Stormwater Management Action Plan – Fish Pond Creek Subbasin

City of Tumwater

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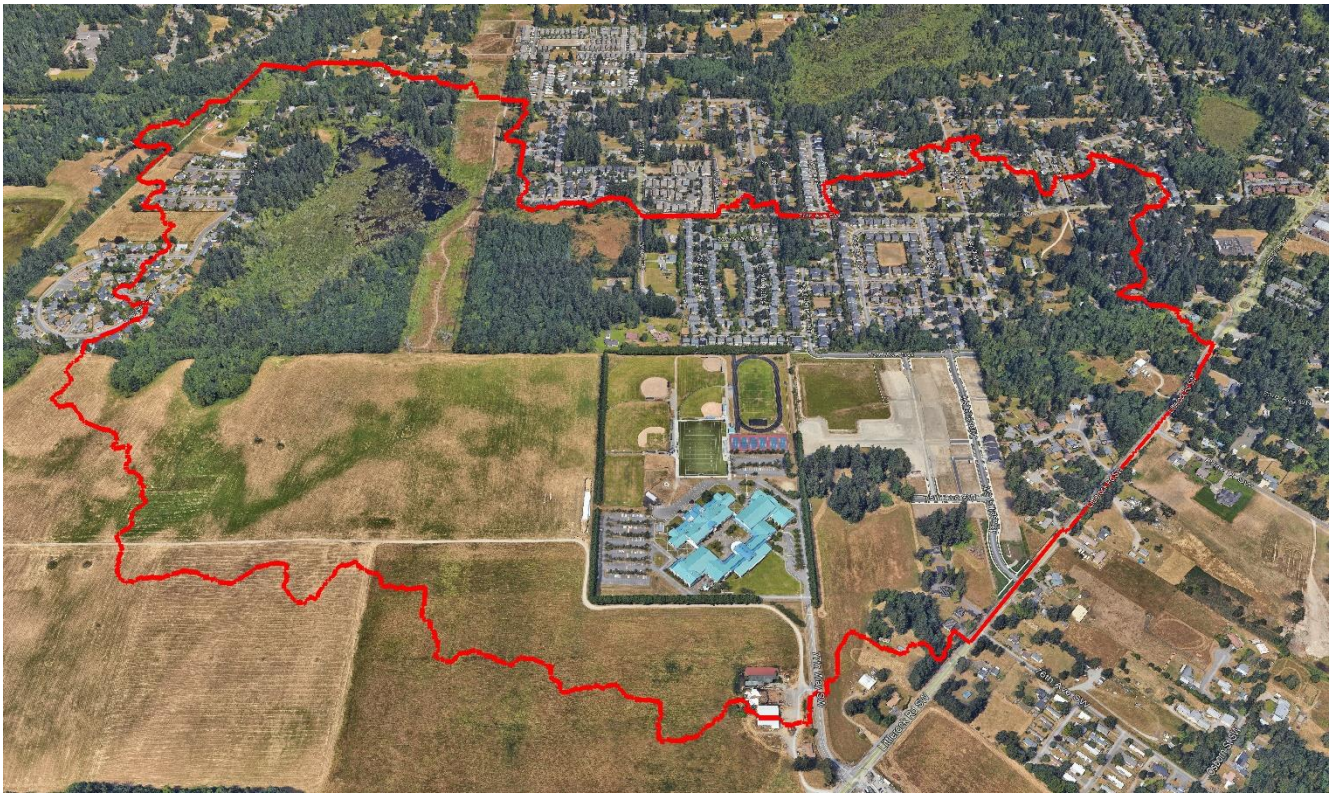

February 2024

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PURPOSE

This City of Tumwater (City) Fish Pond Creek Subbasin Stormwater Management Action Plan (SMAP) has been prepared to meet the requirements of S5.C.1.d.iii of the 2019 – 2024 Western Washington Phase II National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater Permit (2019 – 2024 Permit) issued by the Washington Department of Ecology (Ecology). This SMAP was funded through Ecology's Stormwater Financial Assistance Program (SFAP) grant (WQC-2023-Tumwat-00049) for the Fish Pond Creek subbasin, a high priority catchment located within the larger Black Lake watershed.

The Fish Pond Creek SMAP is organized into the following sections:

- Background. Provides context on the development of the Fish Pond Creek SMAP, including the Watershed Inventory and Assessment, Watersheds Prioritization, and how the Fish Pond Creek SMAP relates to the Trosper Lake and West Mottman SMAPs
- Watershed Prioritization Summary. Summarizes the Black Lake watershed function and Fish Pond Creek subbasin conditions, including land use, future growth, and stormwater influence
- Stormwater Management Actions. Describes the process to identify stormwater management actions and summarizes the following actions and changes:
    - Strategic stormwater facility retrofit project opportunities in the subbasin, including best management practice (BMP) types and preferred locations
    - Land management strategies and actions identified for water quality management
    - Targeted, enhanced, or customized implementation of stormwater management actions related to the 2019 – 2024 Permit sections within S5, including:
        - Public education and outreach (S.5.C.2)
        - Illicit discharge detection and elimination (IDDE) (S.5.C.5)
        - Operations and maintenance (O&M) (S.5.C.7)
        - Source control program for existing development (S.5.C.8)
        - Monitoring and assessment (S.8)
    - Changes to long range plans
- Proposed Implementation Schedule and Budget Sources. Includes a schedule and budget for short-term actions (2024 - 2030) and long-term actions (2031 - 2044)
- Future Assessment and Feedback. Outlines a process and schedule to provide future assessment and feedback

BACKGROUND

The City completed the first two phases of the 2019 – 2024 Permit required SMAP process in 2022. In March 2022, the City submitted the "City of Tumwater Watershed Inventory and Assessment" (City of Tumwater 2022a) to meet the Receiving Waters Conditions Assessment component of the SMAP process. Later in June 2022, the City submitted the "City of Tumwater Watershed Prioritization" (City of Tumwater 2022b) to meet the Receiving Waters Prioritization component of the SMAP process. This document meets the requirements of the third component of the process: the Stormwater Management Action Plan (SMAP). The Watershed Inventory and Assessment is provided in Appendix A and the Watershed Prioritization is provided in Appendix B.

While the City's 2019 – 2024 Permit requires that only one catchment be selected for development of a detailed SMAP, the City elected to develop individual SMAPs for the three highest priority catchments that were identified during the prioritization step in the process. These three subbasins – Trosper Lake, West Mottman, and Fish Pond Creek - were chosen because they are in priority watersheds with high degrees of stormwater influence. The three subbasins also represent distinct land uses (i.e., mixed use, industrial, and rural), which will help inform broader stormwater management retrofit planning and program development across the remaining areas of the priority watersheds and Citywide. Figure 1 shows the three priority subbasins within the City.

The first of the three SMAPs to be developed was the Trosper Lake SMAP. It was delivered to Ecology in March 2023 (Herrera 2023), approved by Ecology grant staff, and served as the official deliverable to satisfy the 2019 – 2024 Permit requirements. This Fish Pond Creek SMAP is a secondary deliverable to Ecology and has been developed concurrently with the West Mottman SMAP. This SMAP identifies some actions that will be applied in the other SMAP subbasins or in some cases will be applied Citywide.

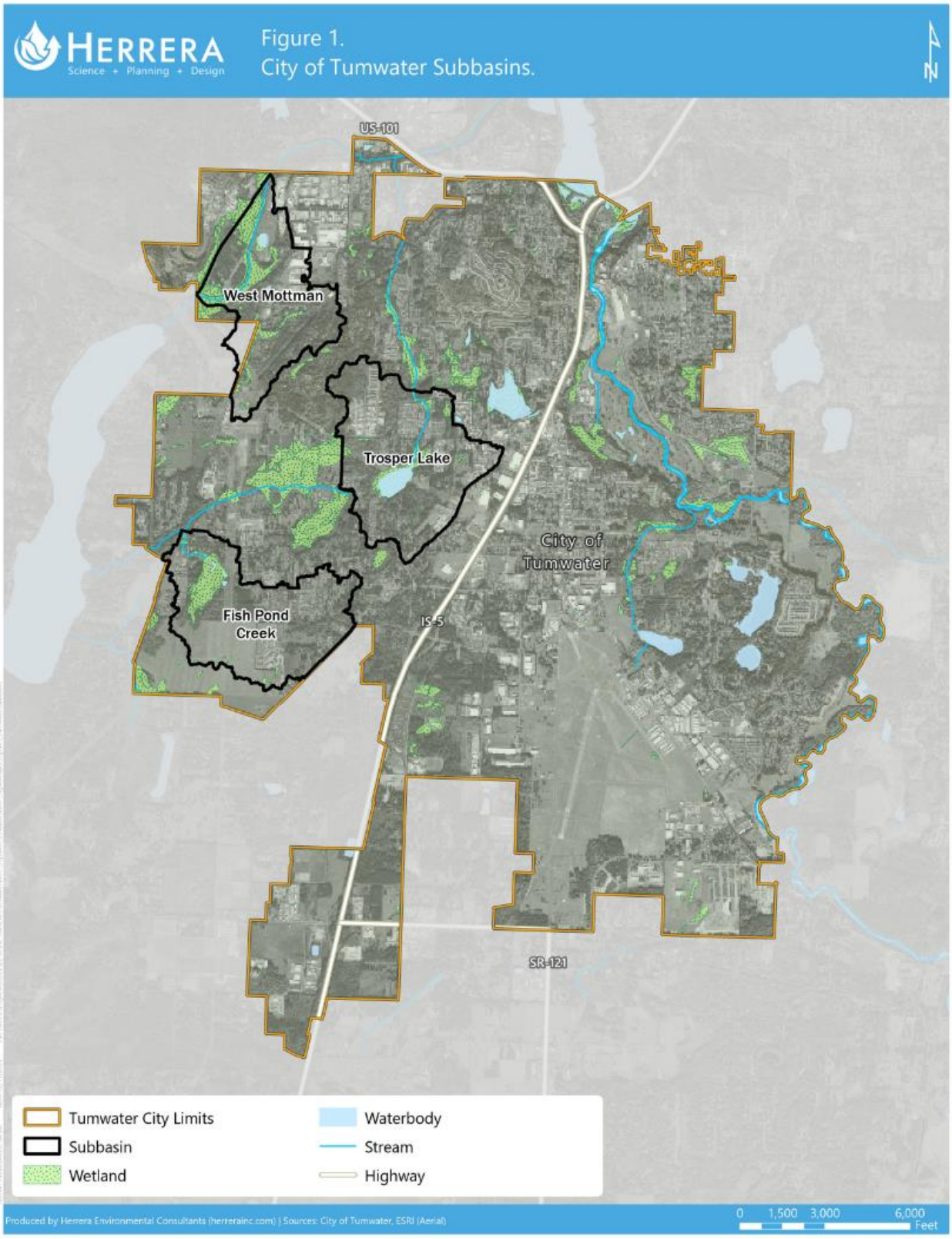
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Figure 1.
City of Tumwater Subbasins.
N
US-101
West Mottman
Trosper Lake
City of Tumwater
Fish Pond Creek
I5
SR-121
Tumwater City Limits
Subbasin
Wetland
Waterbody
Stream
Highway
Produced by Herrera Environmental Consultants (herrerainc.com) | Sources: City of Tumwater, ESRI (Aerial)
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WATERSHED PRIORITIZATION SUMMARY

Seven watersheds were originally identified and considered as potential candidates for the SMAP during an initial screening performed for the City's watershed inventory. These watersheds include the Lower Deschutes River, Salmon Creek, Black Lake, Percival Creek, Capitol Lake, Moxlie Creek, and Chambers Creek (City of Tumwater 2022a). Due to low stormwater influence, Moxlie Creek and Chambers Creek were omitted from the prioritization process. Receiving water conditions and stormwater influence were then evaluated for the remaining five watersheds to complete the watershed prioritization process (City of Tumwater 2022b).

The Black Lake watershed was subsequently identified as a high priority for SMAP development based on several factors (City of Tumwater 2022a):

- Anticipated new residential development was determined to be a prime target for SMAP action within the watershed.
- Black Lake has elevated nutrient concentrations.
- There is high potential for stormwater actions to improve water quality conditions and habitat for fish and wildlife in the watershed.

The Fish Pond Creek subbasin is within the Black Lake watershed. Trosper Lake and West Mottman subbasins are within the Percival Creek watershed, which are described in the Trosper Lake SMAP (Herrera 2023) and West Mottman SMAP (Herrera 2024).

Black Lake Watershed Function

Approximately 2.7 square miles (34%) of the 8 square mile Black Lake watershed lies within City limits. Black Lake's designated uses include recreation, fish habitat, wildlife habitat/corridor, aquifer recharge, and aesthetics. The lake is designated as eutrophic, despite some reduction of total phosphorus levels with a 2006 alum treatment (Thurston County 2020). The lake also experiences elevated temperature, low dissolved oxygen (DO), and algal blooms (Tumwater 2022a).

Black Lake watershed is known for having shallow groundwater present and being surrounded by extensive wetlands on its northern and southern ends. Various creeks and streams flow into Black Lake with the largest creek being Fish Pond Creek. The Black Lake watershed may also receive groundwater inputs from the Salmon Creek basin (Thurston County 2015).

The Black Lake watershed was subdivided into seven subbasins during the SMAP watershed characterization step. Of these, only one subbasin, Fish Pond Creek, was determined to be of appropriate size (i.e., 400 to 600 acres) to consider in the SMAP process.

Fish Pond Creek Subbasin Conditions

A brief description is provided below of the Fish Pond Creek subbasin's land use, growth potential, and stormwater influence. This background information regarding existing characteristics and potential future conditions was considered during development of the SMAP.

Land Use and Future Growth

The Fish Pond Creek subbasin is approximately 530 acres. Land use is primarily agricultural but is quickly being developed into single family residential as the City expands. The majority of the subbasin is located within the Urban Growth Area and the Tickner Farm Development in the south will add about 1,200 single family homes. The project will include onsite stormwater treatment facilities in the design. The subbasin also include a large wetland complex along the creek that is considered good beaver habitat and is suspected to be fish bearing. See Figure 2 for an overview of these areas.

Stormwater Influence

Stormwater management in the Fish Pond Creek subbasin includes some piped conveyance and stormwater detention ponds in residential areas. Many culverts within the subbasin are undersized as identified in the 2011 Annexation Area Drainage Report (Tumwater 2011). Undersized culverts coupled with beaver activity means the subbasin is susceptible to localized flooding during heavy rain events (Tumwater 2022a). The projected residential development in the subbasin is a prime target for SMAP projects. Actions would be expected to improve water quality conditions and habitat for fish and wildlife.

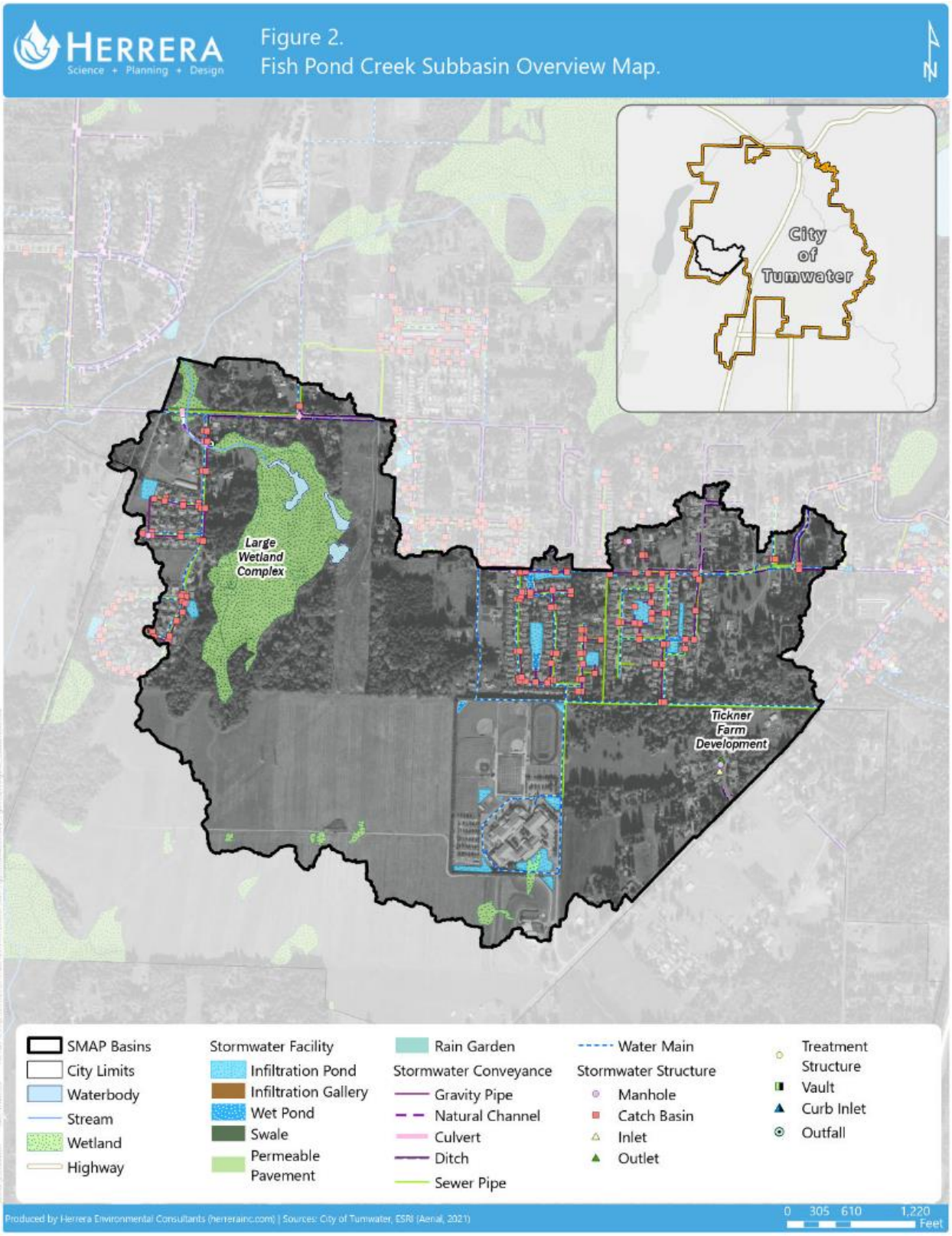
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Figure 2.
Fish Pond Creek Subbasin Overview Map.
N
City of Tumwater
Large Wetland Complex
Tickner Farm Development
SMAP Basins
City Limits
Waterbody
Stream
Wetland
Highway
Stormwater Facility
Infiltration Pond
Infiltration Gallery
Wet Pond
Swale
Permeable Pavement
Rain Garden
Stormwater Conveyance
Gravity Pipe
Natural Channel
Culvert
Ditch
Sewer Pipe
Water Main
Stormwater Structure
Manhole
Catch Basin
Inlet
Outlet
Treatment Structure
Vault
Curb Inlet
Outfall
Produced by Herrera Environmental Consultants (herrerainc.com) | Sources: City of Tumwater, ESRI (Aerial, 2021)
0 305 610 1,220
Feet

STORMWATER MANAGEMENT ACTIONS

Process to Identify Stormwater Management Actions

Identifying stormwater management actions included a detailed evaluation of landscape characteristics and the existing stormwater system in the Fish Pond Creek subbasin. Landscape characteristics included zoning, vacant lands, stream buffers, wetlands, geohazard areas, and road right-of-way (ROW). In addition, stormwater infrastructure, projects, and programs were reviewed. The assessment of the stormwater system included identifying existing stormwater problem areas, facilities and outfalls, including previously unmapped outfalls. Current capital improvement projects (CIPs) were also reviewed to identify projects that improve stormwater quality and/or flow control. Based on this information a series of 'actions' were identified to further protect and/or enhance ecosystem function of the Fish Pond Creek subbasin. Actions were selected based on greatest benefit per City capacity. The City's interdisciplinary team was involved in action prioritization, timing, and costing through bi-weekly meetings, fieldwork days, and three workshops conducted in July, September, and October 2023.

