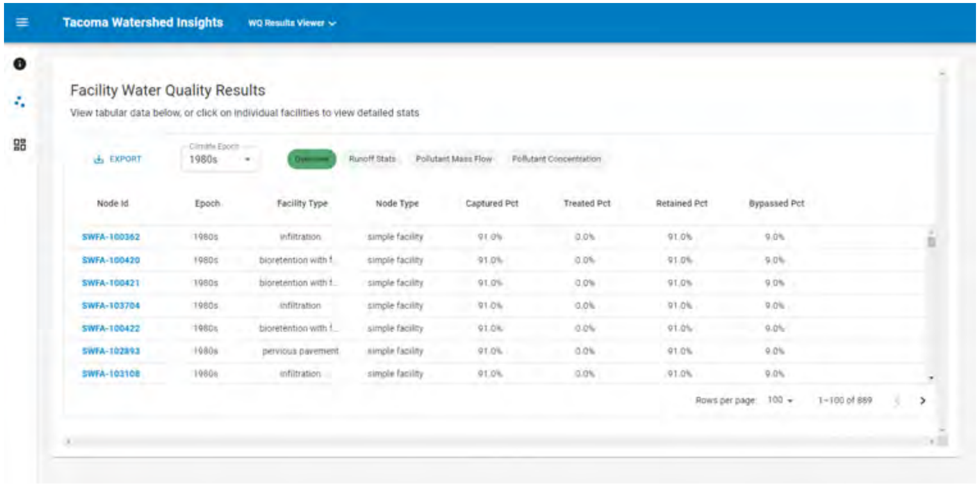
Results Reviewer

Explore WQ Performance at Facilities and Subbasins

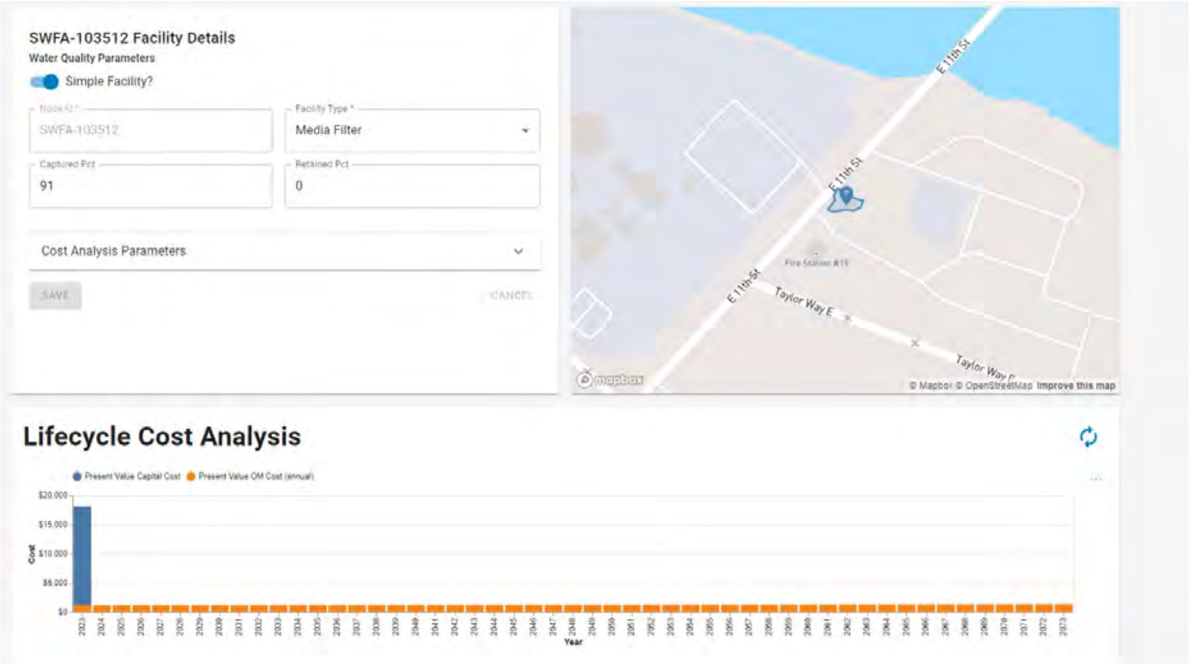


Explore BMP Attributes

- Link to individual facility details
- View stats by climate epoch and type

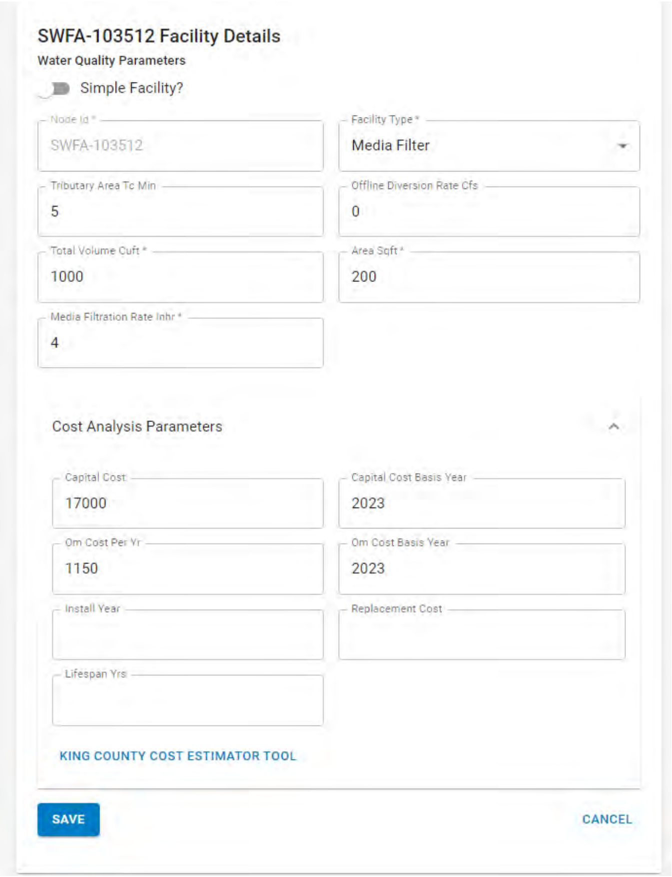


Drill down to individual BMPs



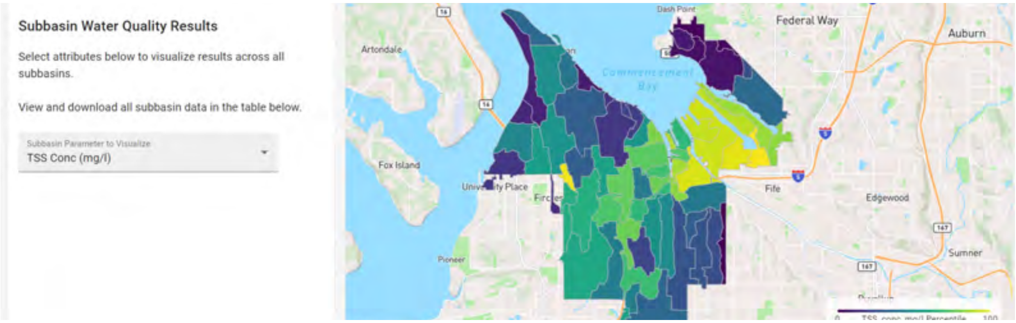
Create BMPs with Detailed Performance and Cost Attributes

- Toggle between 'simple' facilities driven by percentage based capture and treatment stats to ones based on physical attributes
- Add cost data that allows for capital and O&M costs to be amortized over the lifespan of the facility



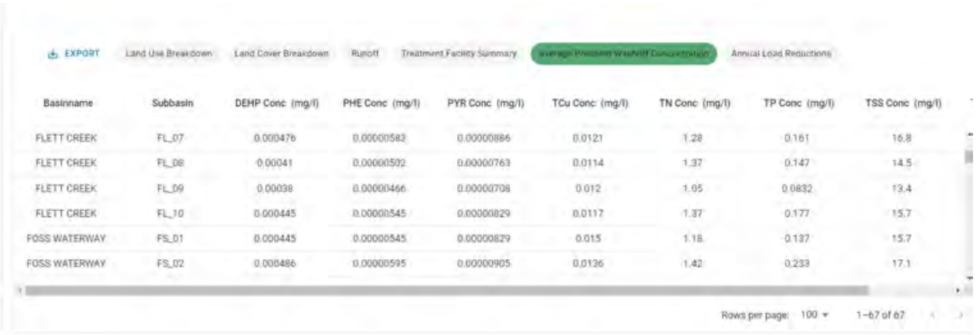
Visualize Subbasin Attributes

- Available Parameters:
- -Land Use/Cover
- -Runoff
- -Treatment Facility Summary
- -Pollutant Concentrations/Reductions



Visualize Subbasin Attributes

- View and download tabular results



Basinname	Subbasin	DEHP Conc (mg/l)	PHE Conc (mg/l)	PYR Conc (mg/l)	TCu Conc (mg/l)	TN Conc (mg/l)	TP Conc (mg/l)	TSS Conc (mg/l)
FLETT CREEK	FL_07	0.000476	0.00000583	0.00000886	0.0121	1.28	0.161	16.8
FLETT CREEK	FL_08	0.00041	0.00000502	0.00000763	0.0114	1.37	0.147	14.5
FLETT CREEK	FL_09	0.00038	0.00000466	0.00000708	0.012	1.05	0.0832	13.4
FLETT CREEK	FL_10	0.000445	0.00000545	0.00000829	0.0117	1.37	0.177	15.7
FOSS WATERWAY	FS_01	0.000445	0.00000545	0.00000829	0.015	1.18	0.137	15.7
FOSS WATERWAY	FS_02	0.000486	0.00000595	0.00000905	0.0136	1.42	0.233	17.1

