City of Kenmore
Surface Water Master Plan

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Acknowledgements

2015 City Council

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List of Acronyms/Terms

AKART	All Known and Reasonable Treatments
BMP	Best Management Practice
BO	Biological Opinion
CIP	Capital Improvement Project
City	City of Kenmore
County	King County
CWA	Clean Water Act
DNR	Washington State Department of Natural Resources
Ecology	Washington State Department of Ecology
ECOSS	Environmental Coalition of South Seattle
EPA	US Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
GMA	Growth Management Act
IDDE	Illicit Discharge Detection and Elimination
KCC	King County Code
KCSWDM	King County Surface Water Design Manual
KMC	Kenmore Municipal Code
LID	Low Impact Development
MS4	Municipal Separate Storm Sewer
N/A	Not Applicable
NFIP	National Flood Insurance Program
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
PSP	Puget Sound Partnership
QAPP	Quality Assurance Project Plan
RCW	Revised Code of Washington
ROW	Right of Way
RSMP	Regional Stormwater Management Program
SEPA	State Environmental Protection Act
SMA	Shoreline Management Act
SR	State Route
SWMMWW	Stormwater Management Manual for Western Washington
SWMP	Stormwater Management Program
TMDL	Total Maximum Daily Load
USACE	US Army Corps of Engineers
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resources Inventory Area

1. Introduction

This Surface Water Master Plan (Plan) presents strategies and projects for managing surface water and stormwater in the City of Kenmore (City) through 2020. This Plan builds upon previous planning efforts, including National Pollutant Discharge Elimination System (NPDES) compliance efforts that have been implemented in response to issuance of the first Phase II Municipal Separate Storm Sewer (MS4) permit in 2007.

This Plan is organized by the following sections:

1) **Introduction** – Details the drivers behind the Plan and its relationship to other planning efforts, the goals for surface water management in the context of the City's goals and vision, achievements since the last Plan update, and surface water staffing and responsibilities.
2) **Surface Water Trends, Challenges, and Opportunities** – Describes regional trends in the management of surface water that will affect Kenmore, regulatory requirements, surface water management issues in Kenmore, and opportunities for improvement.
3) **Existing Policies** – Describes Kenmore's surface water management policies and provides recommendations for modifications and updates to existing policies and development of new policies.
4) **Current Conditions** – Describes the City's existing surface water and stormwater system conditions, including types and locations of infrastructure and facilities, natural resources, operations and maintenance (O&M), and programmatic management.
5) **The Next 6-10 Years** – Provides recommendations for capital projects and programmatic strategies that address issues described in previous sections.

What is NPDES?

NPDES or the National Pollutant Discharge Elimination System is the permit program under which States and sometimes other designated authorities (in this case, Washington State Department of Ecology) implement the requirements of the Federal Clean Water Act to control water pollution. Kenmore has a NPDES Phase II Permit for their municipal storm sewer system.

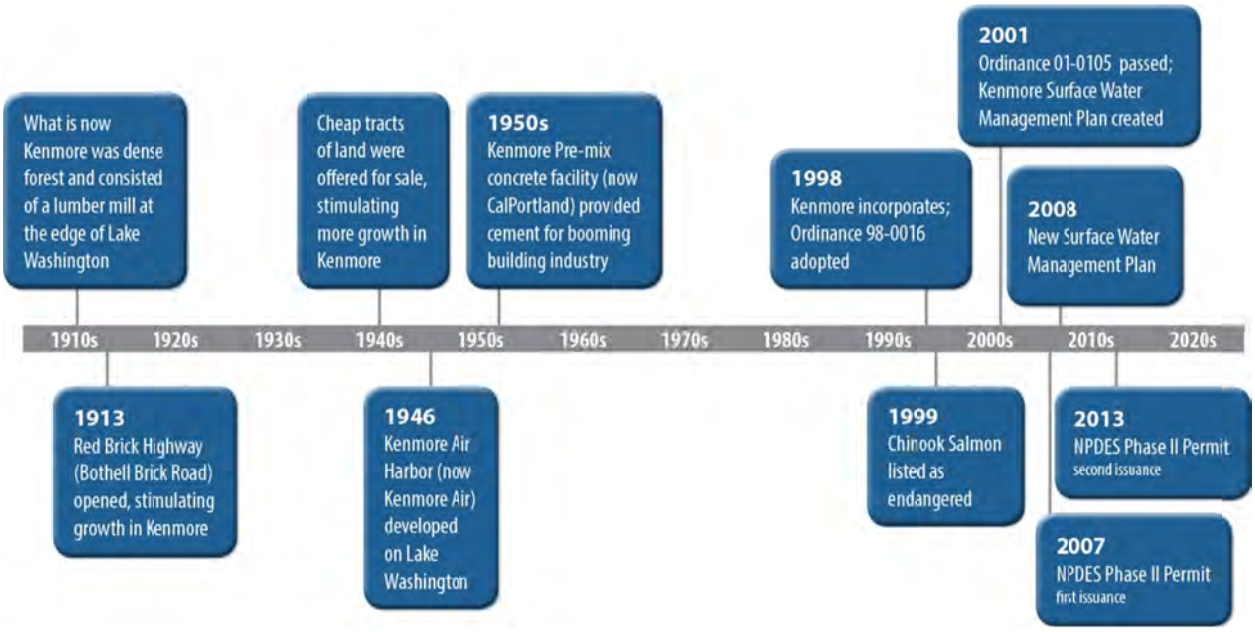
1.1 Kenmore Then and Now

Kenmore is located on the north end of Lake Washington and is surrounded by the Cities of Lake Forest Park, Bothell, Kirkland, Brier, and Lynnwood and Snohomish County (Figure 1-1).

Figure 1-1. Kenmore location

The history of land use, development, and stormwater regulations in Kenmore (Figure 1-2) and surrounding areas is important in the context of current and potential future stormwater planning.

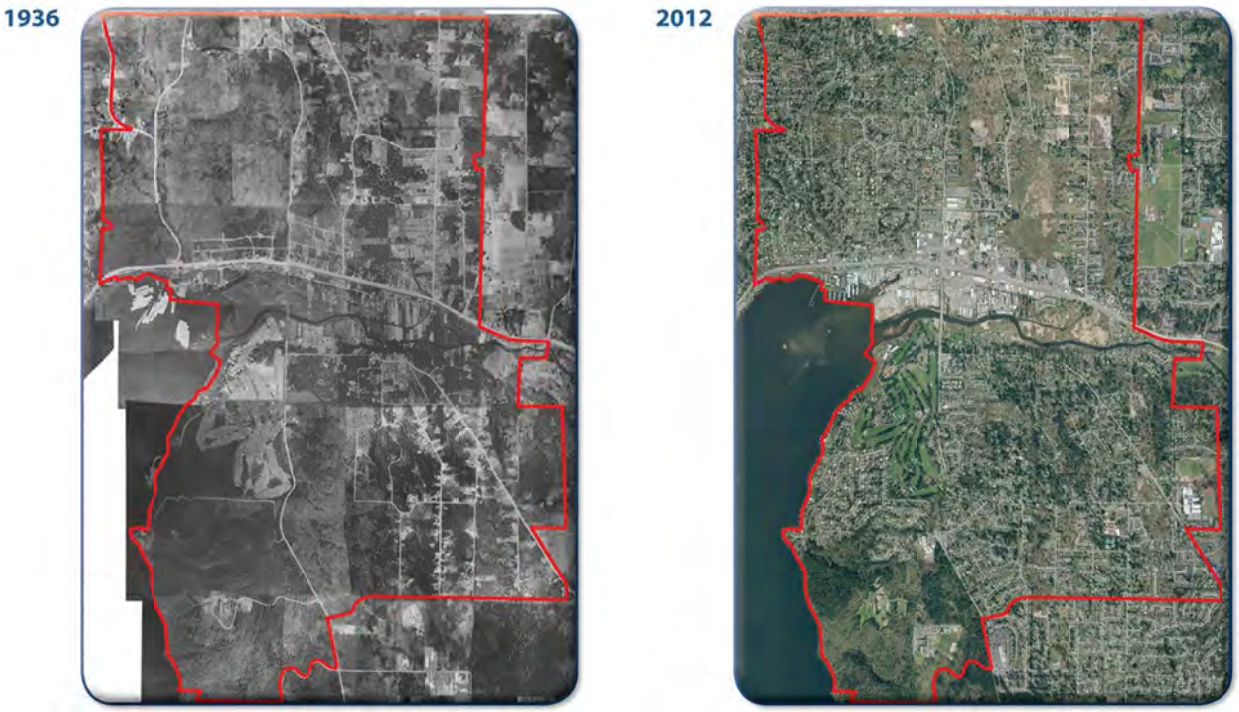
Figure 1-2. History of Kenmore development and surface water management



Kenmore's current population is over 21,000 (Washington State Office of Financial Management 2014), and the City is largely residential outside of the State Route (SR) 522 Commercial Business District. In the early 1900s, the area was densely forested and did not begin to develop until after the 1930s (based on a review of aerial photographs). A selective review of housing ages throughout Kenmore indicates that much of the development occurred in the 1950s through 1970s and started to taper off in the 1980s. Infill areas of new development appear to have started in the 1990s and are still occurring today. Select aerial photos (Figure 1-3) show general development in Kenmore since 1936 (the earliest aerial photograph available).

The City of Kenmore incorporated in 1998 from what was previously unincorporated King County (County). Following incorporation, the City adopted Ordinance 98-0016, which created a stormwater utility and stormwater utility fund for which rates are collected. The ordinance also adopted Chapters 9.04, 9.08, and 9.12 of the King County Code, which described the County's surface water management program at the time and effectively became the City's surface water management program. In 2001, through the passing of Ordinance 01-0105, the City adopted the Kenmore Stormwater Management Plan (SWMP). In 2008, a new SWMP was developed to: 1) address new regulatory requirements under the NPDES Phase II MS4 permit, for which Kenmore became a permit holder; 2) identify capital facility needs; and 3) recommend funding options for ongoing surface water management needs (Otak 2008). The 2008 SWMP is comprised of a series of technical memoranda that documented strategies for 2007-2012 NPDES Phase II permit compliance, City stormwater assets management, capital improvement projects (CIPs) and implementation schedules, and staffing needs and stormwater rate increases necessary for permit compliance.

Figure 1-3. Aerial photographs from 1936 and 2012 depicting land use changes in Kenmore



1.2 Need for an Updated Plan

There are a number of reasons for updating this Plan in 2014, including:

- Coordination with the City's 2014 Comprehensive Plan Update,
- Compliance with the second issuance of the NPDES Phase II MS4 Permit (effective August 2013), and
- Need for updated CIPs.

Figure 1-4 shows the planning framework into which the Surface Water Master Plan fits.

Figure 1-4. Surface water planning framework

1.2.1 Kenmore Comprehensive Plan

The City developed a Comprehensive Plan in 2001, which included a Surface Water Element and Capital Facilities Element (includes the Surface Water Capital Improvement Program) (City of Kenmore 2001). In 2014, City Council approved updates to the Surface Water and Capital Facilities Elements. The Surface Water Element update incorporated NPDES requirements that had emerged during the City's three NPDES Permit implementations since 2001. The Capital Facilities Element updated the Surface Water Capital

Improvement Program list, which had become outdated. The Surface Water Master Plan must be consistent with the Comprehensive Plan, which must also be consistent with:

- The Washington State Growth Management Act (GMA) (Chapter 36.70A Revised Code of Washington [RCW]),
- Puget Sound Regional Council's Vision 2040 (Puget Sound Regional Council 2009), and
- King County Countywide Planning Policies (King County 2012).

1.2.1.1 Washington State GMA

The GMA requires jurisdictions within urban growth areas, such as Kenmore, to conduct comprehensive city planning and to develop policies and regulations that protect the functions and values of critical areas.

1.2.1.2 Puget Sound Regional Council's Vision 2040

The Puget Sound Regional Council's Vision 2040 is a multi-county planning and regional growth strategy created to accommodate the 5 million people expected to live in our region by 2040.

> "…envision a significant share of the region's growth being accommodated in already urbanized areas, with the growth occurring in an environmentally sensitive manner. VISION 2040 also encourages the efficient use of urban land, maintaining natural hydrological functions and, where feasible, restoring them to a more natural state. VISION2040 promotes a sustainable approach, such that these goals are not seen as mutually exclusive."

1.2.1.3 2012 King County Countywide Planning Policies

King County first adopted Countywide Planning Policies in 1992 and updated the policies in 2012 to address changes in the GMA and reflect regional direction established in Puget Sound Regional Council's Vision 2040. As part of the 2012 Countywide Planning Policies, the County articulated a Vision for King County 2030. One ideal of that Vision is:

> Protected Critical Areas. Effective stewardship of the environment has preserved and protected the critical areas in the County, including wetlands, aquifer recharge areas, and fish and wildlife conservation areas. These critical areas continue to provide beneficial functions and values for reducing flooding, protecting water quality, supporting biodiversity, and enriching our quality of life for future generations as the region's population continues to grow.

Countywide Planning Policies are organized by topic. The Environment (EN) section's overarching goal: "The quality of the natural environment in King County is restored and protected for future generations." Several of the policies that support that goal apply to surface water and stormwater management. These policies (as stated in the 2012 Countywide Planning Policies) include:

- EN-2: Encourage low impact development (LID) approaches for managing stormwater, protecting water quality, minimizing flooding and erosion, protecting habitat, and reducing greenhouse gas emissions.
- EN-6: Coordinate approaches and standards for defining and protecting critical areas especially where such areas and impacts to them cross jurisdictional boundaries.

What is LID?

LID or Low Impact Development is a stormwater planning and best management practice technique that is designed to mimic natural hydrologic processes. Low impact development techniques often focus on preserving native vegetation and soils and utilizing infiltrative stormwater management practices.

- EN-7: Encourage basin-wide approaches to wetland protection, emphasizing preservation and enhancement of the highest quality wetlands and wetland systems.
- EN-8: Develop an integrated and comprehensive approach to managing fish and wildlife habitat conservation, especially protecting endangered, threatened, and sensitive species.
- EN-9: Implement salmon habitat protection and restoration priorities in approved Water Resource Inventory Area plans.
- EN-10: Coordinate and fund flood hazard management efforts through the King County Flood Control District.
- EN-11: Work cooperatively to meet regulatory standards for floodplain development as these standards are updated for consistency with relevant federal requirements including those related to the Endangered Species Act (ESA).
- EN-13: Collaborate with the Puget Sound Partnership to implement the Puget Sound Action Agenda and to coordinate land use and transportation plans and actions for the benefit of Puget Sound and its watersheds.
- EN-14: Manage natural drainage systems to improve water quality and habitat functions, minimize erosion and sedimentation, protect public health, reduce flood risks, and moderate peak storm water runoff rates. Work cooperatively among local, regional, state, national and tribal jurisdictions to establish, monitor and enforce consistent standards for managing streams and wetlands throughout drainage basins.
- EN-15: Establish a multi-jurisdictional approach for funding and monitoring water quality, quantity, biological conditions, and outcome measures and for improving the efficiency and effectiveness of monitoring efforts.

1.2.2 NPDES Phase II Permit

The primary changes made in the City's third issuance of the NPDES Phase II permit (2013) include the following which could affect Kenmore's SWMP:

- No minimum area threshold for controlling runoff from new development, redevelopment, and construction sites. The previous permit had a 1-acre threshold.
- LID principles and Best Management Practices (BMPs) are required and must be incorporated into local development code, rules, standards, and other enforceable documents. LID was encouraged, but not required in the previous permit cycle.
- All catch basins and inlets owned by the permittee must be inspected once every 2 years. The previous permit required 1 inspection before the end of the permit cycle.
- Water quality monitoring is now required by Phase II permittees (either through payment to a regional water quality monitoring fund or through individual efforts by the permittee). Water quality monitoring was not previously required.
- On-site stormwater management requirements include a LID Performance Standard that requires stormwater discharges to match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 8 percent of the 2-year peak flow to 50 percent of the 2-year peak flow.

1.2.3 New Capital Projects

The capital projects identified in Kenmore's 2008 SWMP have been constructed, are on the books for construction, or are no longer relevant. At the same time, new issues have arisen and grant funding has become increasingly available for identified LID projects. Now is the time for a fresh look at the stormwater capital improvement program.

1.3 Surface Water Goals

Kenmore's primary goal for surface water management is to:

> Develop, maintain, manage and improve a surface water system that serves the community, enhances the quality of life, and protects the environment (Surface Water Element of 2014 Comprehensive Plan).

This is generally achieved through projects and programs that are designed to maintain, repair, and replace existing stormwater infrastructure; prevent and minimize flooding; prevent and minimize water quality issues; and preserve or improve aquatic habitat. The NPDES Phase II permit requires many elements that also support these goals. The Permit and other regulatory requirements are discussed in Section 2.

Kenmore's City vision is shown below (with surface water management-related elements in blue italics) (City of Kenmore 2000).

> As we look into the future, 20 years from now, we see Kenmore as a place that residents, businesses, and visitors find special with welcoming, courteous people, offering a high quality of life as a place to live, raise children, shop, work, recreate, and socialize. In 2020, we see Kenmore as…
>
> - A community that is family friendly with a small town feeling that recognizes its history, and is open to and values diversity.
> - A community that fosters a sense of belonging and pride, makes use of the vast skills of its citizens, and promotes volunteerism.
> - A community that has preserved the character of its single family residential neighborhoods, which offers a range of housing types and prices to ensure an adequate choice of attractive living accommodations, and promotes compatible housing.
> - A community that actively protects natural and environmentally sensitive areas, significant open space, and trees.
> - A community with an attractive, vital, pedestrian-friendly city center offering commercial, civic, cultural and park spaces, integrated with higher density housing.
> - A community with clear design standards creating attractive, functional, and enduring buildings and places.
> - A community that manages its traffic well, and is united by a safe and effective system of streets, transit routes, sidewalks, and trails, linking significant regional and local destinations.
> - A community that supports and encourages quality schools, diverse and continuing education opportunities.
> - A community with a network of parks, trails, open spaces, and recreational facilities providing for passive and active recreation, and waterfront access.
> - A community with clear public priorities that efficiently and effectively utilizes its public resources.
> - A community with an economic base that provides for the needs of its citizens and provides quality employment opportunities.
> - A community that is attentive to, and seeks to provide for, the health, safety, and welfare of all its citizens.
> - A community that is a good partner with citizens and governments throughout the region.
> - A community with an informed citizenry working with an open, responsive government that seeks out and integrates public input.

To achieve this vision, responsible commitments in planning and resources will be made. We share and support this vision for Kenmore.

In addition, City Council Goal #11 shown below is directly related to surface water management.

> City Council Goal #11: To address watershed issues affecting the City.

This Plan aims to be consistent and supportive of the City's vision and goals.

1.4 Achievements since Last Plan

Kenmore has made great strides in surface water management since the last Plan update in 2008. A full-time Surface Water Manager was hired in 2009 and a full-time Surface Water Technician was hired in 2012. These positions have allowed the City to effectively address the requirements of the NPDES Phase II permit, develop documents and tools to make program implementation easier, and complete several CIPs that were identified in the previous plan. Specific accomplishments include:

- Adoption of the 2009 King County Surface Water Design Manual (KCSWDM) (King County 2009).
- Updated Kenmore water quality municipal codes to comply with Phase II permit requirements.
- Mapping of the surface water and stormwater system in geographic information system (GIS) and making those maps publicly available online.
- Development of a stormwater pollution prevention manual.
- Participation in a stormwater attitudes survey in conjunction with neighboring communities in 2009 and 2012.
- Development of an O&M policies and practices manual.
- Development of an illicit discharge detection and elimination (IDDE) manual.
- Completion of a LID barriers summary to identify potential limitations of using LID.
- Completion of outfall reconnaissance surveys in Swamp Creek, Sammamish River, and Tributary 0057 evaluating potential for illicit discharges.
- Completion of on-going water quality measurements and evaluation in support of the Swamp Creek total maximum daily load (TMDL).
- Annual inspections of public and private stormwater treatment facilities.
- Annual inspections of public stormwater conveyance system.

1.4.1 Projects Constructed

The surface water-related projects below were either constructed or are in the process of being constructed.

- SR 522 Drainage Improvements (SR 522 Corridor Improvement Project)
- NE 181st Street Box Culvert (Tributary 0056)
- NE 175th Street Box Culvert (Tributary 0057)
- Juanita Drive NE Ditch Improvements
- Swamp Creek Property Acquisitions for Open Space
- NE 192nd Street Box Culvert (Little Swamp Creek – Scheduled 2015/2016)

1.5 Surface Water Staffing and Responsibilities

A simplified City of Kenmore organizational chart is shown in Figure 1-5, identifying where surface water management functions reside within the City's structure. Currently, the City has 2 full-time, dedicated surface water management staff including a Surface Water Manager and a Surface Water Technician. A temporary summer position is hired each year to support surface water inspection and outreach activities. Additionally,

City staff in other departments also support surface water management through development review and other activities described in section 1.6.1. O&M activities are currently implemented through Interlocal Agreements with King County and the neighboring City of Lake Forest Park as well as with private contractors.

Figure 1-5. City of Kenmore organizational chart

1.5.1 Responsibilities

Surface water functions include the following types of responsibilities:

- **Development review and permitting** – New development and redevelopment activities within the City require stormwater site plans showing how and where stormwater from the site will be treated and where it will discharge to the City's system (if applicable).
- **Water quality/NPDES compliance** – As a permittee, the City must comply with the NPDES Phase II MS4 Permit and relevant TMDLs. The permit is all encompassing and compliance requires a multi-faceted program and approach to surface water management.
- **Identification and implementation of capital projects** – Surface water related projects (e.g., stormwater infrastructure repair, culvert replacements, and stormwater retrofit) are the types of capital projects recommended by Surface Water Staff. Public Works engineers typically design or manage the design and construction of the projects once they are included in the Capital Improvement Program.

- **Response to complaints –** Drainage complaints ranging from flooding to water quality and ditch or hillslope erosion are received and addressed by Surface Water staff.
- **Education and outreach –** Individual choices in everyday life can greatly affect water quality, habitat, and flooding. Surface water education and outreach is important to the goal of preventing water quality issues, flooding, and/or habitat impacts. Education and outreach is also required by the NPDES Phase II MS4 Permit. The City participates in regional programs, pooling resources to accomplish societal change.
- **Regional forums and participation –** Surface Water staff participate in a variety of regional forums for the purpose of sharing information and resources and being part of the discussion regarding regional issues that affect Kenmore.

2. Surface Water Trends, Challenges, and Opportunities

The management of surface water and stormwater runoff can be challenging, especially for a city such as Kenmore that is geographically situated at the bottom of large upstream drainage areas that extend beyond the City limits. Unlike other public utilities, the functionality of stormwater infrastructure and the characteristics of runoff can be significantly affected by the actions of the public and individuals. Likewise, the runoff itself can impact property and aquatic habitat. These and other challenges are discussed in this section.

2.1 History — Jurisdictional and Surface Water Management

Stormwater regulations have evolved over the last 2 decades as more research has been conducted on the effects of stormwater runoff on water and natural resources. The current regulations continue to require greater flow controls and water quality treatment than in the past – generally prior to 1990 – and focus on impacts other than just flood control. Additionally, different types of stormwater BMPs are being implemented on the regional and national scales, and there has been a shift toward "greener" solutions (e.g., LID).

An example of the shift toward greater flow control is shown in Table 2-1, which compares stormwater facility sizes needed for the same development under different versions of the Washington State Department of Ecology (Ecology) Stormwater Management Manual for Western Washington (SWMMWW).

How does the Ecology SWMMWW differ from NPDES?

NPDES lays the groundwork for the requirements – what the permittee (e.g., Kenmore) has to do to comply. The permit references the Ecology manual (the current permit references Ecology's 2012 SWMMWW) that provides standards on how to meet the requirements.

Table 2-1. Evolution of flow control standards and facility sizes based on previous and current Ecology manuals

SWMMWW Year	Relative Facility Size Footprint*	Description
Pre-1992		Prior to 1992, no flow control was necessary.
1992 (Ecology 1992)		The 1992 manual required that peak flows for certain size events be matched.
2001 (Ecology 2001)		In 2001, Ecology added flow duration requirements to matching peak events, resulting in larger stormwater facility sizes.
2012 (Ecology 2014)		The 2012, Ecology required even greater flow control – particularly with regard to providing on-site stormwater flow control that matches between 8 percent and 50 percent of the 2-year flow event. This standard requires implementation of LID.

* For illustrative purposes, the footprint of a traditional stormwater detention facility was assumed.

2.2 Current Issues

Since incorporation in 1998, Kenmore's primary surface water issue has been flooding associated with Swamp Creek. Other surface water issues include the inheritance of stormwater facilities from King County during incorporation that are undersized or require significant maintenance, and the lack of stormwater treatment (water quality or flow control) in many parts of the City that were developed ahead of current regulations. As infill development occurs within the City, and also in upstream jurisdictions, additional surface water and stormwater conveyance and capacity issues have come to light.

2.2.1 Swamp Creek Flooding

Swamp Creek has been studied extensively over the years in an attempt to reduce flooding. Numerous actions have also been taken by King County and the City of Kenmore to reduce flood-related impacts. Figure 2-1 shows the history of actions taken and studies conducted at Swamp Creek since the 1950s. A description of current conditions in Swamp Creek is provided in Section 4 and Appendix A.

Figure 2-1. Timeline of actions and studies related to Swamp Creek

2.2.2 Inherited King County Facilities

Upon incorporation in 1998, Kenmore assumed responsibility for stormwater facilities previously constructed or maintained by King County. These facilities were sized according to the standards in place at the time of construction, and many are currently undersized. Additionally, several sediment management facilities were installed and, in many cases, these facilities must be maintained on a more frequent basis than was originally planned. The Wallace Park sedimentation pond is one example.

2.2.3 Existing Development

Much of Kenmore was developed prior to 1990 when regional stormwater regulations began to require stormwater facilities to retain or detain water to lower flow rates to the downstream conveyance and eventually control flow durations and provide water quality treatment as described above. The areas of the City that are currently lacking treatment are primarily on the west side of the City. Recent transportation projects along SR 522 and major Kenmore arterials have implemented modern stormwater treatment in those locations. As older neighborhoods redevelop, stormwater retrofit will improve conditions.

Why will stormwater retrofit occur as older neighborhoods redevelop?

New stormwater regulations require developers and property owners to implement stormwater treatment for redeveloped parcels. This is a shift from past requirements that only focused on stormwater treatment for newly developed parcels.

2.2.4 Upstream Jurisdictions

Kenmore is in the unfortunate geographic position of being downstream of large watersheds for which it has no control. The actions and inactions of upstream jurisdictions have created and can create impacts in the City of Kenmore. Swamp Creek is the primary example. The Cities of Lynnwood, Brier, Everett, Bothell, Mountlake Terrace and unincorporated areas of Snohomish County contribute runoff to Swamp Creek, which discharges to the Sammamish River in the City of Kenmore. Water and sediment transported from upstream reaches is slowed through the natural shift in gradient near Wetland #3 (located on the east side of 73rd Avenue NE) in Kenmore. The City has participated in regional forums with upstream jurisdictions to collectively manage stormwater runoff to reduce impacts for all stakeholders. However, there is more to be done.

2.3 Future Issues and Opportunities

There are a number of potential future surface water- and stormwater-related issues that the City will need to manage in the coming years, including compliance with changing permit conditions, implementation of new stormwater standards, and different maintenance needs for new facilities. Additionally, influences beyond the City's control (e.g., climate change and invasive species) may also affect surface water and stormwater management approaches.

On the positive side, Kenmore has the opportunity for incremental improvement in water quality, aquatic habitat, and flood conditions as portions of the City are redeveloped and more stringent stormwater controls are implemented according to current regulations. Additionally, the City may wish to start retrofitting its properties and roads to include new or updated stormwater facilities as grant funding is increasingly available for stormwater retrofit, particularly if LID techniques are included in the design.