The City created a Stormwater Management Action Plan webpage with details about the Stormwater Management Action Planning process and timeline. The webpage includes the previously completed Trosper Lake SMAP, SMAP Story Map, web map, and a link to a quick survey to provide feedback on the SMAP approaches and priorities. In addition to the webpage, representatives from the Water Resources and Sustainability Department engaged with HOA members from six neighborhood groups. The conversations were productive and Tumwater received positive feedback and interest in hosting onsite training for HOA members on a variety of topics including stormwater BMPs, leaf litter, car washing, and pet waste. These topics of interest helped to shape the priority outreach topics listed in more depth in the stormwater program enhancements section of this report.

The proposed stormwater management actions in this SMAP cover three categories: strategic retrofit project opportunities, land management strategies, and stormwater program enhancements. All strategic retrofit project opportunities are one-time actions. However, land management strategies and stormwater program enhancements can be conducted over varying time frames: one-time, pilot, or annually for the short-term (2024 – 2030) and/or long-term (2031 – 2044). Projects identified as annual or pilot projects may be evaluated during and after the project to determine if it is beneficial to continue the action or end the action based on project success, effectiveness, need, and capacity.

Strategic Stormwater Retrofit Project Opportunities

The City of Tumwater's Comprehensive Stormwater Management Plan (Herrera 2018) and 2020 – 2025 Capital Facilities Plan (CFP) (City of Tumwater 2019) were used to develop an initial list of stormwater retrofit project opportunities. The list of stormwater retrofit project opportunities was then evaluated using a desktop assessment to create a project opportunity matrix. The matrix was reviewed at a

workshop with City staff and the top project opportunities from the workshop were assessed further during a field evaluation.

Based on the desktop and field assessments, Cavalier Street Southwest Linear Facilities (RP-1) was selected for further consideration in the Fish Pond Creek subbasin. This retrofit project opportunity will improve water quality in the subbasin by installing four bioretention cells on Cavalier Street Southwest. This project opportunity will follow the long-term (2031-2044) implementation schedule.

The location of the Cavalier Street Southwest Linear Facilities project opportunity is shown in Figure 3. More information about the retrofit project opportunity can be found in Appendix C.


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Figure 3. Fish Pond Creek Subbasin Stormwater Retrofit Project Opportunities.
N
Trosper Lake
Cavalier Street SW Linear Facilities
SMAP Basins
Stormwater Retrofit Project Opportunity
Stream
Waterbody
Wetland
Road
Cavalier Street SW Linear Facilities Contributing Basin
Produced by Herrera Environmental Consultants (herrerainc.com) | Sources: City of Tumwater, ESRI (Aerial, 2021)
0 280 560 1,120
Feet

Land Management Strategies

Six land management strategies were selected for the Fish Pond Creek subbasin (Table 1). These strategies were identified using the Fish Pond Creek Subbasin Background (City of Tumwater 2023) document and refined over multiple workshops with City staff. Some actions parallel those in the Trosper Lake and West Mottman SMAPs and are denoted with a symbol. The table also includes the expected implementation schedule. Appendices E and F include anticipated cost information.

Table 1. Fish Pond Creek Subbasin Land Management Strategies.

Strategy	Description	Schedule	
		2024-2030	2031-2044
LM-1: Coordinate with other City Departments to incorporate stormwater into projects, especially CFP projects.*†~	Annually, meet with other department staff during planning of capital improvement projects (such as the annual Transportation Improvement Projects review, or Parks planning projects review) to determine how anticipated projects could incorporate stormwater planning and retrofits, especially projects related to the Transportation and Engineering Department.	✓	✓
LM-2: Evaluate options for development of an ecosystem services asset management program.*†~	Conduct initial study to identify how an ecosystem services asset management program would be developed, funded, and applied to inform land use planning, restoration actions and overall benefit to receiving waters Citywide. A natural resources or ecosystem services asset management program would follow a similar framework that the City uses for managing infrastructure. An asset management program helps measure, and track the condition of assets, compare the condition of assets against the desired condition, and identify strategies to reduce gaps and risks to services. Specifically, an ecosystem services asset management program would compile and update environmental data and criteria as a proxy for ecosystem service function, which would be incorporated into planning and budgeting through a level of service framework.		✓
LM-3: Implement ecosystem services asset management program.*†~	Based on the initial evaluation (LM-2), implement an ecosystem services asset management program. In addition, as information is available through development projects, update aquatic resources maps including wetland, streams, and buffer areas Citywide.		✓
LM-4: Partner with Thurston County in implementing conservation incentives, including easements, to preserve and restore habitat.†~	Partner with Thurston County to increase land conservation through the County's land conservation incentives programs, including Habitat Conservation Plan easements. Parts of the City of Tumwater have been identified by the County as an area of immediate interest for habitat conservation. (Paired with SE-2).	✓	✓
LM-5: Maintain inventory and maps of aquatic resources.†~	Update maps for aquatic resources including wetlands, streams, buffer areas, critical wildlife habitat (e.g., Oregon Spotted Frog Habitat), and habitat corridors. Conduct every 3 - 5 years. Incorporate these maps into the ecosystem services asset management program (LM-3) when it is in place.	✓	✓
LM-6: Conduct a review of City stormwater code and language.†~	Conduct an annual review of stormwater codes and language to ensure compliance with the NPDES permit. Meet with Community Development to update on code changes as needed. Every five years, conduct a comprehensive update as new permit language is published.	✓	✓

LM = Land Management Strategy
* Action is also included in the Trosper Lake SMAP.
† Action is also included in the West Mottman SMAP.
~ Action has a Citywide focus.

Stormwater Program Enhancements

The City supports many activities in compliance with the 2019 – 2024 Permit. These include activities associated with Public Education and Outreach, Illicit Discharge Detection and Elimination, Operations and Maintenance, Source Control, and Monitoring and Assessment objectives. The 2019 – 2024 Permit requires the City to do the following:

- Public Education and Outreach (S.5.C.2). Implement public education and outreach programs to build awareness, foster behavior change, and provide stewardship opportunities related to water resource protection.

- Illicit Discharge Detection and Elimination (S.5.C.5). The 2019 – 2024 Permit requires the City to inspect an average of 12% of their municipal separate storm sewer system (MS4) annually.

- Operations and Maintenance (S.5.C.7). Inspect all City-owned or operated catch basins and inlets every two years and clean if inspection indicates cleaning is needed. Additional provisions exist for reduced cleaning based upon inspection.

- Source Control Program for Existing Development (S.5.C.8). The 2019 – 2024 Permit requires the City to implement a business source control inspection program that started on January 1, 2023. Under the business source control inspection program, the City is directed to inspect 20% of the businesses and/or sites listed in their source control inventory annually and implement a progressive enforcement policy. Complaint response and follow up inspections count towards the total target inspection number.

- Monitoring and Assessment (S.8). Participate in regional status and trends monitoring and in stormwater management program (SWMP) effectiveness and source identification studies.

The City's existing procedures for implementing these activities were reviewed to consider what enhancements would be beneficial for accelerating water quality and habitat improvements in the Fish Pond Creek subbasin. This section describes the enhancements for the Fish Pond Creek subbasin that will exceed the 2019 – 2024 Permit required actions. Table 2 summarizes stormwater program enhancement (SE) actions. Appendices D and E include detailed information, anticipated costs, and implementation schedules. As with land management actions, some actions parallel those in the Trosper Lake and West Mottman SMAPs. In addition, some actions are for a basin scale whereas others are for Citywide implementation. The appropriate scale and focus of actions were determined through knowledge of subbasin and conversation with City staff.

Table 2. Fish Pond Creek Subbasin Stormwater Program Enhancements.				
2019 – 2024 Permit Section	**Action**	**Description**	**Schedule**	
			2024-2030	2031-2044
Public Education and Outreach S.5.C.2	SE-1: Conduct targeted outreach on wetland benefits and management†	Distribute wetland "myth-busting" information via print and online mediums to residents and businesses in the Fish Pond Creek subbasin. Couple this with in-person outreach about wetlands, wetland benefits, and ways to live with them.	✓	✓
	SE-2: Educate on and support County conservation incentive programs†~	Develop online and print resources to share with residents who may be eligible to participate in Thurston County's conservation incentives programs. Conduct targeted outreach in priority areas and assist landowners in participating in the programs. (Paired with LM-4).	✓	✓
	SE-3: Provide free technical assistance to landowners*†	Provide free technical assistance to businesses and landowners with questions/concerns about flooding or water quality issues. This includes site visits, over-the-phone assistance and via email.	✓	
	SE-4: Pilot leaf litter best practices educational campaign	Pilot an educational campaign on leaf litter management best practices to HOAs in the Fish Pond Creek subbasin. Consider educational outreach postcards. Pair with outreach and technical assistance visits (SE-9).	✓	
	SE-5: Conduct natural yard care outreach and technical assistance	Expand the natural yard care program to include more educational resources, conduct targeted outreach in the Fish Pond Creek subbasin especially to HOAs, and implement "boots on the ground" projects related to retaining trees, retaining wetlands, preventing stream buffer encroachment, controlling noxious and invasive weeds, and encouraging natural yard care.	✓	
	SE-6: Research vehicle pollutants and high-priority neighborhoods	Research pollutant sources related to vehicle care and identify actions, outreach, and high-priority neighborhoods for larger car care campaigns. Consider approaches including promoting clean car washing techniques, promoting the Don't Drip and Drive campaign, selling car wash tickets as fundraisers, and offering free oil leak checks at participating mechanics.		✓
	SE-7: Provide stewardship opportunities	Provide stewardship opportunities for local residents. Focus on improving participation and restoration opportunities in overburdened communities.	✓	
	SE-8: Increase pet waste stations*	Expand the existing pet waste station program to target high-traffic dog areas and under resourced neighborhoods in the Fish Pond Creek subbasin and conduct targeted outreach to these areas.	✓	

Table 2. Fish Pond Creek Subbasin Stormwater Program Enhancements.				
2019 – 2024 Permit Section	**Action**	**Description**	**Schedule**	
			2024-2030	2031-2044
	SE-9: Pilot outreach and technical assistance to HOAs	Use the Fish Pond Creek subbasin as a pilot for development and implementation of an outreach and technical assistance program for stormwater management, focused on HOAs. Through outreach, build partnerships with HOAs to develop maintenance plans and a more rigorous technical assistance program. Conduct one or more onsite workshops in partnership with the HOAs on stormwater best management practices. Pair with SE-4.	✓	
Illicit Discharge Detection and Elimination S.5.C.5	SE-10: Implement enhanced IDDE screening*†	Conduct dry weather sampling supplemental to outfall screening in the Fish Pond Creek subbasin. Inventory private and public stormwater infrastructure for the subbasin.	✓	
Operations and Maintenance S.5.C.7	SE-11: Provide additional O&M training*†~	Provide training to O&M staff and plan review training for engineering department.	✓	
	SE-12: Establish ditch maintenance program*†~	Develop ditch maintenance program to better address heavily vegetated and undersized ditches and alleviate flooding and water quality concerns.	✓	
	SE-13: Pilot leaf litter sweeping program	Pilot a street sweeping program focused on leaf litter pickup in the Fish Pond Creek subbasin. Use the catchment to test different schedules and frequencies for optimal results before rolling out a city-wide program.	✓	
Monitoring and Assessment S.8	SE-14: Develop water quality monitoring program*†~	Develop a long-term water quality monitoring program. Identify purpose, goals, indicators, frequency, analysis, and locations. Incorporate other existing monitoring and estimated annual costs. Note: this has been started and is included as Appendix F.	✓	
	SE-15: Implement water quality monitoring program*†~	Implement a long-term water quality monitoring program that includes routine, stormwater, sediment, and B-IBI monitoring.	✓	✓

SE = Stormwater Program Enhancement
* Action is also included in the Trosper Lake SMAP.
† Action is also included in the Fish Pond Creek SMAP.
~ Action has a Citywide focus.

Changes to Long Range Plans

Long range plans are documents that outline an organization's goals, objectives, and strategies for an extended period into the future. The City has a Long Range Planning Division within their Community Development Department that develops and maintains long range planning documents, including the Comprehensive Plan, stormwater basin plans, the Shoreline Master Program, subarea plans, and citywide plans.

Changes to long range plans will be dependent upon the anticipated 2024 - 2029 NPDES permit requirements. Water Resources and Sustainability staff will work collaboratively with other City departments to incorporate SMAP elements into the City's 2024 Comprehensive Plan Periodic Update. The City anticipates conducting an update to their stormwater system plan beginning in 2025. This stormwater system plan update will consider incorporating elements of the SMAP into plan sections associated with implementation, capital project planning, level of service, and utility rates, as appropriate.

PROPOSED IMPLEMENTATION SCHEDULE AND BUDGET SOURCES

For each action, the City identified if the action would be implemented in the short-term or long-term. Short-term is assumed to be 2024 – 2030 and long-term is assumed to be 2031 – 2044. These timelines are dependent on the NPDES stormwater permit re-issuance on August 1, 2024 and the new permit requirements. The City may need to reprioritize these actions based on the new requirements.

Budget sources are primarily from the existing stormwater utility fund, with the exception of those noted as potential future grant applications and the stormwater retrofit projects. Stormwater retrofit projects may be included in the future stormwater comprehensive plan update and incorporated into capital project planning. Future permit requirements for stormwater facility retrofits will be reviewed and applied to capital project planning.

Table 3 identifies the proposed implementation schedule and potential budget sources for each action. Appendix C includes concept details and associated cost estimates for the stormwater retrofit project. Appendix D (Tables D-1 and D-2) show the cost estimates and assumptions for both short and long-term land management and stormwater enhancement actions. Appendix E (Figures E-1 and E-2) include a schedule with cost breakdowns by year. Cost estimates and assumptions are in 2023 dollars and designed to inform the potential impact to the City stormwater funds of future NPDES permit requirements.

Table 3. Fish Pond Creek Subbasin Stormwater Management Action Plan Implementation Schedule and Budget Sources.				
ID	Action	Schedule		Budget Source
		2024 2030	2031 2044	
Retrofit Project Opportunities				
RP-1	Design and Construct Cavalier Street Southwest Linear Facilities		✓	Ecology Water Quality Combined Funding
Land Management Actions				
LM-1	Coordinate with other City Departments to incorporate stormwater into projects	✓	✓	Existing Stormwater Utility Fund
LM-2	Evaluate options for development of an ecosystem services asset management program		✓	Grant Program (TBD)[a]
LM-3	Implement ecosystem services asset management program		✓	Grant Program (TBD)[a]
LM-4	Partner with Thurston County in implementing conservation incentives, including easements, to preserve and restore habitat	✓	✓	Community Development Department planning review budget and Existing Stormwater Utility Fund
LM-5	Maintain inventory and maps of aquatic resources	✓	✓	Capacity Grant
LM-6	Conduct a review of City stormwater code and language to ensure compliance	✓	✓	Existing Stormwater Utility Fund
Stormwater Enhancements				
SE-1	Conduct targeted outreach on wetland benefits and management	✓	✓	Existing Stormwater Utility Fund
SE-2	Educate on and support County conservation incentive programs	✓	✓	Existing Stormwater Utility Fund
SE-3	Provide free technical assistance to landowners	✓		Existing Stormwater Utility Fund
SE-4	Pilot leaf litter best practices educational campaign	✓		Existing Stormwater Utility Fund
SE-5	Conduct natural yard care outreach and assistance	✓		Existing Stormwater Utility Fund
SE-6	Research vehicle pollutants and high-priority areas		✓	Existing Stormwater Utility Fund
SE-7	Provide stewardship opportunities	✓		Existing Stormwater Utility Fund
SE-8	Increase pet waste stations	✓		Existing Stormwater Utility Fund
SE-9	Pilot technical assistance to HOAs	✓		Existing Stormwater Utility Fund
SE-10	Implement enhanced IDDE screening	✓		Existing Stormwater Utility Fund
SE-11	Provide additional O&M training	✓		Existing Stormwater Utility Fund
SE-12	Establish ditch maintenance program	✓		Existing Stormwater Utility Fund
SE-13	Pilot leaf litter sweeping program	✓		Existing Stormwater Utility Fund
SE-14	Develop water quality monitoring program	✓		Existing Stormwater Utility Fund
SE-15	Implement water quality monitoring program	✓	✓	Existing Stormwater Utility Fund

[a] Funding sources may include Department of Ecology Water Quality Combined Funding Source, Capacity Grants, or other funding programs/opportunities that may arise in the next seven to ten years.