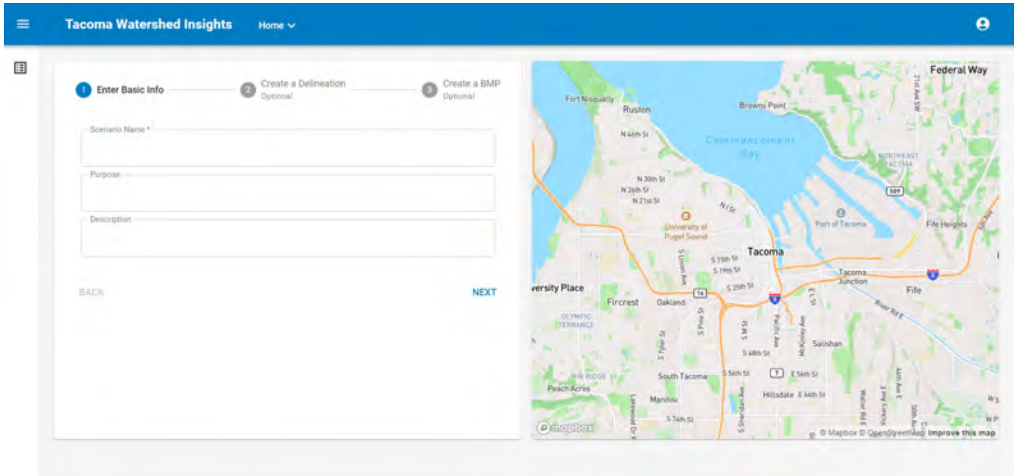
Rows per page: 100 1–67 of 67

Scenario Builder

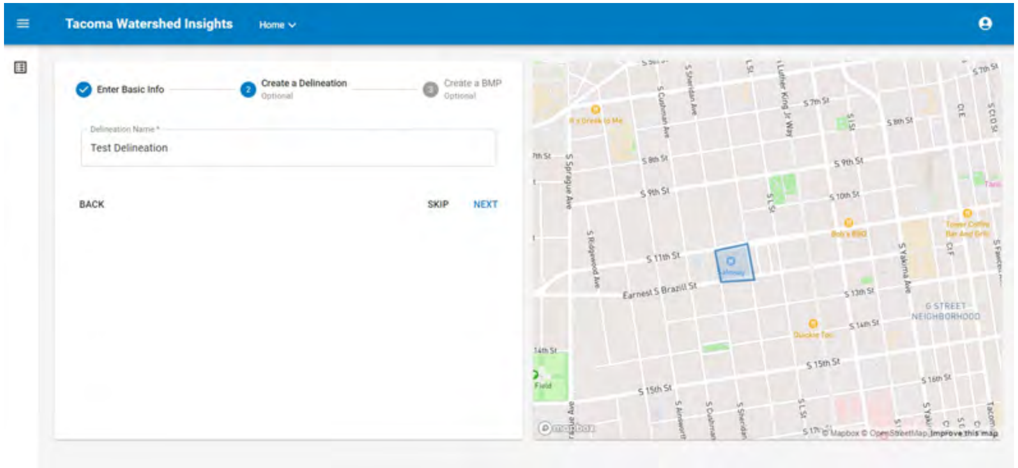
Purpose and Process

- Allows users to model a proposed single BMP facility with an upstream delineation
- Scenarios can be designed incrementally (facility/delineation can be added after creation)
- WQ results can be generated after scenario creation and future edits

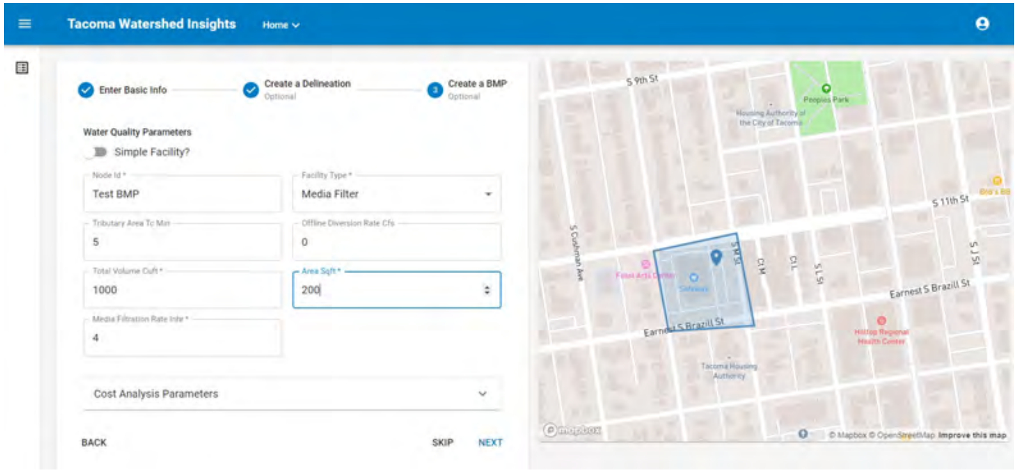
Scenario Design Process



Scenario Design Process

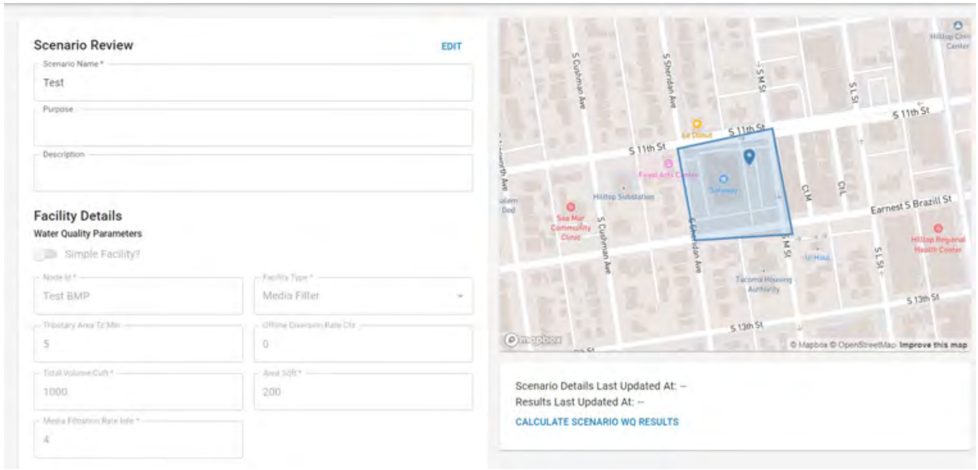


Scenario Design Process



Scenario Design Process

Make edits and calculate results



Purpose and Process

Allows users to prioritize subbasins for stormwater improvements based on a number of goals and subgoals:

- Clean Water Goal
- Resilient Community Goal
- Healthy Ecosystem Goal
- Equity Goal

Subbasins are ranked using a pairwise algorithm - visual/tabular results are produced

Criteria and subbasin ranks can be downloaded for future use

About Subbasin Prioritization

Use this tool to identify regions of the City of Tacoma Watershed that are most in need of stormwater retrofit or preservation projects

Set a project type

Are you prioritizing preservation projects or retrofit projects?

Retrofit

Set Priority Weights

Goal 1: Improve water quality outcomes (Clean Water Goal)

1.1: Prioritize areas based on pollutant concentrations

1

1.2: Improve infrastructure in areas with inadequate stormwater management

0

Goal 2: Increase resilience to climate change impacts (Resilient Community Goal)

2.1: Target areas most vulnerable to and at risk for climate change impacts

0

Goal 3: Preserve and restore critical and sensitive habitat (Healthy Ecosystems)

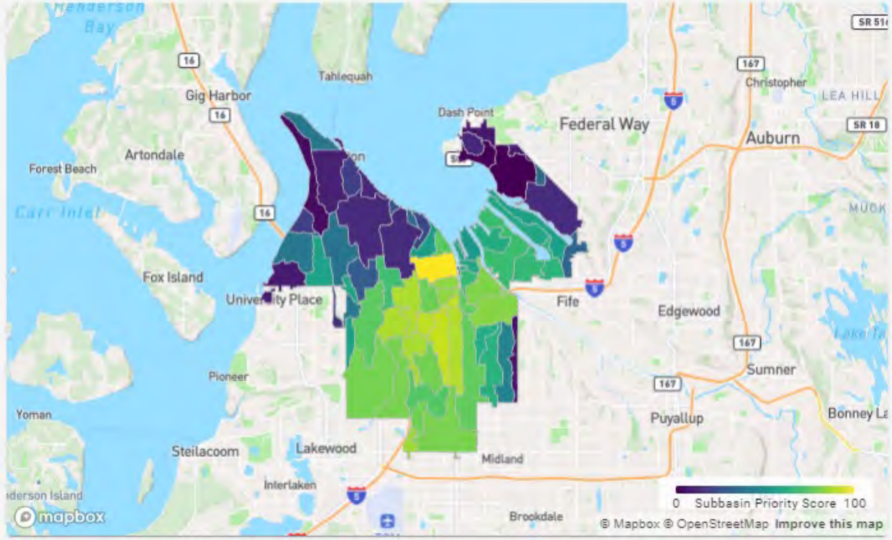
3.1 Preserve and improve Natural Spaces

0

Goal 4: Implement Equity and Social Justice (Healthy neighborhoods; Equity)

4.1: Prioritize areas of overlapping equity needs as identified by other Tacoma programs

2



Subbasin Prioritization Results

Higher priority scores indicate subbasins more favorable for new projects

To view the specific subbasin attributes that determine scores, export the results below

EXPORT

Subbasin ID	Priority Score ↓
FS_05	100
FS_09	91.153
FS_08	90.349
FS_10	88.204
FS_02	87.668
FS_03	87.668
FL_05	86.863

After submitting priorities, subbasins are scored, and results can be visualized and downloaded

Tacoma GIS (refreshed each morning)

- BMP Facilities
- BMP Facility Delineations
- Subbasins (and static subbasin metrics forthcoming)

TNC in Washington Stormwater Heatmap

- POC concentration
- runoff depth (4 climate epochs)

Changeable data

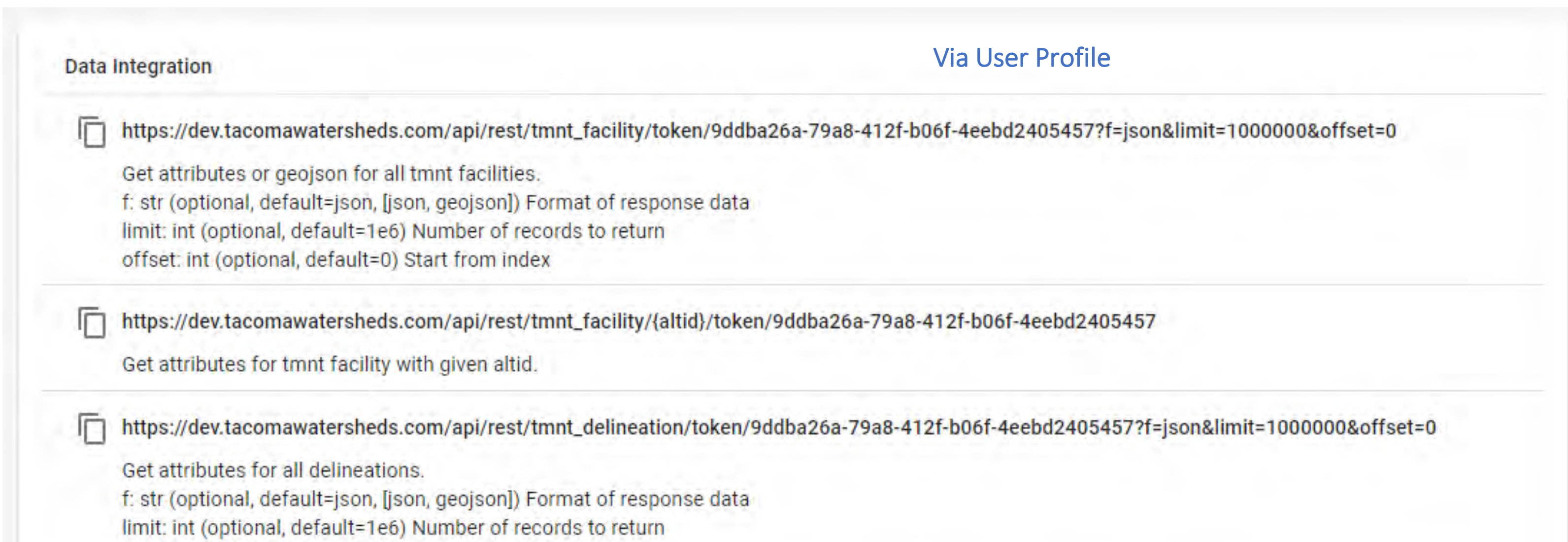
- BMP Facility modeling attributes (e.g. % capture performance, size)
- BMP Facility cost attributes (e.g., capital cost)
- Scenarios
  - Delineations, facility attributes
- Users & Permissions
- Cost Settings (e.g,. Inflation rate)