2.3.1 Regulatory Changes

LID is soon to become the commonly used and preferred BMP for managing stormwater impacts. The NPDES Phase II MS4 Permit requires that permittees (e.g., Kenmore) require LID by the end of 2016. For cities like Kenmore that are largely built out already, the LID BMPs most likely to be incorporated are those that infiltrate into the ground (e.g., pervious pavement and bioretention facilities). These types of LID BMPs require maintenance personnel and different maintenance frequencies, tools, and skill sets. These LID solutions also provide ancillary benefits beyond stormwater treatment, including aesthetic, cooling, and air quality benefits. Implementing LID will require significant changes to established standards and will change how developments, roads, parcels and buildings look and function. However, Kenmore's surface water and topographic characteristics will provide challenges to implementing LID due to the abundance of shallow groundwater, steep slopes, and till soils throughout the City.

2.3.2 Invasive Species

Invasive species have wreaked havoc on native populations of fish, animals, and vegetation for centuries. The new threat in our region is the New Zealand Mud Snail. Although this snail has not been identified in Kenmore's streams, it is present in other streams draining to Lake Washington, including McAleer Creek in Lake Forest Park. This species is of concern because it can quickly dominate river and lakebed habitats, thus outcompeting native aquatic snails and insects, leading to implications for fish and other species that rely on these insect for their food source. Widespread presence of the New Zealand Mudsnail is almost inevitable. However, regional efforts are being made to educate biologists, contractors, and maintenance staff about methods to avoid proliferation. Decontamination of equipment when moving between streams is the best method to prevent spread of the species, but it does add time and costs to projects that involve in-water work.

2.3.3 Climate Change

Researchers at the University of Washington and elsewhere predict climate change could increase the frequency and intensity of precipitation events in the Pacific Northwest (Snover, et al. 2013), with heavy rainfall events becoming more severe, leading to increased periods of flooding in low-land areas. The City of Kenmore's downtown core is located in a low-lying area and already experiences flooding problems, so the impacts of heavier rain events could be worse than other areas of Puget Sound. Stormwater infrastructure designed to convey a certain size storm event may not be adequate if more frequent, higher-intensity, or longer duration storms become commonplace. Already unstable slopes could also experience more frequent slope failures due to prolonged saturated conditions. As the City upgrades its piped infrastructure and replaces culverts, there are opportunities to upsize systems to accommodate predicted future flow increases.

2.4 Regulatory Context

There are a variety of local, state, and federal regulations and permits pertaining to surface water and stormwater with which Kenmore must comply. Table 2-2 provides a summary of applicable regulations and permits. Regulations and permits that have been subject to recent revisions or planned future changes are highlighted in bold text and described in more detail below.

Table 2-2. Regulations and permits applicable to the City of Kenmore

Entity	Law	Program	Intent	Relevance to Kenmore Surface Water Management
Federal or Tribal	Clean Water Act (CWA)	NPDES MS4	Eliminate discharge of pollutants to nation's water and achieve water quality that supports beneficial uses (e.g., fishing and swimming)	NPDES permit delegates Kenmore responsible for water quality leaving the City's system. New NPDES Permit in effect as of August 1, 2013, with phased implementation schedule for new requirements.
		Other NPDES Permits (e.g., Industrial, Sand and Gravel, Boatyard, etc.)	Reduce discharge of pollutants to nation's water and hold permittees accountable for meeting water quality standards.	Requires entities in Kenmore that conduct certain pollutant-generating activities to obtain a permit and implement a plan to eliminate or minimize discharge of pollutants to Kenmore's receiving waters.
		Water quality standards (303(d) list)	Protect human health and the environment using research-based numeric criteria for acceptable values of constituents.	Requires development of a TMDL for each pollutant in water bodies at levels greater than the water quality standards. Kenmore is party to a TMDL for fecal coliform bacteria in Swamp Creek.
		Section 401 and 404	Limits filling and dredging activities in nation's waters.	Requires a permit for activities that produce discharge or dredge fill material to or from waters of the United States. Any in-water work, such as culvert replacements or stream restoration activities require Section 401 and 404 permits from the US Army Corps of Engineers (USACE).
	Tribal Agreements and Related Case Law	"Culvert Case" (March 29, 2013) – US District Court rules that the State of Washington must replace culverts that impede fish passage to their spawning grounds.	Protect fish populations in traditional fishing grounds of Indian Tribes.	The Muckleshoot Indian Tribe is party to the State Environmental Policy Act (SEPA) review of development proposals and programs. The March 29, 2013, US District Court ruling could lead to future implications for counties and cities whose culverts impede fish passage.
	National Flood Insurance Act, Flood Disaster Protection Act	National Flood Insurance Program (NFIP)	Reduce property damage and public safety threats from flooding.	City enacts restrictions/requirements on development in floodplain and residents get reduced flood insurance rates in return. The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) issued a Biological Opinion requiring changes to the NFIP to comply with the ESA.
	ESA	Chinook salmon listed as a threatened species	Prevent further decline of Chinook salmon populations through prohibition on "take" of the fish or their habitat.	City participates in Water Resources Inventory Area (WRIA) 8 Salmon Conservation Planning. Chinook salmon are present in Lake Washington.

Entity	Law	Program	Intent	Relevance to Kenmore Surface Water Management
State	SEPA (Chapter 43.21C RCW)	City of Kenmore reviews proposals and issues SEPA determinations	Identify and require mitigation for the environmental impacts or proposals and programs.	SEPA is used to address impacts that are not covered in other City requirements.
	Shoreline Management Act (SMA) (Chapter 90.58 RCW)	Kenmore Shoreline Master Program	Protect use and functions (e.g., economic, ecological, and aesthetic) of shoreline areas. Implemented by Kenmore Municipal Code (KMC) Title 16.	Kenmore's Shoreline Master Program was updated and made effective in 2012. The shoreline sub-element in the City's Comprehensive Plan addresses shoreline policies, some of which are related to surface water management.
	Hydraulic Code (Chapter 22-110 Washington Administrative Code [WAC])	WAC	Set requirements for placement of culverts and other hydraulic devices that may impact fish use.	Projects proposing work within the wetted perimeter of a stream must obtain a Washington Department of Fish and Wildlife (WDFW) Hydraulic Project Approval (HPA), including culvert replacements and stream restoration work.
	GMA	City Comprehensive Plan, City zoning, and critical areas regulations	Regulate land use to meet growth targets while providing necessary services and protecting sensitive environmental resources.	City of Kenmore Comprehensive Plan and supporting municipal code sections address land use and growth management.

2.4.1 Federal Clean Water Act (CWA) - NPDES Phase II Permit

The federal CWA is implemented through a variety of regulations and programs. The most significant of these for the City is the NPDES MS4 Permit. Under Phase II of this program, the City must apply for a permit from the US Environmental Protection Agency (EPA) (or, in this case the State of Washington, which has been authorized to act as the EPA's agent) to discharge stormwater from streets, public facilities, and drainage network into waters of the United States.

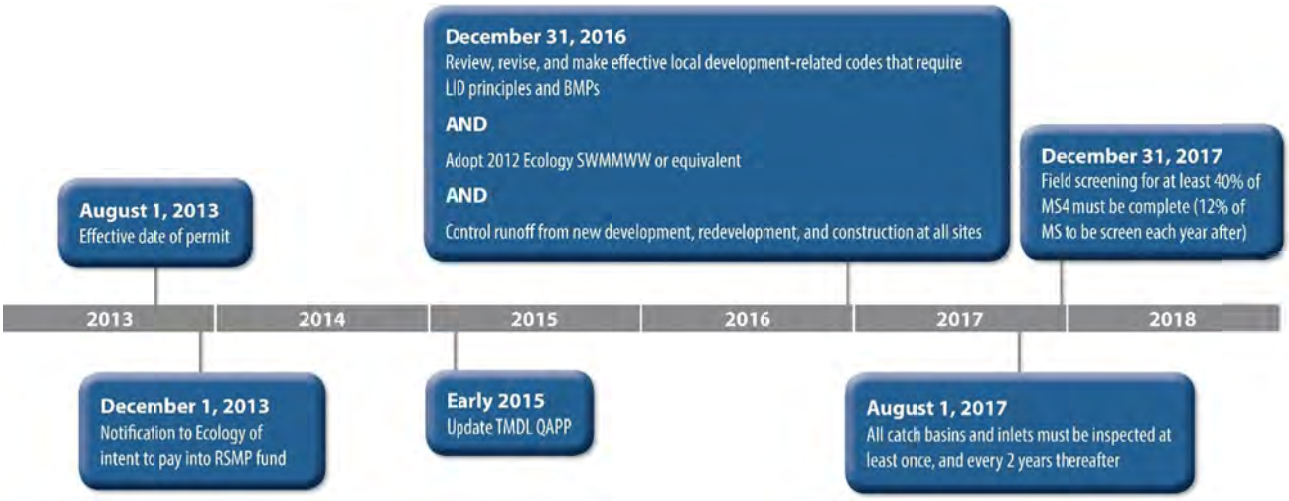
The City was issued its first NPDES Permit in 2007, which was effective from February 16, 2007, until February 15, 2012. The City's second permit was issued in 2012 and was effective from September 1, 2012, through July 31, 2013. The City's third, and current, permit was issued in 2012 and is effective from August 1, 2013, through July 31, 2018. The City's NPDES Permit authorizes the discharge of stormwater into surface and ground waters of the state, subject to several limitations and conditions designed to protect and improve water quality. The core of the permit revolves around the development and implementation of the Stormwater Management Program (SWMP) and compliance with Total Maximum Daily Load (TMDL) requirements. In each permit issuance, the SWMP has consisted of the same five components:

- Public Education and Outreach
- Public Involvement and Participation
- Illicit Discharge Detection and Elimination (IDDE)
- Controlling Runoff from New Development, Redevelopment, and Construction Sites
- Municipal Operations and Maintenance (O&M)

SWMP implementation deadlines are staggered throughout the permit cycle to give permit holders time to develop and implement new or updated programs. Each permit issuance may see additional requirements added to existing programs or more stringent standards required (e.g., more frequent inspections or more stringent flow control standards for stormwater facilities).

There were a number of substantive new requirements in the 2013-2018 permit that are to be phased in over the 5-year permit cycle (Figure 2-2).

Figure 2-2. NPDES Phase II permit timeline of new requirements



The primary changes are:

- **Monitoring** – The Phase II permit includes monitoring and assessment requirements that allow permittees to conduct individual monitoring or pay into a Regional Stormwater Management Program (RSMP) fund that: 1) collects status and trends monitoring data, 2) conducts stormwater program effectiveness studies, and 3) performs source identification and diagnostic monitoring. Kenmore has opted to pay into the regional monitoring fund.
- **LID** – The Phase II permit requires permittees to adopt LID site-scale standards and update development-related codes in addition to adopting Ecology's 2012 SWMMWW or an equivalent manual which emphasizes the incorporation of LID standards and has a new LID performance standard for flow control.
- **O&M** – The Phase II permit has new inspection and maintenance frequencies, increasing catch basin inspections from once per permit cycle to every 2 years.
- **Threshold for sites requiring flow control** – The Phase II permit changes the threshold for controlling runoff from new development, redevelopment, and construction from 1 acre to all sites regardless of size.
- **IDDE** –The Phase II permit requires 40 percent of the MS4 to be field screened by December 31, 2017, and 12 percent of the MS4 to be screened each year thereafter.

These changes will mean a shift in how the City permits development projects, and inspects and maintains the stormwater system. Because the changes are required by regionally based permits, most cities and counties are making similar changes to their programs and collectively going through the process. Kenmore is active in regional stormwater groups and continued participation and collaboration will inform Kenmore's program adaptations.

2.4.2 Federal CWA – Total Maximum Daily Load (TMDL)

Under section 303(d) of the CWA, Washington State is required to develop lists of impaired water bodies (waters that are too polluted or otherwise degraded to meet water quality standards). Washington State performs a water quality assessment of all surface waters that have available data and categorizes them based upon the status of their water quality (ranging from "Category 1 - meets water quality standards" to "Category 5 - polluted"). Those water bodies whose beneficial uses (e.g., drinking, recreation, aquatic habitat, and industrial use) are impaired by pollutants are placed into the polluted category. These Category 5 polluted water bodies require a water cleanup plan, such as a TMDL, or other approved water quality improvement project. A TMDL identifies how much pollution is allowed in a water body so that the beneficial uses of the water are not impaired and allocates that amount among various sources.

The City currently has one TMDL for fecal coliform bacteria pollution in Swamp Creek. Ecology established the TMDL in 2006 and approved the City's Quality Assurance Project Plan (QAPP) for Swamp Creek Fecal Coliform Bacteria TMDL in 2008 (City of Kenmore 2008). The TMDL is primarily administered through its NPDES municipal stormwater permit. The City's QAPP was updated in February 2015.

2.4.3 Federal Endangered Species Act (ESA) – Chinook Salmon

Puget Sound Chinook salmon and bull trout were listed as threatened species under the ESA in 1999. To prevent further decline of the species and to encourage restoration, the ESA prohibits "take" of the species or its habitat. Those agencies or individuals found to be creating take of the species are subject to third-party lawsuits. The outcome of such lawsuits could have severe economic consequences for the region, such as curtailing of development or requirements for specific, potentially costly habitat restoration activities.

The listing of Puget Sound Chinook salmon required National Oceanic Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) to develop a recovery plan for the species. NMFS worked with the Shared Strategy for Puget Sound and other local partners to develop the Puget Sound Chinook Recovery

Plan, which was presented in 2005 and adopted in 2007. In 2008, a new state agency called the Puget Sound Partnership (PSP) became the responsible agency for implementing the plan. NMFS, PSP, as well as federal, state, tribal and local partners work together to implement the recovery plan.

Kenmore participates regionally in Water Resource Inventory Area (WRIA) 8 Salmon Recovery efforts and implements actions in the WRIA 8 Chinook Salmon Conservation Plan, as well as other guidelines such as the Regional Road Maintenance ESA Program Guidelines for road maintenance activities that contribute to conservation of Chinook salmon, bull trout and other aquatic species listed under the ESA.

2.4.4 Tribal Agreements - Culvert Case

In 1974, US District Court Judge George Boldt ruled that treaties signed in the 1850s guaranteed tribes the right to take fish "in common with" other residents of the area. The decision became known as the "Boldt" decision, and Boldt further held that Washington State had a duty to make sure fish were available to catch and that it had a duty to protect the environment. In 2007, US District Court Judge Ricardo Martinez ruled that the State was violating treaty rights by operating culverts that hinder fish passage.

In March 2013, the US District Court ruled that Washington State is not fulfilling obligations to remove barriers that impede fish movement. This has become known as the "Culvert Case," and requires the State to accelerate their program to upgrade and replace state-owned culverts. The ruling is under appeal, but, nonetheless, many jurisdictions around the State are assessing their culverts in anticipation of future rulings. Kenmore has assessed some of its culverts for fish passage and may wish to prioritize culverts specifically for fish passage modifications in the future to address potential future rulings.

2.4.5 National Flood Insurance Program (NFIP)

The NFIP was created in 1968 as a way to offer flood damage assistance in exchange for regulated development within the Federal Emergency Management Agency (FEMA) mapped 100-year floodplains. This program focuses on public health, safety, and welfare by protecting all new and substantially improved buildings. In exchange for a city regulating development in floodplains, property owners within that city obtain the ability to purchase flood insurance at substantially reduced rates.

The NFIP was revised based on findings from a NMFS study that showed how floodplain development can negatively affect aquatic habitat. NMFS issued a BO that required changes to the NFIP in order to meet the requirements of the ESA as well as protect buildings from flood damage. Kenmore complies with the NFIP by conducting a review of floodplain impacts on a case-by-case basis for all development within the City's 100-year floodplains, which include Swamp Creek, Little Swamp Creek and Sammamish River.

2.4.6 Other Related Regulations

In addition to directly related regulations (e.g., NPDES and CWA), the state Growth Management Act (GMA) (Chapter 36.70A RCW) and the state Shoreline Management Act (SMA) have significant overlap with surface water and SWMPs. The GMA requires jurisdictions within urban growth areas, such as Kenmore, to conduct comprehensive city planning and develop policies and regulations that protect the functions and values of critical areas. The City of Kenmore's Comprehensive Plan, zoning regulations, and supporting municipal code sections address land use and growth management.

The SMA of 1971 requires local governments to develop shoreline management programs that protect the public interest associated with shorelines of the State while, at the same time, recognizing and protecting private property rights consistent with the public interest.

Kenmore, a waterfront city, adheres to the SMA through the City's Shoreline Master Program (updated in 2012) and KMC Title 16: Environment, which includes sections on requirements for implementation of the program. Many of the priorities require involvement and cooperation of the Surface Water Management Division, as they involve managing surface water in the context of shoreline beneficial uses. Shorelines

covered under the City's Shoreline Master Program include the entire shoreline of Lake Washington within Kenmore and the Sammamish River, Swamp Creek, and portions of Little Swamp Creek.

2.4.6.1 Critical Areas

Critical areas include:

- Wetlands
- Areas with a critical recharging effect on aquifers used for potable water
- Fish and wildlife habitat conservation areas
- Frequently flooded areas
- Geologically hazardous areas

Critical areas are, more often than not, inexplicitly linked to the built and natural surface water and stormwater systems. The City's wetlands, streams, and open spaces provide beneficial surface water functions, and stormwater regulations are designed to protect these important functions. Title 18.55 of the KMC designates and classifies the City's critical areas such that they are ecologically protected and that life and property are protected from hazards while allowing reasonable use of private property.

2.4.6.2 Development Code

Land use and activities conducted in Kenmore directly affect surface water and stormwater management through the creation of impervious surfaces and pollution-generating activities. The City's code is designed to ensure that development is carried out in locations and methods that are safe, do not negatively impact public resources, and fit within the overall context of the City's neighborhoods. The City's Comprehensive Plan outlines goals and policies related to development activities, and the municipal code outlines how the goals and policies are to be met. Surface water management is included in KMC Title 13: Utilities and Public Works, and zoning, development standards, land alterations, and permits are located in other sections of the municipal code.

2.4.6.3 Transportation Standards

Most of the City's public stormwater infrastructure is located within road right-of-way (ROW). Pollutants from roadway runoff contribute to water quality issues in the City's water bodies. Transportation design standards affect the amount and quality of stormwater runoff that is conveyed and/or treated. Non-motorized transportation planning and design also involves coordination with surface water and stormwater management, as hard surfaces such as trails and sidewalks contribute flow to the surface water system.

Kenmore adopted the 1993 King County Road Standards (King County 1993), with a few minor amendments. The standards are located in KMC Title 12: Streets and Bridges. Kenmore is currently working on a new road standards manual, which is expected to be adopted in 2015. Subsequent amendments may be required to meet LID requirements before December 31, 2016.

3. Existing Policies

Surface water and stormwater management policies and current relevance are discussed in this section. These policies provide the framework for managing the City's natural surface water systems, MS4, and privately constructed storm sewer systems. Current financial policies guiding the management of the City's surface water management service charge are also included in this section.

Surface water and stormwater management policies have been established and administered primarily through the City's Comprehensive Plan, KMC, and the City's SWMP. The Surface Water Element of the City's Comprehensive Plan provides long-range goals and policies that support the community's vision of the City's future. The KMC establishes the surface water management program and outlines policies to fund and carry out the program's mission. The SWMP describes the program components that meet NPDES municipal stormwater permit requirements.

What's the purpose of having stormwater policies?

Kenmore's stormwater policies provide the basic framework and principles from which the stormwater utility operates and functions. Policy statements are intended to provide clarity to the City's goals for surface and stormwater management. Opportunities to update goals and policies coincide with updates to the City's Comprehensive Plan.

3.1 Comprehensive Plan – Surface Water Element

The City's Comprehensive Plan contains the community's vision of the City's future and a statement of the City's long-range goals and policies. The Plan serves as the guide for City staff and the City Council in making decisions regarding ordinances, regulations, and public facility investments to ensure the overall goals and policies are furthered by those decisions. The Surface Water Element of the Comprehensive Plan (established in 2001 and updated in 2014) addresses the surface water portion of that vision and has one primary goal:

> Develop, maintain, manage and improve a surface water system that serves the community, enhances the quality of life, and protects the environment.

Two objectives relate to obtaining the Surface Water Element goal:

- **Objective SW-1**: Effectively manage the City's MS4 and private surface water systems in a manner that reduces flooding, maintains water quality, and protects the natural environment.
- **Objective SW-2**: Protect, maintain, enhance, and restore natural surface water systems.

Tables 3-1 and 3-2 provides a summary of policies that support objectives SW-1 and SW-2, respectively, as well as a description of the policies and how they are implemented. References to supporting documentation are provided where appropriate.

Table 3-1. Objective SW-1 policies and implementation

Policy	Policy and Description	How is it Implemented?
SW 1.1	Comply with the current Western Washington Phase II Municipal Stormwater Permit (NPDES and Washington Waste Discharge General Permit).	The City's Surface Water Program Manager oversees the development, implementation, tracking, and reporting of the City's NPDES Municipal Stormwater Permit. An annual report and updated SWMP Plan is submitted to Ecology annually.
SW 1.2	Implement and update as necessary the City's SWMP Plan, which describes the City's programs for public education and outreach public involvement and participation; IDDE; controlling runoff from new development, redevelopment, and construction sites; municipal O&M; and TMDL.	The City updates the SWMP Plan, as needed, to meet NPDES Municipal Stormwater Permit requirements and submits it to Ecology annually.
SW 1.3	Adopt and implement an approved Surface Water Design Manual, as needed, which is equivalent to the Ecology SWMMWW.	Upon incorporation, the City adopted the 1998 KCSWDM (King County 1998). The City's 2007 NPDES Municipal Stormwater Permit required an update to the design manual and Ordinance 10-0305 adopted the 2009 KCSWDM, which became effective January 21, 2010, satisfying Permit requirements. The City's 2013 NPDES Municipal Stormwater Permit requires an update to the current design manual by December 31, 2016, and the City will review and consider King County's 2015 manual or Ecology's 2012 manual for adoption.
SW 1.4	Where feasible, the City will make LID the preferred and commonly used approach to site development. LID is a stormwater and land use management strategy that strives to mimic pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation, and transpiration by emphasizing conservation, use of on-site natural features, site planning, and distributed stormwater management practices that are integrated into a project design.	This policy is primarily implemented through the City's Road Design and Construction Standards, Surface Water Design Standards, various KMC sections and the NPDES Municipal Stormwater Permit. These standards and regulations will see significant updates in 2015 and 2016 to meet requirements making LID the preferred and commonly used approach to site development.
SW 1.5	Implement a Capital Improvement Program that maintains and improves the MS4 in a manner that enhances and protects the City's natural environment; mitigates flooding problems; improves water quality; promotes a reliable and safe transportation network; and provides the community a safe and healthy place for living, working, and recreation.	The Surface Water Capital Improvement Program is periodically reviewed and updated through several processes, including: Capital Facilities Element updates of the Comprehensive Plan (2001 and 2014); budget updates (most recently for the 2015-2016 biennium budget); Surface Water Master Plan updates (2001, 2008, and 2015); and 6-year Capital Improvement Program updates (every 1-2 years to ensure appropriate prioritization).
SW 1.6	In an effort to protect public resources, water quality, and reduce flooding, the City manages private surface water systems by providing inspections, education, technical assistance, and, if necessary, enforcement action to private property owners within the City. The City does not operate or maintain privately owned surface water systems unless that system has been formally accepted by the City and is located within the ROW or within a tract or easement dedicated to the City for the purpose of operating and maintaining said system.	The City conducts annual inspections of privately owned and maintained surface water facilities and notifies owners of outstanding maintenance items, which must be completed by the property owner.

Policy	Policy and Description	How is it Implemented?
SW 1.7	Seek opportunities to design and implement surface water management facilities that are functional, serve as amenities, and serve multiple purposes such as those described in the Parks Element of the City of Kenmore Comprehensive Plan.	KMC Title 18: Zoning provides incentive to developers to combine stormwater tracts and recreational open space areas. Emerging LID techniques integrate site function with surface water management by utilizing BMPs such as permeable pavements and bio-filtration in landscaping.
SW 1.8	Participate in the RSMP, which includes effectiveness monitoring of SWMP activities and source identification information repository.	The City provides funds, annually, to the RSMP for effectiveness studies and source identification and diagnostic monitoring. Funds collected from multiple permit holders are combined into one regional program. By contributing funds to the RSMP, the City is in compliance with section S8 of its NPDES Municipal Stormwater Permit.

Table 3-2. Objective SW-2 policies and implementation

Policy	Policy and Description	How is it Implemented?
SW 2.1	Support shoreline management policies outlined in the Shoreline Element of the City of Kenmore Comprehensive Plan, which strive to preserve, protect, and enhance the City's abundant shoreline habitat.	Kenmore's Public Works Department and Planning and Community Development Department coordinate efforts to implement the Shoreline Element, primarily through appropriate project and permit review.
SW 2.2	Support natural environment policies outlined in the Natural Environment Element of the City of Kenmore Comprehensive Plan, which include protection of wetlands, plants and wildlife, maintaining and promoting a diversity of species and habitat, participation in WRIA 8 and using LID BMPs.	Kenmore's Public Works Department and Planning and Community Development Department coordinate efforts to implement the Shoreline Element, primarily through appropriate project and permit review.
SW 2.3	Implement critical and sensitive area regulations that protect and enhance surface waters, which may include but are not limited to buffers; setbacks; erosion and sediment control; mitigation; SEPA compliance; HPA compliance; and compliance with any other applicable local, state, and federal requirements.	The City's Development Department implements critical and sensitive area regulations through permits and code enforcement.
SW 2.4	Protect, enhance, and restore flood storage, conveyance functions, and ecological values of floodplains, wetlands, and riparian corridors through the development and implementation of CIPs, studies, and plans.	Each year, City departments construct and improve infrastructure through various CIPs. Environmental impacts, including those to surface water, are evaluated for each project and projects often improve surface water environments within their limits. Examples include recent park projects that have created or expanded wetland areas in the City. Recent transportation projects have installed stormwater treatment facilities where none previously existed and removed undersized culverts, which were replaced with fish-passable culverts.

Policy	Policy and Description	How is it Implemented?
SW 2.5	Promote and support opportunities for public involvement and participation, which may include, but are not limited to, stewardship groups, volunteer opportunities, and grant partnerships.	The City's volunteer program has expanded significantly over the last 2 years, including the creation of a dedicated volunteer coordinator position. Volunteers interested in surface water-related activities are connected with appropriate staff. Recent projects include construction of surface water informational displays, invasive species removal, and catch basin stenciling. The City also provided support for private parties seeking water quality grant funds. No formal stewardship groups have been formed in Kenmore, but City staff have communicated with interested residents and will continue to promote and support stewardship roles in the community.
SW 2.6	Promote and support opportunities for regional coordination and watershed-level management of the City's natural surface water systems. Kenmore often contains only a portion, and in some cases a very small portion, of the natural surface water systems that pass through the City. The City will actively pursue coordination with upstream jurisdictions and partners to manage these natural resources and share responsibility.	The City participates with WRIA 8 for large-scale management of the Lake Washington/Cedar/Sammamish Watershed. The City also coordinates with Swamp Creek Watershed partners for managing TMDL requirements for fecal coliform. Additionally, the City has provided support to private parties seeking water quality grant funds and has supported formation of stewardship groups.
SW 2.7	Participate in RSMP, which includes status and trends monitoring in receiving waters.	The City provides funds, annually, to the RSMP for status and trends monitoring. Funds collected from multiple permit holders are combined into one regional program. By contributing funds to the RSMP, the City is in compliance with section S8 of its NPDES Municipal Stormwater Permit.

3.2 Kenmore Municipal Code (KMC)

Ordinance 98-0016, passed in 1998, established the City's Surface Water Utility, adopted its Surface Water Management Program, and created the Stormwater Utility Fund. It adopted by reference, with slight modification, Chapters 9.04, 9.08, and 9.12 of King County Code (KCC) Title 9: Surface Water Management, along with all subsequent amendments (King County 2014). KCC Title 9 establishes surface water runoff policy, a surface water management program, water quality requirements, and groundwater protection requirements. Since that time, the City has codified its surface water management requirements within the KMC. Today, the City's Surface Water Management Program operates primarily through KMC Title 13: Utilities and Public Works that includes the following chapters, some of which are discussed below:

- KMC Chapter 13.30: General Provisions – outlines establishment of the stormwater utility.
- KMC Chapter 13.35: Surface Water Runoff Policy – outlines development policies.
- KMC Chapter 13.40: Surface Water - general policies are outlined and a utility fee structure is established.
- KMC Chapter 13.45: Water Quality – addresses water quality.
- Utility rates are adopted by resolution.