FUTURE ASSESSMENT AND FEEDBACK

This SMAP identifies and describes retrofit projects, land management strategies, and stormwater program enhancement activities that are intended to protect or enhance the receiving waters in the Fish Pond Creek subbasin. The City will assess implementation of this SMAP by tracking project implementation and program effectiveness. The City will use the results of this assessment to adjust SMAP implementation over time. Assessment and feedback may be altered based on future permit requirements.

The retrofit project opportunity will be reviewed and tracked as part of capital project planning and budgeting. More detailed stormwater program assessment, capital project planning, and financial analysis will occur on a 6-year cycle as part of comprehensive planning and provide an additional opportunity for tracking. The SMAP as a whole will be updated in alignment with Tumwater's comprehensive planning effort, starting in 2025.

Progress on land management strategies will be assessed annually and staff allocation will be shifted as needed to meet implementation needs. Stormwater program activities will be reviewed annually during NPDES Phase II Permit reporting. Staff and budget allocation will be shifted as needed to meet implementation needs.

City staff will continue to monitor water quality data collected by the City, Ecology, neighboring jurisdictions, and partners to determine if SMAP implementation is adequate to meet desired water quality conditions identified in the Receiving Water Inventory and Assessment (Appendix A), if additional actions are required, or if actions should be modified based on improved BMPs or emerging science.

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APPENDIX A

City of Tumwater Watershed Inventory and Assessment

City of Tumwater Receiving Water Inventory and Assessment

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Lower Deschutes River

Receiving Water Inventory

Relative Conditions:

The Deschutes River is under pressure from growth, resulting in many small, uncontrolled sources of pollution entering the river. In 1998, the Deschutes River was placed on Ecology's 303(d) list of impaired waters due to temperature, fecal coliform bacteria, dissolved oxygen, and fine sediment problems. Now that a Total Maximum Daily Load (TMDL) study has been completed and an Implementation Plan is in place (Ecology 2015b), the Deschutes River is listed as Category 5 (Polluted waters that require a TMDL or other cleanup plan) for these same constituents plus pH and fine sediment (Ecology 2015). It is also listed as Category 4 (Polluted waters that do not require a cleanup plan.) Often this is because a plan (e.g., a TMDL) is already in place, but it can also refer to waters with problems that cannot be addressed through a cleanup plan, such as flow impairments or aquatic plant problems) due to low instream flows.

Total Watershed Area:

17.70 mi^2

Watershed Area in City Limits:

8.96 mi^2

Percent of the total watershed area in Tumwater city limits:

50.62%

Receiving Water Assessment

Designed Uses:

Recreation
Fishing
Salmon Habitat
Wildlife Corridor
Aquifer Recharge
Aesthetics

Desired Water Quality Conditions:

Temps for Salmon Rearing
Minimal Sediment Transport
Sufficient Oxygenation
Consistent In-Stream Flows
Variable Sediment Composition
Wildlife corridor habitat
Optimal pH
Reduced bacteria counts

Known Water Quality Impairments:

Temperature
Fecal coliform or E. coli bacteria
Dissolved oxygen
Fine sediment
pH
In stream flows
The Deschutes River is under pressure from growth, resulting in many small, uncontrolled sources of pollution entering the river. In 1998, the Deschutes River was placed on Ecology's 303(d) list of impaired waters due to temperature, fecal coliform bacteria, dissolved oxygen, and fine sediment problems. Now that a Total Maximum Daily Load (TMDL) study has been completed and an Implementation Plan is in place (Ecology 2015b), the Deschutes River is listed as Category 5 (Polluted waters that require a TMDL or other cleanup plan) for these same constituents plus pH and fine sediment (Ecology 2015). It is also listed as Category 4 (Polluted waters that do not require a cleanup plan. Often this is because a plan (e.g., a TMDL) is already in place, but it can also refer to waters with problems that cannot be addressed through a cleanup plan, such as flow impairments or aquatic plant problems) due to low instream flows.

Land Use (limited and unreliable):

The Lower Deschutes Watershed within Tumwater is primarily urban areas with green spaces that include Pioneer Park, The Tumwater Valley Golf Course and the Brewery Park at Tumwater Falls. The industrial area known as the Olympia Brewery still occupies areas of the waterfront across from Brewery Park at Tumwater Falls, but remains vacant.

Zoning (Top 5):

Airport Industrial - 21%
Single Family Low Density - 14.9%
Open Space - 14.6%
Single Family Medium Density - 12.1%
Light Industrial - 10.2%

Tree Canopy (%):

32.82%

Impervious Surface (%):

31.44%

Sensitive/Critical Areas:

31.44%

Projected Growth:

The Lower Deschutes River Watershed includes a wide variety of accepted land uses and zoning. There is robust growth projected throughout the watershed for commercial and residential properties.

What are the causes for impairment?

Reduced channel complexity and flood plain connectedness

Tree canopy loss due to development

Bank erosion at Pioneer Park

Untreated stormwater from East Linwood Basin and M St. outfall

Other stormwater inputs include bacteria, nutrients, oil and other pollutants.

What are solutions to impairment?

Implement restoration projects to improve and restore riparian and channel conditions.

Maintain riparian buffer throughout the golf course and Brewery District

Design and construct stormwater treatment for the East Linwood Basin

Maintain Salmon Safe Certification for the Tumwater Valley Golf Course

NPDES Permit implementation (IDDE, E &O, O&M, inspection programs, etc.)

Reduce anthropogenic sources of heat including stormwater outfall retrofits to retain runoff and encourage infiltration; evaluate runoff from large areas of impervious surface, with focus on on-site retention and infiltration.

Consider a regional stormwater facility

Assess current land use and future development and consider adjusting to improve and protect water quality.

Overburdened Communities Evaluation:

NA

Data Sources:

2018 SW Comp Plan

Deschutes River, Percival Creek, and Budd Inlet Tributaries Temperature, Fecal Coliform Bacteria, Dissolved Oxygen, pH and Fine Sediment TMDL Water Quality Improvement Report and Implementation Plan

SMAP Findings

Stormwater Management Influence Assessment findings. (See the guidance document for definitions and description of this assessment):

SMAP requirements that affect the Deschutes River will not have a significant impact on the overall health of the Deschutes Watershed, however, Tumwater is pursuing improvements in stormwater treatment for the Watershed such as East Linwood Basin Stormwater Treatment Project, Tumwater Valley Golf Course Parking Lot Stormwater Treatment Project, Pioneer Park Restoration Project, and Tumwater Regional Stormwater Facility Project.

Will receiving water be included in the prioritization process?

Yes

SMAP Stormwater Management Influence (high, medium, or low):

Medium

Salmon Creek

Receiving Water Inventory

Relative Conditions:

The Salmon Creek Watershed is relatively flat (.014% grade) and is defined by the surface and groundwater sources that contribute to recharge of Salmon Creek. Above average rainfall typically causes localized flooding due to the high groundwater table in the watershed. There is very little impervious surface in the watershed that contributes to flooding. Only about 8-10% of the land in the Salmon Creek Basin is covered by impervious surface (2004). Some flooding concerns are addressed through the Hopkins Ditch District and the Hickman Ditch District.
Stormwater management strategies that require infiltration are challenging due to high groundwater table. If detention and treatment facilities are inundated by high groundwater or flooding, it is not possible to treat stormwater and then discharge off site.
Very little water quality information exists specifically for the Salmon Creek Watershed.

Total Watershed Area:

11.52 mi^2

Watershed Area in City Limits:

1.81 mi^2

Percent of the total watershed area in Tumwater city limits:

15.71%

Receiving Water Assessment

Designed Uses:

Recreation
Fish Habitat
Wildlife Habitat/Corridor
Aquifer Recharge
Aesthetics

Desired Water Quality Conditions:

Sufficient oxygenation
Consistent in stream flows
Reduced flooding

Known Water Quality Impairments:

High temperature
Low oxygen
Bacteria

Land Use (limited and unreliable):

Industrial, low-density residential (4-7 units per acre), forest (38% in 2004), pasture land (51% in 2004

Zoning (Top 5):

Light Industrial - 58.3%
Airport Light Industrial - 20%
General Commercial - 5.2%
Single Family Medium Density - 4.7%
Single Family Low Density - 2.2%

Tree Canopy (%):

36.75%

Impervious Surface (%):

21.42%

Sensitive/Critical Areas:

15.86%

Projected Growth:

Salmon Creek is targeted for growth in planning documents and projections. The 1995 Tumwater-Thurston County Joint Plan designates Urban Growth Area boundaries that stretch into the Salmon Creek Basin, but also recognize that some areas are unsuitable for development due to flooding from surfacing groundwater. The plan directs Thurston County and the City of Tumwater to determine appropriate stormwater management in advance of development in areas where existing soils make drainage difficult.
Critical Areas Ordinance affect the density on 72% of the basin's undeveloped land.
City of Tumwater Stormwater Comprehensive Plan Update (1995) identifies Salmon creek Watershed as a lower priority for planning activities.

What are the causes for impairment?

Flooding concerns
High ground water
Failed septic systems

What are solutions to impairment?

Integrate SW solutions into development

Install a basin wide sewer system

Preserve tree cover

Overburdened Communities Evaluation:

NA

Data Sources:

Salmon Creek Comprehensive Drainage Study
2018 Comp Plan

SMAP Findings

Stormwater Management Influence Assessment findings. (See the guidance document for definitions and description of this assessment):

Salmon Creek Watershed is limited in Tumwater with only 15% of the watershed delineated within the city limits. High groundwater in this area limits future development potential. The watershed lacks water quality data to fully understand reactions to stormwater management actions. Due to limits on the amount of watershed within the City limits as well as limited opportunities to affect stormwater management, Salmon Creek Watershed ranks lower on the prioritization list.

Will receiving water be included in the prioritization process?

Yes

SMAP Stormwater Management Influence (high or low):

Medium

Black Lake

Receiving Water Inventory

Relative Conditions:

General water quality conditions in the Black Lake Watershed are rated as fair (TCEH Black Lake Water Quality Report 2019), however Black Lake is eutrophic. In 2019, the mean Total Phosphorus (TP) concentration was above the action level. Productivity was high and transparency was lower than average. The TP concentration has declined since 2016, when the Black Lake Special District applied alum. Samples for algal toxins have not been above the Washington State advisory levels since 2015. The main portion of the Black Lake Watershed within Tumwater City Limits is the Fish Pond Creek sub-basin. Fish Pond Creek drains an extensive wetland system that extends East to the vicinity of Trosper Lake and south to the vicinity of Black Hills High School. The area is considered to be good beaver habitat and is suspected to be fish bearing, although no recent fish surveys have been conducted to confirm the presence of fish. The sub-basin has numerous undersized culverts identified in the Annexation Area Drainage Report (2011). The combination of undersized culverts and the presence of beaver activity make the sub-basin susceptible to localized flooding during heavy rain events. Maintenance needs and capitol improvement projects for upgrading conveyance and treatment are identified in the Mottman Industrial Area Basin Evaluation (2020)

Total Watershed Area:

8.10 mi^2

Watershed Area in City Limits:

2.74 mi^2

Percent of the total watershed area in Tumwater city limits:

33.83%

Receiving Water Assessment

Designed Uses:

Recreation
Fish Habitat
Wildlife Habitat/Corridor
Aquifer Recharge
Aesthetics

Desired Water Quality Conditions:

Decreases in excess nutrients and seasonal temperatures.
Reduced algal blooms

Known Water Quality Impairments:

Recent improvements in Phosphorus are due in part to the Black Lake Management District's actions to apply alum to treat for algae blooms, however seasonally high nutrient levels can have other negative impacts to water quality.

Land Use (limited and unreliable):

Predominately residential
Extensive wetland systems on the south and north ends of the lake

Zoning (Top 5):

Single Family Low Density - 54.1%
Single Family Medium Density - 17.5%
Residential/Sensitive Resource - 13.8%
Light Industrial - 6.7%
Multi-Family Medium Density - 4.1%

Tree Canopy (%):

42.68%

Impervious Surface (%):

17.94%

Sensitive/Critical Areas:

41.53%

Projected Growth:

The majority of the Black Lake Watershed is in the Urban Growth Area and is subject to moderate development of single family residences. Within Tumwater, stormwater treatment within the watershed is usually addressed on a site by site basis and larger developments have stormwater treatment and infiltration within the neighborhood. The Tikner Farm Development (~1,200 single family homes) is scheduled to begin in 2022-2023 and will have extensive onsite stormwater treatment facilities included in the design. WRS anticipates an enhanced level of TESC inspections for this project.

What are the causes for impairment?

Excess nutrient
Algal blooms (although this seems to have been addressed by the Black Lake Management District).
DO (source of Black Lake Ditch)
Temperature (source of Black Lake Ditch)
Potential: Construction related runoff from new development
Lack of Conveyance and infiltration capacity in the Mottman Industrial Area

What are solutions to impairment?

Potential: Waterfront property owners lawn care practices
Overburdened Communities Evaluation:

NA

Data Sources:

WRIA 13 Freshwater Prioritization Summary Memo
TCEH Black Lake Water Quality Report, 2019
City of Tumwater Annexation Area Drainage Study
Mottman Industrial Area Basin Evaluation (2020)

SMAP Findings

Stormwater Management Influence Assessment findings. (See the guidance document for definitions and description of this assessment):

There are opportunities to improve flooding conditions during heavy rain events through increasing conveyance capacity in select locations. Opportunities also exist for enhanced TESC inspections and LID installations at new development locations. The Black Lake Watershed ranks high due to potential improvements for conveyance at culverts and opportunities for stormwater facilities and BMPS for future development.

Will receiving water be included in the prioritization process?

Yes

SMAP Stormwater Management Influence (high or low):

High

Percival Creek

Receiving Water Inventory

Relative Conditions:

Percival Creek is considered to rank as a Category 5 (Polluted waters that require a TMDL or other cleanup plan) according to the Ecology's water body assessment. The creek is considered polluted and requires a TMDL or other clean up plan specifically for elevated temperature and low dissolved oxygen. While Black Lake Ditch meets the bacteria water quality standards, Percival Creek does not, and additional source identification is warranted. Potential sources include recreational users and homeless populations. Maintenance needs and capitol improvement projects for upgrading conveyance and treatment are identified in the Beehive Industrial Area Drainage Evaluation Analysis (2021).

Total Watershed Area:

7.19 mi^2

Watershed Area in City Limits:

3.28 mi^2

Percent of the total watershed area in Tumwater city limits:

45.62%

Receiving Water Assessment

Designed Uses:

Salmonid Habitat
Wildlife Corridor
Aesthetics

Desired Water Quality Conditions:

High Quality Salmonid Habitat
Sediment Composition
Water Quality parameters within state standards

Known Water Quality Impairments:

Fecal coliform/E coli
Seasonal turbidity
Seasonal DO
Seasonal temperature
Fish passage barriers

Land Use (limited and unreliable):

Urban
Suburban residential
Commercial/industrial

Zoning (Top 5):

Single Family Low Density - 24.7%
Light Industrial - 21.8%
Residential/Sensitive Resource - 16.6%
Single Family Medium Density - 9.5%
Green Belt - 8.8%

Tree Canopy (%):

49.05%

Impervious Surface (%):

30.85%

Sensitive/Critical Areas:

40.99%

Projected Growth:

Modest development for residential and commercial. Increases in stormwater runoff could impact the stream through degraded water quality, stream bank erosion, hillslope failures, and channel scour.

What are the causes for impairment?

Sewage overflows / Elevated bacteria levels
Sediment Composition due to scour
stormwater runoff
Fish Passage Barriers
Lack of conveyance and treatment Beehive Industrial Area

What are solutions to impairment?

Increased surveillance for E. coli. (bracket sampling)
Increase inspections for construction sites
Increase street sweeping
Complete fish passage barrier removal
Maintenance and capitol improvement projects at the Beehive Industrial Area

Overburdened Communities Evaluation:

There are two areas within the watershed that are identified as "elevated burden" (index score 5 and 6). One area is identified as "decreased burden" (index score = 1). One area is identified as "limited burden" (index score = 0).

Data Sources:

WRIA 13 Freshwater Prioritization Summary Memo
IDDE Reports
SAM Puget Sound Small Stream Monitoring website
Deschutes River, Percival Creek, and Budd Inlet Tributaries Temperature, Fecal Coliform Bacteria, Dissolved Oxygen, pH and Fine Sediment TMDL Water Quality Improvement Report and Implementation Plan, Ecology 2015.
2018 Stormwater Comp Plan
Thurston County Annual WQ Monitoring Report (2011)
Percival Creek Comprehensive Drainage Basin Plan (1993)
Beehive Industrial Area Drainage Evaluation Analysis and Recommendations (2021)

SMAP Findings

Stormwater Management Influence Assessment findings. (See the guidance document for definitions and description of this assessment):

The presence of industrial areas and projected residential development are prime targets for SMAP projects within the watershed. The upper watershed lies entirely within the City limits and its scale is consistent with SMAP objectives. There is the potential for high quality salmon spawning in Percival Creek if conditions were improved. Percival Creek Watershed has a high potential for stormwater actions to improve water quality conditions and habitat for fish and wildlife.