Calculated data

- BMP Facility volume and load reductions
- BMP Facility cost metrics
- Delineation and Subbasin loading
- Upstream and Downstream source control measures (sweeping and drain line cleaning for Foss Watershed)
- Scenarios
  - Delineations, BMP Facility WQ, BMP Facility Cost

Access via api with token

- TMNT Facilities: https://dev.tacomawatersheds.com/api/rest/tmnt_facility/token/<token>?f=geojson



Data Integration

Via User Profile

https://dev.tacomawatersheds.com/api/rest/tmnt_facility/token/9ddba26a-79a8-412f-b06f-4eebd2405457?f=json&limit=1000000&offset=0

Get attributes or geojson for all tmnt facilities.
f: str (optional, default=json, [json, geojson]) Format of response data
limit: int (optional, default=1e6) Number of records to return
offset: int (optional, default=0) Start from index

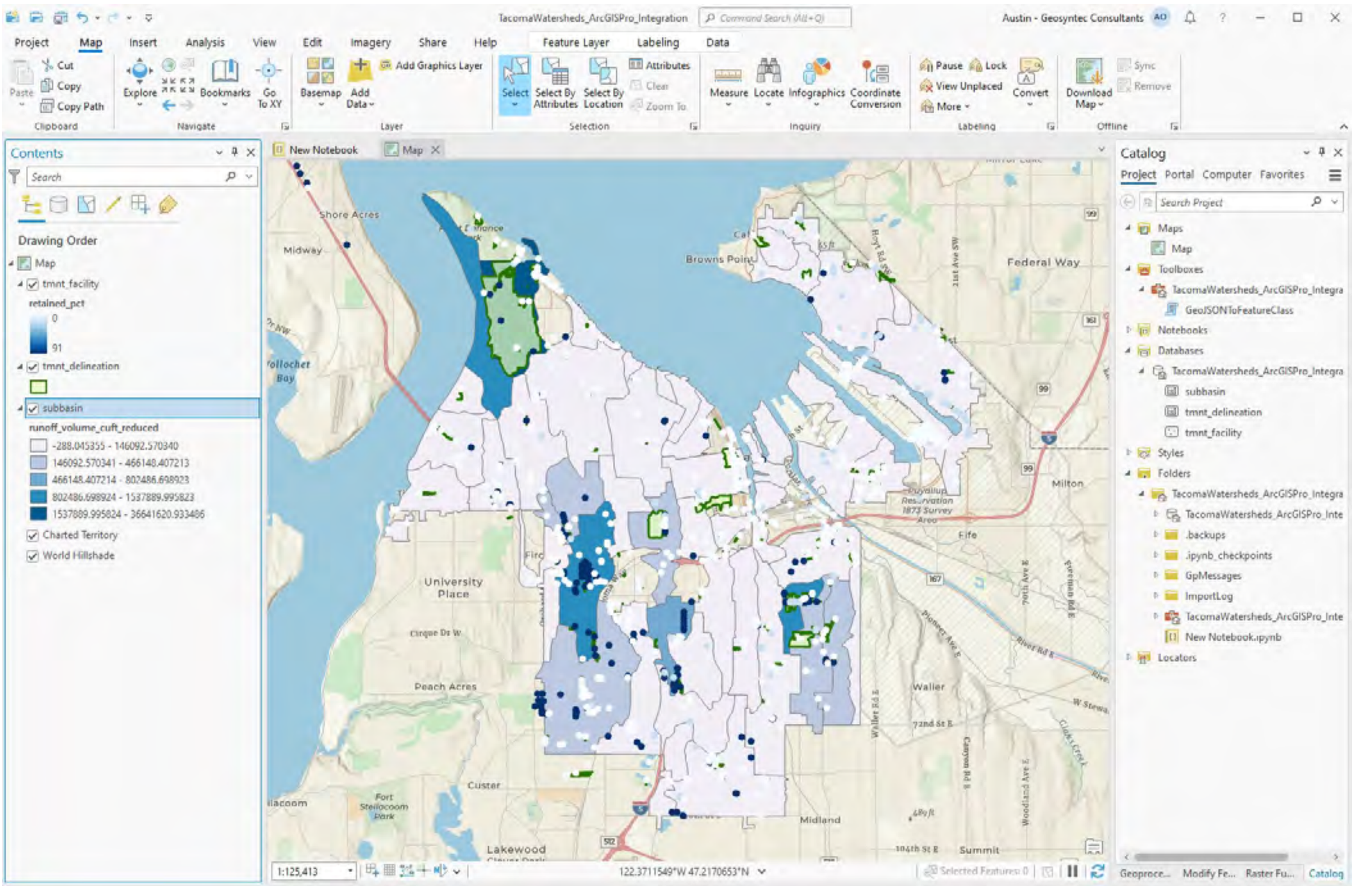
https://dev.tacomawatersheds.com/api/rest/tmnt_facility/{altid}/token/9ddba26a-79a8-412f-b06f-4eebd2405457