Additional chapters relevant to the stormwater program include:

- KMC Chapter 1.20: Code Enforcement
- KMC Chapter 12.50: Street Standards
- KMC Chapter 15.25: Grading
- KMC Chapter 16.00: Environment
- KMC Chapter 20.00: Development Permits
- KMC Chapter 21.00: Financial Guarantees

3.2.1 KMC Chapter 13.35: Surface Water Runoff Policy

The City Council adopted KMC Chapter 13.35 to provide comprehensive management of surface water and stormwater with thorough permit review, construction inspection, enforcement, and maintenance associated with development and redevelopment within the City. The goals: Promote public health, safety, and welfare; preserve and utilize the many values of the City's natural drainage system (e.g., open space and fish and wildlife); reduce flooding, erosion, and sedimentation; prevent and mitigate habitat loss; enhance groundwater recharge; and prevent water quality degradation.

The City Council initially adopted the 1998 King County Surface Water Design Manual (KCSWDM), which provides standards and specifications for projects within the City. The manual outlines many "core requirements" that must be addressed by applicable projects, which include: discharge location, offsite analysis, flow control, conveyance, erosion and sediment control, O&M, financial guarantees and liability, and water quality. Other "special requirements" are also considered for applicable projects, including: area-specific requirements, flood hazard areas, flood protection facilities, source control, and oil control. In 2010, the City Council adopted the 2009 KCSWDM, which has a similar structure to the 1998 version but contains updated standards, specifications and thresholds to meet State requirements at that time. By December 31, 2016, City Council will adopt a Surface Water Design Manual to meet current State requirements outlined in the 2013 Western Washington Phase II Municipal Stormwater Permit and Ecology's 2012 Stormwater Management Manual for Western Washington (SWMMWW), as amended in December 2014.

3.2.2 KMC Chapter 13.40: Surface Water

KMC Chapter 13.40 was adopted by the City Council to provide comprehensive management of surface and storm waters with basin planning, land use regulation, construction of facilities, maintenance, public education and provision of surface water and stormwater management services. The chapter also establishes a sustainable surface water fund to financially support the City's surface water and stormwater management programs.

3.2.2.1 General Policies

Basin Coordination

The majority of the City's surface water basins are shared with other cities and counties and Kenmore, located on Lake Washington, is at the low point of these watersheds. Kenmore has limited ability to manage surface water and stormwater that emanates outside of City limits. Therefore, it is the City's policy to support basin-wide efforts that would improve downstream conditions within Kenmore. These efforts may include participation and support for regional watershed groups that focus on issues such as salmon recovery, flood reduction, pollutant load reduction, and water quality improvement. Private watershed associations are supported and encouraged by the City. The City also provides support for regional regulations that reduce stormwater runoff and improves stormwater quality from development, redevelopment, and construction sites.

Public Education

Historically, there has been a general lack of public knowledge about the relationship between human actions and surface water and stormwater management. Therefore, it is the City's policy to reduce or eliminate behaviors and practices that cause or contribute to adverse surface water and stormwater impacts through public education and outreach programs and by integrating education into code enforcement. The City may implement these programs locally or participate in regional public education and outreach programs. The City's surface water and stormwater education and outreach programs target many audiences, including the general public, school age children, business owners, and developers.

Impacts of Development

Developed parcels contribute to an increase in surface water and stormwater runoff to the surface water management system. In many cases, storm and surface water runoff also contain pollutants which contaminant the surface water management system and receiving water bodies. Developed parcels have had their native soils, vegetation, and trees removed and replaced with impervious surfaces such as streets, sidewalks, buildings, driveways, and parking lots and non-native pervious areas such as lawns, pastures, and open fields. Undeveloped parcels comprised of native soils, vegetation, and trees have little to no impact on the surface water and stormwater system.

The City implements many policies to mitigate the effects of development. Engineering, planning, and construction standards and regulations are continually updated as science and technology improve. The City's surface water funding structure is also influenced by development and land use, which is discussed in more depth in the following section.

City Streets and Highways

City streets and SR 522 contribute surface water and stormwater runoff to the surface water management system. However, the City Council recognizes that much of the City's surface water management system is located and operated within street ROWs.

Capital Improvement Program

The Surface Water Management Program prepares and updates a multi-year Capital Improvement Program which encompasses all of the program's activities related to the acquisition, construction, replacement, or renovation of capital facilities or equipment. All proposed new or retrofitted facilities are subject to a consistent and thorough needs analysis and updated appropriately. The program's capital facilities are planned and financed to ensure that the benefits of the facilities and the costs for them are balanced over time.

The Capital Improvement Program is a six year, living document that undergoes review and update through various processes. The Capital Facilities Element of the Comprehensive Plan contains a long-range program list. The Surface Water Master Plan (updated approximately every 5 years) and the biennium budget (updated every 2 years) prioritize, update, and budget surface water CIPs.

3.2.2.2 Surface Water Service Charge

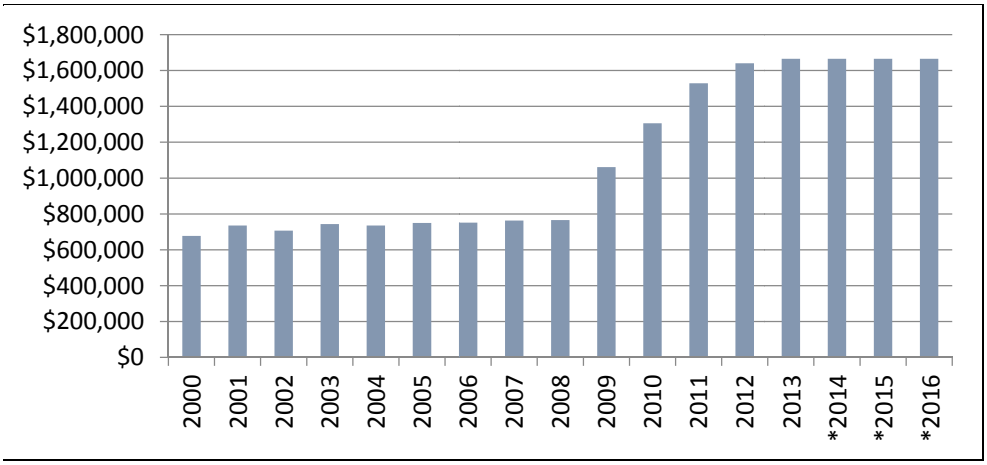
Surface water service charges are assessed for each parcel within the City. The assessment considers land use, parcel size, and impervious area to determine the annual surface water service charge. Residential and very lightly developed parcels are charged a flat rate service charge. Residential parcels, which account for a majority of the parcels in the City, have minimal variance in impervious area and determining the ratio of impervious area for each parcel is not cost effective to administer. Very lightly developed parcels (less than 10 percent impervious area) have much less impact to the City's surface water and stormwater systems than those that have higher impervious areas. Nonresidential parcels with impervious area ratios higher than 10 percent are charged a variable rate service charge. The rate is determined by the ratio of impervious area of the parcel and increases as the ratio increases. The City contracts with King County to collect surface water service charges. King County includes the service charge on each parcel's property tax statement, which is sent out twice a year.

Table 3-3 summarizes the rate categories and provides a history of the City's surface water service charge rates since incorporation in 1998. The 2008 Surface Water Master Plan update included a detailed financial analysis that resulted in a phased increase in service charge rates from 2009 through 2012. Additional rate increases may be considered in the future, if needed, to sustain surface water management services and capital projects, but rate increases are not currently planned through 2016. Figure 3-1 summarizes the City's surface water service charge annual revenue from 2000 through 2016.

Table 3-3. Summary of Kenmore's surface water management service charges

Class	Impervious Area Ratio	Annual Rates				
		1998-2008	2009	2010	1998-2008	2012-2016
Residential	NA	$85.02	$120.24	$143.40	$166.80	$167.40
Very Light	0 ≤ 10%	$85.02	$120.24	$143.40	$166.80	$167.40
Light	>10% to ≤ 20%	$198.40	$280.59	$334.63	$389.24	$390.64
Moderate	>20% to ≤ 45%	$410.98	$581.23	$693.18	$806.30	$809.20
Moderately Heavy	>45% to ≤ 65%	$793.60	$1,122.35	$1,338.53	$1,556.96	$1,562.56
Heavy	>65% to ≤ 85%	$1,006.16	$1,422.97	$1,697.05	$1,973.98	$1,981.08
Very Heavy	>85% to ≤ 100%	$1,317.94	$1,863.90	$2,222.92	$2,585.66	$2,594.96

Figure 3-1. Surface water service charge annual revenue



* Estimate

3.2.2.3 Surface Water Service Charge Rate Adjustments

Surface water service charge rate adjustments are available to parcel owners if the parcel owner qualifies for a low-income senior citizen exemption, the parcel qualifies as open space, or the parcel is served by a qualified flow control and/or water quality treatment facility.

Qualification for the low-income senior citizen exemption is determined by the County Assessor and is authorized under Chapter 84.36.381 RCW. Through the contract with King County for service charge collection, the County Assessor applies the rate adjustment to the parcel owner's property tax statement and surface water service charges are not collected from qualifying residential parcels.

The City recognizes that undeveloped parcels may conserve and enhance natural resources and protect streams or other aquatic habitats. Therefore, parcels may qualify for an open space rate adjustment if they are classified as open space or agricultural or timber lands under criteria contained in Chapter 84.34 RCW or for which the development rights have been sold to the City.

Design and construction of surface water facilities is a required and integral component of the development process. However, the City recognizes that privately maintained surface water facilities offer a benefit to the City's surface water systems. Therefore, parcels may qualify for a rate adjustment if the parcel is served by a qualified flow control and/or water quality treatment facility. The facility must be maintained at the expense of the parcel owner to the City's current maintenance standards. Currently, the City has adopted the maintenance standards in Appendix A of the 2009 KCSWDM.

The City recognizes that engineering standards have changed over time and the level of service provided by facilities can vary significantly depending on the age of the facility. To account for this variance in level of service, the City provides a four-tier rate adjustment depending on the design standard used for the facility. Facilities permitted prior to 1998 (designed under the 1969, 1977, 1979 or 1990 KCSWDM) may receive a 10 percent reduction in their total service charge. Facilities permitted from 1998 to 2009 (designed under the 1998 KCSWDM) may receive a 20 percent reduction in their total service charge. Facilities permitted from 2009 to 2016 (estimated date of next KCSWDM update) may receive a 30 percent reduction in their total service charge. Facilities permitted after 2016 may receive a 40 percent reduction in their total service charge. Table 3-4 summarizes the surface water facility rate reduction options.

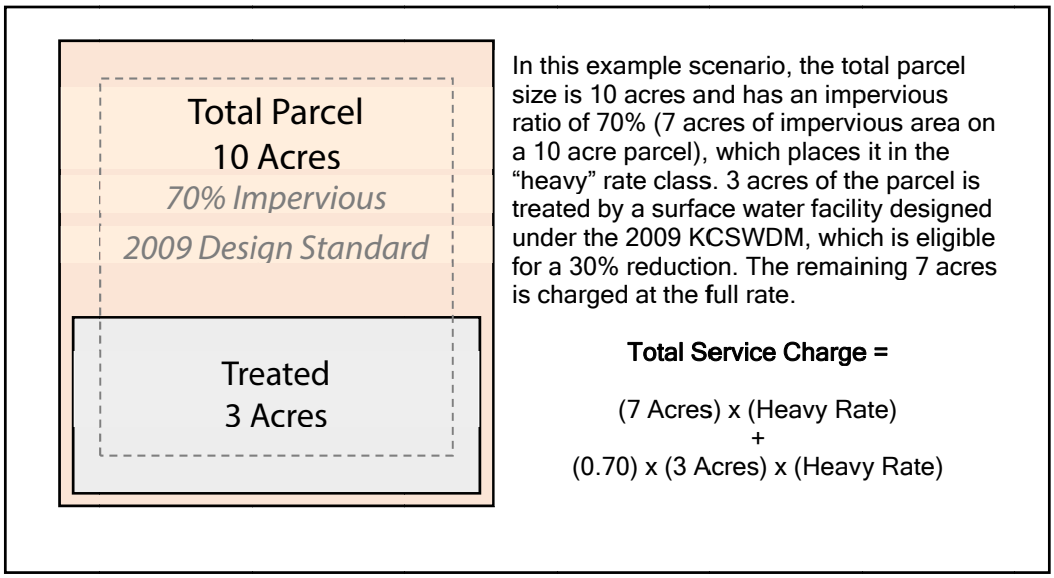
Table 3-4. Private Facility Service Charge Reductions

	King County Surface Water Design Standard (KC SWDM) Version & Permit Year			
	Before 1998	1998-2009	2009-2016*	After 2016*
Service Charge Reduction	10%	20%	30%	40%

* Estimated year of KCSWDM update

The City recognizes that some larger parcels may be partially served by a qualified flow control and/or water quality treatment facility. In this scenario, the area of the parcel served by the facility may receive the appropriate reduction in the total area served by the facility and the non-served portion of the parcel will be charged at the full rate applicable to that parcel. Figure 3-2 provides an example of a partial surface water facility rate reduction.

Figure 3-2. Example surface water service charge calculation for parcels partially served by a qualified flow control and/or water quality treatment facility



3.2.3 KMC Chapter 13.45: Water Quality

City Council adopted this chapter to protect the City's surface and ground water quality by providing minimum requirements for reducing and controlling the discharge of contaminants. Water quality degradation can result either directly from one discharge or through the collective impact of many small discharges. Therefore, KMC Chapter 13.45 establishes policies restricting or prohibiting the discharge of contaminants into surface, storm, and ground waters.

Prohibited discharges are not allowed in surface, storm, and ground waters. The most common examples include sediment, trash, petroleum products, pesticides, herbicides, fertilizers, and soap. Some activities may result in allowable discharges if appropriate BMPs are implemented to eliminate or restrict prohibited discharges into surface, storm, and ground waters. Examples of activities that may result in allowable discharges with application of BMPs include application of pesticides, vehicle washing and maintenance, building washing and maintenance, and potable water line flushing. Common exceptions to discharge rules include dye testing and emergency response activities. If property and project owners are appropriately implementing BMPs and all known, available, and reasonable treatments (AKART) to prevent, control, or abate pollutants associated with a discharge, then an exception may be provided for the discharge.

Ordinance 09-0299 adopted the Stormwater Pollution Prevention Manual, which provides BMPs for commercial, multi-family, and residential properties. BMPs for a wide range of activities are addressed in the manual, including storage of hazardous materials; maintenance of vehicles, buildings, and ground surfaces; landscaping; animal handling; and swimming pool maintenance.

In addition to enforcement actions outlined in KMC Chapters 1.15: General Penalty and 1.20: Code Enforcement, Chapter 13.45 includes enforcement procedures specific to water quality. Generally, compliance with this chapter is achieved through public education, warnings, technical assistance, implementation of BMPs, and, if necessary, AKART. Immediate penalties may be assessed if the violation is a result of a flagrant act or if the discharge is posing a hazard to the public.

3.2.4 KMC Chapter 12.50: Street Standards

City Council adopted the 1993 King County Road Design and Construction Standards (KC RDCS), which provides additional standards and specifications for projects within the City specific to stormwater conveyance systems. The City is currently working on updates to these standards and by December 31, 2016 they will include low impact development (LID) standards, which may include elements such as permeable pavements, narrower road options and bioretention swales.

3.3 Administrative Policies

3.3.1 Private Property Surface Water Management

Surface water (which includes surface, storm, and ground water) impacts properties in Kenmore regardless of land use or ownership. Generally, the City is responsible for managing surface water in public ROWs, publicly owned properties, and dedicated easements on private property that have been formally accepted by the City for the purpose of managing surface water. Generally, private property owners are responsible for managing surface water on their property.

The City frequently responds to private property drainage questions, complaints, and issues. The City attempts to provide a consistent response to private property owners. City staff reviews existing surface water information on and around the property, including historical complaints, GIS information, and plat or construction documents. Staff will look to see if there are publicly maintained facilities involved or easements present. Site visits will be conducted to meet with the property owner and to assess adjacent ROW conditions to determine if public infrastructure or ROW is associated with the private property issue. If the ROW is associated with a private property surface water issue, staff will assess the situation case-by-case to determine a course of action.

Often property owners will want staff to assist them with assessing their problem. Staff may provide general assessments (*e.g.*, determinations that groundwater seeps are impacting the property) or education for property owners about the local drainage in the neighborhood and how it is potentially affecting their situation. Staff may walk the site with an owner to inspect drainage structures, look for maintenance issues, or look at downspouts to see where they discharge.

After assessing an issue, property owners will often ask staff to provide a solution to their problem or recommend a course of action. Staff will not direct or recommend any particular action and will always advise owners to consult a private professional if they are not comfortable managing the issues themselves. Staff may also direct property owners to publicly available resources, such as King County's small site drainage manual. Property owners often ask staff to recommend a contractor to design or conduct work. The City does not recommend any particular company or individual for surface water management services. In short, staff will provide general technical assistance to property owners, but it is up to the property owner to decide on a course of action, if needed, to address their private drainage issues.

When private property owners have an issue or dispute arising from neighboring private property and they want the City to legally address the issue with the neighboring property or properties, the City will generally advise the owner to consult a legal professional to address the issue. The City may become involved and can use the KMC to enforce surface water issues on private property when it involves water quality and critical area (*e.g.*, streams) violations. Otherwise, surface water is considered a "common enemy" to all property owners, and private property situations need to be addressed by the property owners themselves.

The City may occasionally determine that City involvement in a surface water management issue on private property is warranted, if some or all of the following criteria are met:

- The affected private property or properties are residential;
- The issue is beyond the control of the private property owner;
- The issue does not involve waters of the State (e.g., streams, wetlands, Lake Washington, etc.);
- The issue is not caused primarily by ground water;
- The issue is not caused by runoff from neighboring private properties;
- The private property owner will provide an easement to the City for the purpose of managing the surface water issue.

In evaluating these criteria, the City may also take into account factors including:

- The cost of addressing the issue, including whether resolution of the issue would require an expensive Capital Improvement Project; and
- The public benefit of addressing the issue.

3.3.2 Beaver Management

Beavers and beaver dams located in the public ROW or on public property that are not negatively impacting public infrastructure and do not appear to pose a hazard to the public welfare and safety will be allowed to remain. At the City's discretion, vegetation (e.g., significant trees) may be protected.

When beavers and beaver dams located in public ROWs or on public property that have potential to negatively impact public infrastructure or pose a hazard to the public welfare and safety, but could be controlled through engineered solutions (e.g., use of barriers or "Beaver Deceivers"), the City may choose to pursue these methods.

When beavers and beaver dams located in public ROWs or on public property that have potential to negatively impact public infrastructure or pose a hazard to the public welfare and safety, and the City determines that engineered solutions are not practical or recommended, then beaver removal is required. Non-lethal removal methods (e.g., live trapping and relocation) are the City's preferred choice, but, as a last resort, lethal control may be required if non-lethal methods are not effective.

Beavers and beaver dams located on private property are the responsibility of the property owner to manage. The City may require private property owners to remove beavers and associated dams when they impact public ROWs. The City may also require private property owners to assess tree damage caused by beavers if the trees pose a hazard to the public ROW and remove said trees if the hazard is confirmed.

4. Current Conditions

This section describes the conditions of Kenmore's physical setting, built environment, natural systems and the surface water and stormwater infrastructure that has been constructed to manage surface water and stormwater conveyance, storage, and treatment.

4.1 Physical and Biological Setting

The physical location of Kenmore is a big factor in the City's management of surface water and stormwater because much of the water that is conveyed through Kenmore comes from outside of its jurisdictional boundaries. Kenmore is located at the low point of 2 major drainages: the Sammamish River and Swamp Creek. It is situated on the northwestern shore of Lake Washington (Figure 4-1) and is approximately 6 square miles in size. Topographically, Kenmore is somewhat of a bowl shape with higher elevations to the north, east, and south (ranging from 100 to 500 feet above mean sea level) and low elevations in the downtown area where the Sammamish River valley cuts through the City and enters Lake Washington (around 18 feet above mean sea level). The Swamp Creek valley and floodplain forms another topographically low area in the City from its confluence with the Sammamish River in downtown Kenmore to the northern boundary of the City. Figure 4-2 shows relative elevation differences in the City and the topographically higher (darker) and lower (lighter) areas.

4.1.1 Geologic Conditions

Geologic conditions in Kenmore are typical of the Puget Sound lowland, consisting of Quaternary-age glacially deposited sediments that have been reworked by more recent river processes in the Sammamish and Swamp Creek valleys. Figure 4-3 shows surficial geology in Kenmore. The high points in the City are typically composed of glacial till, a very dense deposit of fine-grained material mixed with sand, gravel, cobbles, and sometimes very large boulders. Glacial till typically has very low permeability and is generally not well-suited for stormwater infiltration. The Swamp Creek and Sammamish River valleys are dominated by alluvium that consists of material that has eroded from the landscape upstream, been transported and reworked by the stream channel processes, and deposited in the floodplain and valley since the glaciers retreated. Other surficial geologic units in Kenmore are: 1) advance outwash, primarily noted on the west flanks of Swamp Creek and the north slopes of Finn Hill; 2) transitional beds stratigraphically beneath the advance outwash; 3) recessional outwash in a few small areas; and 4) landslide deposits.

How does geology influence surface water runoff?

Geologic conditions affect how much water runs off the landscape naturally, how much is infiltrated and how easily stream channels and hillslopes are eroded. The Swamp Creek drainage is mapped with naturally high potential for infiltration, but the stream channel bed and banks are also highly erodible.

From a surface water management standpoint, advance outwash typically represents the best opportunity for stormwater infiltration. Advance outwash generally consists of fine-to-medium sand that is fairly permeable and readily infiltrates water. Advance outwash can also be very erosive and prone to landslides, so the ability to infiltrate into this geologic unit will depend on proximity to steep slopes, thickness of the unsaturated zone, or ability to accept additional water.

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Figure 4-1
Kenmore Vicinity

Prepared by E. Nelson 1/20/2015: C:\Users\Erin\Documents\ArcGIS\Kenmore GIS\Figure4-2

Figure 4-2
Kenmore
Topographic Features

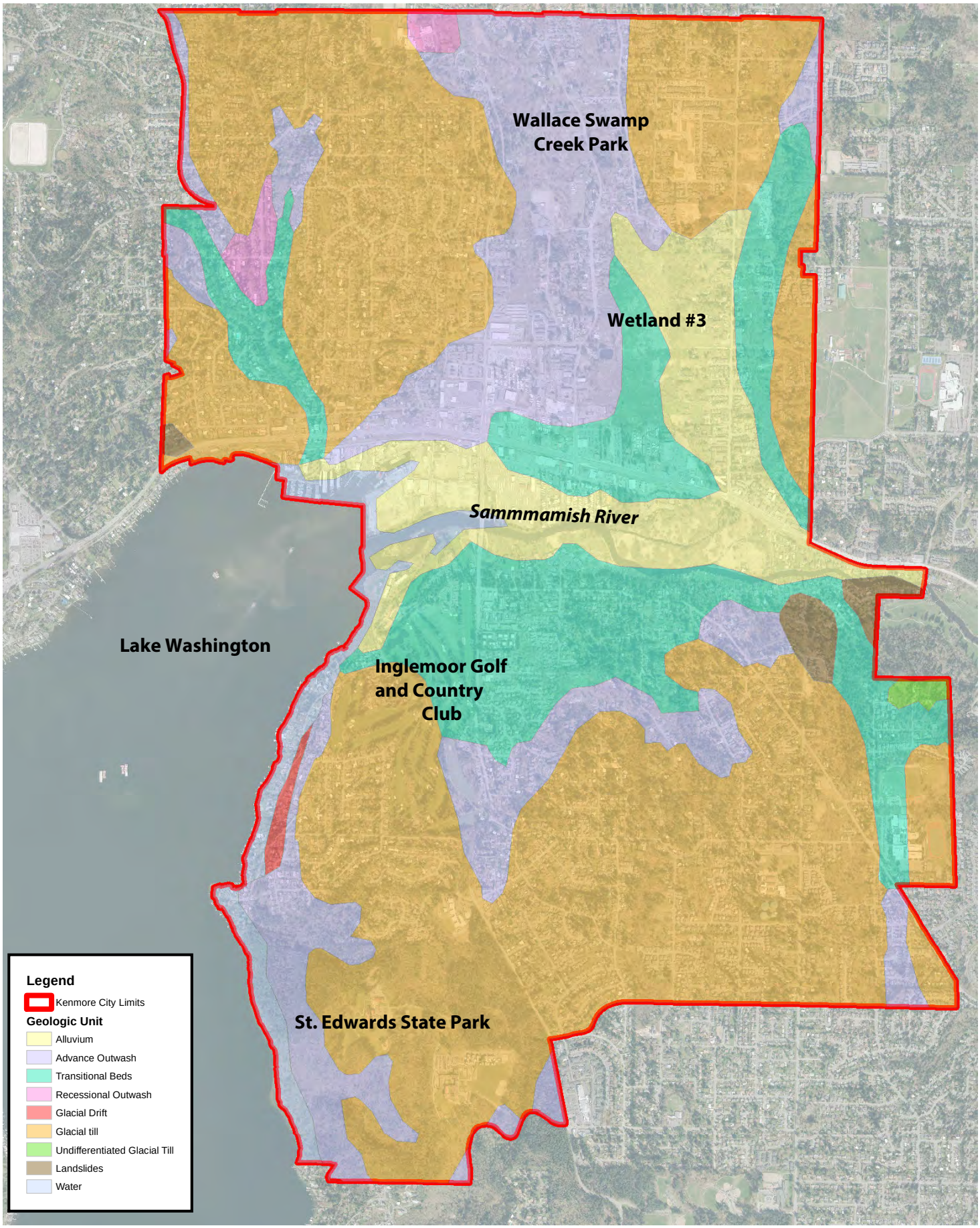


Figure 4-3
Kenmore Geology

4.1.2 Stream Channels and Drainage Basins

There are nearly 27 miles of stream channel in Kenmore, but only a few small stream systems that are wholly within City's jurisdictional boundaries. Figure 4-4 shows the locations of the drainage basins that make up Kenmore and Table 4-1 provides a summary of each drainage basin's acreage. The Sammamish River and Swamp Creek are the largest drainage basins in Kenmore, at 14 percent each, and approximately 60 percent of the City's water drains to these drainages. However, Kenmore contains only a fraction of the overall basin areas for each of these watersheds. The remaining drainage basins enter Lake Washington either directly through tributaries in Kenmore (i.e., Tributary 0056 and Arrowhead Creek), or to the south in Kirkland (i.e., Juanita Creek). Summary characteristics of each drainage basin, including physical characteristics, land use, zoning, and stormwater infrastructure are included on basin summary sheets in Appendix B.