Will receiving water be included in the prioritization process?

Yes

SMAP Stormwater Management Influence (high or low):

High

Capitol Lake

Receiving Water Inventory

Relative Conditions:

General water quality conditions in Capitol Lake are considered poor according to the Thurston County Annual Water Quality Monitoring Report (2011). The lake is listed on the state's 303(d) list of water quality impaired water bodies for total phosphorus and fecal coliform. Sediment deposition in the lake from the Deschutes River, Percival Creek, shoreline erosion, and landslides has been an on-going issue since the lake was created. Excessive aquatic plant and algae growth in the summer severely impedes navigation on the lake. Control is ongoing for an infestation of the noxious aquatic plant, Eurasian water milfoil. In 2009 another invasive species, the New Zealand mud snail, was discovered in the lake. Efforts are underway to control the spread of the mud snail.
The 2021 Thurston County Basin Report lists Capitol Lake as "degraded" to "very degraded" based on amount of impervious surface, forest canopy cover and intact riparian land cover in the watershed. Stormwater runoff from I-5 and Hwy 101 have negative impacts, especially as more is known about the 6PPD chemical.

Total Watershed Area:

2.56 mi^2

Watershed Area in City Limits:

0.97 mi^2

Percent of the total watershed area in Tumwater city limits:

37.89%

Receiving Water Assessment

Designed Uses:

Recreation
Wildlife habitat
Aesthetics
Salmon corridor

Desired Water Quality Conditions:

Management plan dependent on desired lake or estuary habitat.

Known Water Quality Impairments:

Bacteria
Sedimentation
Phosphorus
Invasive species

Land Use (limited and unreliable):

Residential
Commercial
Brewery District Industrial
Green space

Zoning (Top 5):

Single Family Medium Density - 41.2%
Historic Commercial - 11.6%
Multi-Family Medium Density - 11.6%
Open Space - 8.8%
Green Belt - 4.9%

Tree Canopy (%):

42.79%

Impervious Surface (%):

35.20%

Sensitive/Critical Areas:

30.60%

Projected Growth:

The Capitol Lake Watershed consists primarily of established neighborhoods and open/green space in the form of parks and greenbelts. Development and redevelopment usually happens at a small scale and future development and redevelopment should continue on a small scale. Due to the nature of runoff sources, retrofit projects could enhance stormwater runoff into the lake.

What are the causes for impairment?

Sewage overflows in Percival Creek
Homeless encampments
Sediment from the Deschutes River and Percival Creek

What are solutions to impairment?

Specific invasive species remediation activities
Source control and illicit connection investigations for phosphorus and bacteria
TMDL actions for reduced sediment

Overburdened Communities Evaluation:

NA

Data Sources:

Thurston County Annual WQ Monitoring Report (2011)
Thurston County Basin Conditions Report (2021)

SMAP Findings

Stormwater Management Influence Assessment findings. (See the guidance document for definitions and description of this assessment):

Capitol Lake ranks moderately high for opportunities for stormwater action planning, however considerations should be made for the fate of Capitol Lake as an estuary or freshwater lake. WSDOT highways are a considerable input into Capitol Lake and SMAP projects would benefit from partnering with WSDOT. This watershed could benefit from retrofit projects and enhanced maintenance activities.

Will receiving water be included in the prioritization process?

Yes

SMAP Stormwater Management Influence (high or low):

High

Moxlie Creek

Receiving Water Inventory

Relative Conditions:

High levels of bacteria, phosphorus, and ammonia have negative impacts on the health of Moxlie Creek. The Moxlie Creek Watershed is heavily impacted by urbanized land uses. The creek is piped through downtown Olympia before entering Budd Inlet.

Total Watershed Area:

2.17 mi^2

Watershed Area in City Limits:

.04 mi^2

Percent of the total watershed area in Tumwater city limits:

1.84%

Receiving Water Assessment

Designed Uses:

Recreation
Aesthetics
Aquatic life habitat

Desired Water Quality Conditions:

Unknown

Known Water Quality Impairments:

Fecal coliform
Stormwater runoff from highways and city streets

Land Use (limited and unreliable):

Unknown

Zoning (Top 5):

NA

Tree Canopy (%):

28.02%

Impervious Surface (%):

50.87%

Sensitive/Critical Areas:

0%

Projected Growth:

Growth within the city limits will be limited. There is an established neighborhood with limited projected development.

What are the causes for impairment?

Illicit sewer connections
Stormwater runoff

What are solutions to impairment?

Illicit connection investigations including bracket sampling
Enhanced catch basin cleaning

Overburdened Communities Evaluation:

NA

Data Sources:

Thurston County Annual WQ Monitoring Report (2011)
Thurston County Basin Conditions Report (2021)

SMAP Findings

Stormwater Management Influence Assessment findings. (See the guidance document for definitions and description of this assessment):

Moxlie Creek will not be considered in the Watershed scale Stormwater Management Influence Assessment due to the limited area of the watershed within the City of Tumwater (1.84%)

Will receiving water be included in the prioritization process?

No

SMAP Stormwater Management Influence (high or low):

Low

Chambers Creek

Receiving Water Inventory

Relative Conditions:

Chambers Creek suffers from tree canopy loss, sedimentation problems, and fish passage barriers. Seasonal variations in nutrients, in stream flows, DO and turbidity have negative impacts in the overall health of the stream, however the mouth seems to have the highest quality habitat for salmon spawning and rearing.

Total Watershed Area:

0.96 mi^2

Watershed Area in City Limits:

.01 mi^2

Percent of the total watershed area in Tumwater city limits:

1.04%

Receiving Water Assessment

Designed Uses:

Recreation
Aesthetics
Aquatic life habitat
Salmon spawning and rearing habitat

Desired Water Quality Conditions:

Unknown

Known Water Quality Impairments:

Sedimentation
Fish passage barriers
Bacteria
Seasonal variations in DO, turbidity, and nutrients

Land Use (limited and unreliable):

Unknown

Zoning (Top 5):

NA

Tree Canopy (%):

52.43%

Impervious Surface (%):

33.78%

Sensitive/Critical Areas:

0.23%

Projected Growth:

The area within the Tumwater City limits that lies within the Chambers Creek Watershed is an established neighborhood with a functioning stormwater treatment facility and infiltration system. Very limited growth is projected for this area.

What are the causes for impairment?

Stormwater runoff
Tree canopy loss

What are solutions to impairment?

Stormwater treatment
Enhanced tree canopy cover in riparian areas

Overburdened Communities Evaluation:

NA

Data Sources:

Chambers-Ward-Hewitt Drainage Basin Plan (1995)

SMAP Findings

Stormwater Management Influence Assessment findings. (See the guidance document for definitions and description of this assessment):

Chambers Creek will not be considered in the Watershed scale Stormwater Management Influence Assessment due to the limited area of the watershed within the City of Tumwater (1.04%)

Will receiving water be included in the prioritization process?

No

SMAP Stormwater Management Influence (high or low):

Low

Combined Receiving Water Assessment

Receiving Water	Overall Size (sq. mi)	Size within City of Tumwater (sq. mi)	% within Tumwater s jurisdiction	Stormwater Management Influence	Include in prioritization process (S5.C.a.d.ii)?
Lower Deschutes River	17.70 mi^2	8.96 mi^2	50.62%	Medium	yes
Salmon Creek	11.52 mi^2	1.81 mi^2	15.71%	Medium	yes
Black Lake	8.10 mi^2	2.74 mi^2	33.83%	High	yes
Percival Creek	7.19 mi^2	3.28 mi^2	45.62%	High	yes
Capitol Lake	2.56 mi^2	0.97 mi^2	37.89%	High	yes
Moxlie Creek	2.17 mi^2	.04 mi^2	1.84%	Low	no
Chambers Creek	0.96 mi^2	.01 mi^2	1.04%	Low	no

APPENDIX B

City of Tumwater Watershed Prioritization

Permit Requirement S5.C.1.d.ii: Sub-Basin Prioritization:

Permittees shall develop and implement a prioritization method and process to determine which receiving waters will receive the most benefit from implementation of stormwater facility retrofits, tailored implementation of SWMP actions, and other land/development management actions (different than the existing new and redevelopment requirements).

Watershed	Watershed Prioritization Findings	Include in the prioritization process (S5.C.a.d.ii)	Stormwater Mangement Influence	Catchment ID	Is the sub-basin within the size criteria (~400-600 acres)	Is >90% of the sub-basin within city limits?	Are there land uses that have high potential for pollution?	Type of land uses?	Sub-basin prioritization ranking
Percival Creek	1	yes	High	P1 - Trosper Lake	yes	yes	yes	Multi-Family Residential Single Family Residential Manufactured Home Park Commecial Industrial Sensitive Resource Green Belt Open Space	1
				P2 - Linwood Pond	yes	yes	no	Multi-Family Residential Single Family Residential Manufactured Home Park Neighborhood Commercial Sensitive Resource Open Space	4
				P3 - Somerset Hill	yes	no			
				P4	no				
				P5 - West Mottman	yes	yes	yes	Single Family Residential Industrial Green Belt	2
				P6 - Mottman	yes	no			
				P7	no				
				P8	no				
				P9	no				
				P10	no				
				P12	no				
				P11	no				
Black Lake	2	yes	High	BL1	no				
				BL2	no				
				BL3 - Fish Pond Creek	yes	yes	no	Multi-Family Residential Single Family Residential Manufactued Home Park Mixed Use	3
				BL4	no				
				BL5	no				
				BL6	no				
				BL7	no				

Permit Requirement S5.C.1.d.ii: Sub-Basin Prioritization:

Permittees shall develop and implement a prioritization method and process to determine which receiving waters will receive the most benefit from implementation of stormwater facility retrofits, tailored implementation of SWMP actions, and other land/development management actions (different than the existing new and redevelopment requirements).

Watershed	Watershed Prioritization Findings	Include in the prioritization process (S5.C.a.d.ii)	Stormwater Mangement Influence	Catchment ID	Is the sub-basin within the size criteria (~400-600 acres)	Is >90% of the sub-basin within city limits?	Are there land uses that have high potential for pollution?	Type of land uses?	Sub-basin prioritization ranking
Lower Deschutes River	3	yes	Medium	LDR1	no				
				LDR2 - Swamp Creek	yes	yes	yes	Multi-Family Residential Airport Reated Industrial Industrial Sensitive Resource Green Belt	5
				LDR3 - Munn Lake	yes	yes	yes	Multi-Family Residential Single-Family Residential Commercial Industrial Green Belt Open Space	6
				LDR4	no				
				LDR5	no				
Salmon Creek	4	yes	Medium	SC1 - Hopkins Ditch	yes	no			
				SC2	no				
Capitol Lake	5	yes	High	CL1 - Capitol Lake	no				
Moxlie Creek	6	no	NA						
Chambers Creek	7	no	NA						

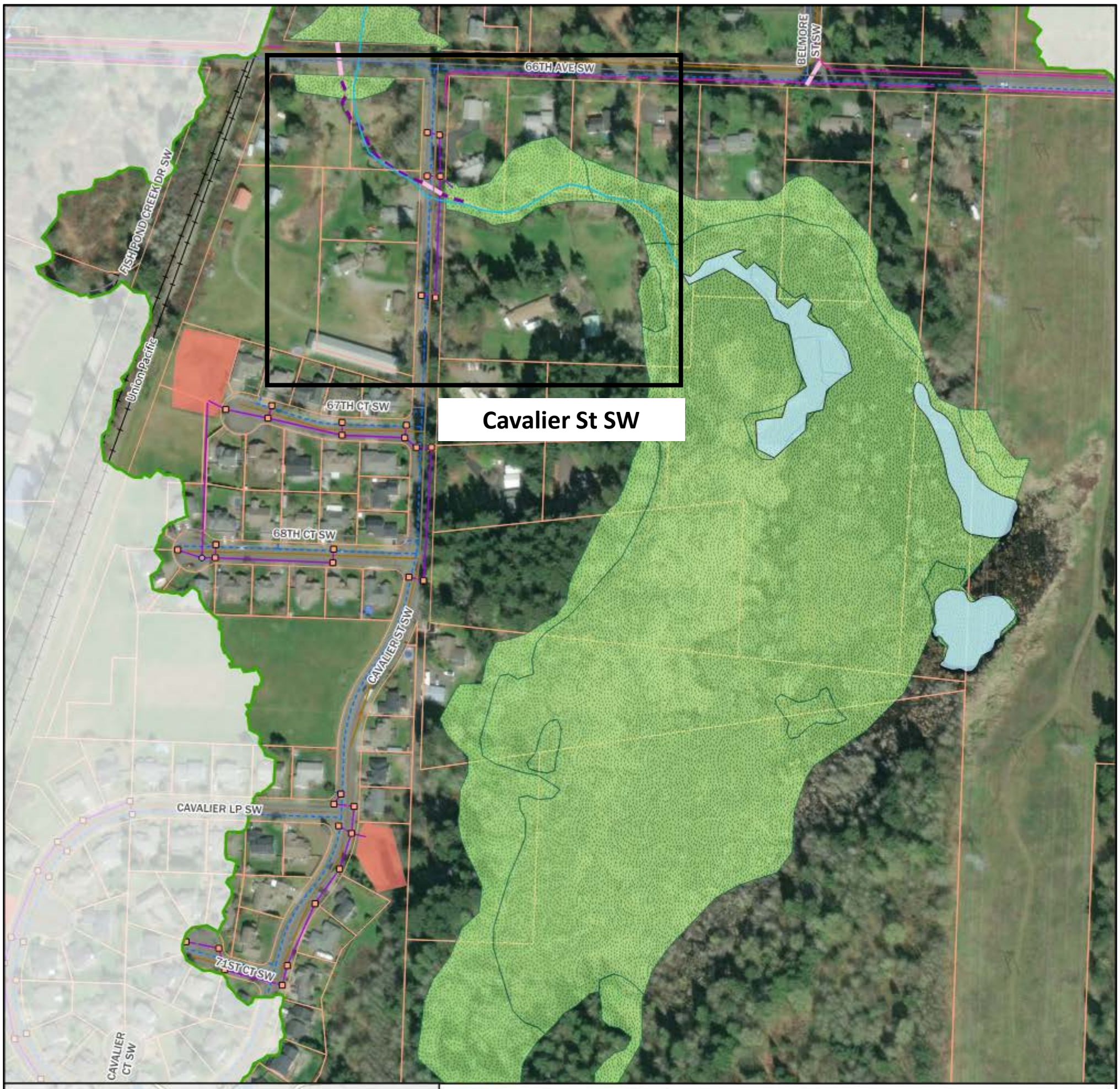
APPENDIX C

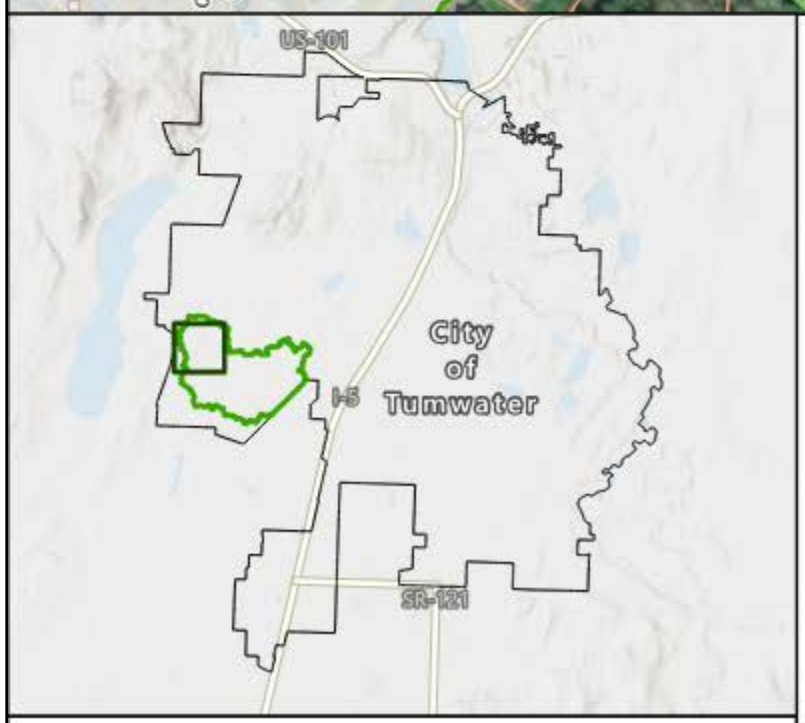
Project Summary Sheet:
Cavalier Street Southwest Linear Facilities

City of Tumwater Stormwater Management Action Plan – Fish Pond Creek Subbasin Retrofit Project Opportunities