Get attributes for tmnt facility with given altid.

https://dev.tacomawatersheds.com/api/rest/tmnt_delineation/token/9ddba26a-79a8-412f-b06f-4eebd2405457?f=json&limit=1000000&offset=0

Get attributes for all delineations.
f: str (optional, default=json, [json, geojson]) Format of response data
limit: int (optional, default=1e6) Number of records to return

Data Integration GIS



Appendix I:
Example Capital Project Summary Sheet

I-705 Bridge Regional Treatment Stormwater Park

Why is this project important?

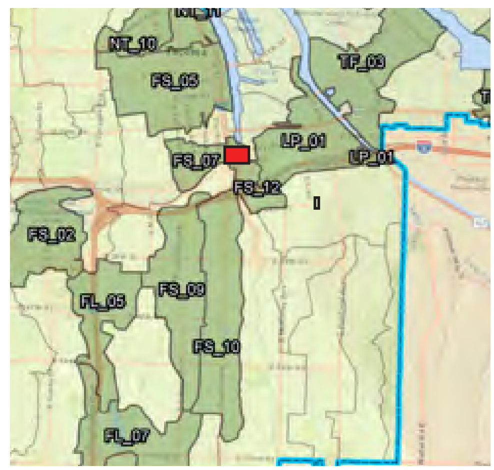
Underneath the I-705 bridge, a paved unused parking lot has been an ongoing location for encampments and dumping. A portion of the site also has legacy soil contamination from coal gas industrial activities. The City of Tacoma is partnering with the Department of Ecology in developing a site plan for site remediation and long-term monitoring. Using this site for a regional stormwater treatment facility would provide a positive use for the redevelopment of this site as well as improve water quality at the head of the Thea Foss Waterway. At this time, a preliminary concept includes siting an underground treatment vault to treat runoff from 123 acres in downtown Tacoma draining to the Thea Foss Waterway.

Project Description

This innovative stormwater park location has the potential to include Depaving a portion of the abandoned and crumbling roadway adjacent to the bridge to create a community gathering space as well as rebuild an access road for maintenance vehicle access. It's location at the terminus of the proposed alignment for the Mountain Line Railway Trail has the potential of connecting the future trail via a pedestrian bridge across the BNSF railroad tracks to the Foss Waterway Esplanade and regional trail to Point Defiance. The existing parking lot under I-705 is being considered for City Public Works Inspector vehicle parking and EV chargers and may eventually be used for event overflow parking for the Tacoma Dome or off-site supplemental parking for events and activities along the Thea Foss waterfront. This project has the potential to create multiple community benefits including public gathering space, event parking, trail connectivity to the waterfront, and improvements to the water quality of the Thea Foss Waterway.

Location

East 23rd and Dock Street
Tacoma, WA



Project Timing

Near-term (2024-2030)

Partners

WA Dept. of Transportation
City of Tacoma - Public Works
City of Tacoma - Neighborhood and Community Services
WA Dept. of Ecology

Site Challenges

- Portion of the site is underlain by contaminated soil, additional remedial site investigation is required to assess extents of soil contamination and potential impact on treatment facility sizing and location.
- Requires negotiation of a public easement and maintenance memorandum of understanding with WSDOT.
- Will need to compete for state or federal funding for design and construction costs.

Project Benefits

- Restores active use to an abandoned and derelict area under the bridge.
- Existing support from local businesses for community placemaking.
- Potential regional trail connectivity.
- Property is publicly owned by WA Department of Transportation (WSDOT).
- Sufficient space is available to accommodate a treatment vault sized to treat the majority of upstream drainage basin.
- The site evaluation to identify the extent of contaminated soils and groundwater and alternative analysis for site remediation proposals is underway.