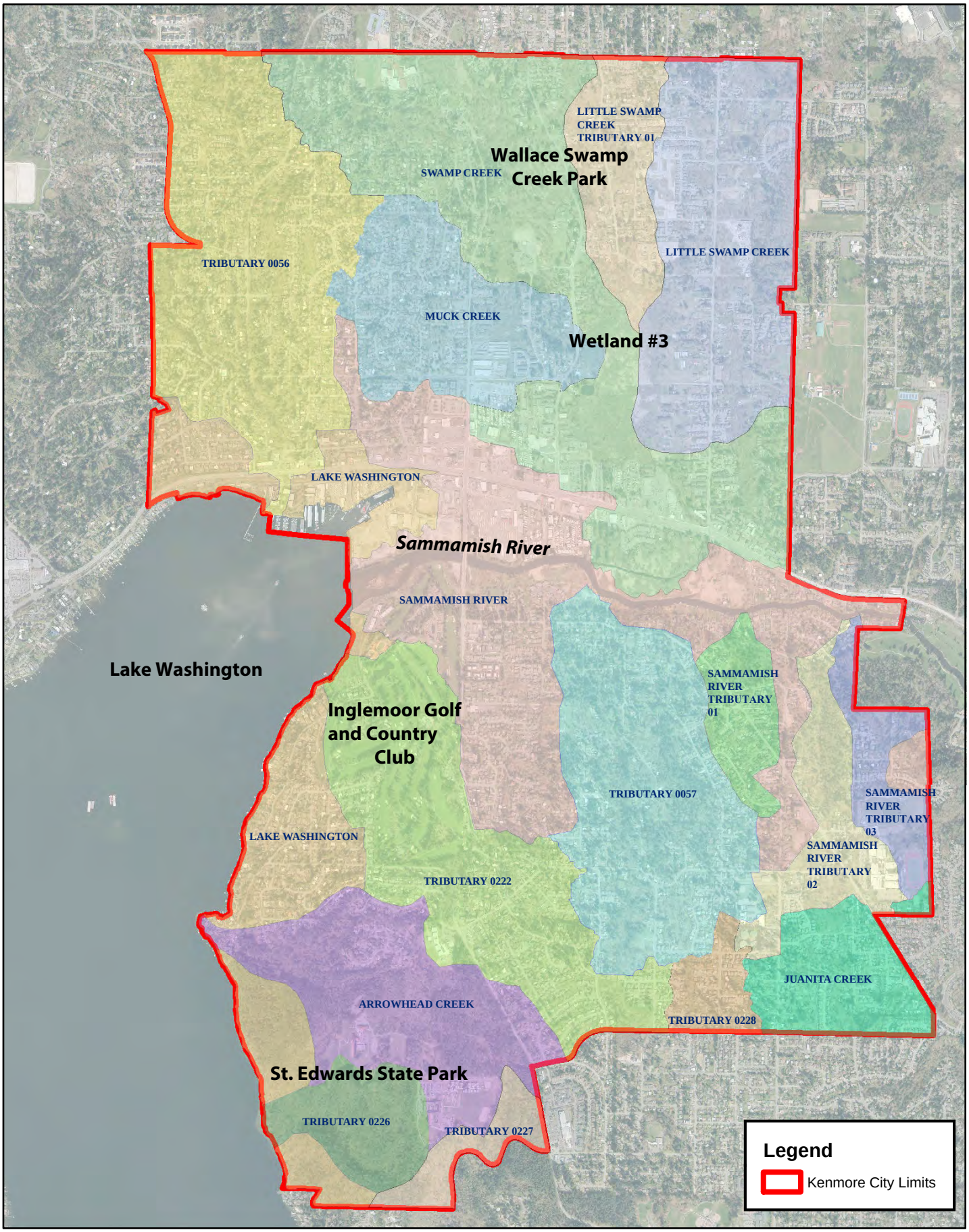
Table 4-1. Kenmore drainage basins and sizes

Drainage Basin	Watershed	Basin Size (acres)	Percent of City
Arrowhead Creek*	Lake Washington	250.88	6%
Juanita Creek	Lake Washington	117.97	3%
Lake Washington Drainages	Lake Washington	303.27	8%
Little Swamp Creek	Swamp Creek	330.60	8%
Little Swamp Creek Tributary 01	Swamp Creek	114.16	3%
Muck Creek*	Swamp Creek	206.36	5%
Sammamish River	Sammamish River	547.47	14%
Sammamish Tributary 01*	Sammamish River	65.49	2%
Sammamish Tributary 02*	Sammamish River	111.59	3%
Sammamish Tributary 03	Sammamish River	69.27	2%
Swamp Creek	Swamp Creek	567.98	14%
Tributary 0056	Lake Washington	407.47	10%
Tributary 0057*	Sammamish River	333.42	9%
Tributary 0222*	Lake Washington	347.69	9%
Tributary 0226*	Lake Washington	86.33	2%
Tributary 0227	Lake Washington	46.22	1%
Tributary 0228	Lake Washington	43.86	1%
	Total	3,950.03	100%

*Indicates drainage basin is 100% or nearly 100% contained within Kenmore city limits.

Streams in Kenmore are designated by type according to KMC Section 18.55.400: Designation and Rating of Streams as follows:

- **Type 1** streams are those streams identified as "shorelines of the State" under Chapter 90.58 RCW, including the Sammamish River and the main stem of Swamp Creek.
- **Type 2** streams are those streams that are:
    a. Natural streams that have perennial (year-round) flow and are used by salmonid fish, or
    b. Natural streams that have intermittent flow and are used by salmonid fish.
- **Type** 3 streams are those streams that are:
    a. Natural streams that have perennial flow and are used by fish other than salmonids, or
    b. Natural streams that have intermittent flow and are used by fish other than salmonids.
- **Type 4** streams are those natural streams with perennial or intermittent flow that are not used by fish.



Prepared by E. Nelson 1/15/2015 C:\Users\Erin\Documents\ArcGIS\Kenmore GIS\Figure 4-4

N

0 1,875 3,750 7,500 Feet

Figure 4-4
Kenmore Drainage Basins

Table 4-2 provides a summary of stream length of each type, including stream channels that are unclassified, and Figure 4-5 shows the location of stream channels in Kenmore and stream type designation.

Table 4-2. Summary of stream types and lengths in Kenmore

Stream Type	Example Stream Channels	Length of stream (miles)
Type 1	Sammamish River, main stem of Swamp Creek	7.7
Type 2	Little Swamp Creek, main stems of Tributaries 0056 and 0057	6.9
Type 3	Small tributaries to Tributaries 0056 and 0057	4.1
Type 4	Headwater tributaries	3.6
Unclassified	Upper reaches of streams that flow to Kirkland	4.6
	Total	**26.9**

WDFW's SalmonScape mapping application (http://apps.wdfw.wa.gov/salmonscape/map.html) was reviewed for a general overview of the type of salmonids documented in Kenmore and the general life history phases (i.e., spawning, rearing) known to occur in what reaches. Chinook, coho, sockeye, bull trout, and steelhead salmon have been documented in 1 or more stream reaches in Kenmore, including the Sammamish River, Swamp Creek, and Little Swamp Creek. Table 4-3 summarizes the overview from SalmonScape.

Table 4-3. List of documented salmonid presence in Kenmore stream reaches

Stream Reach	Salmon Species							
	Spring Chinook	Summer Chinook	Fall Chinook	Coho	Winter Steelhead	Sockeye	Kokanee	Bull Trout
Sammamish River	DP	DP	DS	DR	DP	DP	DP	DP
Swamp Creek (Main Stem)	DP	DP	DS	DS	DP	DS	ND	ND
Little Swamp Creek	DP	DP	MP	DR	DP	DP	ND	ND

DP = Documented Presence
DR = Documented Rearing
DS = Documented Spawning
MP = Modeled Presence
ND= No Documentation on SalmonScape

The SalmonScape application also lists fish passage barriers. Partial or total fish passage barriers include:

- SR 522 culvert on Tributary 0056
- 61st Avenue NE on Tributary 0056
- NE 192nd Street Crossing on Little Swamp Creek
- NE 195th Street Crossing on Little Swamp Creek
- Several driveway crossings on 80th Avenue NE on Little Swamp Creek
- Two roadway culverts on Holmes Point Drive

Additionally, other public and private blockages were noted downstream of SR 522 on Tributary 0056. Stream types, salmonid presence or absence, and confirmation of fish barriers were not confirmed for this Surface Water Master Plan. Rather, information from SalmonScape and City GIS data was used to provide an overview of current conditions.

4.1.3 Wetlands

Kenmore has several wetlands that are integral parts of the surface water and drainage network, including the largest wetland in Kenmore, Wetland No. 5603, commonly referred to as Wetland #3. Wetland #3 is located on the east side of 73rd Avenue NE, south of NE 192nd ST and is associated with Swamp Creek and its floodplain. It is approximately 92 acres in size and is designated as a Class 1 wetland according to KMC Section 18.55.30: Designation and Rating of Wetlands. The confluence of Little Swamp Creek and Swamp Creek is near the middle of Wetland #3 and a very large Great Blue Heron rookery is on the south end of this wetland as well. The other Class 1 wetland in Kenmore is Wetland No. 1601, located near the mouth of Swamp Creek on Lake Washington.

The City defines Class 1 wetlands as those wetlands that meet any of the following criteria:

1) Documented habitat for federal or State listed endangered or threatened fish, animal or plant species; or
2) Wetlands listed as high quality habitats in the Natural Heritage Information System; or
3) Wetlands with irreplaceable ecological functions, including sphagnum bogs and fens or natural forested swamps; or
4) Wetlands of exceptional local significance, specifically those wetlands proximal to and influenced by the main stem of Swamp Creek, the Sammamish River, or Lake Washington.

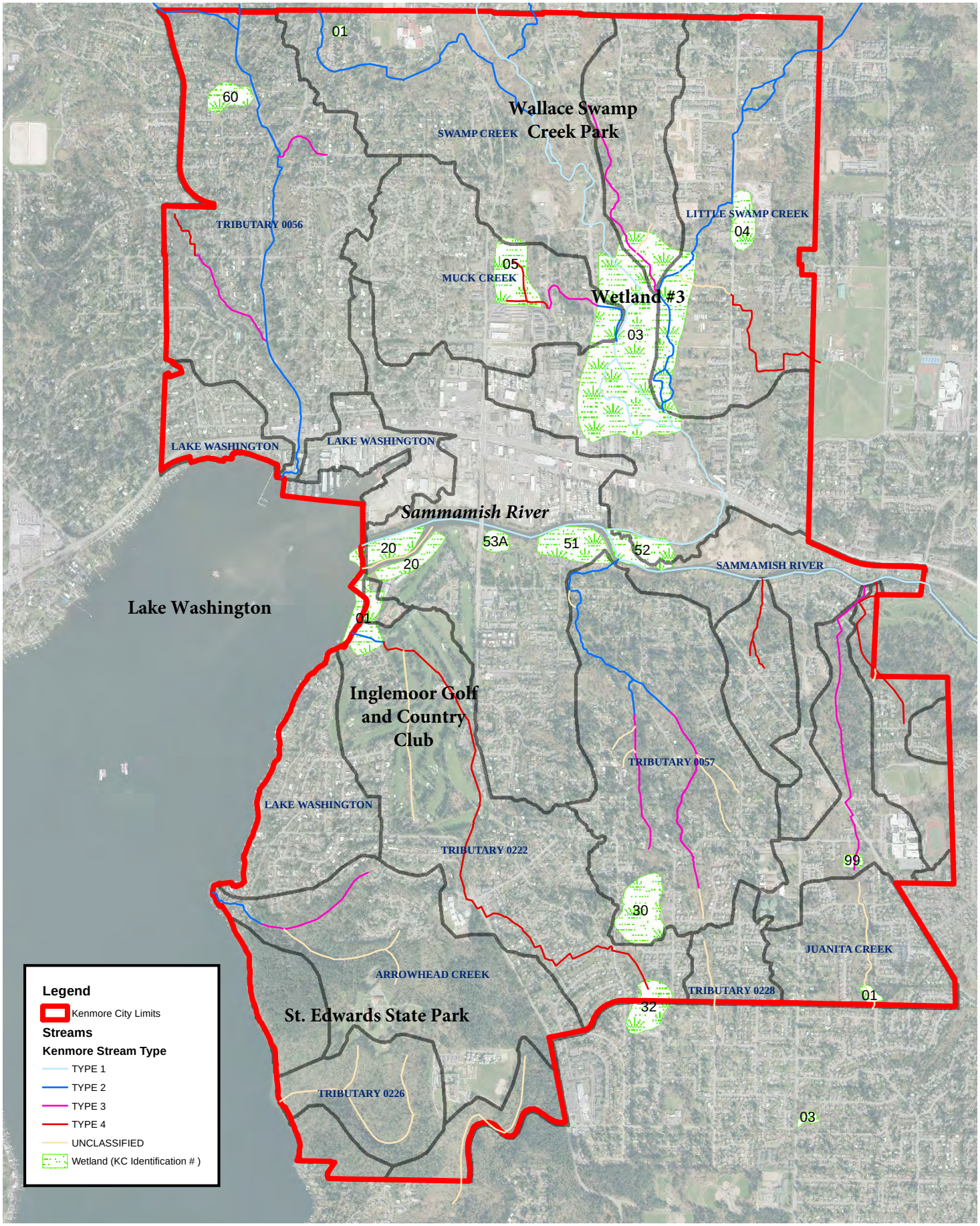
Table 4-4 summarizes the wetlands in Kenmore, their sizes, and their ratings. The wetlands are shown in Figure 4-5.

What is the role of wetlands in surface and stormwater management?

Wetlands naturally play an important role in surface water management. Wetlands typically attenuate peak flows by providing storage space for water to spread out and slow down, alleviating flooding problems. They also provide water quality benefits through filtering actions of vegetative matter, soils, and residence time as pollutants and sediments drop out of the water column in these flat environments. Kenmore's largest wetland, Wetland #3, likely serves some of these surface water management functions although flood-related problems still occur on Swamp Creek.

Table 4-4. Summary of Kenmore wetlands, sizes and ratings

King County Wetland Identification (Common Reference)	City of Kenmore Rating	Size (acres)
5601	3	0.3
1660	2	3.9
5604	2	6.2
5603 (Wetland #3)	1	92
5605	2	9.2
5120	2	12.5
5151	2	9.3
5152	2	26
5153A	4 (NWI)	0
5120	2	12.5
1601 (Inglewood Wetlands)	1 (A)	9.5
5130	2	8.5
1632	2	8
2701	2	1
5199	2	0.9
	Total	**199.8**



Prepared by E. Nelson 1/25/2015 C:\Users\ErinDocuments\ArcGIS\Kenmore GIS\Figure 4-5

N

0 1,850 3,700 7,400 Feet

Figure 4-5
Kenmore Streams and Wetland Locations

4.2 Water Quality Conditions

Two Kenmore water bodies – Swamp Creek and the Sammamish River – are listed on Ecology's Category 5 303(d) list for impairment by various pollutants, including fecal coliform bacteria, high temperature, and low dissolved oxygen. Kenmore has been monitoring bacteria levels in Swamp Creek in an effort to identify sources and implement a source reduction strategy as part of the regional TMDL established by Ecology for Swamp Creek. The 2014 monitoring report is provided in Appendix C.

4.3 Overview of City's Built Environment

In addition to the City's physical and biological attributes, the built environment influences how and where surface water and stormwater runoff is conveyed. That influence starts with the City's zoning and density of development relative to geologic, topographic, and other drainage basin features. How the City's stormwater is managed can also be different dependent on the types of land uses in a given area.

How does the built environment affect stormwater runoff?

The type and density of development affect the quantity of hard surfaces (imperviousness) that create runoff, as well as the types of pollutants that could be transported from different surface types. Whereas, one single family home doesn't have a great impact, the cumulative effect of many does.

4.3.1 Zoning and Impervious Surfaces

Most of the City is zoned as residential R-6 (6 dwelling units per acre). Table 4-5 summarizes the zoning designations and statistics and Figure 4-6 show the City's current zoning.

Table 4-5. Zoning designation and percent of Kenmore

Zoning Designation	Percent of City
Community Business	<1
Downtown Commercial	1
Downtown Residential	1
Golf Course	4
Neighborhood Business	<1
Parks	13
Public/Semi-public	5
Residential R-1 (1 dwelling unit per acre)	7
Residential R-12 (12 dwelling units per acre)	2
Residential R-4 (4 dwelling units per acre)	15
Residential R-6 (6 dwelling units per acre)	45
Residential R-18 (18 dwelling units per acre)	1
Residential R-24 (24 dwelling units per acre)	1
Residential R-48 (48 dwelling units per acre)	<1
Regional Business	4
Total	100

Since the City is predominantly zoned single-family residential, the density of development is not as high as other urban or suburban areas; however, as infill is occurring, densities are increasing, especially in the downtown area. Table 4-6 summarizes the impervious surface coverages based on 2012 mapping completed for the City. Figure 4-7 shows impervious surfaces in Kenmore.

Table 4-6. Summary of impervious surfaces in Kenmore

Type of Impervious Surface	Acres	Percent of City
Roofs	~450	~12
Roadways	~310	~8
Other Surfaces (e.g., sidewalks, patios, parking lots)	~472	~12
Approximate Percent Impervious		**32**

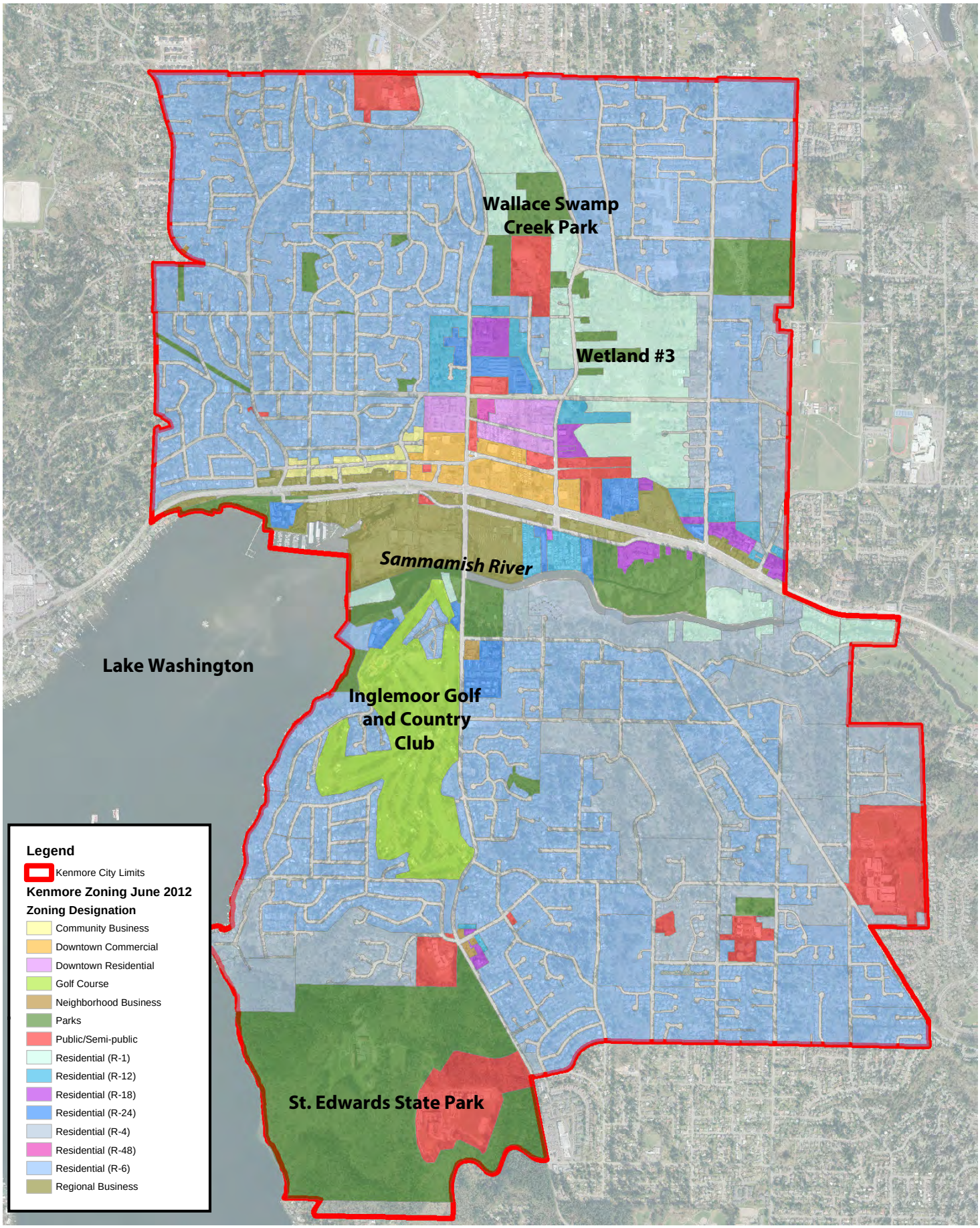
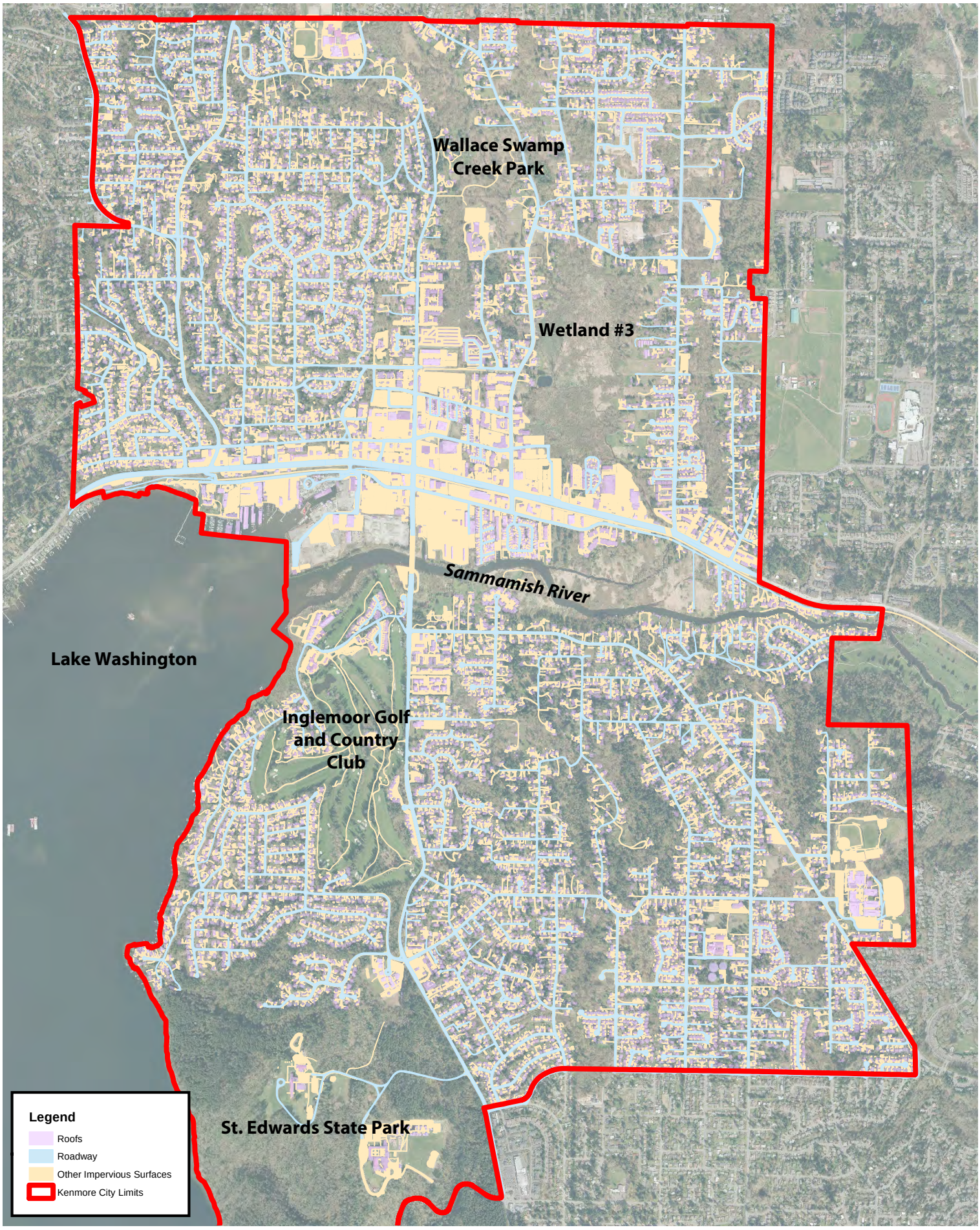


Figure 4-6
Kenmore Current Zoning Designation



Prepared by E. Nelson 1/15/2015 C:\Users\Erin\Documents\ArcGIS\Kenmore GIS\Figure 4-7

Figure 4-7
Kenmore Impervious Surfaces

There are some relatively large mostly undeveloped green spaces in Kenmore that are both publicly and privately owned including the following:

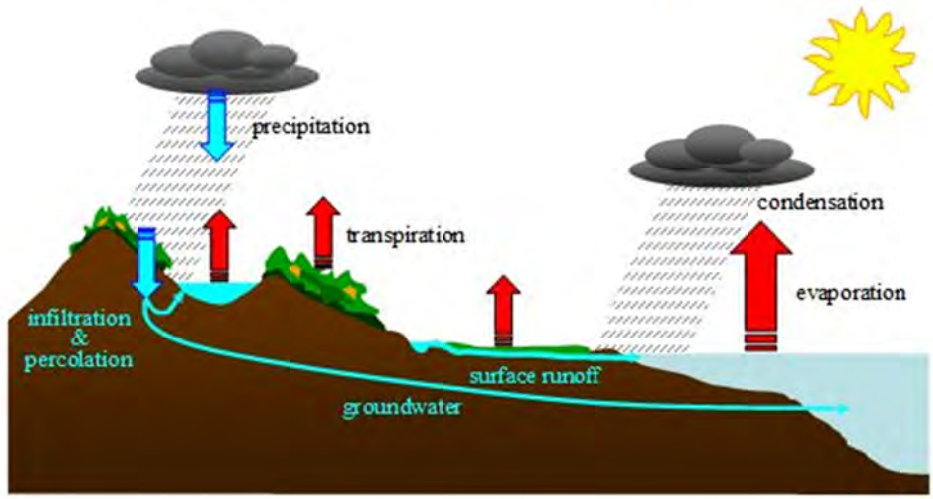
- Washington State Parks, Saint Edwards State Park – ~300 acres
- Inglewood Golf and Country Club - ~ 144 acres
- City of Kenmore Wallace Swamp Creek Park - ~25 acres

Other relatively undeveloped green spaces include:

- Wetland #3, which is a combination of both public and private ownership, but is largely undevelopable because of the wetland and floodplain;
- Open space adjacent to the Sammamish River that is also considered floodplain, wetland, or otherwise undevelopable property; and
- Ravines adjacent to tributary streams (e.g., Tributary 0057).

These areas, with the exception of the steep ravines, are good for surface water and stormwater management in that surface water can infiltrate into the ground and can generally be less confined and free to move across the landscape without damaging built infrastructure. The spaces also provide opportunities for vegetation that can support water quality treatment, water uptake, and evaporation and transpiration as shown in the generalized hydrologic cycle diagram in Figure 4-8.

Figure 4-8. Schematic of hydrologic cycle



4.3.2 Stormwater Infrastructure

As the landscape in Kenmore has developed, drainage infrastructure has been constructed to manage and convey surface water and stormwater flows away from properties (e.g., agricultural and logging properties) and roadways to prevent flooding and minimize impacts from prolonged wet conditions. Early stormwater management strategies consisted of developing conveyance systems that would collect and convey runoff from a property or road to the nearest receiving water body. As knowledge and awareness of stormwater impacts to natural resources and water quality have increased and stormwater regulations have evolved, stormwater management began to focus on construction of facilities that detain water and provide water quality treatment. Design and construction of these facilities began in earnest during the 1980s, but early design standards underestimated the volume needed to adequately protect the aquatic environment from the impacts of increased runoff. This resulted in many undersized facilities that are still operating today, but are much smaller than newer facilities. Flow control facilities slow the release of water (reducing peak flows and durations to small stream channels that experience erosion) and water quality facilities provide water quality

treatment, and reduce pollution (some facilities are a combination of flow control and water quality). The vast majority of stormwater runoff, whether conveyed directly or managed by a facility, is conveyed to a natural water body (e.g., Swamp Creek, the Sammamish River, or Lake Washington), so it is important to understand how actions upstream impact downstream.