CAVALIER STREET SOUTHWEST LINEAR FACILITIES

Vicinity Map





Fish Pond Creek
Wetland
Parcel
City Limits
Waterbody
Stream
Road
Railroad

Stormwater Facility
Infiltration Pond

Stormwater Structure
Manhole
Catch Basin

Stormwater Conveyance
Gravity Pipe
Natural Channel
Culvert
Ditch

Utilities
Water Main
Sewer Pipe

0 125 250 500 Feet

CITY OF TUMWATER

HERRERA

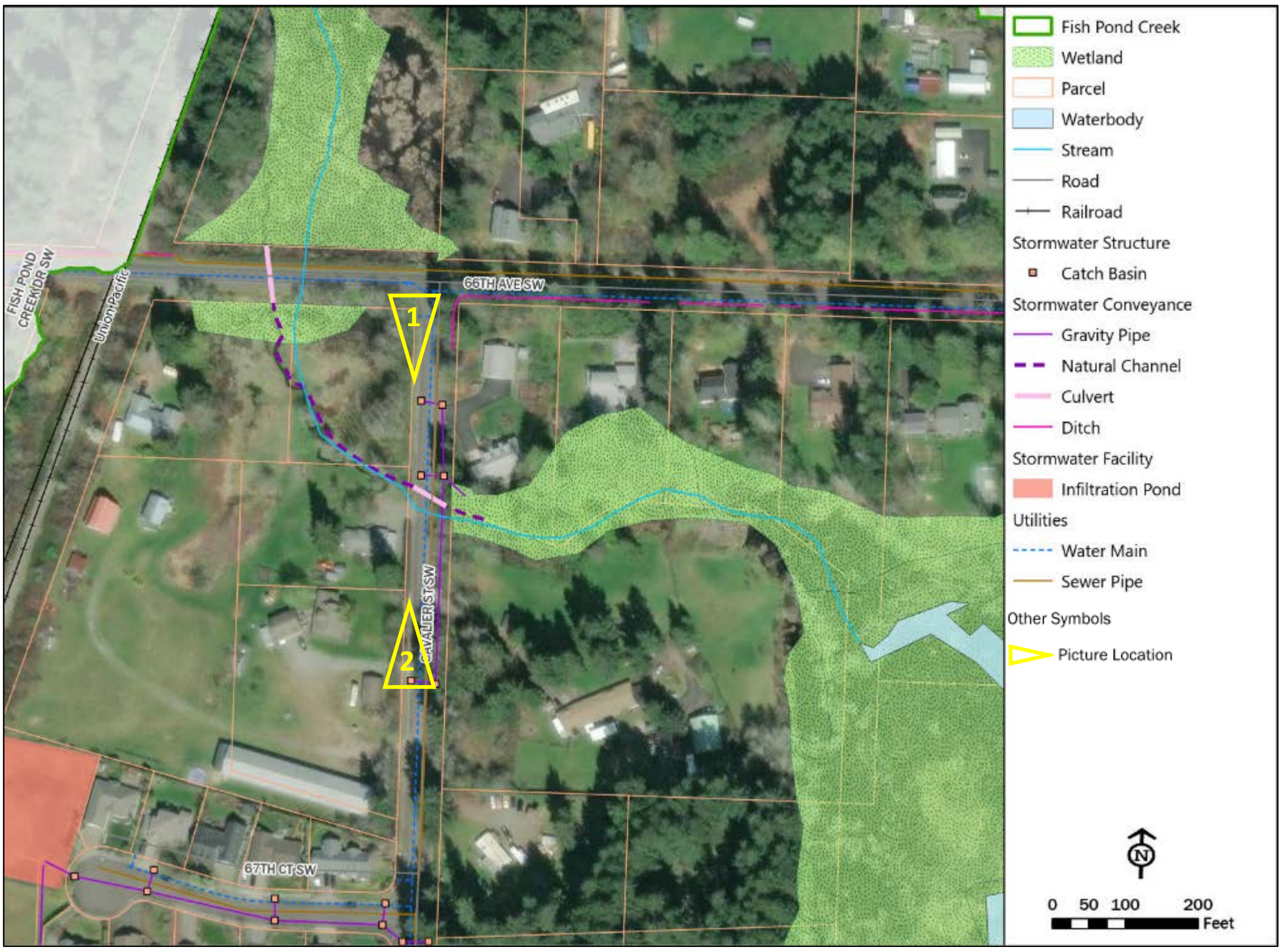
City of Tumwater Stormwater Management Action Plan – Fish Pond Creek Subbasin Retrofit Project Opportunities

CAVALIER STREET SOUTHWEST LINEAR FACILITIES

Problem Description

There is no existing water quality treatment on Cavalier St SW. Untreated runoff in this area is discharged directly to the southern tributary of Fish Pond Creek that eventually flows into Black Lake.

Existing Site Plan



Site Characteristics and Constraints

Available Space	Grades and Elevations	Soils and Groundwater	Critical Areas	Utility Conflicts
• Some space available in the right-of-way parking/curb lane	• Road is mostly flat with slight grade (<1%) toward creek crossing.	• Mostly Indianola loamy sand • Somewhat excessively drained • Low runoff potential • Hydrologic Group A • Not located in a high groundwater area	• No critical areas present on the project sites • Wetlands and southern tributary of Fish Pond Creek are located adjacent to the project site	Potential conflicts with: • Water mains/service lines • Above-ground power lines • Communications

Existing Conditions

Facing South on Cavalier St SW Towards 68th Court SW
(Photo Courtesy of Google Earth)

Facing North on Cavalier St SW Towards 66th Avenue SW
(Photo Courtesy of Google Earth)

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City of Tumwater Stormwater Management Action Plan – Fish Pond Creek Subbasin Retrofit Project Opportunities

CAVALIER STREET SOUTHWEST LINEAR FACILITIES

Project Description

Install four bioretention facilities on Cavalier Street SW to improve water quality treatment. The facilities are proposed between 66th Avenue SW and 67th Court SW. Pollutants removed by the facilities may include heavy metals (copper and zinc), organics (nitrogen and phosphorus), suspended solids, and hydrocarbons.

Concept Site Plan

Design Parameters

Native Soil Design Infiltration Rate	2.0 in/hr
Ponding Depth	0.5 ft
Media Depth	1.5 ft
Bottom Length	170 ft (30–65 ft each)
Bottom Width	6 ft
Side Slope	None; Walled

Estimated Costs

Design Cost	$65,000
Construction Cost	$330,000
Total Cost [a]	$545,000
Cost per Acre Treated	$419,000

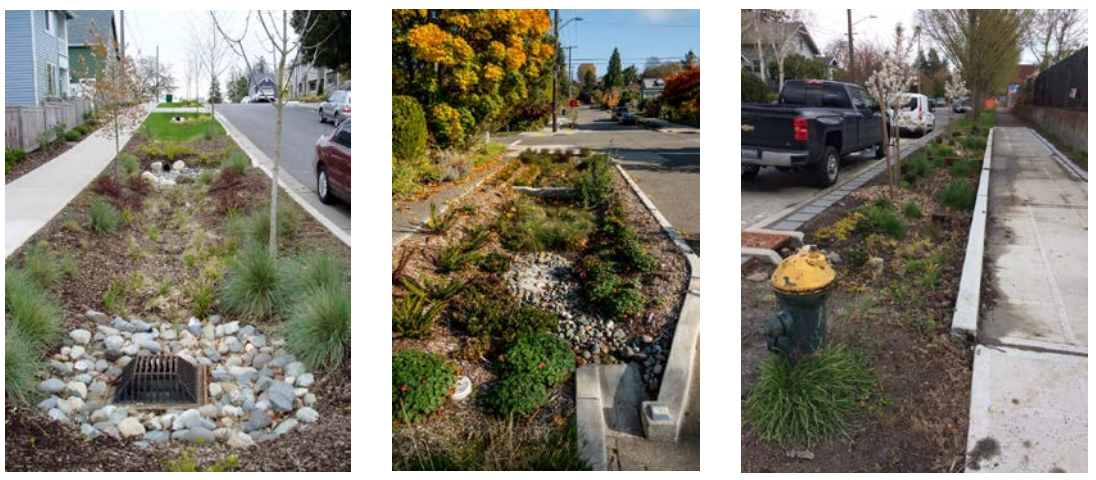
[a] Includes 50% project contingency.

Facility Sizing

Facility ID	Facility Footprint Area (sf)	Contributing Basins (acres) [b]
1	390	0.34
2	180	0.35
3	210	0.39
4	240	0.22
TOTAL	1,020	1.30

[b] Contributing basins consist entirely of pollution generating impervious surfaces in the right-of-way.

Design Precedents



Bioretention Examples (Seattle, Washington)

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APPENDIX D

Stormwater Program Enhancements and Land Management Strategies Costs and Assumptions

Table D 1. Fish Pond Creek Subbasin Land Management and Stormwater Enhancement Estimated Short Term Costs (2024 2030).								
Action	**Description**	**Action Type**	**Upfront Costs**	**Annual Costs**	**Total Cost**	**Cost Assumptions [a] [b]**	**Cost Basis**	**Budget Source**
LM-1: Coordinate with other City Departments to incorporate stormwater considerations into projects, especially CFP projects.*~	Annually, meet with other department staff during planning of capital construction projects (such as the annual Transportation Improvement Projects review, or Parks planning projects review) to determine how anticipated projects could incorporate stormwater planning and retrofits, especially projects related to Transportation and Engineering.	Create new program	$0	$11,200 ($1,600/ year for 7 years in ongoing into long-term)	$11,200	Staff time: 20 hours of City management staff time to review planning documents and attend project planning meetings, annually. Assumed to continue for 20 years, spanning short and long-term action lists. Cost covers all SMAPs.	Professional judgement; itemized cost	Existing Stormwater Utility Fund
LM-4: Partner with Thurston County in implementing conservation incentives, including easements, to preserve and restore habitat.~	Partner with Thurston County to increase land conservation through the County's land conservation incentives programs, including Habitat Conservation Plan easements. Parts of the City of Tumwater have been identified by the County as an area of immediate interest for habitat conservation. (Paired with SE-6).	Expand existing program	$0	$33,600 ($4,800/ year for 7 years in short-term; ongoing into long-term)	$33,600	Staff time: 60 hours of City management staff time to coordinate with Thurston County Community Planning and Economic Development Program staff. Assumed to continue for 10 years, spanning short and long-term. Cost covers both SMAPs.	Professional judgement; itemized cost	CDD planning review budget and Existing Stormwater Utility Fund
LM-5: Maintain inventory and maps of aquatic resources.~	Update maps for aquatic resources including wetlands, streams, buffer areas, critical wildlife habitat (e.g., Oregon Spotted Frog Habitat), and habitat corridors. Conduct every 4 years. As an initial focus, complete mapping of wetlands in the Fish Pond Creek subbasin, including those on private property, to inform wetland enhancement and preservation projects. When the ecosystem services asset management program (LM-3) is in place, maps will be incorporated into that program.	Expand existing program	$0	$8,000 ($4,000/ year every 3 – 5 years; ongoing into long-term)	$8,000	Staff time: 25 hours of City Field Technician staff time, 25 hours for GIS time, and 10 hours for City management staff time. Cost only covers this subbasin.	Professional judgement; itemized cost	Capacity Grant

Table D 1. Fish Pond Creek Subbasin Land Management and Stormwater Enhancement Estimated Short Term Costs (2024 2030).								
Action	**Description**	**Action Type**	**Upfront Costs**	**Annual Costs**	**Total Cost**	**Cost Assumptions [a] [b]**	**Cost Basis**	**Budget Source**
LM-6: Conduct a review of City stormwater code and language to ensure compliance.~	Conduct an annual review of stormwater codes and language to ensure compliance with the NPDES permit. Meet with Community Development to update on code changes as needs. Every five years, conduct a comprehensive update as new permit language is published.	Expand existing program	$0	$17,600 ($1,600/ year; $4,800/year in 2024 and 2029; ongoing into long-term)	$17,600	Staff time: 20 hours of City management staff time annually and 60 hours every 5 years with permit reissuance. Cost covers all SMAPs.	Professional judgement; itemized cost	Existing Stormwater Utility Fund
SE-1: Conduct targeted outreach on wetland benefits and management in the Fish Pond Creek subbasin.~	Distribute wetland "myth-busting" information via print and online mediums to residents and businesses in the Fish Pond Creek subbasin. Couple this with in-person outreach about wetlands, wetland benefits, and ways to live with them.	Expand existing program	$1,200	$3,000 ($600/ year for 5 years; ongoing into long-term)	$4,200	Staff time: 20 hours of City field technician staff time acquiring and implementing messaging. Annually over five years, 50 hours of field technician time for outreach. Pair with annual source control inspections. Cost only covers this subbasin.	Itemized cost	Existing Stormwater Utility Fund
SE-2: Educate and support eligible residents participating in Thurston County's conservation incentives programs.~	Develop online and print resources to share with residents who may be eligible to participate in Thurston County's conservation incentives programs. Conduct targeted outreach in priority areas and assist landowners in participating in the programs. (Paired with LM-4).	Expand existing program	$3,200	$25,200 ($3,600/ year for 7 years in short-term; ongoing into long-term)	$28,400	Staff time: 40 hours of City management staff time to coordinate with Thurston County on messaging and resources and to develop outreach materials for web and print. 60 hours annually for outreach and tech support by field technician staff. Assumed to continue for 10 years, spanning short and long-term. Cost covers both SMAPs.	Professional judgement; itemized cost	Existing Stormwater Utility Fund

Table D 1. Fish Pond Creek Subbasin Land Management and Stormwater Enhancement Estimated Short Term Costs (2024 2030).								
Action	**Description**	**Action Type**	**Upfront Costs**	**Annual Costs**	**Total Cost**	**Cost Assumptions [a] [b]**	**Cost Basis**	**Budget Source**
SE-3: Provide free technical assistance to landowners related to flooding and stormwater in the Fish Pond Creek subbasin.*~	Provide free technical assistance to landowners in the Fish Pond Creek subbasin with questions/concerns about flooding or water quality issues. This includes site visits, over the phone assistance and via email. (Paired with SE-12).	Expand existing program	$0	$37,500 ($7,500/ year for 5 years)	$37,500	Staff time: 120 hours of City field technician/O&M staff time to field inquiries and conduct 10 site visits annually for five years. Cost covers all SMAPs.	Professional judgement; itemized cost	Existing Stormwater Utility Fund
SE-4: Pilot an educational campaign on leaf litter best practices to Homeowners Associations (HOAs) in the Fish Pond Creek subbasin.	Pilot an educational campaign on leaf litter management best practices to HOAs in the Fish Pond Creek subbasin. Consider educational outreach postcards and aligning with outreach and technical assistance visits (SE-5). (Paired with SE-13).	Expand existing program	$2,400	$6,000 ($2,000/ year for 3 years)	$8,400	Staff time: 30 hours of City management staff time initially to develop campaign. Then, 20 hours of staff time annually at end of summer to fall to send out educational materials. Supplies: $400 in printing and mailing costs annually. Cost only covers this subbasin.	Professional judgement; itemized cost	Existing Stormwater Utility Fund
SE-5: Conduct natural yard care outreach and technical assistance with private landowners and HOAs.	Expand the natural yard care program to include more educational resources, conduct targeted outreach in the Fish Pond Creek subbasin especially to HOAs, and implement "boots on the ground" projects related to retaining trees, retaining wetlands, preventing stream buffer encroachment, controlling noxious and invasive weeds, and encouraging natural yard care.	Expand existing program	$3,200	$24,000 ($4,800/ year for 5 years)	$27,200	Staff time: 40 hours initially of City management staff time to develop additional educational materials. Then, 80 hours of City field technician staff time to field inquiries and conduct 5 site visits annually for five years. Cost only covers this subbasin.	Professional judgement; itemized cost	Existing Stormwater Utility Fund

Table D 1. Fish Pond Creek Subbasin Land Management and Stormwater Enhancement Estimated Short Term Costs (2024 2030).								
Action	**Description**	**Action Type**	**Upfront Costs**	**Annual Costs**	**Total Cost**	**Cost Assumptions [a] [b]**	**Cost Basis**	**Budget Source**
SE-7: Provide stewardship opportunities for Fish Pond Creek subbasin residents.	Provide stewardship opportunities for local residents. Focus on improving participation and restoration opportunities.	Expand existing	$0	$16,800 ($5,600/ year for 3 years)	$16,800	Staff time: 80 hours of a combination of City management and field technician staff time to identify, set up, advertise, and staff restoration opportunities. Cost only covers this subbasin.	Professional judgement; itemized cost	Existing Stormwater Utility Fund
SE-8: Increase pet waste stations in the Fish Pond Creek subbasin.*	Expand the existing pet waste station program to target high-traffic dog areas and under resourced neighborhoods, conduct targeted outreach to these areas.	Expand existing program	$7,600	$12,000 ($2,400/ year for 5 years)	$19,600	Start-up: 60 hours total of City field technician/O&M staff time including 2 field days to conduct windshield survey for locations. Ongoing staff time: 40 hours annually for maintaining stations, replacing equipment, and outreach. Equipment and bags: $3,000 for 10 sites. Cost covers only this SMAP.	Professional judgement; itemized cost	Existing Stormwater Utility Fund
SE-9: Pilot an outreach and technical assistance program to HOAs in the Fish Pond Creek subbasin around stormwater management.	Use the Fish Pond Creek subbasin as a pilot for development and implementation of an outreach and technical assistance program for stormwater management, focused on HOAs. Through outreach, build partnerships with HOAs to develop maintenance plans and a more rigorous technical assistance program. Conduct one or more onsite workshops in partnership with the HOAs on stormwater best management practices. (Paired with SE-3).	Create new program	$2,800	$16,000 ($3,200/ year for 5 years)	$18,800	Staff time: 20 hours of City field technician staff time and 20 hours of City management staff to develop pilot program. 40 hours of City field technician staff time and 10 hours of City management staff time to host one or more onsite workshops and conduct 5 site visits annually for five years. Cost only covers this subbasin.	Professional judgement; itemized cost	Existing Stormwater Utility Fund