Retrofit Type	Underground filter vault
Location	Dock Street and E. 23rd Street under I-705
Existing Use	Abandonded parking lot and vacant land
Tributary Area	123 Acres
Facility Area	540 Square Feet
Planning Level Construction Cost	$2.1 Million
Construction Cost/Acre Treated	$17,073/Ac
Planning Level Annual O&M Cost	$42,160/Yr
Annual O&M Cost/Acre Treated	$343/Ac

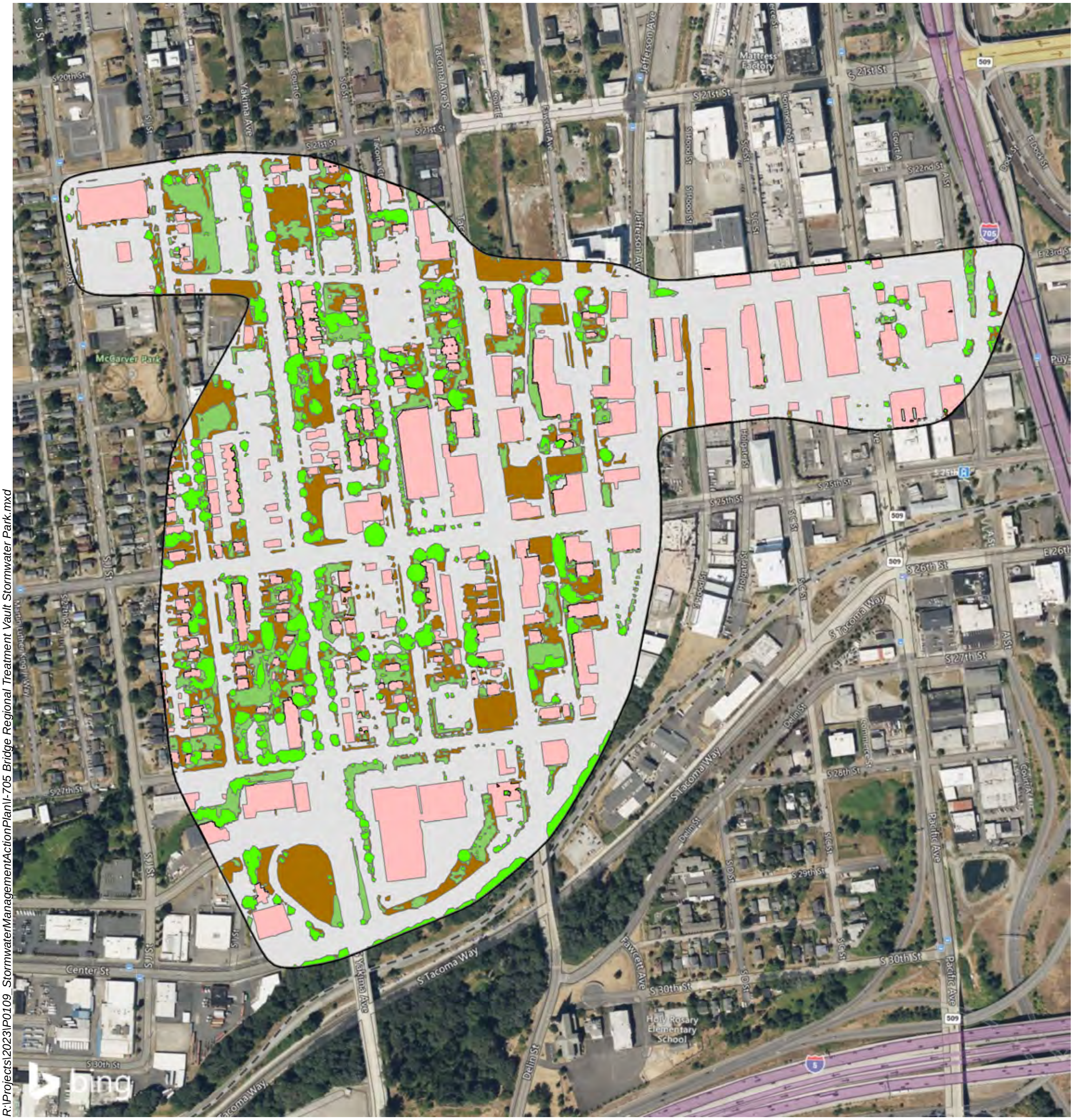
I-705 Bridge Regional Treatment Vault/Stormwater Park - Site Map

I-705 and S. 23rd – Regional Treatment Facility Potential Location

Stormfilter Vault (540 sf) with 136 – 27" Cartridges

WQ Treatment Flow Rate: 5.7 cfs

I-705 Bridge Regional Treatment Vault/Stormwater Park - Drainage Basin



R:\Projects\2023\P0109_StormwaterManagementActionPlan\I-705 Bridge Regional Treatment Vault Stormwater Park.mxd

Land Cover

- Building = 22.9 Acres
- NonCanopyVegetation = 10 Acres
- Other Impervious = 66.7 Acres
- Soil And Dry Vegetation = 14.35 Acres
- Tree Canopy = 9.5 Acres
- Water = n/a
- I-705 Bridge Regional Treatment Vault Stormwate Basin = 123.46 Acres
- Tacoma City Limits

Feet
0 150 300 600

Map Date: 1/9/2024
Source: Science and Engineering Division
Environmental Services Department
City of Tacoma
326 East D Street, Tacoma WA 98421
(253) 591-5588

Tacoma

Appendix J:
CIP Project
Public Engagement Template

Project Public Involvement Plan Template

BACKGROUND

This section is intended to provide a 3-4 paragraph description of the project, including the project location and goals, project phase, and associated timeline.

KEY MESSAGES

Complete this section with key messages related to the overall Watershed Management Planning process and project specifics. This section is intended to help ensure that everyone on the project team and outside of the project team use consistent messaging when communicating about the project.

PROJECT TEAM

Add all key members of the project team. Examples are provided below.

Project Manager:	
Communications Lead:	
Outreach Support	
Additional City Staff:	

PUBLIC OUTREACH

Complete this section with the public engagement objectives for each of the three project phases: Options Analysis; Design; and Construction. Examples for public outreach objectives by phase are listed below. It is also important to identify and list anticipated concerns for each project phase. Examples are also listed below.