The conveyance infrastructure matches the type of development in Kenmore, from rural roads with adjacent drainage ditches in the outlying areas to curb, gutter, and sidewalk configurations in the downtown area. Currently, Kenmore has a mix of an open and enclosed conveyance system of ditches and pipes, although it is predominantly enclosed. The conveyance system includes pipes, ditches, and other infrastructure that is owned and maintained by Kenmore and also infrastructure that is privately owned and maintained. The tables below provide a summary of the entire system as mapped in the City's GIS system, public and private. Table 4-7 provides a summary of the conveyance system types and lengths and who is responsible for maintenance; and Table 4-8 provides a summary of the enclosed conveyance system materials, sizes, and lengths. Figures 4-9 and 4-10 show locations and types of the open and enclosed conveyance systems.

Table 4-7. Conveyance system maintenance responsibility, type, length and percentage of system (in parentheses)

Maintenance Responsibility	Enclosed Conveyance Length (mi)	Open Conveyance Length (mi)	Catch Basins
City of Kenmore	74.12 (65.3%)	14.77 (77.8%)	4,262
City of Kenmore (Via Easement)	2.16 (1.9%)	0.19 (1.01%)	79
Private	36.81 (32.4%)	4.00 (21.05%)	1,849
NA	0.40 (0.4%)	0.03 (0.13%)	11
Total	**113.49**	**18.98**	**6,201**

Table 4-8. Enclosed conveyance material, sizes, and lengths

Pipe Material	Pipe Diameter and Length (miles)						
	<12 inches	12-24 inches	30-48 inches	54-72 inches	> 72 inches	No diameter reported	**Total**
Clay	0.03	0.00	0.00	0.00	0.00	0.00	**0.03**
Corrugated Metal Pipe	1.94	16.49	2.42	0.83	0.25	0.57	**22.51**
Concrete	2.49	30.36	0.73	0.01	0.00	0.21	**33.80**
Corrugated Polyethylene	3.51	23.24	0.42	0.05	0.00	0.06	**27.28**
Ductile Iron	0.64	1.47	0.02	0.00	0.00	0.01	**2.14**
Earthen	0.00	0.01	0.00	0.00	0.00	0.00	**0.01**
Metal	0.02	0.03	0.00	0.04	0.00	0.00	**0.09**
NA	1.49	2.64	0.04	0.03	0.00	4.29	**8.50**
Plastic	0.09	0.03	0.00	0.00	0.00	0.00	**0.11**
Polyvinyl Chloride	12.24	6.34	0.04	0.00	0.00	0.27	**18.90**
Rock	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Total	**22.54**	**80.61**	**3.67**	**0.96**	**0.25**	**5.43**	**113.45**

Pipes in Kenmore's publicly maintained systems are composed primarily of concrete (37%), corrugated polyethylene (26%), corrugated metal (22%) and polyvinyl chloride (9%). Pipe diameters of 12-inch (70%) and 18-inch pipe (10%) account for 80% of the public system. Pipes in Kenmore's privately maintained systems are composed primarily of polyvinyl chloride (33%), corrugated polyethylene (21%), corrugated

metal (16%), concrete (14%) and unknown (13%). Pipe diameters of 12-inch (33%), 6-inch pipe (24%), 8-inch (15%) and 4-inch (8%) account for 80% of the public system. Smaller diameter pipes (less than 12-inch) account for 48% of privately maintained systems, which is in contrast to publicly maintained systems that are comprised of mostly 12-inch pipes and larger. Private systems typically connect downspouts and small yard drains to the public drainage system. Larger privately maintained pipes are typically associated with private commercial drainage systems.

In addition to Kenmore's drainage conveyance systems, there are 152 publicly maintained stormwater treatment facilities with many more under construction or planned. There are also over 100 privately owned and operated drainage facilities including stormwater treatment ponds and vaults. Figure 4-11 shows the locations of these facilities. An analysis of where stormwater facilities are located and where there are none was completed for this plan to identify potential stormwater retrofit opportunities. The stormwater retrofit memorandum is in Appendix D. Section 4.5 describes the City responsibilities for operating and maintaining its stormwater treatment facilities and ensuring that privately owned facilities are also properly maintained and operated.

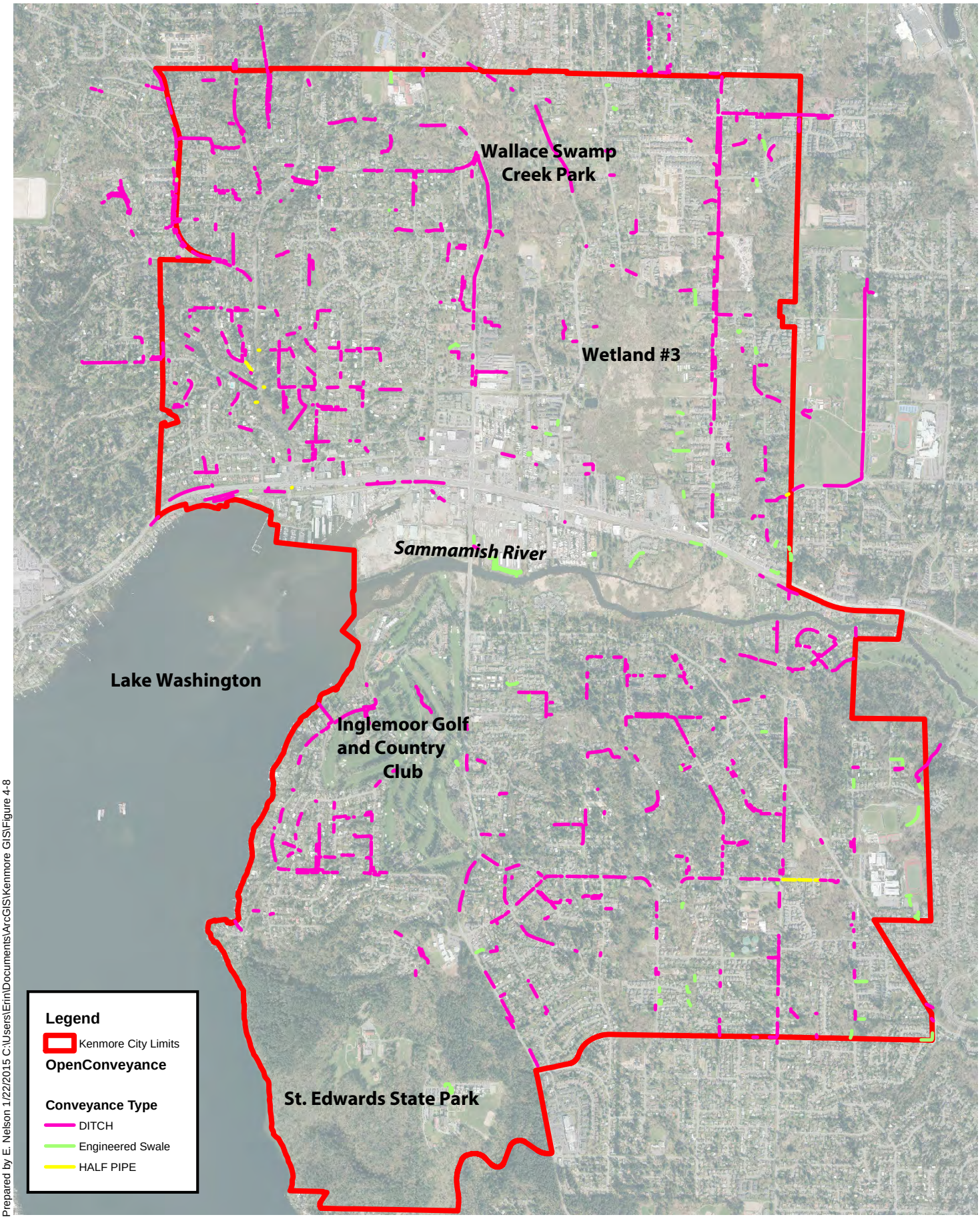


Figure 4-9
Location and Types of Open Conveyance

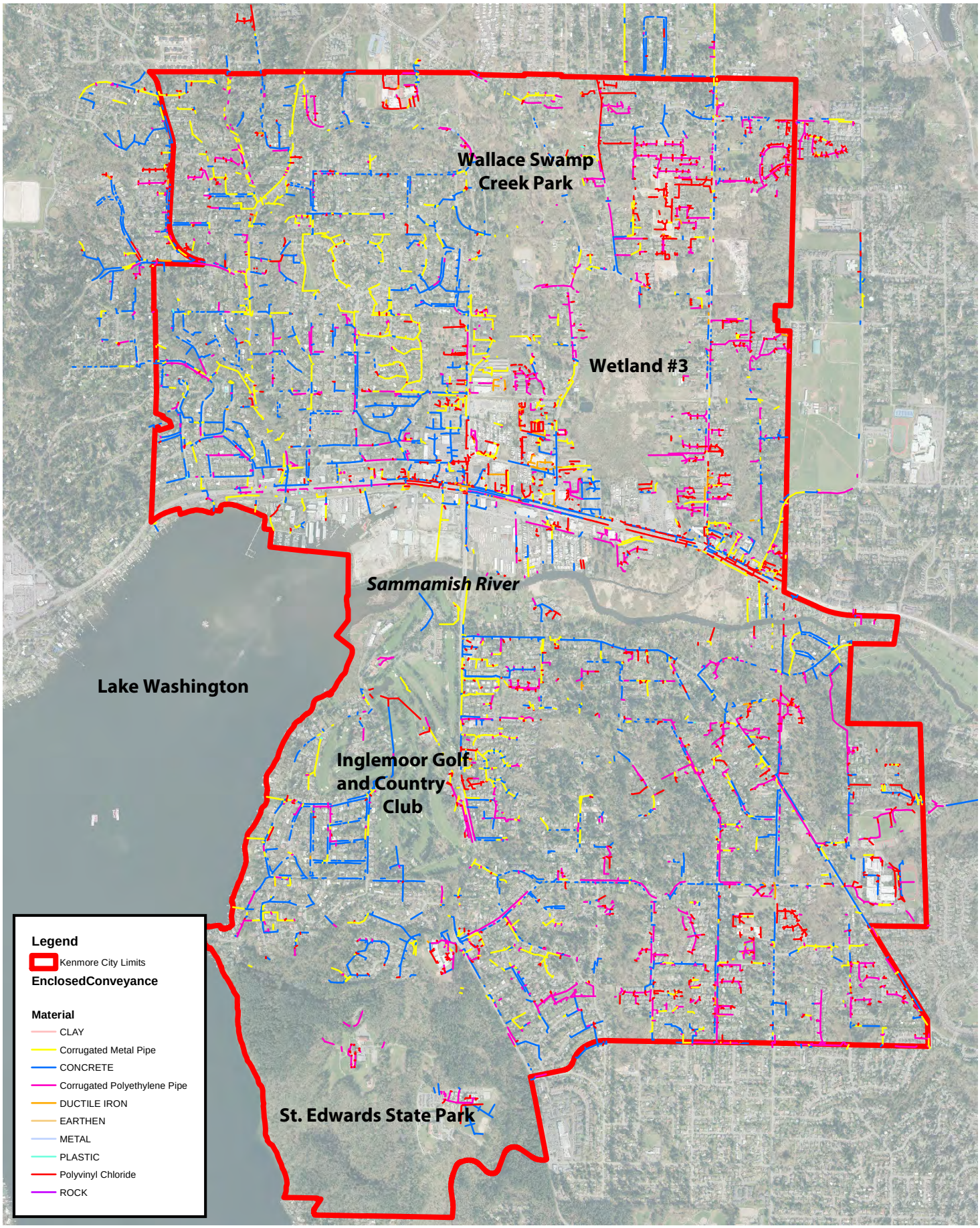


Figure 4-10
Location and Types of Enclosed Conveyance

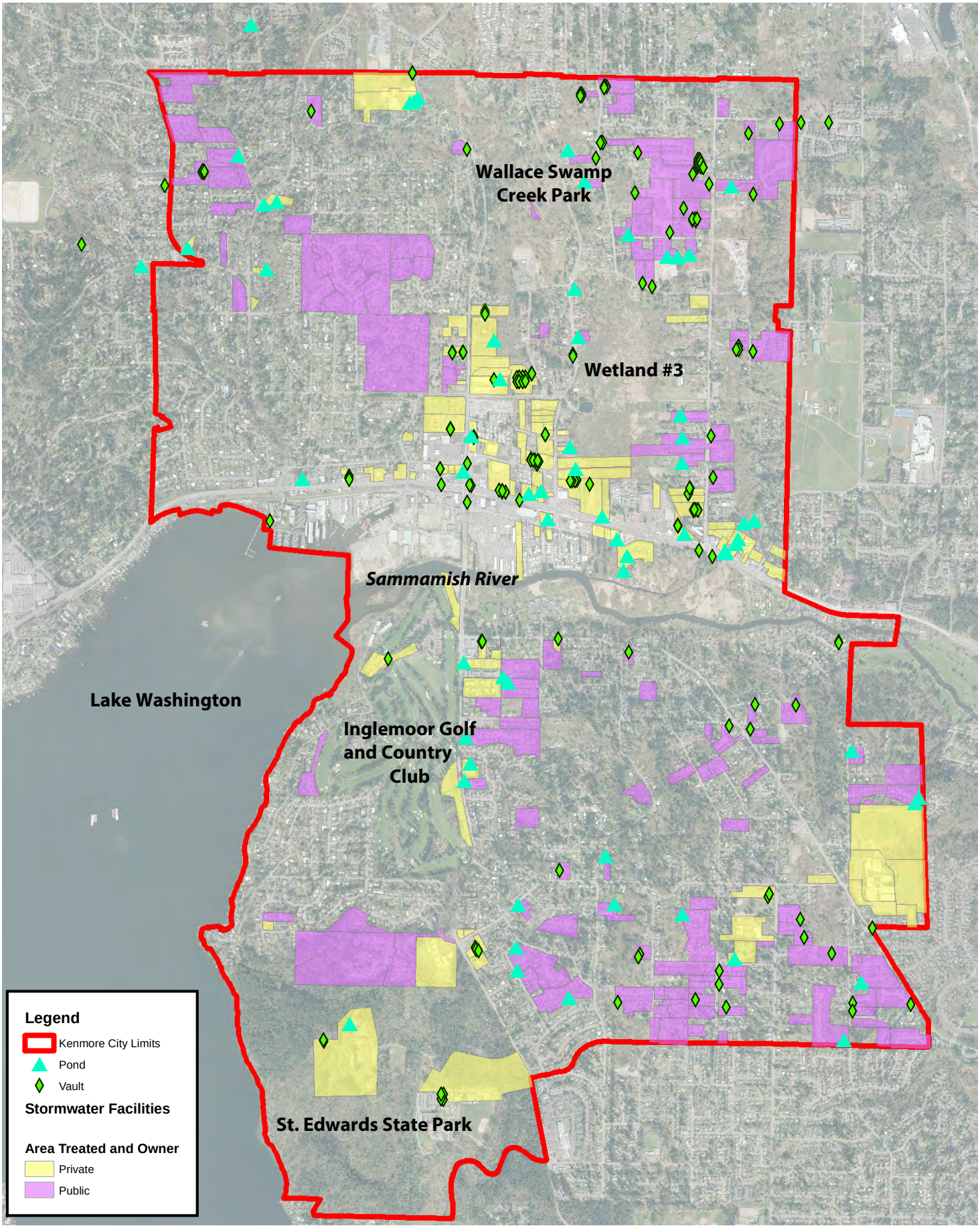


Figure 4-11
Location,Type, and Owner of Stormwater Facilities

4.4 Complaint History and Existing Problems

The City has 16 complete years of service request history (also referred to as citizen action requests), which includes data from 1999 through 2014. During this period, the City documented 1,555 surface water related service requests (Figure 4-12). From 1999 through 2006, the City averaged 63 service requests per year and during 2007-2014 the City averaged 131 service requests per year. In the last few years, service request volumes range from 130 to 180 per year. The top five categories of service request types include maintenance issues (36%), nuisance problems (20%) water quality concerns (13%), general inquiries (10%) and flooding (6%). Each service request is logged, routed to appropriate staff, investigated and responded to. January and December have the highest volumes of service requests with other months remaining relatively steady (Figure 4-13).

Drainage complaints reported to the City were reviewed to evaluate the types, locations, frequency, and timing of surface water and stormwater related problems. One of the most problematic areas in Kenmore is flooding associated with Swamp Creek in the vicinity of 73rd Avenue NE. This particular area has been the subject of many past studies and flood reduction projects. Additional analysis on the Swamp Creek flooding problem was also completed for this Plan and the summary memorandum is provided in Appendix A.

Other problematic areas in Kenmore have included localized flooding of smaller tributaries, such as Tributaries 0056 and 0057. Numerous slides have occurred on steep slopes on both public and private property, which will require additional evaluation with upcoming low impact development requirements to infiltrate runoff. Kenmore's topography and location at the bottom of its watersheds provide many challenges in managing shallow groundwater springs at many locations in the City, which will also require additional evaluation when implementing low impact development. The City continues to respond to these issues with maintenance, capital improvement projects and small works projects.

Figure 4-12. Number of drainage-related calls received between 1999 and 2014

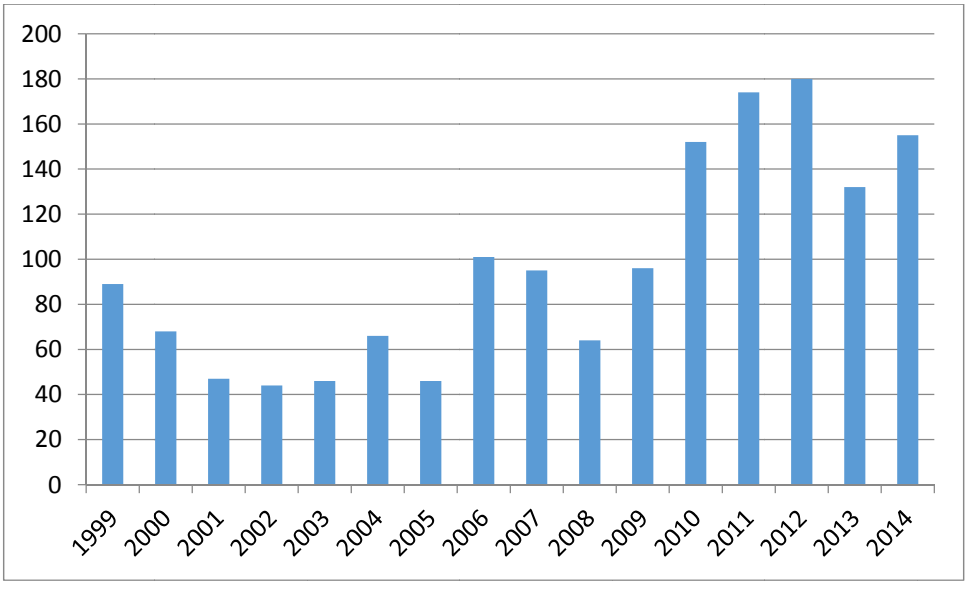
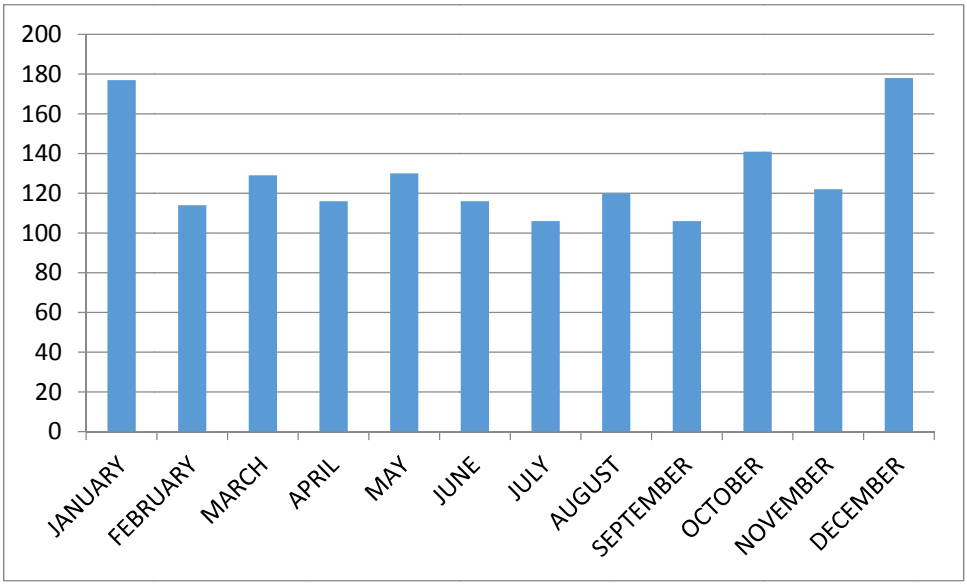


Figure 4-13. Drainage-related calls by month between 1999 and 2014



The predominant type of drainage-related call received was requests for maintenance of infrastructure, including ditches and catch basins (Figure 4-14). Nuisance issues and water quality complaints were also quite high. Drainage calls are categorized into 14 types based on the predominant factor causing the issue (Table 4-9). Drainage issues will often have several components but one main contributing factor. For instance, if an intersection flooded only because a catch basin needed maintenance then it was categorized as a maintenance issue, not flooding.

Figure 4-14. Drainage-related calls by type between 1999 and 2014

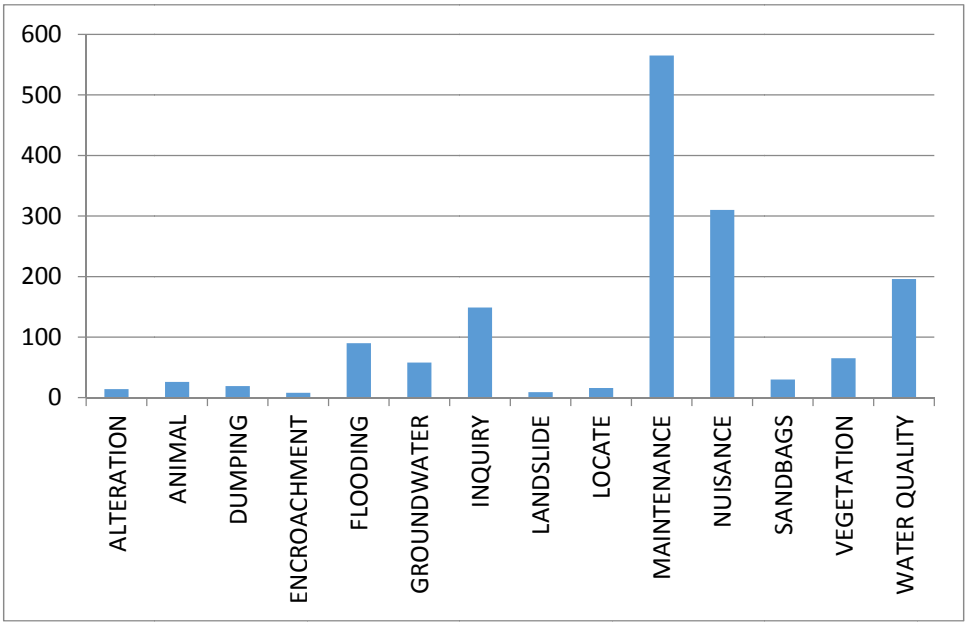


Table 4-9. Drainage call category descriptions

Drainage Call Categories	Description
Alteration	Drainage infrastructure has been altered without permission or permits
Animal	Animal related issues (beavers, nutria) or dead animals in drainage system
Dumping	Illegal dumping into drainage system
Encroachment	Private construction in right-of-way or drainage easement without permits
Flooding	Flooding that impacts roadway usage or habitable structures
Groundwater	Drainage issues resulting from groundwater
Inquiry	General drainage questions or comments
Landslide	Landslide issues
Locate	Requests to locate drainage infrastructure
Maintenance	Drainage system maintenance issues (i.e., clogged drains, broken grates, etc.)
Nuisance	Drainage issues, often of a flooding nature, that are not impacting the roadway or habitable structures (i.e., soggy yard, puddles, private drainage system issues, etc.)
Sandbags	Request for sandbags
Vegetation	Vegetation issue in drainage system (i.e., dangerous trees, excessive growth, etc.)
Water Quality	Reports of water quality issues (i.e., spills, odors, illegal activity, etc.)

4.5 Operations and Maintenance

O&M of the stormwater system is challenging and needs to be flexible and occur at many levels, because of the varied ownership and cross-jurisdictional connections, combination of constructed and natural features, and unpredictable frequency of storm events that cause major problems.

Cities and counties with NPDES MS4 Permits, such as Kenmore (described in Section 2), are required to operate and maintain their systems according to standards set forth in the permit. All jurisdictions in Western Washington of a certain minimum size are subject to the same NPDES Permit standards, providing some level of certainty for Kenmore that upstream jurisdictions are maintaining their systems for stormwater that discharges to streams and rivers that flow into Kenmore.

The constructed stormwater system (e.g, pipes, ditches, vaults, ponds) flows to naturally formed stream channels, rivers, and wetlands in Kenmore and ultimately Lake Washington. Issues that occur in one part of the system can have profound effects on the other. Of particular challenge is managing the natural system in what is now an urban/suburban environment. Natural processes that used to occur in these natural systems without negative effects on infrastructure or properties can now cause damage because of human encroachment. Examples of natural processes include deposition of sediment, wood, and debris that alters the course of water flow or blocks stormwater outfalls and beaver dams that cause the same result. These are some of the problems that City staff encounter in management of the stormwater system that is linked to the natural system.

Although there is some predictability in seasonal weather patterns (the rainy season is typically during the winter months), the degree to how often and how much rainfall occurs is not predictable. This makes managing stormwater challenging - especially for dealing with known problem areas that need to be inspected prior to storm events.

The City documents its O&M procedures in a detailed Operations and Maintenance Practices and Policies Manual (City of Kenmore 2010) that is updated as necessary to be current with NPDES Phase II Permit requirements or changing procedures. The sections below provide a summary of how Kenmore operates and maintains the public stormwater system and the procedures that are in place to ensure that the private system is adequately maintained.

The City's current NPDES Phase II Permit has new requirements to adopt stormwater management standards equivalent to Ecology's 2012 SWMMWW by December 31, 2016, as well as revised inspection and maintenance requirements (described in Section 2). The City will need to modify its maintenance program to meet these new standards and requirements.,which may result in additional staffing and funding needs.

Kenmore's public stormwater system includes stormwater infrastructure that is within the City's ROW, or infrastructure for which the City has an easement or agreement to operate and maintain. Stormwater infrastructure and facilities associated with SR 522 are also operated and maintained by Kenmore.

Table 4-10 summarizes the types of O&M activities conducted, the general frequency of those activities, and the entity that does the work. Kenmore contracts out much of the labor to operations crews from Lake Forest Park or King County through Interlocal Agreements and uses maintenance contractors for other types of services.

Table 4-10. Summary of stormwater O&M tasks

O&M Task	General Frequency	Infrastructure	Ownership	Who Does the Work?
Inspection	Routine	Stormwater facilities	Public	City of Kenmore
			Private	City of Kenmore
		Catch basins	Public	City of Kenmore
	Storm-related spot checks	Culverts, known problem areas	Public/Private	Lake Forest Park City of Kenmore
Cleaning	Routine	Pipes	Public	Private Contractor
		Culverts associated with ditch conveyance	Public	Private Contractor
		Ditches	Public	Private Contractor
		Streets (vacuum sweeping)	Public	Lake Forest Park
		Private systems	Private	Property Owner
Maintenance	Routine (vegetation management)	Stormwater facilities	Public	Private Contractor Lake Forest Park
		Private systems	Private	Property Owner
	Non-routine (dependent on inspection results)	Stormwater facilities	Public	Lake Forest Park King County Roads Maintenance
		Pipes	Public	Private Contractor King County Roads Maintenance
		Private systems	Private	Property Owner
Repairs	Non-routine	Stormwater facilities	Public	If the project is too large for Lake Forest Park or King County, then a Small Works Project or CIP is created
		Culverts	Public	
		Pipes	Public	
		Ditches	Public	
		Private systems	Private	Property Owner

Because the stormwater system is a combination of private and public infrastructure, the facilities often cross between public and private properties. One of the problems that occur in the O&M of the public system is when the public system becomes private and responsibility becomes unclear. The City does not knowingly maintain private drainage systems and takes a conservative approach when dealing with private property drainage systems. Many drainage systems on private property may have an easement indicated on the plat. However, these systems will only be maintained by Kenmore if an easement, or other legally acceptable

document, has specifically provided Kenmore the right to access the drainage system and clearly indicates what actions the City is authorized to conduct on the drainage system. The City is not necessarily obligated to maintain private drainage systems because an easement exists. Easements may exist for many reasons, including: protecting the drainage system from being removed by the property owner, allowing the City access to inspect the system, and providing adequate space for the property owner to maintain the system.