Table D 1. Fish Pond Creek Subbasin Land Management and Stormwater Enhancement Estimated Short Term Costs (2024 2030).								
Action	**Description**	**Action Type**	**Upfront Costs**	**Annual Costs**	**Total Cost**	**Cost Assumptions [a] [b]**	**Cost Basis**	**Budget Source**
SE-10: Implement enhanced IDDE screening in the Fish Pond Creek subbasin.*~	Conduct dry weather sampling supplemental to outfall screening in the Fish Pond Creek subbasin. Inventory private and public stormwater infrastructure for the subbasin.	Expand existing program	$0	$23,300 ($11,650/ year every 4 years; once in 2025 and once in 2029)	$23,300	Staff time: 16 hours for preparation - map locations, assembling equipment and field kits/lab analyses/collection bottles. 4 field days of sampling. 4 field days for follow up on suspect samples. Sample costs: $150 per sample (20 samples) for combination of lab analysis and field kits (bacteria, detergent, ammonia, phosphorus, temperature, conductivity and pH). Cost only covers this subbasin.	Professional judgement; itemized cost	Existing Stormwater Utility Fund
SE-11: Provide additional O&M training.*~	Provide training to O&M staff and plan review training for the engineering department.	Expand existing program	$10,000	$3,000 ($1,000/ year for 3 years)	$13,000	External training: Cost for 5 staff to attend one additional training provided by the WSU Stormwater Center or other similar training program in a three-year period. Internal training: One-time plan review training is developed and provided by a consultant after the new stormwater manual update is adopted. Conducted at the City once during implementation period. Cost covers all SMAPs.	Analog cost; itemized cost	Existing Stormwater Utility Fund
SE-12: Establish ditch maintenance program.*~	Develop ditch maintenance program to better address heavily vegetated and undersized ditches and alleviate flooding and water quality concerns.	Create new program	$12,100	$0	$12,100	Staff time: 60 hours of consultant and 20 hours city management staff time, or some other combination of expertise, to conduct research and develop ditch maintenance protocols. Cost covers all SMAPs.	Professional judgement; itemized cost	Existing Stormwater Utility Fund

Table D 1. Fish Pond Creek Subbasin Land Management and Stormwater Enhancement Estimated Short Term Costs (2024 2030).								
Action	**Description**	**Action Type**	**Upfront Costs**	**Annual Costs**	**Total Cost**	**Cost Assumptions [a] [b]**	**Cost Basis**	**Budget Source**
SE-13: Pilot a leaf litter sweeping program in the Fish Pond Creek subbasin.	Pilot a street sweeping program focused on leaf litter pickup in the Fish Pond Creek subbasin. Use the catchment to test different schedules and frequencies for optimal results before rolling out a city-wide program. Accompany sweeping with residential and HOA outreach through site visits (SE - 4).	Expand existing program	$3,200	$22,820 ($7,600/ year for three years)	$26,000	Staff time: 40 hours of city management staff time to develop an approach with schedules and frequencies. Annually over five years, 100 hours of city technician staff time implementing the plan and 20 hours of management time for revising the approach and program evaluation. Cost only covers this subbasin.	Professional judgement; itemized cost	Existing Stormwater Utility Fund
SE-14: Develop water quality monitoring program.*~	Develop a long-term monitoring implementation and quality assurance project plan. Identify purpose, goals, indicators, frequency, analysis, and locations. Incorporate other existing monitoring and estimated annual costs.	Create new program	$60,200	$0	$60,200	Based on Water Quality Monitoring Program plan written with the City and delivered in September 2023. Costs covers all SMAPs.	Professional judgement; itemized cost	Existing Stormwater Utility Fund
SE-15: Implement water quality monitoring program.*~	Implement a long-term water quality monitoring program that includes routine, stormwater, sediment, and B-IBI monitoring.	Create new program	$0	$1,207,200 ($201,200/ year for 6 years)	$1,207,200	Based on Water Quality Monitoring Program plan written with the City and delivered in September 2023. Costs covers all SMAPs.	Professional judgement; itemized cost	Existing Stormwater Utility Fund

LM= Land Management; SE = Stormwater Enhancement

* Action is also included in the Trosper Lake subbasin SMAP.

~ Action is also included in the West Mottman subbasin SMAP.

[a] Cost estimates are in 2023 dollars. Inflation and escalation of costs were not incorporated into these cost estimates.

[b] Cost estimates assume billing rates of $80/hour for City Management, $60/hour for City Field Technician/O&M Staff, and $175/hour for a consultant.

Table D 2. Fish Pond Creek Subbasin Land Management and Stormwater Enhancement Estimated Long Term Costs (2031 2044).								
Action	**Description**	**Action Type**	**Upfront Costs**	**Annual Costs**	**Total Cost**	**Cost Assumptions [a] [b]**	**Cost Basis**	**Budget Source**
LM-1: Coordinate with other City Departments to incorporate stormwater into projects, especially CFP projects.*~	Annually, meet with other department staff during planning of capital improvement projects (such as the annual Transportation Improvement Projects review, or Parks planning projects review) to determine how anticipated projects could incorporate stormwater planning and retrofits, especially projects related to the Transportation and Engineering Department.	Create new program	$0	$20,800 ($1,600/ year for 13 years in long-term; ongoing from short-term)	$20,800	Staff time: 20 hours of City management staff time to review planning documents and attend project planning meetings, annually. Assumed to continue for 20 years total. Cost covers all SMAPs.	Professional judgement; itemized cost	Existing Stormwater Utility Fund
LM-2: Evaluate options for development of an ecosystem services asset management program.*~	Conduct initial study to identify how an ecosystem services asset management program would be developed, funded, and applied to inform land use planning, restoration actions and overall benefit to receiving waters citywide.	Create new program	$150,000	$0	$150,00 0	Staff time: combination of consultant hours and City management staff time. Cost covers all SMAPs.	Analog cost	Grant Program (TBD)[c]
LM-3: Implement ecosystem services asset management program.*~	Based on the initial evaluation (LM-2), implement an ecosystem services asset management program. In addition, as information is available through development projects, update aquatic resources maps including wetland, streams, and buffer areas Citywide.	Create new program	$0	$250,000 ($83,333/ year for 3 years)	$250,00 0	Staff time: combination of consultant hours and City management staff time. Suggest revisiting estimate in the future. Cost covers all SMAPs.	Analog cost	Grant Program (TBD)[c]
LM-4: Partner with Thurston County in implementing conservation incentives, including easements, to preserve and restore habitat.~	Partner with Thurston County to increase land conservation through the County's land conservation incentives programs, including Habitat Conservation Plan easements. Parts of the City of Tumwater have been identified by the County as an area of immediate interest for habitat conservation. (Paired with SE-6).	Expand existing program	$0	$14,400 ($4,800/ year for 3 years in long-term; ongoing from short-term)	$14,400	Staff time: 60 hours of City management staff time to coordinate with Thurston County Community Planning and Economic Development Program staff. Assumed to continue for 10 years, spanning short and long-term. Cost covers both SMAPs.	Professional judgement; itemized cost	Existing Stormwater Utility Fund

Table D 2. Fish Pond Creek Subbasin Land Management and Stormwater Enhancement Estimated Long Term Costs (2031 2044).								
Action	**Description**	**Action Type**	**Upfront Costs**	**Annual Costs**	**Total Cost**	**Cost Assumptions [a] [b]**	**Cost Basis**	**Budget Source**
LM-5: Maintain inventory and maps of aquatic resources.~	Update maps for aquatic resources including wetlands, streams, buffer areas, critical wildlife habitat (e.g., Oregon Spotted Frog Habitat), and habitat corridors. Conduct every 4 years. As an initial focus, complete mapping of wetlands in the Fish Pond Creek subbasin, including those on private property, to inform wetland enhancement and preservation projects.	Expand existing program	$0	$12,000 ($4,000/ year every 4 years; ongoing from short-term)	$12,000	Staff time: 25 hours of City Field Technician staff time, 25 hours for GIS time, and 10 hours for City management staff time. Cost only covers this subbasin.	Professional judgement; itemized cost	Capacity Grant
LM-6: Conduct a review of stormwater code and language to ensure compliance.~	Conduct an annual review of stormwater codes and language to ensure compliance with the NPDES permit. Meet with Community Development to update on code changes as needed. Every five years, conduct a comprehensive update as new permit language is published.	Expand existing program	$0	$32,000 ($1,600/ year; $4,800/ year in 2034, 2039, and 2044; ongoing from short-term)	$32,000	Staff time: 20 hours of City management staff time annually and 60 hours every 5 years with permit reissuance. Cost covers all SMAPs.	Professional judgement; itemized cost	Existing Stormwater Utility Fund
SE-1: Conduct targeted outreach on wetland benefits and management in the Fish Pond Creek subbasin.~	Distribute wetland "myth-busting" information via print and online mediums to residents and businesses in the Fish Pond Creek subbasin. Couple this with in-person outreach about wetlands, wetland benefits, and ways to live with them.	Expand existing program	$0	$3,000 ($600/ year for 5 years; ongoing from short-term)	$3,000	Staff time: 20 hours of City field technician staff time acquiring and implementing messaging. Annually over five years, 50 hours of field technician time for outreach. Pair with annual source control inspections. Cost covers only this subbasin.	Professional judgement; itemized cost	Existing Stormwater Utility Fund
SE-2: Educate and support eligible residents with participating in Thurston County's conservation incentives programs.~	Develop online and print resources to share with residents who may be eligible to participate in Thurston County's conservation incentives programs. Conduct targeted outreach in priority areas and assist landowners in participating in the programs. (Paired with LM-4).	Expand existing program	$0	$10,800 ($3,600/ year for 3 years; ongoing from short-term)	$10,800	Staff time: 60 hours annually for outreach and tech support by field technician staff. Assumed to continue for 10 years, spanning short and long-term. Cost covers both SMAPs.	Professional judgement; itemized cost	Existing Stormwater Utility Fund

Table D 2. Fish Pond Creek Subbasin Land Management and Stormwater Enhancement Estimated Long Term Costs (2031 2044).

Action	Description	Action Type	Upfront Costs	Annual Costs	Total Cost	Cost Assumptions [a] [b]	Cost Basis	Budget Source
SE-6: Research vehicle pollutants and high-priority neighborhoods and conduct outreach around car care.	Research pollutant sources related to vehicle care and identify actions, outreach, and high-priority neighborhoods for larger car care campaigns. Consider approaches including promoting clean car washing techniques, promoting the Don't Drip and Drive campaign, selling car wash tickets as fundraisers, and offering free oil leak checks at participating mechanics.	Expand existing program	$3,600	$12,000 ($4,000/ year, every other year over 6 years total)	$15,600	Staff time: 20 hours of City management staff time and 40 hours City technician staff to research pollutant sources, identify high-priority neighborhoods, and develop vehicle outreach program. Additionally, 10 hours of management staff time and 20 hours of technician staff time biannually and $2,000 in program costs. Cost covers only this SMAP.	Professional judgement; itemized cost	Existing Stormwater Utility Fund
SE-15: Implement water quality monitoring program.*~	Implement a long-term water quality monitoring program that includes routine, stormwater, sediment, and B-IBI monitoring.	Create new program	$0	$804,800 ($201,200/ year for 4 years; ongoing from short-term)	$804,800	Based on Water Quality Monitoring Program plan written with the City and delivered in September 2023. Costs covers all SMAPs.	Professional judgement; itemized cost	Existing Stormwater Utility Fund

LM= Land Management; SE = Stormwater Enhancement

* Action is also included in the Trosper Lake subbasin SMAP.

~ Action is also included in the West Mottman subbasin SMAP.

[a] Cost estimates are in 2023 dollars. Inflation and escalation of costs were not incorporated into these cost estimates.

[b] Cost estimates assume billing rates of $80/hour for City Management, $60/hour for City Field Technician/O&M Staff, and $175/hour for a consultant.

[c] Funding sources may include Department of Ecology Water Quality Combined Funding Source, Capacity Grants, or other funding programs/opportunities that may arise in the next seven to ten years.

APPENDIX E

Stormwater Management Actions Costs and Schedules

Figure E-1. Fish Pond Creek Subbasin Stormwater Management Short-Term Actions.

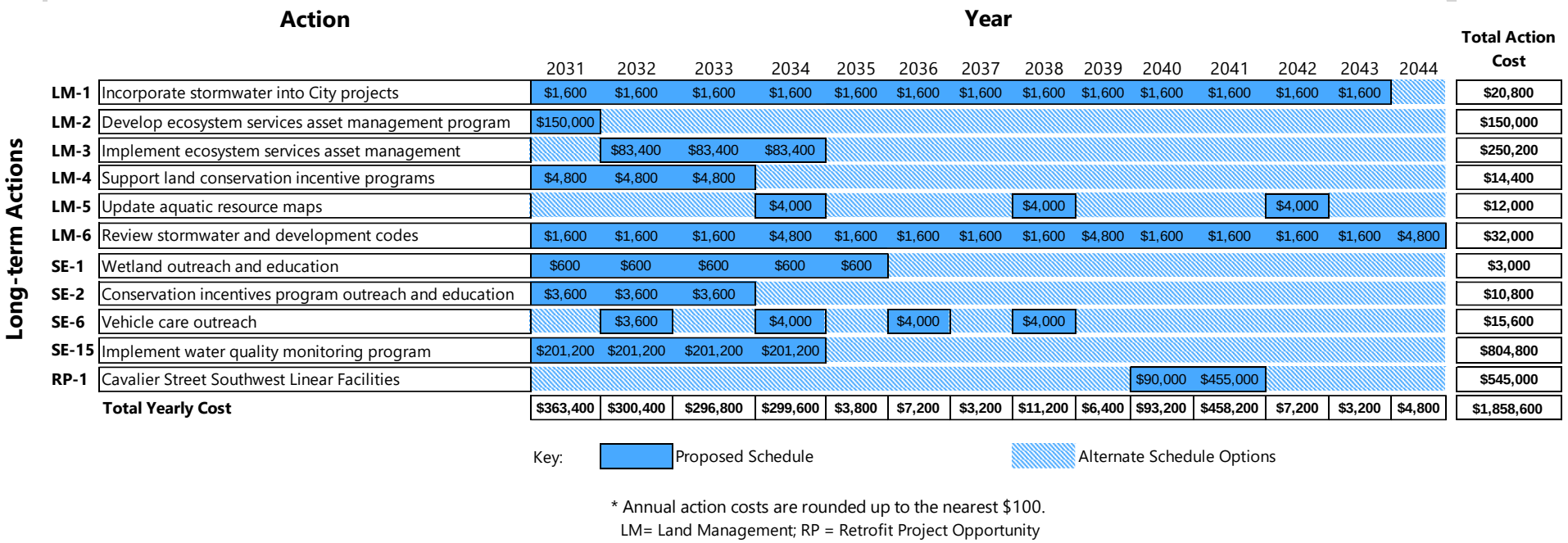
	Action	Year							Total Action Cost
		2024	2025	2026	2027	2028	2029	2030	
LM-1	Incorporate stormwater into City projects	$1,600	$1,600	$1,600	$1,600	$1,600	$1,600	$1,600	**$11,200**
LM-4	Support land conservation incentive programs	$4,800	$4,800	$4,800	$4,800	$4,800	$4,800	$4,800	**$33,600**
LM-5	Update aquatic resource maps			$4,000				$4,000	**$8,000**
LM-6	Review stormwater and development codes	$4,800	$1,600	$1,600	$1,600	$1,600	$4,800	$1,600	**$17,600**
SE-1	Wetland outreach and education			$1,800	$600	$600	$600	$600	**$4,200**
SE-2	Conservation incentives program outreach and education	$3,800	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	**$25,400**
SE-3	Technical assistance for landowners		$7,500	$7,500	$7,500	$7,500	$7,500		**$37,500**
SE-4	Leaf litter educational campaign		$2,400	$2,000	$2,000	$2,000			**$8,400**
SE-5	Natural yard care outreach	$3,200	$4,800	$4,800	$4,800	$4,800	$4,800		**$27,200**
SE-7	Stewardship opportunities					$5,600	$5,600	$5,600	**$16,800**
SE-8	Increased pet waste stations	$7,600	$2,400	$2,400	$2,400	$2,400	$2,400		**$19,600**
SE-9	Pilot technical outreach to HOAs		$3,200	$3,200	$3,200	$3,200	$3,200		**$16,000**
SE-10	Enhanced IDDE screening		$11,700				$11,700		**$23,400**
SE-11	Provide O&M training		$11,700				$11,700		**$23,400**
SE-12	Establish ditch maintenance program		$12,100						**$12,100**
SE-13	Pilot street sweeping program		$3,200	$7,600	$7,600	$7,600			**$26,000**
SE-14	Develop water quality monitoring program	$60,200							**$60,200**
SE-15	Implement water quality monitoring program		$201,200	$201,200	$201,200	$201,200	$201,200	$201,200	**$1,207,200**
	Total Yearly Cost	**$86,000**	**$271,800**	**$246,100**	**$240,900**	**$246,500**	**$263,500**	**$223,000**	**$1,577,800**

Key: Proposed Schedule Alternate Schedule Options

*Short-term actions are best to implement for a limited term, and then reviewed if the action is: no longer needed, has minimal demand, challenging to continue, subject to funding changes, or not effective. Annual action costs are rounded up to the nearest $100.

LM= Land Management; SE = Stormwater Enhancement

Figure E-2. Fish Pond Creek Subbasin Stormwater Management Long-Term Actions



* Annual action costs are rounded up to the nearest $100.

LM= Land Management; RP = Retrofit Project Opportunity

APPENDIX F

Draft Water Quality Monitoring Plan

Water Quality Monitoring Program

City of Tumwater

Prepared for
City of Tumwater
555 Israel Road SW
Tumwater, Washington 98501

Prepared by
Herrera Environmental Consultants, Inc.
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
Telephone: 206-441-9080

February 2024

CITY OF TUMWATER

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Science + Planning + Design

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Introduction

Water quality monitoring is a key component of protecting and restoring watershed health. Data collected through water quality monitoring are used to characterize waters, identify trends over time, identify existing and emerging problems, evaluate effectiveness of programs, and direct improvement efforts where they are most needed. Recognizing the need for greater baseline data on streams and rivers, the City of Tumwater (City) contracted with Herrera Environmental Consultants (Herrera) to provide recommendations for establishment of a long-term water quality monitoring program to document the condition of rivers and streams within the City.