Objectives

Options Analysis

- Notify community members and nearby neighbors of project and solicit feedback
- Provide multiple opportunities for community input on design options
- Share regular updates about project at key project milestones
- Communicate equitably and gather feedback from all project stakeholders

Design

- Involve adjacent businesses, area residents, members of the community and other affected stakeholders to inform the planning/design process, and reduce impacts as much as is reasonable and feasible
- Engage the nearby neighborhood and surrounding communities by maintaining communication channels, listening, and responding quickly to public questions and concerns
- Communicate equitably and gather feedback from all project stakeholders

Construction

- Notify community members and nearby stakeholders of project and solicit pre-construction feedback
- Inform members of the community, area residents, nearby businesses and other affected stakeholders of upcoming construction project timeline and expected impacts
- Engage the surrounding neighborhoods and communities by maintaining open and accessible communication channels, listening and responding to questions and concerns, and providing multiple avenues for input

Anticipated Concerns	**Options Analysis** • Lack of support for options and/or overall lack of support for project • Overall project delays and expense **Design** • Quality of life impacts: Changes to local community character, neighborhood development/gentrification • Project delays and expense **Construction** • Project delays and expense
Media & Stakeholders	• **Stakeholders:** *Examples could include: Adjacent businesses, residents, and property owners/managers in vicinity of project* • **Media:** *List local media sources here.*
Outreach Budget and Assumptions	**Budget:** $200,000 **Budget Assumptions:** • Outreach budget for options analysis, design, and construction • Includes direct expenses for printing materials, renting event venues, etc. • Can include budget for subconsultants (as needed)
Public Project Contact	**EMAIL:** **PHONE:**

BUDGET

Total Funds	$
Funding Programs	

PLANNED MAJOR OUTREACH ACTIVITIES

Please complete this table with a detailed list of public engagement outreach activities and include when those activities will take place and the justification for those activities. Please refer to Engagement Strategies Phase One on p. X for a list of potential activities.

When	What	Why	Complete
			☐
			☐

SCHEDULE & MAJOR MILESTONES

Options Analysis	**Design**	**Construction**
Timeline Details	Timeline Details	Timeline Details

Webpage: *Add project website here.*

BACKGROUND

Add project background here.

PROJECT BENEFITS

Add project benefits here.

Insert project area map here.

TABLE 2: STAKEHOLDER CHECKLIST

Incorporated? (Y or N)	Audiences to Consider	Examples (full list will be developed over project life)
	Adjacent property owners and tenants, including businesses and residents	
	Typical users of project area	
	District Councils	
	Community groups and neighborhood organizations	
	Cultural and religious organizations	
	Tribes	
	Chambers of commerce and local business organizations	
	City of Tacoma Departments	
	Other agencies	
	Adjacent municipalities	
	Universities and institutions	
	Public facilities	
	Schools and childcare facilities	
	Hospitals/Medical Facilities	
	Social service organizations and facilities (including those serving people with disabilities)	
	CBOs	
	City of Tacoma Advisory Boards	
	Event Centers	
	Media Outlets	
	Populations that may need targeted outreach to due to cultural barriers, language differences, etc.	

GUIDING QUESTIONS

Please provide responses to the below questions.

1. **What are the goals of the project?**

2. **What racial or social inequities currently exist in the project area?**

3. **How do the project goals address or consider the existing racial or social inequities? How will the project increase or decrease racial or social equity?**

4. **How will you address the project's impacts (including unintended consequences) on racial or social equity?**

DEMOGRAPHIC DATA AND LANGUAGE NEEDS

Projects are required to provide materials and information in non-English languages if 5% or more of the population in that project area speaks a given language. For any project, materials in other languages are available upon request.

TRANSLATIONS THRESHOLD

2010 US Census Bureau Language Map data

Census Tract #	%Speak Spanish	% Speak Vietnamese	% Speak Russian	% Speak African Languages	% Speak Chinese	% Speak Korean

2010 - 2014 American Community Survey 5 Year Average provided by the United States Census Bureau

Census Tract #	Total Population	% Speak Spanish	% Speak Vietnamese	% Speak Russian	% Speak African Languages	% Speak Chinese	% Speak Korean	% English less than very well	% Other Languages Spoken

2010 US Census Bureau Language Map

Recommendations:

- *Provide recommendations here based on census data.*

INCLUSIVE ENGAGEMENT ELEMENTS

Examples are provided below.

Events

- The project team will coordinate with other City projects, performing public outreach in the area to share project information at existing outreach events and outlets.
- The project team will share project information with the community at local events where people in the area are already gathering (i.e. festivals, drop-ins at coffee shops, pop-ups, etc.) Include multi-lingual interpretation upon request.
- The project team will host in-person walk and talk events, along with one online survey to include stakeholders with limited availability/access to attend in-person events, respectively

Mailings

- Include translated text on mailings
- Send translated mailings and ensure they reach populations of those speaking languages other than English

Web

- Include all translated materials on project webpage
- Web content will be formatted to work with popular screen readers for blind audiences
- Project webpage will contain translated text explaining additional project materials in other languages can be provided upon request

Print Materials

- Easy to understand graphics and written materials will be created to promote accessibility for all audiences

Construction outreach

- Partner with Community Based Organizations, schools, healthcare facilities, organizations and housing developments within the neighborhood to help share information with the community.