4.5.1 Ensuring Private System Maintenance

The City relies on property owners to operate and maintain their own stormwater systems in a manner that contributes to the functionality of the system as a whole, and in many cases maintenance is required by code. The methods that the City uses to ensure that private systems are operated properly include annual facility inspections that detail any deficiencies, corrections that need to be made, and a timeline to make them, followed by repeat inspections to verify that corrections have been made. If deficiencies aren't corrected, the City can use other measures, including enforcement actions. As an incentive for complying with stormwater regulations, the City offers stormwater rate reductions for properly operating and maintaining private facilities (see Section 3 for a description).

4.6 Asset Management

Kenmore manages surface water and stormwater assets using a combination of GIS software and asset management software. Asset information for surface water and stormwater features (e.g., catch basins, pipes, ponds, etc.) is stored in GIS using ArcGIS, which is a GIS software developed by Environmental Systems Research Institute. Kenmore's surface water and stormwater assets have been thoroughly mapped and updated in GIS for many years. Surface water and stormwater GIS information is available through the City's online map application located on the City's webpage. Kenmore uses Cityworks, an asset management software developed by Azteca, Inc., to manage inspections, work orders, and service requests. Cityworks leverages the City's existing GIS information and adds the ability to track actions associated with any asset in GIS. In addition to assets, Cityworks also tracks and manages surface water and stormwater related service requests (historically called a citizen action request "CAR"). Service requests may include complaints, requests for maintenance, inquiries, reported water quality issues, etc., and are spatially referenced for easy reporting and analysis.

4.7 Coordination with Neighboring Jurisdictions

By virtue of its location at the bottom of two very large drainages that pass through Kenmore, the City must pursue coordination with upstream jurisdictions and partners to effectively manage natural resources and share responsibility. The City participates in the WRIA 8 Watershed Forum for the Lake Washington/Cedar/Sammamish Watershed. The City also coordinates with Swamp Creek watershed partners for managing the TMDL requirements for fecal coliform bacteria (as described in Section 2) and partners with other jurisdictions, such as Lake Forest Park and King County in sharing O&M resources through Interlocal Agreements.

4.8 Development and Business Support

The thresholds that trigger implementation of stormwater management on properties in Kenmore and elsewhere in Western Washington are changing with the most recent NPDES Phase II Permit. However, the manner with which the City ensures new development or redevelopment that triggers stormwater requirements meets the current standards is through the development review and permitting process conducted by the City' Development Services Department, which implements and enforces the City's stormwater management requirements.

4.8.1 Permit Review

In 2014, Kenmore received 30 engineering permit applications; issued 20 engineering permits (for plats, clearing and grading, and commercial and multi-family development); received 172 building permit applications; and issued 135 building permits (for new or remodeled residential, commercial, and multi-family buildings). These types of permits may involve drainage review and require stormwater management facilities if certain thresholds identified in the KCSWDM are triggered. The number of permits received and issued annually fluctuates with economic conditions and is dependent on how much growth and building is occurring. However, drainage review needs are expected to rise with the elimination of a lower size threshold for requiring stormwater management with the current NPDES Phase II Permit. The elimination of existing thresholds requiring stormwater management will be implemented no later than December 31, 2016.

4.8.2 Business Outreach and Technical Assistance

The City uses business outreach and technical assistance as the primary method for helping businesses and private property owners comply with surface water and stormwater regulations. One of the primary areas where outreach and technical assistance is provided is for illicit discharges to the stormwater system. The City uses its Illicit Discharge Detection and Elimination (IDDE) program to identify and resolve water quality problems. A detailed description of the program is in the City's IDDE Program Manual (City of Kenmore 2011). When a problem is identified, either through facility inspection, staff observation, or citizen complaint, a site visit is made to investigate and try to identify the source. If the source is tied to a property unknowingly or willingly discharging unallowable materials to the stormwater system, the City works with those individuals to try to correct the problem in the most expeditious way possible.

The City has utilized King County water quality staff and The Environmental Coalition of South Seattle (ECOSS), a non-profit environmental organization, to provide water quality outreach and technical assistance to Kenmore business owners and will continue to participate in these kinds of partnerships. King County conducts a water quality audit program in which qualified staff meet with business owners, often after a water quality issue has been discovered, and provide guidance and resources to bring the business back into compliance. ECOSS provides a more proactive outreach and education program to businesses, often before a water quality issue has occurred, which includes guidance on how to avoid illicit discharges and how to respond to spills if they occur (spill response kits are also provided to businesses).

4.9 Public Education and Outreach

Public education and outreach is a big component of surface water and stormwater management because of the collective impacts of individual decisions on water resources. Recognizing its importance, Ecology also requires NPDES Phase II permittees, such as the City, to conduct stormwater-related public education and outreach as a condition of the permit. The City has expanded its volunteer program significantly over the last 2 years, which included the creation of a dedicated volunteer coordinator position. Volunteers interested in surface water-related activities are connected with appropriate staff. Recent projects include construction of surface water informational displays, invasive species removal, and catch basin stenciling. The City has provided support for private parties seeking water quality grant funds. No formal stewardship groups have been formed in the City, but City staff has communicated with interested residents and will continue to promote and support stewardship roles in the community.

5. The Next 6-10 Years

Surface water and stormwater management has continued to evolve in the Puget Sound region over the past 2 decades. At the same time, the region has experienced tremendous growth. Kenmore, now in its second decade of incorporation, has made many strides in the management of its surface water and stormwater resources, and this Plan will help guide the City's strategy for the next several years.

The primary surface water and stormwater issues that the City will continue to manage include:

- Swamp Creek floodplain issues.
- Flooding-related issues. Flood-related issues typically result from undersized culverts, lack of appropriate drainage systems, or changes in local hydrology.
- Groundwater issues, particularly within geologically hazardous areas of the City.
- Compliance with NPDES Phase II requirements (to be phased in by December 31, 2016), including:
    - Adoption and implementation of Surface Water Manual equivalent to Ecology's 2012 SWMMWW,
    - Implementation of LID techniques.
    - Increased inspection and maintenance frequencies.
    - Increased development review.
    - Swamp Creek TMDL.
- Issues associated with older flow control and water quality facilities and conveyance systems, both public and private, which have reached or exceeded their functional lifespan. Many of these facilities and conveyance systems are 30 to 60 years old.

Opportunities to improve water quality and reduce flow volumes in Kenmore will occur as properties are redeveloped. However, the City should also take an active approach to implementing stormwater treatment where none currently exists through available grant opportunities or incentive programs for private citizens. Recommended projects and strategies are described in the sections below.

5.1 Capital Projects

Surface water capital projects were identified to address specific surface and storm water issues in Kenmore. These issues were identified by maintenance crews, through drainage complaints or City staff. Small Works capital projects (SW-20) are intended to provide annual funding for on-going, city-wide issues that are smaller in size. Table 5-1 lists the projects, problems addressed, and associated costs. Detailed information for each capital improvement project can be found in summary sheets located in Appendix E.

Table 5-1. Updated CIP list (not fiscally constrained)

CIP Number	Basin	Description	Cost
SW-08	Tributary 0056	Final design and construction of box culvert, rockery, new sidewalk, and stream channel reconstruction of Tributary 0056 adjacent to 61st Avenue NE.	$1,111,000
SW-17	Little Swamp Creek	Replace culverts and relocate Little Swamp Creek adjacent to 80th Avenue NE to alleviate flooding.	$1,264,000
SW-19	Little Swamp Creek	Replace existing culvert with a fish-passable box culvert to alleviate flooding at NE 192nd Street.	$395,000
SW-20	City-wide	Small works projects in various basins include repair and replacement of half-pipe conveyance structures, interception of groundwater seepage, installation of new stormwater infrastructure, and improvement of a diversion structure.	$50,000
SW-21	Tributary 0056	Use ground penetrating radar to evaluate and develop preliminary design of new rockery wall adjacent to Tributary 0056 and 61st Avenue NE.	$100,000

CIP Number	Basin	Description	Cost
SW-22	Tributary 0057	Evaluate rate and risks of on-going erosion in Tributary 0057 on infrastructure and properties to determine capital project, if necessary.	$25,000
SW-23	Swamp Creek	Design and construction of a Beaver Deceiver at Wallace Swamp Creek Park sedimentation pond.	$96,400
SW-24	Sammamish River Tributaries 02 and 03	Evaluate upstream sediment sources and causes of excessive maintenance for existing sedimentation vaults and determine whether vaults should be upsized or other upstream projects should be considered.	$25,000
SW-25	Tributary 0222	Replace failing stormwater detention tanks in the Strawberry Hills neighborhood.	$459,700
SW-26	Arrowhead Creek	Replace existing stormwater detention pipe with a larger pipe and control structure adjacent in the ROW of Juanita Drive NE to provide improved stormwater flow control.	$698,200
SW-27	City-wide	Re-establish ditches throughout the City that have been impacted with sedimentation, filled, or otherwise do not function properly.	$50,000
SW-28	Swamp Creek	Install LID facilities along NE 185th Street between 64th Avenue NE and 68th Avenue NE to manage runoff in the Northlake Heights neighborhood.	$1,500,000
T-06	Tributary 0056 Lake Washington	Install water quality facilities and improve conveyance systems along NE Bothell Way between 61st Avenue NE and 65th Avenue NE.	$633,500
		Total	**$6,408,200**

There are no capital projects being recommended for Swamp Creek Wetland #3 and associated floodplains at this time. The analysis conducted for this Plan determined that the flood reduction projects completed in 2005 were adequate to protect the City's road, 73rd Avenue NE (See Appendix A, Swamp Creek Memorandum). Some properties adjacent to 73rd Avenue NE continue to have impacts from Swamp Creek due to natural processes, sediment deposition and upstream flows. The City does not have plans to purchase privately owned properties. The current funding available for surface water capital projects is approximately $600,000 per year. A preliminary schedule for design and construction of these projects is shown in Figure 5-1, which does not consider the potential for grants and loans.

Figure 5-1. CIP preliminary project schedule

5.2 Programmatic Strategies

Programmatic strategies recommended below are strategies primarily focused on tasks that need to be completed for NPDES permit compliance. Table 5-2 lists the recommended programmatic strategies and estimated costs. Programmatic strategy project sheets are included in Appendix F.

Table 5-2. List of surface water programmatic strategies (not fiscally constrained)

Project Number	Description	Estimated Cost
SProg-01	LID Code Review - Conduct city-wide review of development codes and standards and revise where necessary to ensure that LID is the preferred and commonly used approach to site development.	$46,800
SProg-02	Adopt a new stormwater manual, revise engineering standards and procedures, and conduct education and outreach to implement the manual.	$28,600
SProg-03	Develop LID infeasibility tools (e.g., an infiltration potential map) to assist City staff and permit applicants with preliminary understanding of what types of BMPs may or may not be appropriate for site conditions.	$42,900
SProg-04	Evaluation of stormwater incentive and rebate programs, including voluntary rain garden programs and initiatives used by other jurisdictions, and review of current incentive, rebate, and stormwater discount program	$14,300
SProg-05	Easement management - Evaluate existing drainage easements and whether easements need to be acquired or renewed, or policies need to be developed to address this issue.	$20,800
SProg-06	Stormwater retrofit - Identify potential stormwater retrofit opportunities and prioritize and pursue grant funding.	$24,700
SProg-07	Evaluation of landslide and groundwater issues – Conduct review of on-going landslide and groundwater seepage issues in the City where routine complaints are received to evaluate potential solutions and measures to prevent additional impacts.	$31,200
SProg-08	Culvert assessment –Conduct fish barrier analysis of Kenmore culverts and prioritize for replacement and/or replacement.	$16,500
SProg-09	SEPA Notification for Upstream Projects–Create opportunities to provide input on projects in other jurisdictions that could impact Kenmore.	$69,920
	Total	**$295,720**

Two NPDES-related programmatic projects for LID code review and stormwater manual adoption (SProg-01 and SProg-02) are tasks that need to be completed by December 31, 2016, and will require engagement by City staff at multiple levels. A third NPDES-related project to develop LID infeasibility tools (SProg-03) will help development review staff and permit applicants better understand where they may and may not be able to implement certain stormwater BMPs, in the hope of saving time and money.

Other programmatic recommendations include:

- An evaluation of possible incentive and rebate programs to encourage voluntary implementation of on-site stormwater management on residential or commercial properties (SProg-04),
- A review of easements, or lack thereof, where drainage infrastructure crosses private properties and an analysis of appropriate action, if needed (SProg-05),
- Identification and prioritization of stormwater retrofit opportunities, preferably grant eligible, for which the City should pursue (SProg-06).
- Evaluation of geologic-related issues including landslides and groundwater seepage (SProg-07); and
- A culvert assessment to evaluate Kenmore's culverts with regard to fish passage barriers (SProg-08).
- Requests to upstream jurisdictions to notify Kenmore of projects under the State Environmental Policy Act such that the City has an opportunity to provide input on projects that could impact surface water flows or water quality in Swamp Creek and other drainages (SProg-09).

It will take decades to reverse the impacts from development that occurred prior to the requirement for stormwater flow control and water quality treatment. Two programmatic measures (SProg-04 and SProg-06) could help accelerate the trend to reverse impacts by treating small areas of stormwater runoff one parcel at a time. Impacts happen cumulatively, and the collective actions of many may help reverse them. Grant opportunities have become more available for stormwater retrofits in the last few years, as Ecology has recognized that the scale of the stormwater problem and that new regulations alone will not solve the problem.

5.3 Summary

This Surface Water Master Plan presents strategies and projects in support of the City's primary surface water management goal to:

> Develop, maintain, manage and improve a surface water system that serves the community, enhances the quality of life, and protects the environment (Surface Water Element of 2014 Comprehensive Plan).

This Plan builds upon previous planning efforts, and past successes including National Pollutant Discharge Elimination System (NPDES) compliance efforts that have been implemented in response to issuance of the first Phase II Municipal Separate Storm Sewer (MS4) permit in 2007, and construction of many surface water capital projects.

Current surface and stormwater issues in Kenmore are common in the Puget Sound Region and other urban and suburban areas—untreated impervious surfaces that contribute excess flows and polluted water to streams, rivers, and lakes. Through implementation of recommended capital projects and programmatic strategies, Kenmore-specific issues associated with this underlying problem will be addressed.

Incorporating new stormwater treatment, or upgrading existing stormwater facilities to provide better treatment is a regional trend, and there are opportunities for Kenmore to take advantage of grant funding available to implement these types of projects. This Plan provides recommendations for stormwater retrofit of both outdated and undersized facilities (Capital projects SW-25 and SW-26) and areas in the City where no treatment currently exists (Capital projects SW-28 and T-06 and Programmatic Project SProg-06).

Flood-reduction projects constructed by the City in 2005 in the vicinity of 73rd Avenue NE and NE 192nd Street and property acquisitions have currently alleviated flood impacts on City infrastructure at 73rd Avenue NE, however, private properties continue to be impacted by flooding adjacent to Wetland #3 on the east side of 73rd Avenue NE. An updated analysis of flooding on Swamp Creek was conducted for this Plan, and because the City's infrastructure appears to be adequately protected from current and future predicted flooding (if upstream conditions improve through implementation of more stringent development requirements), the City does not have any plans to purchase additional private properties at this time and there are no further recommendations for flood reduction projects in the Swamp Creek area in Kenmore. However, the City will implement new procedures to receive State Environmental Policy Act (SEPA) notification from upstream jurisdictions on projects that could impact Kenmore, so that the City has an opportunity to provide input on projects that affect flows coming into Kenmore via Swamp Creek or the Sammamish River (Programmatic Project SProg-09).

Flooding and erosion issues on Tributaries 0056 and 0057 and Little Swamp Creek are other current concerns in Kenmore that are addressed with new capital projects in this Plan (Capital projects SW-08, SW-17, SW-19, SW-21 and SW-22). Programmatic Project SProg-07 also addressed City-wide landslide and groundwater issues that contribute to erosion and flooding.

Low Impact Development (LID) is soon to become the commonly used and preferred Best Management Practice (BMP) for managing stormwater impacts. The NPDES Phase II MS4 Permit requires that permittees (e.g., Kenmore) require LID by the end of 2016. For cities like Kenmore that are largely built out already, the LID BMPs most likely to be incorporated are those that infiltrate into the ground (e.g., pervious pavement and bioretention facilities). These types of LID BMPs require maintenance personnel and different maintenance frequencies, tools, and skill sets. These LID solutions also provide ancillary benefits beyond stormwater treatment, including aesthetic, cooling, and air quality benefits. Implementing LID will require significant changes to established standards and will change how developments, roads, parcels and buildings look and function. However, Kenmore's surface water and topographic characteristics will provide challenges to implementing LID due to the abundance of shallow groundwater, steep slopes, and till soils throughout the City. Several programmatic projects are recommended in this Plan for the City to be prepared to comply with the Permit and effectively implement LID BMPs appropriately throughout the City.

Administrative policies are also addressed in this Plan, which include topics that have emerged as important surface water management issues in the City but had little to no documentation or prior guidance. These topics include how the City manages private property drainage issues, and beaver and beaver dam management (particularly when they pose a threat to public welfare and safety). Additionally, a programmatic project was created to address the issue of drainage easement management, renewal, and acquisition. Modifications of existing surface water service charge policies were also addressed and modified to reflect changes in private drainage facility management.

Developing, maintaining, managing and improving a surface water system that serves the community, enhances the quality of life, and protects the environment requires a regional effort that includes governments, businesses, developers and residents to work together. This Plan provides the framework for the City to strive towards reaching this goal. As Kenmore proceeds with Plan implementation, coordination and consultation with neighboring jurisdictions and regional partners will be valuable as many cities and counties are facing similar challenges and there are opportunities for collaboration and sharing of information and lessons learned. The City will need to educate and work with businesses, developers and residents to foster behaviors and actions that achieve the City's surface water management goal and community vision.

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Appendix A:

Swamp Creek Technical Memorandum

Swamp Creek Technical Memorandum

To: Richard Sawyer, City of Kenmore Surface Water Manager

From: Erin Nelson P.E.,L.G., Altaterra Consulting LLC
Hugh Mortensen, The Watershed Company

Date: December 8, 2014

Subject: Swamp Creek Technical Memorandum

1. Introduction

Swamp Creek flooding has been a persistant issue in Kenmore for decades in the vicinity of 73rd Avenue NE and NE 192nd Street, both in the main channel upstream of the bridge located near this intersection and in the wetland complex just downstream of this bridge. The Federal Emergency Management Agency (FEMA) King County and Kenmore have invested millions of dollars over the last 20 years to control flooding, sedimentation and improve habitat through various capital projects and property acquisitions. These projects have had varying degress of success in protecting public infrastructure and reducing the frequency of flooding in some locations. However, high flows and sediment loads continue to impact Swamp Creek. Staff have prepared this report to provide City Council and the City Manager capital project and programmatic alternatives, if desired, to address this issue. The report summarizes decades of research, provides results from updates to existing hydrologic model calculations and evaluates potential outcomes for Swamp Creek surface water levels in areas of continued flooding as sediment accumulates and high flows persist.

2. Swamp Creek Basin

The Swamp Creek watershed extends north to south from Snohomish County to the City of Kenmore where Swamp Creek meets the Sammamish River and enters Lake Washington (Figure 1). Over 95 percent of the 24 square-mile watershed is within Snohomish County, including about 20% in the City of Lynnwod and smaller portions within the cities of Bothell, Brier, Everett and Mountlake Terrace. Once Swamp Creek passes into Kenmore, it flows approximately 2,700 feet where it reaches a sediment pond in Wallace Swamp Creek Park. From the pond, it flows another 2,000 feet before reaching the 73RD Avenue NE bridge, which was constructed in 2005. From the bridge, Swamp Creek flows east-southeast into a large wetland complex (Wetland #3) where the main channel becomes braided into numerous shallow streams which wind through the wetland. Approximately 3,500 feet southeast of the bridge, Swamp Creek re-establishes itself as a single channel and continues under State Route 522 to the Sammamish River.

> "The Swamp Creek watershed lies on the intercity plateau, an upland till plateau between Puget Sound and the Snohomish River. Most of the northern two-thirds of the watershed is moderately sloped, undulating terrain draining to the stream network as it traversed the till plateau. Downstream of I-5, the stream corridor enters an outwash valley consisting of recessional outwash embedded in advance outwash, with the intervening till typical of glacial formations largely missing. The channel flows primarily through advance outwash between I-5 and Scriber Creek and again south of the county line: in between, the channel traverses recessional outwash.

(Personal communication, Derek Booth, University of Washington, January 25, 2002 described in *Snohomish County Drainage Needs Report* [Snohomish County, 2002]).”

Advance and recessional outwash deposits are typically very erodible and highly mobile under the high flows that have been documented in Swamp Creek. These geologic and topographic conditions north of Kenmore and Wetland #3 is consistent with the large volumes of sediment that are being transported and deposited in the downstream Swamp Creek reaches in Kenmore.

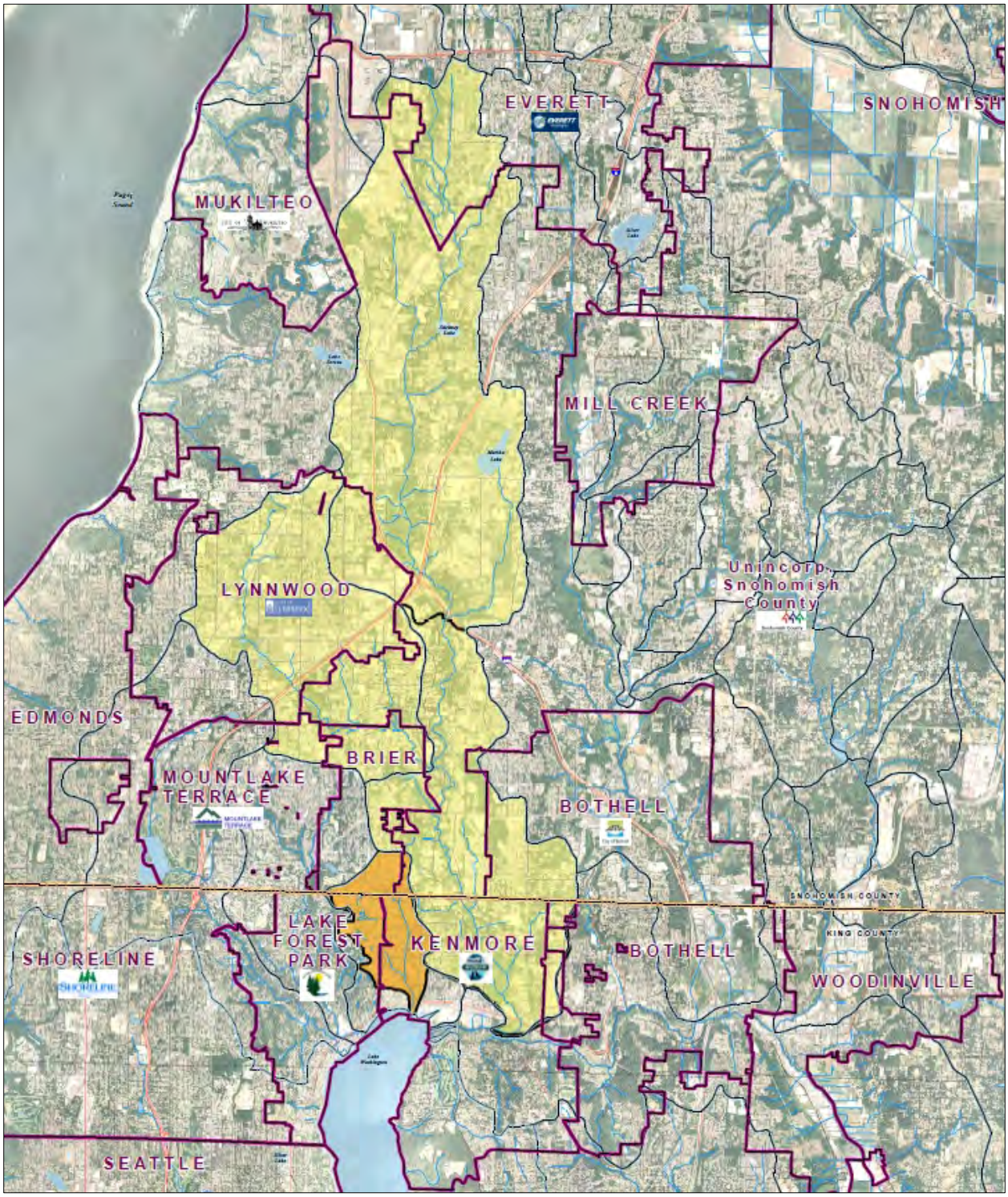


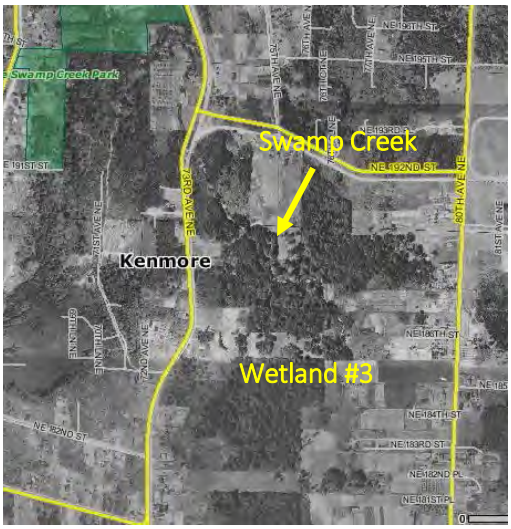
Figure 1. Swamp Creek Basin

3. History

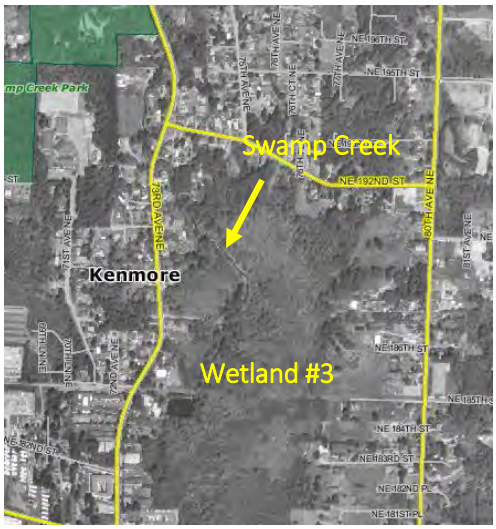
Much like the rest of Puget Sound, the Swamp Creek basin has experienced significant increases in population and land development over the years. Even before the extensive development, historical documentation indicates that flooding associated with Swamp Creek has been occurring in Kenmore for decades.

3.1 Development

The Swamp Creek basin has experienced significant growth and development over the last 80 years. Snohomish County's population alone grew approximately 40% from 1990 to 2010 (Snohomish County Growth Monitoring Reports, 1999 and 2014). Aerial photographs of Kenmore from 1936 and 1998 show land use changes in the vicinity of Swamp Creek (Figure 2). Wetland #3 and the Swamp Creek channel configuration within the wetland have remained relatively unchanged in size. However, the surrounding land has been extensively developed.



1936 Aerial Photograph



1998 Aerial Photograph

Figure 2. Land use changes in the vicinity of Kenmore and Swamp Creek. Wetland #3 has been developed on its flanks and has largely filled in with woody vegetation, but remains undeveloped. Swamp Creek is in roughly the same configuration in both photos.