Objectives for the water quality monitoring program include:

- Develop baseline data for area rivers and streams to evaluate current conditions and to provide background data to address the Deschutes River, Percival Creek, Budd Inlet, and Budd Inlet Tributaries Total Maximum Daily Loads (TMDLs).
- Track long-term changes in river and stream conditions to allow for evaluation of impacts from future changes including development and climate change.
- Provide data needed to support the City decision-making process for policy, program, and capital investment planning.

These objectives will be met through a combination of routine, storm-event, sediment, and macroinvertebrate monitoring.

The intent of this report is to lay out the basic framework for a monitoring program to help inform the City's decision-making process. This framework includes recommendations for selection of monitoring site locations, data collection and assessment considerations for each type of monitoring (i.e., routine, storm event, sediment, and macroinvertebrate), and estimates of general costs and levels of effort to implement the monitoring recommendations. Each of these framework elements is discussed further below. The City will adaptively manage the monitoring program by routinely reevaluating the monitoring approach and the data collected to ensure that the monitoring approach is capturing data of interest and meeting priority objectives. More detailed information (e.g., specific sites, equipment, quality assurance objectives, etc.) would be developed in a Quality Assurance Project Plan (QAPP) should the City decide to move forward with establishing the water quality monitoring plan.

Site Selection

Recommendations for broad site locations for water quality monitoring were developed through review of existing monitoring programs and sites (e.g., Thurston County, South Sound Green, Stream Team, and United States Geological Survey (USGS)) in addition to a desktop assessment and multiple discussions with City staff. In total, twelve site locations were selected for recommendation along Black Lake Ditch, Percival Creek, Fish Pond Creek, the Deschutes River, and two small tributaries to the Deschutes (Table 1) (Figure 1). These twelve sites include both new proposed sites as well as sites that are existing monitoring

locations for Thurston County. Sites were selected to allow comparison of potential changes in conditions as the streams flow through the City. Additionally, some sites were selected to establish baseline conditions in areas with little existing data and areas with planned future development. Table 1 provides suggested site names and codes, whether the site is new or an existing Thurston County site, descriptions of each general site location, the proposed monitoring components (highlighted in distinct colors), and the rationale for selecting each site.

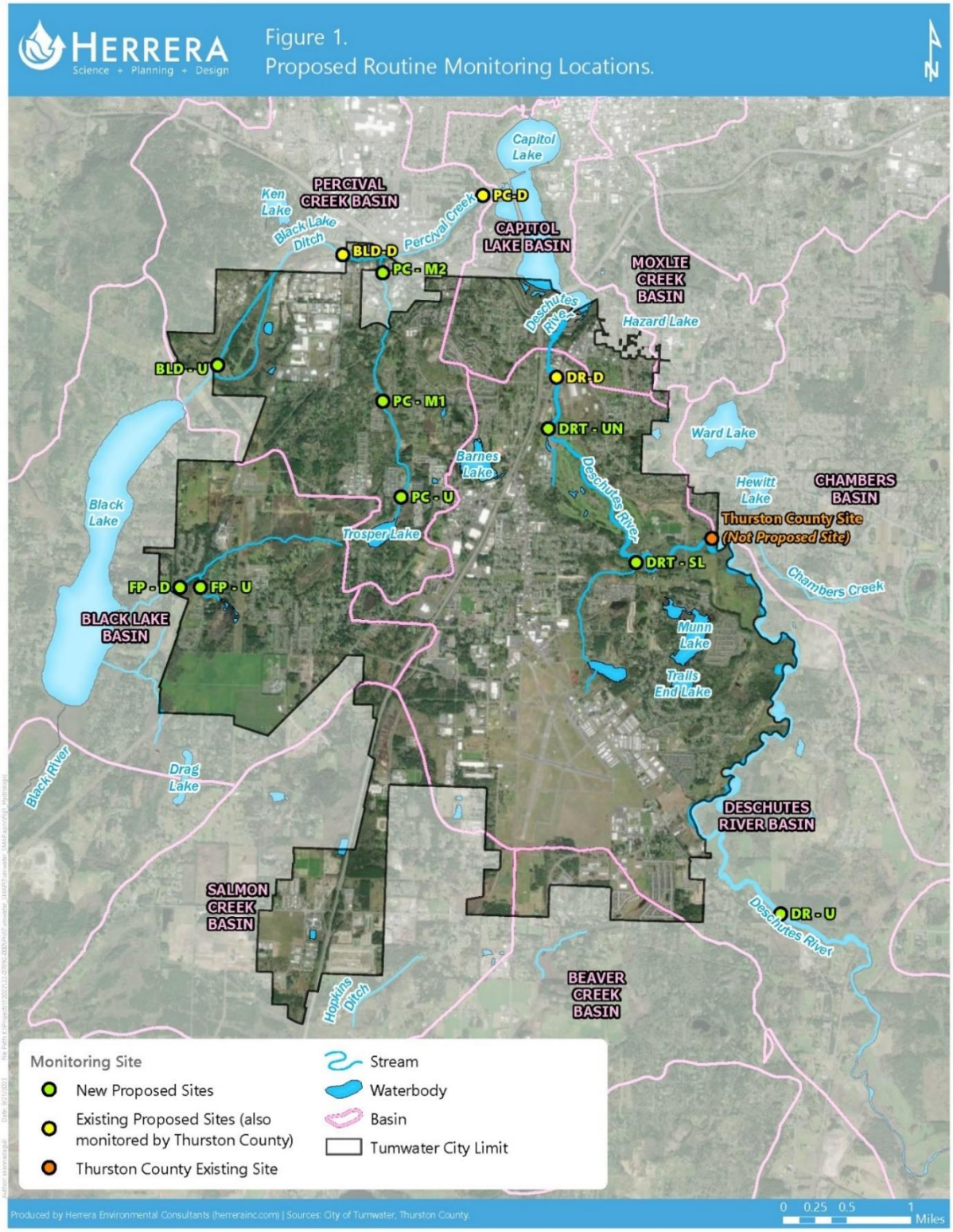
Table 1. List of Proposed Sites and Rationale for their Selection.

Site Name	Site Code	Site Status	General Site Location Description		Rationale for Site Selection
Black Lake Ditch [1]					
Black Lake Ditch - Upstream	BLD-U	Proposed	Near Regal Park Lane SW. (This is near the City boundary but below the area of direct lake influence).	Routine	Establish water quality condition upstream of the main area of City influence. Comparison to the County's downstream site would provide a means of evaluating the change in condition as the stream moves through the City.
Black Lake Ditch – Downstream	BLD-D	Existing Thurston County site (Black Lake Ditch)	At RW Johnson Blvd SW. (This is an existing County monitoring site. It is upstream of the confluence with Percival Creek).	Routine [2] Storm Sediment Macro-invertebrates	Establish water quality condition as impacted by City development including development of commercial/industrial areas. This existing site has a long-term water quality monitoring record the City can use to augment their program. Adding storm, sediment and macroinvertebrate data would enhance comparison of these parameters to other stream systems.
Percival Creek [1]					
Percival Creek – Upstream	PC-U	Proposed	At Trosper Lake Rd/54th. (This is just downstream of the lake wetland complex).	Routine	Establish water quality condition of the stream closest to the headwaters and allow comparison of stream condition as it moves through the City.
Percival Creek – Midstream1	PC-M1	Proposed	At Sapp Rd. (This is upstream of the most densely developed areas).	Routine Macro-invertebrates	This and the other sites on Percival Creek will allow a comparison of stream condition as it moves through the City. Other monitoring occurs at this site and may be useful for general long-term comparison.

Table 1. List of Proposed Sites and Rationale for their Selection.					
Site Name	**Site Code**	**Site Status**	**General Site Location Description**	**Proposed Monitored Components**	**Rationale for Site Selection**
Percival Creek – Midstream2	PC-M2	Proposed	Near Mottman Rd SW. (Upstream of confluence with Black Lake Ditch but within influence of commercial/ industrial area).	Routine Storm Sediment	Establish conditions upstream of confluence with Black Lake Ditch but within influence of commercial/ industrial area. Comparison with the upstream site (PC-U) can be used to evaluate City influence on water quality.
Percival Creek – Downstream	PC-D	Existing Thurston County site (Percival Mouth)	At pedestrian bridge off Evergreen Park Drive SW. (This is an existing County monitoring site near the stream mouth).	Routine [(2)] Storm Sediment Macro-invertebrates	This existing site has a long-term water quality monitoring record the City can use to augment their program. Adding storm, sediment, and macroinvertebrate data would allow comparison of these parameters to other stream systems.
Fish Pond Creek					
Fish Pond Creek - Upstream	FP-U	Proposed	Near 66th Ave SW. (Just upstream of confluence of tributary with main stem).	Routine	Monitoring here, as well as at a site below the confluence with the tributary (FP-D), will allow assessment of development impacts within the basin.
Fish Pond Creek - Downstream	FP-D	Proposed	Near 66th Ave SW. (Just downstream of confluence of tributary with mainstem).	Routine Storm Sediment Macro-invertebrates	See note above.

Table 1. List of Proposed Sites and Rationale for their Selection.					
Site Name	**Site Code**	**Site Status**	**General Site Location Description**		**Rationale for Site Selection**
Deschutes River [1]					
Deschutes River - Upstream	DR-U	Proposed	Near Old Highway 99 SE and 93rd Ave SE. (Just upstream of City boundary).	Routine	Sampling at this location would allow for comparison with downstream sites, which could provide the City with data to evaluate TMDL allocations.
Deschutes River – Downstream	DR – D	Existing USGS & Thurston County site (Deschutes @ Tumwater)	At E Street Bridge & At Tumwater Park/Capitol Blvd.	Routine [2] Storm Sediment Macro-invertebrates	This site would reflect almost the entire influence of the City to the Deschutes watershed. And by comparison to DR-U would allow evaluation of contributions from the downstream portion of the City. Thurston County monitors water quality at this site and USGS provides continuous flow data at this site which is used to evaluate hydrology and to calculate pollutant loads for the Deschutes. (Gage ID: 12080010).[3]
Tributaries of the Deschutes River					
Deschutes River Tributary – Unnamed Stream	DRT-UN	Proposed	Near Tumwater Valley Drive SE. (Downstream of a large stormwater outfall, upstream of confluence with the river).	Routine Storm	This site would reflect influence of a high volume of stormwater and would be used to document impact from the large outfall to the Deschutes River. Ultimately monitoring data would be beneficial to support grant applications or other funding opportunities to f improve water quality at this location.
Deschutes River Tributary - Swamp Lake	DRT-SL	Proposed	On the Swamp Lake tributary. (Upstream of confluence with the Deschutes, potentially on Dennis St).	Routine Storm	This site may be impacted by commercial and industrial development and would be used to document pollutant load contributions from this sector of the City.

[1] South Sound Green has performed water quality monitoring in the City of Tumwater on Percival Creek, Black Lake Ditch, and the Deschutes River. These sites are not included in this Table because the monitoring is intermittent and therefore has not been relied upon as part of a proposed long term monitoring plan.
[2] = Monitored by Thurston County
[3] = The Deschutes River Flood Reduction Study (Stantec 2023) states that the gage height readings at this station may be inaccurate. It is recommended that the City contact the USGS before using the gage data.


HERRERA
Science + Planning + Design
Figure 1.
Proposed Routine Monitoring Locations.
N
Capitol Lake
PERCIVAL CREEK BASIN
Ken Lake
Black Lake Ditch
Percival Creek
PC-D
BLD-D
PC - M2
CAPITOL LAKE BASIN
MOXLIE CREEK BASIN
Deschutes River
Hazard Lake
BLD - U
DR-D
PC - M1
DRT - UN
Ward Lake
Barnes Lake
Hewitt Lake
CHAMBERS BASIN
Black Lake
PC - U
Trosper Lake
Thurston County Site
(Not Proposed Site)
DRT - SL
Chambers Creek
FP - D
FP - U
BLACK LAKE BASIN
Munn Lake
Trails End Lake
Black River
Drag Lake
DESCHUTES RIVER BASIN
SALMON CREEK BASIN
DR - U
Deschutes River
BEAVER CREEK BASIN
Hopkins Ditch
Monitoring Site
New Proposed Sites
Existing Proposed Sites (also monitored by Thurston County)
Thurston County Existing Site
Stream
Waterbody
Basin
Tumwater City Limit
Produced by Herrera Environmental Consultants (herrerainc.com) | Sources: City of Tumwater, Thurston County.
0 0.25 0.5 1
Miles

During development of these program recommendations, some sites identified by the City were initially considered for inclusion in a long-term monitoring program but were ultimately excluded because the concerns related to these sites were deemed more appropriate as a special study. For example, the Mottman Industrial Area stormwater pond was identified as a site that might need focused monitoring, rather than routine monitoring, to answer questions related to the pond's current function and treatment capability. Therefore, this site and others like it are not addressed as part of this monitoring program.

Routine Monitoring

Routine stream and river monitoring as defined for this program refers to monitoring performed on a routine basis (i.e., monthly) that is used to characterize general water quality conditions. Physical and chemical water quality data would be collected monthly at all the routine monitoring sites. Routine monitoring also includes collection of streamflow data to allow evaluation of changes in streamflow over time and to calculate pollutant loads.

Data Collection

In total, twelve sites are proposed for routine stream monitoring (Table 1; Figure 1). These sites include reaches along Black Lake Ditch, Percival Creek, Fish Pond Creek, the Deschutes River, and tributaries of the Deschutes River. Sites were selected to represent conditions near the upstream boundary of the City and then near the mouth of the subbasin or just within or below areas of major City development. The purpose of this site selection strategy is to provide a picture of the extent to which stream conditions change as the stream flows through the City. As indicated in Table 1, some of the sites are also routinely monitored by Thurston County. Co-locating sites will allow the City to take advantage of the decades of monitoring data the County has amassed. However, because of the challenges of coordinating monitoring to align at the same days, times, and locations, it would be important for the City to collect independent samples at the County's sites. This would ensure consistency of data collection on the same day each month, thus allowing for better comparison across monitoring sites. Sites would be sampled once per month throughout the year to capture baseline stream conditions. Sampling would include collection of field measurements including flow, a staff gage reading, and collection of samples for laboratory analysis. The list of recommended parameters is included as Table 2.

In addition to instantaneous flow and temperature measurements, it is recommended that continuous data on stream level and temperature be collected at up to five of the sites. The water level data in combination with the field flow measurements would be used to develop a relationship between water level and flow on a stream and therefore extend the flow data record. Both stream flow and temperature are expected to be critical for tracking long term impacts from development and climate change.

Table 2. List of Parameters for Routine Monitoring.		
Field Measurements		
Parameter	**Criteria Source**	**Criteria**
Conductivity[1]		
Dissolved Oxygen	Deschutes River TMDL Budd Inlet TMDL	8.0 mg/L (Lowest 1-day minimum) 5.0 mg/L (southern Budd Inlet) 6.0 mg/L (remaining portion of Budd Inlet)
Flow[1]		
pH	Deschutes River TMDL	6.5 – 8.5
Temperature	WAC 173-201A-200 – Table 200(1)(d) [2]	17.5°C (63.5°F) (Highest 7-DAD Max, or 7-day average of the daily maximum temperatures)
Turbidity	WAC 173-201A-200 – Table 200(1)(e) [2]	Turbidity shall not exceed: • 5 NTU over background when the background is 50 NTU or less; or • A 10% increase in turbidity when the background turbidity is more than 50 NTU.
Laboratory Measurements		
Parameter	**Criteria Source**	**Criteria**
Escherichia Coli (E. Coli/ EC) Bacteria	WAC 173-201A-200 – Table 200(1)(b) [2]	*E. coli* organism levels within an averaging period must not exceed a geometric mean value of 100 CFU or MPN per 100 mL, with no more than 10 percent of all samples (or any single sample when less than 10 sample points exist) obtained within the averaging period exceeding 320 CFU or MPN per 100 mL.
Nitrogen (Nitrate + Nitrate) (NOx)	Reference conditions for Puget Lowland ecoregion (EPA 2000)	0.26 mg/L
Total Kjeldahl Nitrogen (TKN) [3]		
Total Phosphorus (TP)	Reference conditions for Puget Lowland ecoregion (EPA 2000)	0.019mg/L
Total Dissolved Phosphorus (TDP) [3]		
Total Suspended Solids (TSS) [3]		

(1) Parameter varies based on stream conditions. Typical ranges will be established through monitoring program.
(2) Per WAC 173-201A-602, the Deschutes River upstream from the mouth to Offutt Lake's tributary is considered primary contact recreation and salmonid spawning and rearing. Per WAC 173-201A-600, all other sites not on the Deschutes River are considered primary contact recreation and salmonid spawning, rearing, and migration. These uses set numeric criteria from WAC 173-201A-200.
(3) Parameter does not have set water quality standards or criteria.

Data Evaluation

In the near term, the data collected under this part of the program would have immediate utility. Pollutant concentration data for each site can be compared to State water quality standards to evaluate compliance. In addition, pollutant concentrations and calculated pollutant loads for sites along the same stream system could be compared to develop an understanding of where pollutants are being generated or where stream physical conditions are most problematic within each stream system. Sites between stream systems could also be compared to characterize the streams and support City decision making such as where to improve stormwater infrastructure or modify land use policy. Furthermore, comparing water quality data between seasons could help to determine to what extent problems are driven by stormwater or low stream flow conditions.

Flow data would be used to calculate pollutant loads that would be compared between streams and stream segments but will also allow an improved understanding of the extent to which the hydrology of each system is impacted by groundwater, development, or climate change. Over the long term, the data would be critical to evaluate whether or the extent to which stream quality and flow response changes as the City continues to develop and continues to implement stormwater and land use controls. Long-term monitoring data would also help inform resource and watershed management.

Tracking and managing data would be done through a water quality monitoring database such as EPA's Water Quality Exchange (WQX). Use of a database would provide a way to easily store and share data. It is recommended that the database be linked to a public-facing website dashboard with water quality data.