Surface water development standards and regulations began taking shape in the 1980's and have slowly become more stringent, particularly since the implementation of National Pollutant Discharge Elimination System (NPDES) municipal stormwater permits in Washington State over the last 10 years. Despite the stringent regulations, a significant amount of existing development, if not the majority of it, has been constructed with little to no surface water mitigation. A review of the hydrologic modeling parameters and predicted future land uses assuming built out conditions based on 2002 Snohomish County zoning indicated an increase of approximately 1,849 acres of effective impervious surfaces. The modeling estimated over 350 acre-feet of detention would be needed under the future land use assuming detention standards in Snohomish County Title 24 in 2002 (approximately 18 percent of the effective impervious area). Existing effective impervious area in the 2002 Snohomish County Drainage Needs Report was estimated to be 2,485 acres. Assuming that only a small fraction of the 2002 impervious surfaces in the Swamp Creek watershed were treated with stormwater detention facilities, and applying the ballpark ratio modeled above (acre-feet of detention required equals 18 percent of total effective impervious area), the 2002 existing impervious surfaces would require up to 470 acre-feet of detention to

meet the 2002 standards. One acre foot is equivelant to one foot of water covering an acre of area. Figure 3 provides a visualization of how mcuh area would be needed to detain 470 acre feet of water, using Kenmore as an example. Ecology's most recent 2012 Western Washington Stormwater Management Manual requires even more stringent standards with the goal of mimicing surface water flows that would have occurred under forested conditions prior to any development (Ecology 2012). The new standards would require even more area to manage flows.

Figure 3. Example of area needed to detain 470 acre-feet of stormwater, using Kenmore as a visual. Area shown would be under 4-feet of water to achieve the necessary volume.

3.2 Flooding

Within the City of Kenmore, Swamp Creek has flooded multiple times over the past 50 years, and the City and King County (prior to Kenmore's incorporation in 1998) have conducted several basin and flood reduction studies and implemented a variety of projects and approaches to minimize flood-related impacts to property and infrastructure. Still, Swamp Creek continues to flood.

Historical documentation indicates that flooding associated with Swamp Creek has been occurring in Kenmore for decades. 1934 photos from the University of Washington shows extensive flood damage near the mouth of Swamp Creek at the Sammamish River and Bothell Way (Photo 1 and Photo 2)

Property of MSCUA, University of Washington Libraries. Photo Coll 263

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Photo 1. Flood damage in 1934 on Swamp Creek

Property of MSCUA, University of Washington Libraries. Photo Coll 263

Photo 2. Cleaning up from flood damage on Swamp Creek in 1934

Large precipitation events that resulted in flooding occurred in 1997, 2005, 2006, and 2007 (Table 1) (Otak, City Council Packet March 23, 2009). Photos of these events and a 1980 flood event and Muck Creek flooding are shown in Photos 3 through 7.

Table 1. Summary of rainfall and flow statistics for storm events that caused flooding

Rainfall Summary	January 1997	December 2005	January 2006	December 2007
24-hour rainfall	2.32 inches	0.93 inches	2.63 inches	3.63 inches
1-day flood level	10 year	< 2 year	25 year	100 year
Total storm precipitation	4.7 inches (12/29 – 12/31)	2.4 inches (12/22 – 12/25)	3.1 inches (1/28 – 1/30)	4.7 inches (12/2 – 12/3)
Estimated flow (cfs)	970	425	700	1,100

Photo 3. January 1980 flood event at 19070 73rd Avenue NE(March 23, 2009, City Council Packet)

Photo 4. January 1997 flood eventat 19070 73rd Avenue NE (March 23, 2009, City Council Packet)

Photo 5. January 2006 flood event at Wallace Park (March 23, 2009, City Council Packet)

Photo 6. 2007 flood event (~1,100 cfs) at Wallace Park Bridge (March 23, 2009, City Council Packet)

Photo 7. Muck Creek flooding at 73rd Avenue NE crossing (March 23, 2009, City Council Packet)

3.3 Studies and Projects Completed

As part of efforts to reduce flooding on Swamp Creek, King County, the City of Kenmore, and Snohomish County have conducted various studies and constructed flood reduction projects. Figure 4 shows studies and actions completed over the years. A discussion of relevant studies and projects completed are described below.

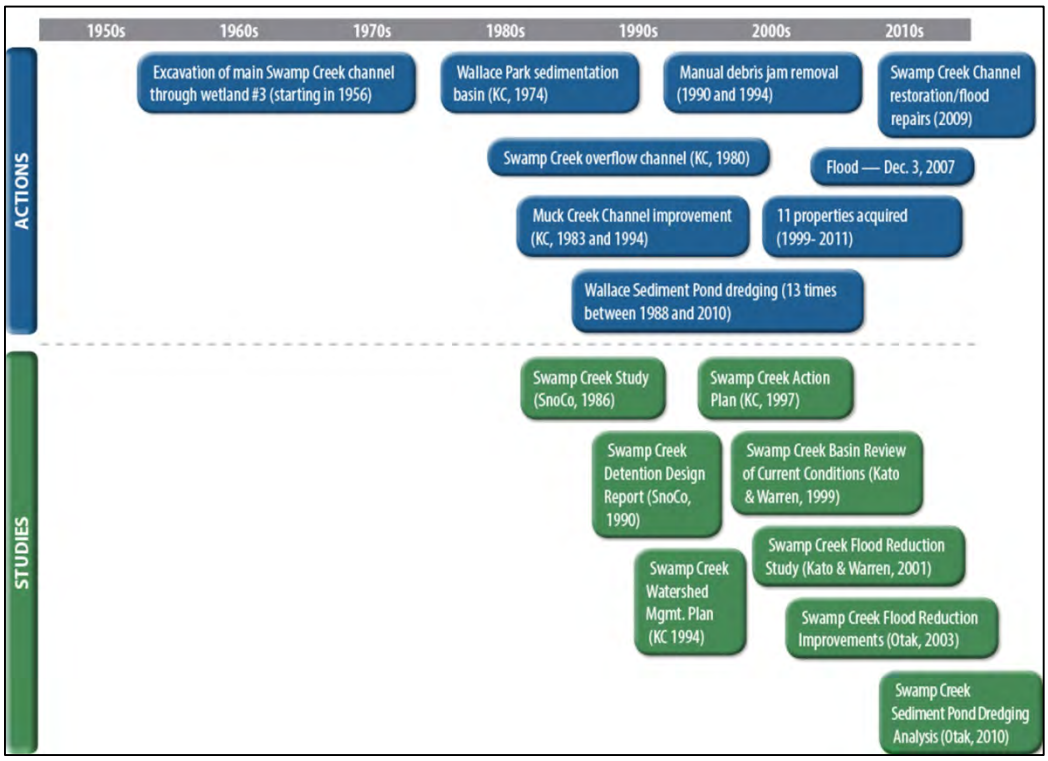

Figure 4. Actions and studies conducted on Swamp Creek

3.3.1 Sediment Transport Analysis

Sediment transport analysis was conducted in 2002 for the flood reduction projects that were completed in 2005 (West Consultants 2002). Hydraulic data coupled with estimates of sediment particle sizes in different reaches within the flood reduction project vicinity were used to evaluate the potential for sediment of various sizes to be mobilized under different flow scenarios. Some factors that influence sediment transport are sediment supply, particle sizes, channel gradient, and flow velocities. Swamp Creek was broken into reaches from the Wallace Swamp Creek Park sedimentation pond to the Sammamish River for sediment transport analysis. The reaches where flooding occurs currently include reaches 2, 3, and 4 shown in Figure 5 (between the 73rd Avenue bridge and approximately 600 feet downstream of the Tolt pipeline). Reaches 3 and 4 are downstream of the confluence with Muck Creek, and these reaches are flatter and have 50 percent lower average velocities for the 2-year flow event than reach 2. An analysis of incipient motion characteristics for sediment particle sizes within each reach was evaluated for general erosion, armoring, and deposition of sediments from upstream. In reaches 3 and 4, the incipient motion analysis indicates that Swamp Creek is not capable of transporting the majority of sediment that would be supplied from upstream, making it a depositional reach for flows ranging from the 1-year to 100-year events. The analysis indicates reach 2, between the 73rd Ave NE bridge and Muck Creek, is capable of transporting much of the upstream sediment load.

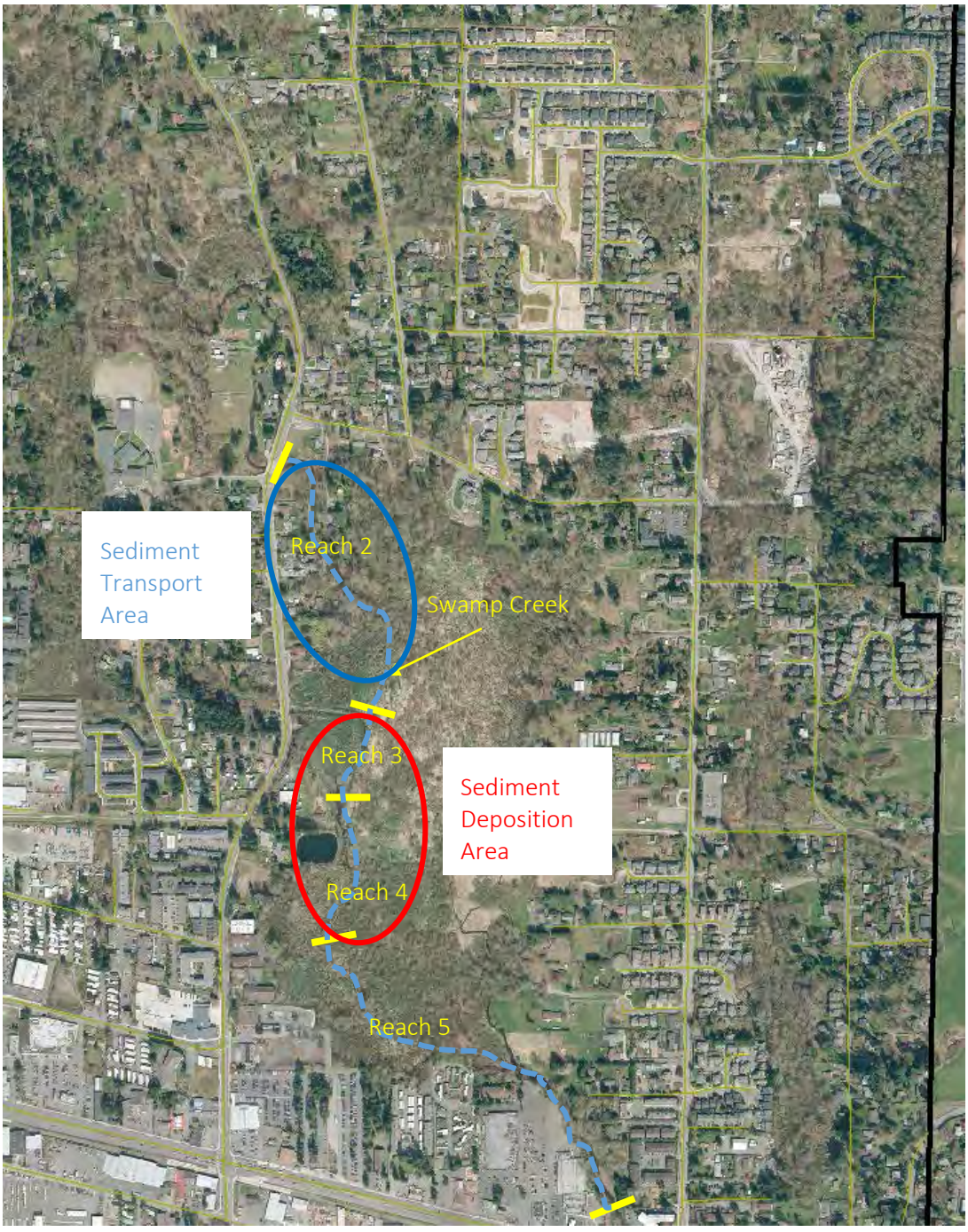

Figure 5. Approximate location of reaches evaluated in Sediment Trasnport Analysis (West Consultants. 2002)

3.3.2 Constructed City of Kenmore Capital Projects

The City has implemented several improvements geared at reducing flooding and flood damage adjacent to Swamp Creek. Table 2 lists the capital improvement projects completed prior to 2009, including the acquisition of several homes.

Table 2. Capital projects completed in Kenmore (pre-2009)

Year	Project Completed	
2008	FEMA flood damage repairs (from December 2007 flood)	
2006	Wallace Swamp Creek Park study and construction	Creation of habitat bypass channel
		Weir modifications
		Installation of plant materials
2005	73rd Avenue flood reduction improvements	Raise school access road
		Replace 73rd Avenue bridge over Swamp Creek
		Swamp Creek main channel flood reduction and habitat improvements
		Raise 73rd Avenue at Muck Creek
		73th Avenue drainage revisions
		Property acquisitions

Figure 6 shows City owned properties highlighted in orange that have been purchased by FEMA, King County and the City in an effort to manage Swamp Creek. Privately owned properties, shown in red, continue to experience impacts from Swamp Creek.

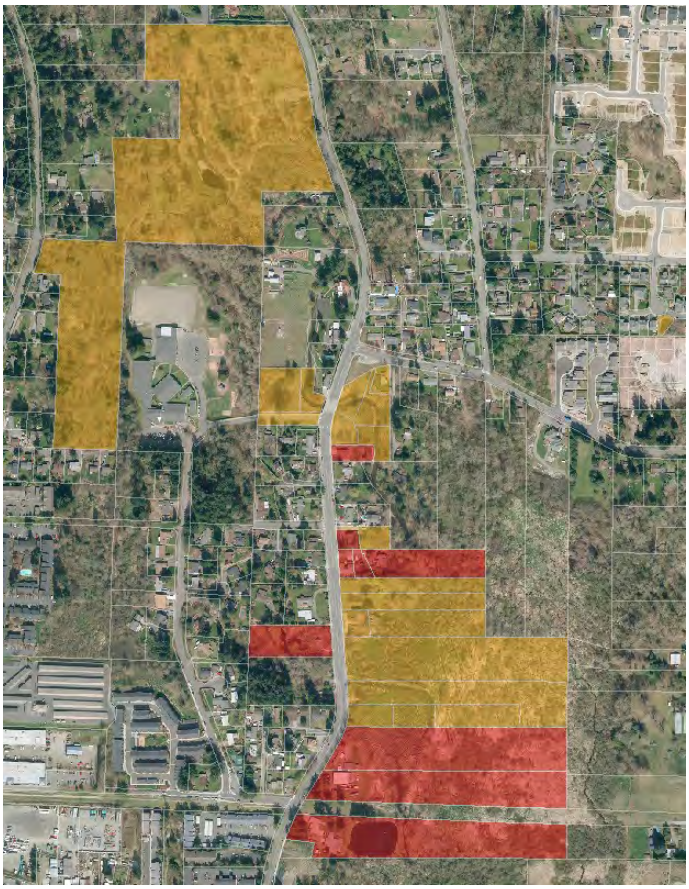

Figure 6 – City owned properties along Swamp Creek are highlighted orange. Privately owned properties that continue to experience impacts from Swamp Creek are shown in red.

Wallace Swamp Creek Park Sedimentation Pond

The Wallace Swamp Creek sedimentation pond provides an opportunity to understand the sediment volumes that are eroded from upstream Swamp Creek reaches and mobilized to downstream Swamp Creek reaches within Kenmore.

The City removes sediment from the Wallace Swamp Creek Park sedimentation pond (constructed by King County) almost every year. The City has considered ceasing dredging operations on occasions in the past due to the maintenance expense. The sedimentation pond has been the source of several recommended basin actions in the last 20 years, including the following:

- Expansion of the existing sedimentation basin to improve efficiency (King County 1997) – not completed.
- Creation of Wallace Park by-pass channel to divert flows around the sedimentation basin during maintenance (King County 1997) – completed.
- Construction of a new outlet structure to reduce overbank flood volumes, depths, and erosion during severe storms (Kato and Warren, 2001) – completed.
- Kenmore considered decommissioning the pond in 2001. GeoEngineers conducted a geomorphic evaluation and discussed potential ongoing downstream deposition, channel aggradation, and local flooding that may result.
- Repair of flood damage in the bypass channel and sedimentation pond from December 2007 flood event – completed in 2009.
- Otak conducted an analysis of sediment dredging in 2010 and recommended a potential trigger elevation of 55 feet based on the fall 2008 dredging design elevation and historical dredging data.

According to Otak's 2010 dredging analysis, sediment was removed from the pond 13 times between 1988 and 2010. The volume of sediment removed ranged from 500 cubic yards (2002) to 3,500 cubic yards (1996), with a mean dredging volume of 1,464 cubic yards. The sedimentation pond had significant accumulation of gravel and cobbles during a field visit in April 2013 (Photo 8) and was since dredged in August 2013 (3,400 cubic yards) and again in July 2014 (2,800 cubic yards).

Photo 8. Wallace Swamp Creek Park sedimentation pond looking upstream

4. Current Swamp Creek Conditions in Kenmore

The focus of this Swamp Creek evaluation was on Wetland #3 in the vicinity of flood-related problems. Current conditions described below are based on survey data collected in October 2013, a field visit in April 2014, and a description of current complaints (fall 2014) provided by the City.

4.1 Sediment Deposition in Wetland #3

Cross sections of Swamp Creek through Wetland #3 were surveyed during the 73rd Avenue flood reduction projects in 2004. Several of these cross sections were resurveyed in 2013 in order to evaluate sediment deposition rates in Wetland #3 and determine whether sediment deposition was reducing the Swamp Creek channel conveyance capacity in this area. Figures 7 (upstream) and Figure 8 (downstream) show the channel cross sections and relative position in the wetland. A comparison of the cross section data indicates deposition is occurring in the vicinity of 73rd Avenue NE and the confluence within Muck Creek. Downstream cross sections (Figure 8) indicate no deposition or slight erosion. Cross section F, the most northerly cross section surveyed in Wetland #3, shows some channel migration from west to east. Deposition as shown on the cross sections ranges from 1.5 to 6 feet in the area surveyed. If an average deposition of 3 feet is assumed across the reach (estimated to be 1,800 feet) and the average channel width is 20 feet, approximately 4,000 cubic yards of sediment were deposited in the 9 years between measurements (less than 450 cubic yards per year). These estimated provide an approximation of deposition rates in Wetland #3, which are consistent with the previous sediment transport evaluation that indicated this area is a depositional environment (West Consultants, 2002). The hydraulic model used in the 2004 flood reduction projects was re-ran with the 2013 cross section data to evaluate the effect of sedimentation on water surface levels. Model results indicate water level changes between the 73rd Avenue NE bridge and the Tolt pipeline range from a decrease of 0.71 feet to an increase of 0.47 feet at the 2-year flow event and a decrease of 0.12 feet to an increase of 0.22 feet at the 100-year flow event. The changes in water surface elevation occur at different cross sections through the wetland, and the greatest increases are on properties already owned by Kenmore. Modeling results are presented in Attachment A.

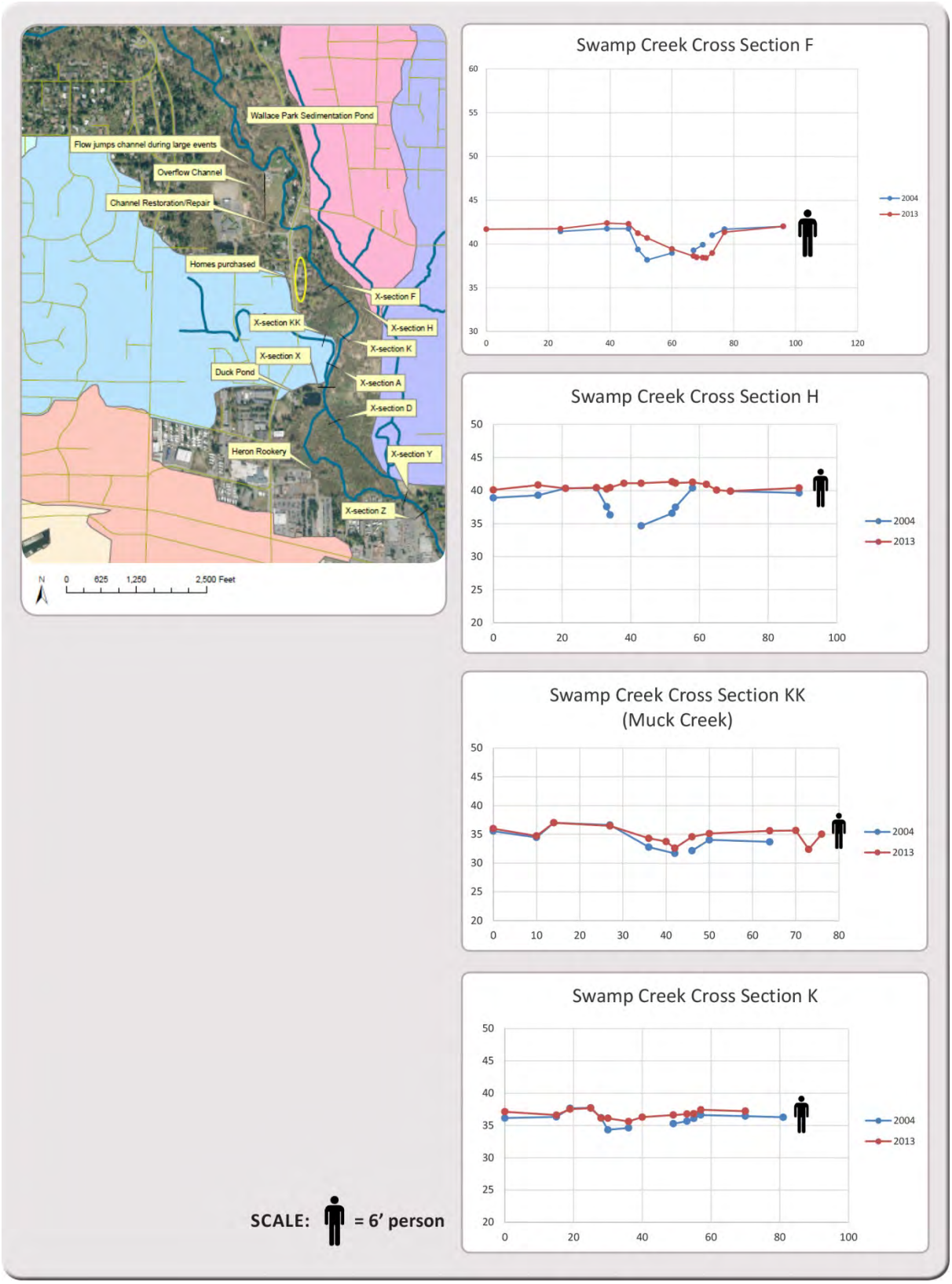

Figure 7. Upstream Wetland #3 cross sections

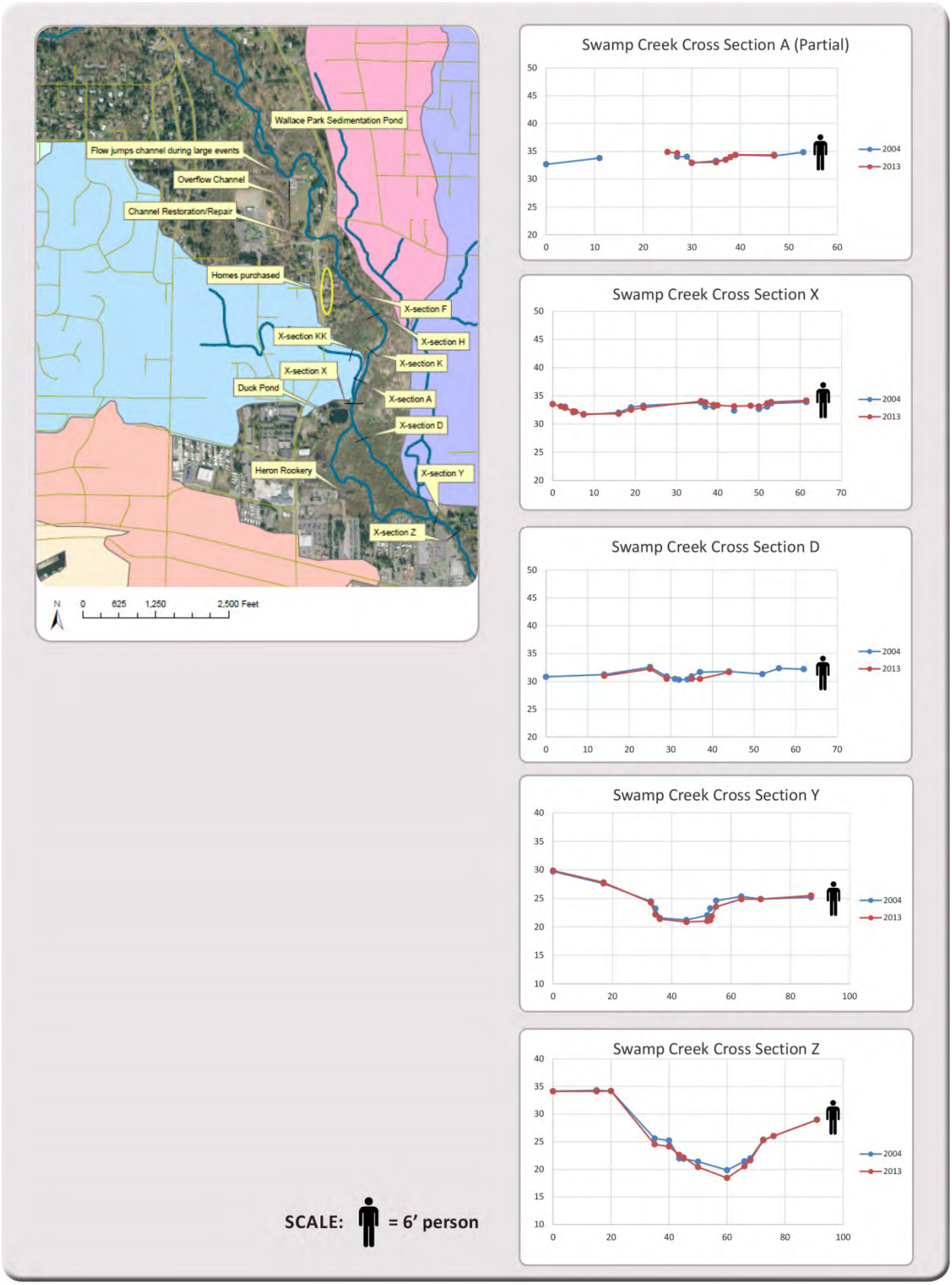

Figure 8. Downstream Wetland #3 cross sections

4.2 On-going Flooding

Based on recent complaints received by the City, several properties on the east side of 73rd Avenue NE adjacent to Wetland #3 continue to be affected by flooding, even by smaller flow events (i.e., 2-year or less). Many of these properties were expected to continue flooding even after the flood reduction projects (e.g., the 73rd Avenue NE bridge replacement) since the focus of those projects was to reduce flooding upstream of the 73rd Avenue NE bridge. Table 3 lists the house numbers and parcel identification numbers (PINs) on 73rd Avenue NE currently being affected and anticipated impacts reported in Otak's *Swamp Creek Flood Reduction Improvements- Phase I Design Report* (Otak, 2003).

In addition to a review of predicted flooding in Otak's 2003 study and current complaints received by the City, hydraulic modeling was conducted with the new 2013 cross section data that shows sedimentation to evaluate changes in water surface elevations at different flow events and whether 73rd Avenue NE would potentially be impacted by flooding during the 100-year flood event. Current predicted changes to water surface elevations at the 2-year event are also included in Table 3. Based on the current modeling results, 73rd Avenue NE should not be overtopped during the 100-year flood event.