Storm Event Monitoring

During storms, pollutants can be mobilized and transported into streams. Therefore, storm event monitoring is recommended to evaluate stream conditions and calculate pollutant loads during storm events. Both water quality concentration and flow are determined to calculate pollutant loading.

Data Collection

Seven sites are proposed for storm event monitoring (Table 1; Figure 1). These include Black Lake Ditch – Downstream, Percival Creek – Midstream2, Percival Creek – Downstream, Fish Pond Creek – Downstream, Deschutes River – Downstream, Deschutes River Tributary – Unnamed Stream, and Deschutes River Tributary – Swamp Lake. These sites were selected at the lower reaches of the subwatersheds and thus would give an indication of the total impact of storm events from the subwatershed.

Sites would be sampled during six storm events: four events during the wet season (November – March) and two events in the dry season (July – September). Specific storm event criteria that defines what qualifies as a storm event and required antecedent conditions will be identified in the Quality Assurance Project Plan (QAPP) that will be developed to support the City's monitoring program.

Sampling would involve collection of field measurements and collection of samples for laboratory analysis. Table 3 lists the parameters and analytes that would be measured during each event. The organic analytes were specifically chosen because they were identified as commonly occurring in Puget Sound streams and rivers in Washington Department of Ecology's (Ecology's) toxic loadings studies (Ecology 2011, Ecology 2017).

Table 3. List of Parameters for Storm Event Monitoring.

Field Measurements
Parameter
Conductivity
Dissolved Oxygen
Flow
Temperature
pH
Turbidity
Laboratory Measurements
Parameter
Escherichia Coli (E. Coli/ EC) Bacteria
Nitrogen (Nitrate + Nitrate) (NOx)
Total Kjeldahl Nitrogen (TKN)
Total Phosphorus (TP)
Total Dissolved Phosphorus (TDP)
Total Suspended Solids (TSS)
Hardness (as $CaCO_3$)
Total and Dissolved Cadmium
Total and Dissolved Copper
Total and Dissolved Lead
Total and Dissolved Zinc
Polycyclic Aromatic Hydrocarbons (PAHs)
Polychlorinated biphenyls (PCBs)
Triclopyr
Bis(2-ethylhexyl) phthalate
6PPD-Quinone (6PPD-Q)

Data Evaluation

Storm event data collected under this program would also be stored in a water quality database. Data would be compared to water quality standards; this will be especially critical for dissolved metal and PAH data. Pollutant concentrations and loads would be compared between different sites on the same stream,

as well as between streams. In addition, pollutant loads can be compared to evaluate changes between routine and storm event conditions, which can reveal how subwatersheds respond to varying precipitation, and identify potential problem areas.

Flow data would also be evaluated to assess how individual streams and stream reaches respond to storm event conditions. Over the long term, storm event data can be used to evaluate how stream quality and flow respond to changes with additional development, land use changes, and climate-driven changes in precipitation patterns.

Sediment Monitoring

Sediment monitoring is conducted in freshwater aquatic environments because sediment quality can be an important indicator of environmental health. Pollutants from urban areas are washed into streams, attach to sediments, and settle to the bottom. Sediments can serve as a record of both historical and recent pollutants that are discharged into surface waters.

Data Collection

Five potential sites are proposed for conducting sediment sampling (Table 1; Figure 1). These include Black Lake Ditch – Downstream, Percival Creek – Midstream2, Percival Creek – Downstream, Fish Pond Creek – Downstream, and Deschutes River – Downstream. As downstream areas, these sites could provide information about pollutants moving through the stream system. Specific sampling sites would in the general vicinity of the routine water quality monitoring sites, but in low gradient areas where there are visible depositional areas.

Sediment samples would be collected once per year during the low flow summer months (July – September) from a wadeable depositional area. Depositional areas are typically low energy locations where fine-grained sediments, such as muds and silts, accumulate. Examples of depositional areas include inside the bends of streams, downstream from obstacles such as boulders and sand bars, and shallow waters near the shore. By sampling later in the summer when stream flows are low, more depositional areas should be near the designated sites. A variety of parameters including physical characteristics (e.g., grain size), metals, and other pollutants are recommended for collection (Table 4).

Table 4. List of Parameters for Sediment Monitoring.
Laboratory Measurements
Parameter
Grain Size
Solids, Total, Dried (TS)
Total Organic Carbon (TOC)
Polycyclic Aromatic Hydrocarbons (PAHs)
Total Cadmium
Total Copper
Total Lead
Total Zinc

Data Evaluation

Sediment data collected under this program would be stored in a water quality database with the routine and storm event monitoring data. Where applicable, data would be compared to the Washington State Sediment Management Standards (WAC Chapter 173-204), which sets qualitative narrative standards for freshwater benthic sediment quality. For those analytes that do not have sediment management standards, comparisons between sites and with other regional databases will be important for evaluating relative condition.

Macroinvertebrate Monitoring

The presence or absence of specific benthic macroinvertebrates can be used as an indicator for watershed health. The data is used to develop a quantitative scoring metric (i.e., benthic index of biotic integrity or B-IBI) for determining and comparing biological conditions of streams. For this type of monitoring, macroinvertebrates are identified and counted to quantify diversity and community structure.

Data Collection

Five sites are proposed for macroinvertebrate sampling (Table 1; Figure 1), including Black Lake Ditch – Downstream, Percival Creek – Midstream 1, Percival Creek – Downstream, Fish Pond Creek – Downstream, and Deschutes River - Downstream. These locations were selected because they are either within or just downstream of the City's influence. Specific site locations would be selected that are outside of the immediate influence of road or bridge crossings. Monitoring would take place once per year during the late summer. Ecology's monitoring protocol provides a relatively long sampling window of July 1 – October 15 (Ecology, 2022). However, since these data will be compared between years it is recommended that the City select a narrow window (e.g., June to mid-July) and consistently sample within that period.

Data Evaluation

Macroinvertebrate data would be used to calculate B-IBI scores using the Puget Sound Lowlands B-IBI calculation method. The data collected would be entered into the Puget Sound Stream Benthos database, which serves as a data repository and analysis tool for macroinvertebrate data collected throughout the Puget Sound region. B-IBI scores would be compared between streams in the City as well as compared to other streams in the region through use of this database. Local macroinvertebrate data is also collected through Stream Team and South Sound Global Rivers Environmental Education Network (GREEN) monitoring efforts and can serve as another source of comparative data.

Adaptive Management

It will be important for City staff to meet once each year to review results from the previous year's monitoring and to discuss possible adjustments to the program to insure it continues to meet the City's objectives. However, the primary objective of the monitoring program is to develop a long-term database that will support the City's need to document the condition of area streams through time. Any changes to the program should be considered carefully in light of the impact the change would have on developing the long-term data record.

Program Implementation Costs

Costs for implementing a water quality monitoring program vary depending on the number of sites and parameters, and sampling frequency. The tables below provide a general breakdown of estimated costs for labor, analytical, and equipment expenses related to implementation of the different components of the program. Total costs are rounded up to the nearest $100.

Labor Cost Estimates

Monitoring program implementation involves annual labor costs associated with fieldwork, data quality assurance (QA), data management, data upload, and limited data assessment. Estimated annual costs for labor are listed in Table 5 and are approximately $30,100. In addition to annual labor costs, there would be one-time costs related to development of the QAPP and the data dashboard and installation of automated field equipment. These one-time costs have been estimated at $36,100 (Table 6).

For this cost estimate it has been assumed that annual reporting will primarily involve data upload to a web-based data platform that will generate automated data summaries with minimal evaluation and assessment of the findings. It has been assumed that actual detailed data evaluation (e.g., comparisons between sites or assessment of watershed needs) would occur on an as-needed basis and therefore those costs have not been included.

Table 5. Labor Annual Cost Estimates.					
Labor [1]	**Number of Staff**	**Number of Days**	**Hours per Day per Staff**	**Total Estimated Hours**	**Estimated Cost** [2]
Annual data uploads to database	1	NA	NA	20	$1,140
Annual data review	NA	NA	NA	40	$2,280
Annual flow and hydrograph assessment[3]	1	NA	NA	40	$2,280
Annual Data QAQC	NA	NA	NA	40	$1,140
Macroinvertebrate monitoring fieldwork	2	2.5	12	60	$2,820
Routine monitoring fieldwork	2	12	12	288	$13,536
Sediment monitoring fieldwork	2	1	8	16	$752
Storm event monitoring fieldwork	2	6	12	144	$6,768
TOTAL COST					**$30,100**

(1) Costs only include annual costs and do not include one-time costs such as QAPP preparation or gage station installation or costs of analyzing and comparing data.
(2) Labor costs assume that fieldwork will be conducted by a field technician at a rate of $47/hour and that all other activities will be conducted by a City specialist staff at a rate of $57/hour.
(3) Includes stage-discharge curve development for five flow stations.

Table 6. Labor One Time Cost Estimates.	
Labor [1]	**Estimated Cost**
Data dashboard development	$20,000
Data logger equipment installation [1]	$4,700
Staff gage installation [2]	$3,400
QAPP development	$8,000
TOTAL COST	**$36,100**

(1) Assumes up to five stream level and/or temperature stations are installed.
(2) Assumes up to 12 staff stream gages are installed. If gage data will be used in the future for modeling, it is important to survey in the staff gage to ensure elevation data can be translated to the model; surveying would incur additional labor costs. Survey costs have not been included in the cost estimate.

Analytical Cost Estimates

Water and sediment samples analyzed at a lab will incur additional costs. The estimated cost for annual routine monitoring sample analysis is $37,200 (Table 7). Storm event annual monitoring costs are estimated at $127,700 (Table 8). Sediment monitoring annual costs are estimated at $3,500 (Table 9). Macroinvertebrate monitoring annual costs are estimated to be $2,100 (Table 10).

Table 7. Routine Monitoring Annual Analytical Cost Estimates.					
Parameters	**Number of Sites**	**Number of Duplicates**	**Number of Events**	**Cost per Sample** [1]	**Cost Estimate**
Escherichia Coli (E. Coli/ EC) Bacteria	12	1	12	$32	$4,992
Total Suspended Solids (TSS)	12	1	12	$35	$5,460
Nitrogen (Nitrate + Nitrate) (NOx)	12	1	12	$38	$5,928
Total Kjeldahl Nitrogen (TKN)	12	1	12	$55	$8,580
Total Phosphorus (TP)	12	1	12	$45	$7,020
Total Dissolved Phosphorus (TDP) (includes filtering)	12	1	12	$65	$10,140
TOTAL COST					**$37,200**

[1] Costs are based on 2023 costs from Analytical Resources LLC.

Table 8. Storm Event Monitoring Annual Analytical Cost Estimates.					
Parameters	**Number of Sites**	**Number of Duplicates**	**Number of Events**	**Cost per Sample** [1]	**Cost Estimate**
Escherichia Coli (E. Coli/ EC) Bacteria	7	1	6	$32	$1,536
Hardness (as CaCO3)	7	1	6	$75	$3,600
Total Suspended Solids (TSS)	7	1	6	$35	$1,680
Nitrogen (Nitrate + Nitrate) (NOx)	7	1	6	$38	$1,824
Total Kjeldahl Nitrogen (TKN)	7	1	6	$55	$2,640
Total Phosphorus (TP)	7	1	6	$45	$2,160
Total Dissolved Phosphorus (TDP) (includes filtering)	7	1	6	$65	$3,120
Polycyclic Aromatic Hydrocarbons (PAHs)	7	1	6	$240	$11,520
Polychlorinated biphenyls (PCBs)	7	1	6	$200	$9,600
Triclopyr	7	1	6	$1,000	$48,000
Bis(2-ethylhexyl) phthalate	7	1	6	$210	$10,080
6PPD-Quinone (6PPD-Q)	7	1	6	$700	$33,600
Metals Prep ICPMS [2]	7	1	6	$35	$1,680
Total Cadmium	7	1	6	$18	$864
Total Copper	7	1	6	$18	$864
Total Lead	7	1	6	$18	$864
Total Zinc	7	1	6	$18	$864
Metals Prep Dissolved ICPMS [2]	7	1	6	$35	$1,680
Metals Prep Filter 0.45 micron [2]	7	1	6	$20	$960
Dissolved Cadmium	7	1	6	$18	$864
Dissolved Copper	7	1	6	$18	$864
Dissolved Lead	7	1	6	$18	$864
Dissolved Zinc	7	1	6	$18	$864
TOTAL COST					**$127,700**

(1) Costs are based on 2023 costs from Analytical Resources LLC. [2] Analysis of metals includes additional preparation costs.

Table 9. Sediment Monitoring Annual Analytical Cost Estimates.					
Parameters	**Number of Sites**	**Number of Duplicates**	**Number of Events**	**Cost per Sample** [1]	**Cost Estimate**
Grain Size	5	1	1	$180	$1,080
Solids, Total, Dried (TS)	5	1	1	$10	$60
Total Organic Carbon (TOC)	5	1	1	$70	$420
Polycyclic Aromatic Hydrocarbons (PAHs)	5	1	1	$240	$1,440
Total Cadmium	5	1	1	$12	$72
Total Copper	5	1	1	$12	$72
Total Lead	5	1	1	$12	$72
Total Zinc	5	1	1	$12	$72
TOTAL COST					**$3,500**

[1] Costs are based on 2023 costs from Analytical Resources LLC.

Table 10. Macroinvertebrate Monitoring Annual Analytical Cost Estimates.					
Parameters	**Number of Sites**	**Number of Duplicates**	**Number of Events**	**Cost per Sample**	**Cost Estimate**
Macroinvertebrates	5	1	1	$350	$2,100
TOTAL COST					**$2,100**

Equipment Cost Estimates

Special equipment will be needed to implement the monitoring program, including a handheld flow meter, stream staff gages, and the equipment needed to establish continual and automated stream level and temperature monitoring data at up to five key sites. Total cost for equipment has been estimated at $23,600 (Table 11). Except for the miscellaneous field items, which may need to be replaced annually, these equipment costs are one-time costs.

Table 11. Equipment Cost Estimates.		
Equipment	**Quantity**	**Estimated Cost**
Continuous monitoring site gaging station equipment with telemetry. Includes: dataloggers, staff gages, and associated equipment [(1)]	5	$13,500
Staff gage site equipment. Includes: staff gages. [(2)]	7	$500
Flow meter (handheld velocimeter) [(3)]	1	$9,400
Macroinvertebrate sampling net[(4)]	2	$1,200
Miscellaneous field items [(5)]	NA	$500
Water quality probe (YSI) [(6)]	0	$0
TOTAL COST		**$25,100**

[(1)] Assumes installation at five sites ($2,700/site). Assumes telemetry technology will be used, which automatically transmits data measured at the gaging stations back to staff computers.
[(2)] If gages exist at Thurston County sites, cost may be reduced.
[(3)] Assumes an ultrasonic handheld velocimeter (i.e., Hach FH950). However, additional options exist at other price points such as a lower cost propellor version (i.e., Swoffer 3000 or 2100) or a top-of-the-line version (i.e., Hach FH950 portable).
[(4)] Assumes purchase of two Surber samplers at a cost of $600/each per recent Thurston County purchase.
[(5)] Miscellaneous field items could include gloves, coolers, and probe calibration standards. These may be an annual cost.
[(6)] The City already owns a multi- parameter water quality probe.

Summary

Implementation of a water quality monitoring program would aid the City of Tumwater in advancing its objectives of developing baseline data for area streams and rivers, tracking long-term changes in stream and river conditions, and providing data needed to support policy, program, and capital investment planning, including supporting TMDL needs. These objectives would be met through a combination of routine, storm event, sediment, and macroinvertebrate monitoring. The framework proposed in this document describes how each of these monitoring components would be carried out and how the data would be evaluated and provides a cost estimate for each. Although the monitoring program is likely to be adapted over time to meet City needs and to reflect data findings, the key benefit of the program will be its long-term nature and the value of developing a consistent, reliable database.

Conducting all four components of the monitoring program would incur annual costs related to labor, lab analysis of samples, and reporting. Total annual ongoing costs have been estimated at $201,200 per year (Table 12). There are also one-time startup costs of $60,200 (Table 13). Through monitoring and documenting the conditions of area streams and rivers, the City can continue to protect and restore watershed health.

Table 12. Summary of Annual Cost Estimates.				
	Labor Cost [1]	**Analytical Cost [2]**	**Reporting Cost [3]**	**TOTAL COST**
Macroinvertebrate monitoring	$2,820	$2,100	$1,700	$6,600
Routine monitoring	$13,536	$37,200	$1,700	$52,400
Sediment monitoring	$752	$3,500	$1,700	$6,000
Storm event monitoring	$6,768	$127,700	$1,700	$136,200
TOTAL ANNUAL COST	**$23,900**	**$170,500**	**$ 6,800**	**$201,200**

[1] Labor costs assume that fieldwork/labor will be conducted by a field technician at a rate of $47/hour and that reporting will be conducted by City specialist staff at a rate of $57/hour.
[2] Costs are based on 2023 costs from Analytical Resources LLC.
[3] Annual reporting includes uploads to the database, data review, flow and hydrograph analysis, and data QAQC. Costs do not include a written narrative report. These reporting costs have been estimated at $6,800 and this cost has been evenly spread across the monitoring components.

Table 13. Summary of One Time Cost Estimates.	
	TOTAL COST
Data dashboard development	$20,000
Data logger equipment installation [1]	$4,700
Equipment (from Table 11)	$25,100
Staff gage installation [2]	$3,400
QAPP development	$8,500
TOTAL ONE-TIME COST	**$61,700**

[1] Assumes up to five stream level and/or temperature stations are installed.
[2] Assumes up to 12 staff stream gages are installed. If gages exist at Thurston County sites, cost may be reduced.

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