Table 3. Summary of Current and Predicted Flooding Impacts

Swamp Creek Properties Along 73RD AVE NE (From North to South)			
House Number and Parcel Identification Number	Current Impacts (Updated Fall 2014)	Predicted Flooding*	Special Conditions
19034 *0114-100709*	Property Flooding December 2012	Property flooding at 5-year event (Otak 2003)	
19026 *0114-100698*	No Known Flooding of Property or Structures	Property flooding at 5-year event (Otak 2003) No change in 2-year water surface elevation (2014)	
19016 *0114-100697*	No Known Flooding of Property or Structures	Property flooding at 2-year event (Otak 2003) No change in 2-year water surface elevation (2014)	
19010 *0114-100702*	No Known Flooding of Property or Structures	No impacts noted (Otak 2003) No significant (<0.1 foot lower) change in 2-year water surface elevation (2014)	
18926 *0114-100700*	Property Flooding (Vacant) October 2014	Property flooding at 5-year event (Otak 2003) No significant (~0.14 foot lower) change in 2-year water surface elevation (2014)	City of Kenmore Owns Property
19004 *0114-100701*	No Known Flooding of Property or Structures	Potential house flooding (within 1 foot of finished first floor) at 5-year event (Otak 2003)	2005 agreement with City to accept funds to raise home.

		No significant (<0.1 foot lower) change in 2-year water surface elevation (2014)	City released of flooding liability
18922 *0114-100699*	Property Flooding October 2014	Potential house flooding (within 1 foot of finished first floor) at 2-year event (Otak 2003) No signicant (~0.13 foot lower) change in 2-year water surface elevation (2014)	2005 agreement with City to accept funds to raise home. City released of flooding liability
18904 *0114-101017*	Property flooding October 2014	Property flooding at 2-year event (Otak 2003) No significant (~0.13 foot lower) change in 2-year water surface elevation (2014)	
18908 *0114-101011*	Property flooding October 2014	Potential house flooding (within 1 foot of finished first floor) at 2-year event (Otak 2003) No significant (<0.1 foot lower) change in 2-year water surface elevation (2014)	2005 agreement with City to accept funds to raise home. City released of flooding liability
18918 *0114-101015*	Property flooding October 2014	Property flooding at 2-year event (Otak 2003) No significant (<0.1 foot) change in 2-year water surface elevation (2014)	2005 agreement with City to accept funds to raise home. City released of flooding liability
0114-100995 to *0114-101012*	Property Flooding (Vacant) October 2014	Property flooding at 2-year event (Otak 2003) Increase (~0.47 foot) in water surface elevation at 2-year event (2014)	City of Kenmore Owns Properties (9)
18522 *0114-100990*	Property flooding September 2013	No impacts noted in report. Increase (~0.27 foot) in water surface elevation at 2-year event (2014)	
18510 *0114-100985*	Property flooding September 2013	No impacts noted in report. Increase (~0.27 foot) in water surface elevation at 2-year event (2014	
18254 *0114-100979*	Property flooding September 2010	No impacts noted in report. No significant (<0.1 foot) change in 2-year water surface elevation (2014)	
18727 *0114-100410*	Property Flooding October 2014		

*Hydraulic modeling was conducted in 2003 and again in 2014 using new data obtained in Wetland #3 to evaluate changes in water surface elevation compared to the 2003 modeled results.

4.3 Ecological Conditions

Swamp Creek Wetland #3 is the largest wetland in Kenmore. It is a complex riparian wetland that receives hydrology from overbank flooding of Swamp Creek, Little Swamp Creek, and several smaller tributaries. It also receives groundwater inputs from seeps along the valley slopes. Wetland #3 qualifies as a Class 1 wetland per KMC 18.55.090 due to its exceptional local significance and proximity to and influence on Swamp Creek. While the wetland has not been formally rated under the state classification system (which was just revised in July), it would likely rate as either Category 1 or 2.

The wetland is dominated by native shrub and tree vegetation, but also contains large expanses of reed canary grass in the central portion that are likely relic agricultural pastures (see 1936 aerial photo – Figure 2). The wetland offers good forage and nesting habitat for birds (including a large great blue heron rookery) and good forage and shelter habitat for amphibians, reptiles, and small mammals. Ponded areas in the wetland provide resting sites for migrating and resident waterfowl.

Water depths appear to be increasing in and around the Oregon ash forest that supports the great blue heron rookery. While Oregon ash trees tolerate inundation better than most other native trees, there is a risk that future increases in water depths, especially during the growing season, will eventually cause the decline and subsequent loss of the rookery trees. The decline will most likely be gradual with the most inundated trees losing leaves and eventually dying over the course of several seasons. Nests will be abandoned as the trees die, either gradually or if they topple from loss of soil support and/or decay. In general, increasing water depths will favor reed canary grass and, where deep enough, some areas may transition to a more aquatic-bed (floating-leaved plants) vegetation type.

4.4 Factors that Contribute to Flooding

There are multiple factors that likely contribute to flooding in Swamp Creek and particularly adjacent to Wetland #3 in Kenmore. These factors have been discussed previously, but it's worth repeating here. Urbanization and resulting increases in impervious surface without commensurate stormwater controls are considered to be the primary factors that have contributed to continued flooding and sedimentation issues in this part of the basin (King County, 1997; Kato and Warren 1999). As alluded to above, there is not nearly enough detention in upstream basins to account for stormwater impacts in Kenmore. Other factors likely include:

- Previous filling of area wetlands that formerly provided natural flood storage (King County 1997).
- Kenmore's position in the watershed – Kenmore is at the lowest point within the basin, and sedimentation is common in low gradient reaches that are preceded by higher gradient erosive reaches such as are present in the Swamp Creek watershed in Snohomish County (Figure 9 shows the local gradient in the vicinity of Wetland #3).
- Change in active management of the Swamp Creek channel within Wetland #3 – sedimentation in Wetland #3 was likely managed in the past, starting with excavation of the main Swamp Creek channel in 1956. The open channel was likely maintained for many years through periodic dredging, as was common during this era to drain pasture land and adjacent crops.

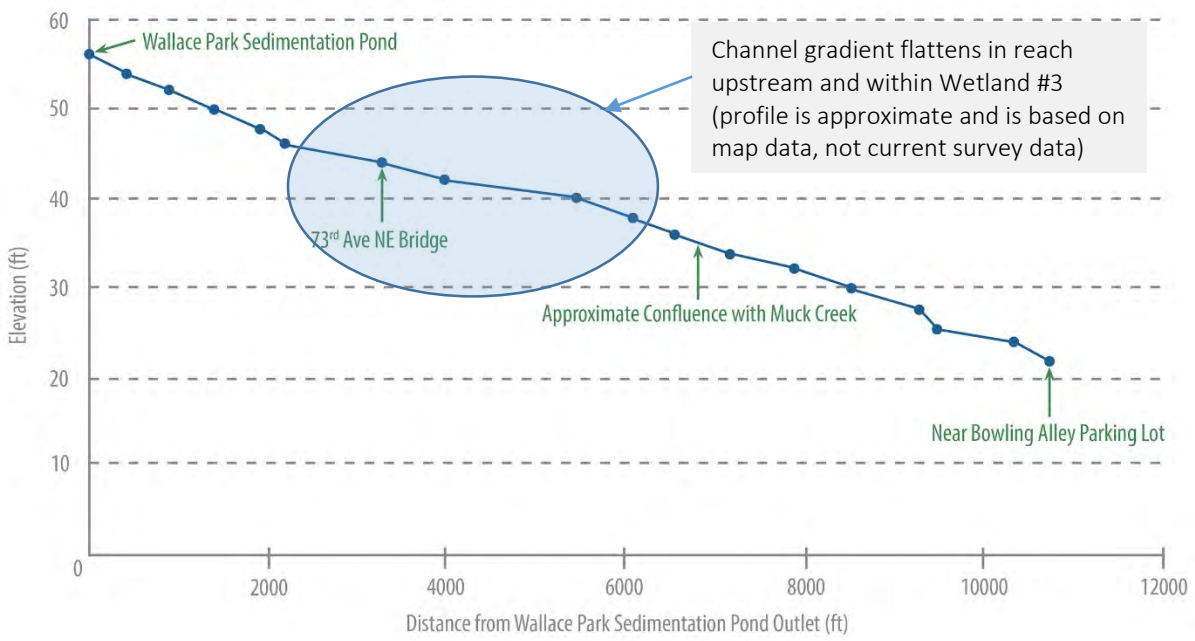

Figure 9. Swamp Creek channel profile in vicinity of Wetland #3

Since at least 1998 (see aerial photograph in Figure 2) and probably earlier, homes have been built adjacent to Wetland #3 in a floodplain environment. The location of infrastructure and homes in this area has resulted in property damage by flooding and acquisition by the City and King County to minimize losses.

5. Alternatives

The ultimate goal of this evaluation is to provide City Council with alternatives to address the ongoing flooding issues in Swamp Creek. While reviewing alternatives, it is important to consider the the current and potential future impacts of Swamp Creek with regard to three different goals, including protection of 1) public infrastructure 2) privately owned properties, and 3) wetland habitat. Updated modeling results indicate that 73rd Avenue NE will not be impacted by a 100-year storm event in both current or potential future conditions. No additional action would be required by the City for protection of public infrastructure for a relatively infrequent 100-year flow event.

Several privately owned properties along 73rd Avenue NE will be impacted in both current and potential future conditions (see Table 3). These properties are also identified on FEMA's Flood Insurance Rate Map (FIRM) as being located within the 100 year flood zone. The City is not legally obligated to protect these homes from Swamp Creek flood waters, which come from upstream jurisdictions (the overwhelming majority of the watershed is outside of Kenmore).

Wetland #3 is a high quality wetland. Under current conditions, the wetland will persist mainly in its current state that includes patches of invasive reed canarygrass with hedgerows, pockets, and large fringes of mainly native- shrubs and trees. Tree and shrub health may decline in the sediment deposition area shown on Figure 5 along with increases in wetland water levels. Future deposition of sediment and episodic heavy flows may alter the spatial distribution of plant and animal communities over time within the wetland, but the overall quality of the wetland would be expected to remain high.

5.1 Previous Basinwide Projects and Strategies

There are multiple ways to approach the flooding problem occuring in Kenmore, including: 1) developing strategies to reduce the causes of the problem (e.g. flow and sediment transport); 2) engineering solutions that deal with flooding where it occurs; and 3) protecting properties and infrastructure from flood damages when it occurs.

These are the types of projects and strategies that have been identified in previous studies, some of which have been implemented with varying degrees of success.

Table 4 lists previously identified flood reduction projects and strategies and the current relevance for today's flooding problem.

Table 4. Summary of Previously Identified Flood Reduction Projects and Strategies

Type of Project	Project Description	Current Relevance
Regional detention	Scriber Creek above confluence with Swamp Creek – Lynnwood and Snohomish County (1996)	Regional detention upstream in the Swamp Creek basin should continue to be pursued as one part of the overall approach to flood reduction in Kenmore. However, it will need to be widespread to make a difference and would take decades (if not longer) to achieve results.
	Topsoil site at 46th Avenue W and 204th Street SW – near Lynnwood Park and Ride (1996)	
	North of 164 th Street SW between Manor Way and 22nd Avenue W in Snohomish County (1996)	
	Downstream of Alderwood Mall – Lynnwood and Snohomish County (1996)	
	Wallace Park in Kenmore (1996)	Regional detention in Kenmore at Wallace Park will likely not be very effective without upstream detention given its low position in the watershed (95 percent of the basin is upstream).
Flood and Erosion Reduction	Sediment removal in Swamp Creek downstream of 73rd Avenue NE • Debris jams in this location in the early 1990s caused accumulation of sediment, logs, and litter, backing up water. Sediment removal was proposed as a follow-on project to debris jam removal that was conducted manually.	Estimates of sediment deposition in Swamp Creek within Wetland #3 is less than 450 cubic yards per year, less than half of what is removed from the Wallace Park sedimentation pond annually. Sediment removal to improve conveyance capacity may alleviate some of the localized flooding. Modeling was conducted to determine impacts from sedimentation and potential flood reduction benefits from dredging. Results are discussed below.
	Debris trap at 73rd Avenue NE	More information needed to evaluate this option.
	Wallace Park sedimentation basin expansion	Expansion of the sedimentation pond could reduce dredging frequency. It is unclear if it would reduce flooding. The sedimentation pond appears to collect larger material, whereas smaller material is likely passed through and settled out in Wetland #3.
	Interlocal coordination for regional stormwater facilities outside of King County	Still relevant in order to coordinate regional flow control to alleviate flooding in the entire Swamp Creek watershed.

Type of Project	Project Description	Current Relevance
Flood and Erosion Reduction (continued)	Selective local berming • Relief for some flooded properties	This could potentially be a short-term approach to limiting local property damage, but would not be considered a long-term solution.
	Improve capacity of Swamp Creek overflow channel (west side of Llama farm property)	May reduce flooding upstream of 73rd Avenue NE, but overflow channel re-enters Swamp Creek prior to Wetland #3 and may not have any effect on properties in that vicinity that are currently flooded.
	Leary/King bank stabilization • Plant streambank to alleviate residential flooding upstream of 73rd Avenue on Leary and King properties	May have limited effectiveness for flooding, but positive benefits for habitat.
	Carter Road bank stabilization coordination • Upstream source of sediment	Likely still relevant – needs evaluation with respect to sediment transport.
	Biofiltration swales in roadside ditches • Reduce sediment transport	Positive benefits for water quality and marginal reduction in sediment sources to Swamp Creek. Would need to be widespread to make a difference.
	Ongoing debris removal • Work with private property owners to manually remove debris on an as-needed basis in Wetland #3	Relevant in that debris jams have a role in local sedimentation and channel movement that could result in new areas being flooded.
	Wallace Park by-pass • By-pass to temporarily route flows around Wallace Pond during maintenance	This project was completed.
Open Space, Taxation, and Property Acquisition	Pursue acquisition of significant lands	Needs to be evaluated to determine if property acquisition upstream in areas that could be converted or modified to provide flood storage would deliver a flood-reduction benefit.
	Register interested residents into the Public Benefit Rating System (open space)	Unclear how this would alleviate flooding. Wetland #3 is undeveloped and critical areas regulations prevent future development.
	Pursue acquisition of chronic flood-prone properties	Several flood-prone properties have been acquired; consider further acquisition for current flood-prone properties.

Type of Project	Project Description	Current Relevance
Wetland Management	Long-term wetland management plan • Remove debris jams, restore old main channel in Swamp Creek Wetland #3 • Remove reed canary grass – re-introduce native vegetation • Annual channel maintenance	Similar to sediment removal in Swamp Creek project listed above under flood and erosion reduction, channel maintenance and wetland management may help improve conveyance through Wetland #3 and alleviate flooding.
	Wetland community link project • Long-term monitoring by community members	Could provide positive benefits, but may not be effective at reducing flood risks.
	Reed canary grass working group • Share information regarding control of reed canary grass	In addition to sedimentation, reed canary grass plays a role in limiting conveyance capacity in Wetland #3. Efforts to control reed canary grass should be explored.
Infrastructure	Replace 73rd Avenue NE bridge with a longer span	Project completed.
	Construct overflow spillway for Wallace Park sediment pond	Project completed.
	Construct berm north of the access road to Kenmore Elementary school	Project completed.
	Elevate police precinct parking lot and access road serving Kenmore Park and Ride	Police department has moved, however, property is still wet. Future redevelopment will need to identify options to reduce flooding.
	Construct berms to protect private properties located east of Kenmore Park and Ride	Redevelopment will need to identify options to reduce local flooding.
	Replace undersized culverts in Muck Creek, including culverts draining the Northshore Utility District headquarters	Project completed.
	Raise 73rd Avenue NE above the 100-year floodplain at the low point near Muck Creek	Project completed.

5.2 Upstream Alternatives

Regional detention facilities in jurisdictions upstream of Kenmore have been considered in the past (Table 4), and specific locations have been identified. As discussed above, the 2002 Snohomish County Drainage Needs Report hydrologic modeling indicated that up to 350 acre-feet of detention would be required for 1,800 acres of new effective impervious surfaces that will likely occur with future development. Much of the basin was developed prior to 1990 with little to no flow control, and, based on a limited review of Snohomish County documents, there is still very few detention facilities in the Swamp Creek basin. Retrofitting the existing impervious surfaces and providing detention for new impervious surfaces is a significant effort and would take decades (if not longer) to realize any effect in Kenmore. Nonetheless, steps should be taken to begin the process of controlling upstream flows, and the City should continue to work with Snohomish County and other upstream jurisdictions in this regard. Regional surface water development standards have become much more protective, however, therse standards are only applied as properties develop or redevelop.

Additionally, the City should work with Snohomish County and upstream jurisdictions to ensure that local flood reduction projects (e.g., increasing culvert capacities in Lynnwood and Snohomish County) do not exacerbate flooding in Kenmore. Undersized culverts that cause backwater flooding could be providing some flood reduction benefits downstream.

5.3 City of Kenmore Alternatives

The City of Kenmore's goal is to reduce flood-related impacts at the least possible cost. Considerable time and resources have been spent by the City and previously by King County on the Swamp Creek flooding issue. Millions of dollars have been spent on flood reduction efforts, including acquisitions of flood-prone properties and capital projects associated with infrastructure and conveyance improvements in Swamp Creek. The funding for much of this work was from King County as mitigation for and protection of the Brightwater Treatment Plant sanitary sewer trunk line that traverses the area.Potential flood-management alternatives the City could enact are described in Table 5.

Table 5. List of Alternatives

Alternative	Description	Considerations
1. Emergency Planning	This alternative assumes that no actions are taken until necessary – when flooding happens.	• Permitting for flood damage repairs would happen after the fact • Risk for property and infrastructure damage • Potential short- and long-term ecological consequences from emergency work or allowing elevated water levels • Lower up-front cost
2. Property Acquisition	Purchase up to 11 properties in what has historically been the flood-prone area	• Large up-front cost • May not completely solve flooding problem, if upstream or channel conditions change
3. Sediment Removal and Maintenance	Conduct routine channel maintenance, including debris, sediment, and reed canary grass removal to improve conveyance through Wetland #3	• Extensive permitting process • Slight water surface elevation improvement. See discussion below.

5.3.1 Alternative 1: Emergency Planning

Swamp Creek flooding has occurred for decades, even before the extensive development and urbanization that occurred in the upstream watershed. Part of the problem is the location of Kenmore at the bottom of the drainage basin. One potential approach to the on-going flooding problem is to manage it as it occurs. Despite property acquisition in flood-prone areas and implementation of infrastructure improvements and sediment management facilities, Swamp Creek still floods and will likely continue to regardless of actions that are taken in the future. Knowing that flooding will happen, one alternative would be to be ready for it when it does through emergency notification of potentially affected property owners, mobilization of crews to prevent damage, and follow-up flood damage repairs. As mentioned before, the potential risk to public infrastructure is believed to be minimal up to the 100-year storm event. Application of this alternative for private property flooding will have to be determined at the policy level.

Permitting

The normal course of action during an emergency is to mobilize contractors and equipment to conduct rapid repairs in the most expeditious way possible to remove the immediate threats to public safety and infrastructure. From an environmental permitting standpoint, the Washington Department of Fish and Wildlife Area Habitat Biologists are to be contacted as soon as possible ahead of, during, or immediately after the work. However, contact and on-site meetings are not always possible to arrange in short order, especially during large, regional, or particularly severe events. After the event, work involving wetland or stream sediment excavation or fill would need to be coordinated with the US Army Corps of Engineers (Corps) and/or the Washington State Department of Ecology. Additionally, any work within wetlands, streams, and/or their buffers would require coordination with the City of Kenmore Development Services

Department to assure compliance with the City's Critical Areas regulations, the State Environmental Policy Act (SEPA), and the Shoreline Master Program. The outcome of coordination is an agreed plan that studies or details environmental damage and often retroactively proposes design and implementation of a mitigation plan to offset impacts.

The "after-the-fact" permitting risk is that the project must first meet the definition of an emergency. Per WAC 220-110-020, "Emergency" means an immediate threat to life or public or private property; or an immediate threat of serious environmental degradation, arising from weather or stream flow conditions, other natural conditions, or fire. In addition, Kenmore Municipal Code 18.55.150.A exempts emergency activities necessary to prevent an immediate threat to public health, safety, property, or welfare. However, as an exempt activity, emergency work is still required to restore, rehabilitate, or replace critical area impacts to the prior condition or better. Proceeding on an emergency basis outside of the normal permitting route will require after-the-fact coordination and permitting at the local, state, and federal jurisdictional levels. The lack of pre-project coordination combined with the somewhat unpredictable actions of contractors working under time and weather constraints may result in agency-required repair/mitigation plans, studies, and evaluations that could be burdensome, and potentially pose significantly large costs to the City.

Ecological Consequences

From an ecological standpoint, the consequences of doing nothing until an emergency are best understood by reviewing both short- and long-term changes. In the short-term, the wetland will persist mainly in its current state that includes patches of invasive reed canarygrass with hedgerows, pockets, and large fringes of mainly native-species dominated shrubs and trees. Tree health will decline along with increases in wetland water levels. Current hydrualic modeling does not suggest increased water levels in the southern part of the wetland, but rather the middle segment. However,increased water levels in the southern part of the wetland, for whatever reason, could cause the Oregon ash forest[1] that supports the heron rookery to be lost, along with the rookery itself eventually (as discussed above). In the long-term, consequences from emergency repairs will be locally severe but episodic in nature as they will occur as frequently as the storms that cause them. Eventually, the region will experience another large storm event or series of events that cause water to overtop, threaten, and possibly damage 73rd Avenue NE. During such an event, the response will be to mobilize contractors with heavy equipment to clear out the stream channel. Due to the rapid need to remedy the emergency, the construction will proceed without the benefit of professional analysis, environmental review, work plans, construction plans, or erosion/sedimentation control plans. Emergency in-water dredging and other work will temporarily lower water quality and disrupt aquatic life, including salmon, and possibly cause long-term damage to wetland, riparian, and buffer vegetation.

Risks to Infrastructure

Choosing not to protect infrastructure in advance of an emergency has obvious risks for greater damages. Acquisitions of the most flood-prone properties have already occurred and projects associated with 73rd Avenue NE have been implemented to reduce risks to the City transportation network. Depending on the size and severity of future floods, the risk to properties and infrastructure could be minimal or substantial.

[1]Because of the importance of herons in Kenmore and the possibility that the current rookery trees could decline, the city should consider implementing a plan to establish Oregon Ash saplings in strategic locations through the wetland. This tree planting could also be staggered over a number of years such that a variety of tree ages and sizes would be available to herons as the trees mature over time.

According to Otak's analysis presented to Kenmore City Council in March 2009, the Swamp Creek flood-reduction improvement projects resulted in modifications to the 100-year floodplain such that 73rd Avenue NE and some of the previously affected properties on 73rd Avnuee NE are now outside of the 100-year floodplain (Figure 10). Coupled with the City's recent modeling update, this would indicate that City infrastructure has low potential risk for impact up to the 100-year storm event.

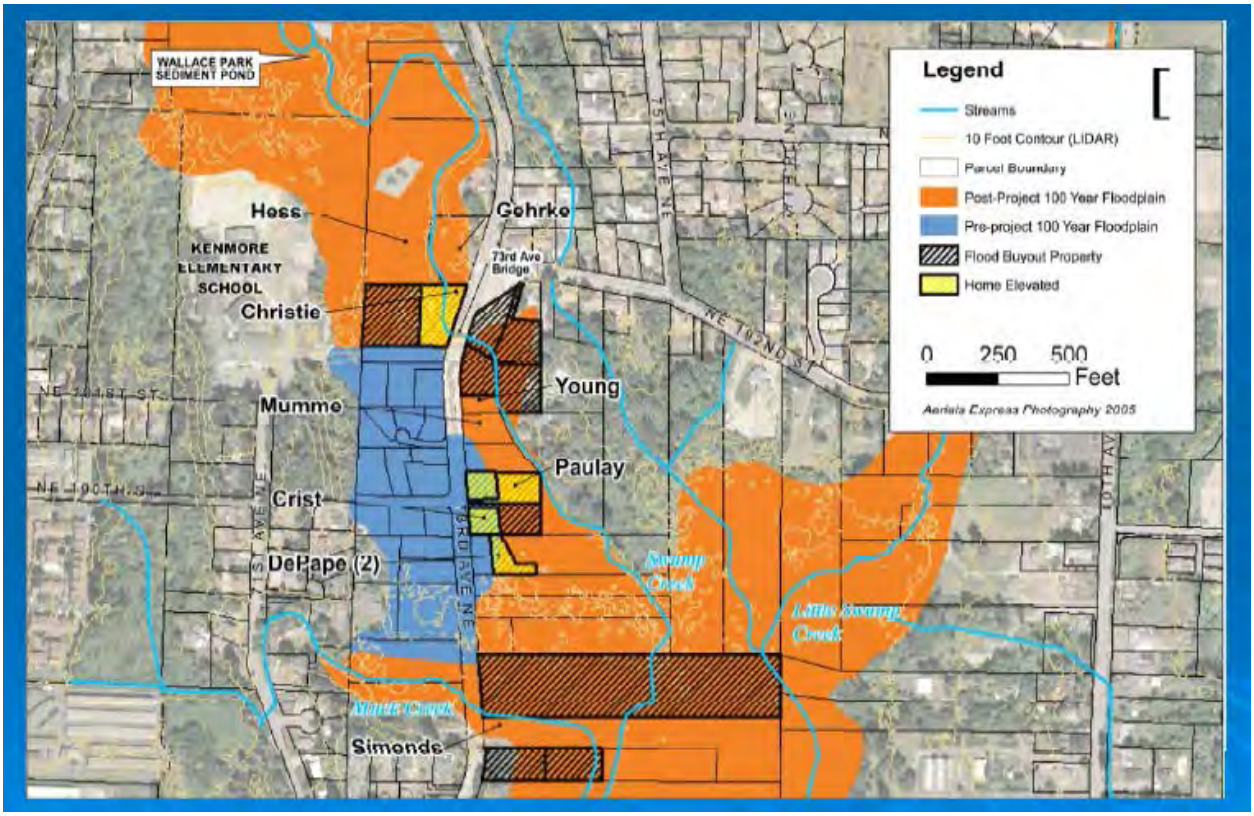

Figure 10. Pre- and post-Swamp Creek flood reduction project implementation 100-year floodplain. Prior to implementation of the 2008 flood reduction projects, the blue-shaded area was previously within the 100-year floodplain.

5.3.2 Alternative #2: Property Acquisition

Acquiring privately owned properties is an alternative to address private flooding impacts, however, as mentioned earlier, this alternative would not be required to protect public infrastructure. In the past, when the City has acquired properties along Swamp Creek, structures are removed and the property is returned to a natural state. Removal of structures and associated impervious areas on acquired private properties will have negligible impacts to the level of flood waters within Wetland #3.

The hatched and yellow properties in Figure 10 indicate properties that were either acquired or structurally modified to reduce flood damage. Since 2009, an additional 4 properties were acquired. In the area downstream of 73rd Avenue NE bridge crossing in the previous and current flood-prone area, there are up to 11 additional properties that are potentially at risk for flooding. Based on current King County assessment information (King County imap http://gismaps.kingcounty.gov/parcelviewer2/?pin=0114100708, accessed July 27, 2014), the total assessed value of these properties is $3,380,000.

If additional property acquisition was pursued, the cost of acquisition could be phased in over the years, similar to previous acquisitions, starting with the properties at greatest risk for flood damages.

5.3.3 Alternative #3: Sediment Removal and Maintenance

This alternative proposes to remove sediment within the central portion of Wetland #3 to establish a Swamp Creek channel similar to what currently exists near the 73rd Avenue NE bridge. Removal of sediment deposited in the Swamp Creek channel in Wetland #3 would provide minimally improved conveyance through the wetland and would not result in significant flood reduction based on modeled scenarios that evaluated sediment removal in Swamp Creek in the vicinity of Muck Creek and the Tolt pipeline. Sediment removal likely occurred in the past, either through farming practices at the time or for flood reduction. Based on estimated sedimentation rates from comparison of the 2004 and 2013 cross sections in Wetland #3 (~450 cubic yards annually) and depending on weather patterns that produce large storm events capable of mobilizing and transporting tons of sediment, channel maintenance could be part of a comprehensive strategy to improve ecological conditions and reduce flooding on some properties.

To make sediment removal a potentially more viable option, the scope of this alternative would have to expand beyond simply removing sediment in the channel and consider changing elevations throughout the wetland to achieve the goal of reducing flooding. Considering the flat topography of the wetland and the volume of water flowing in Swamp Creek, designing and constructing this type of project would be very challenging. Costs associated with this type of project, including ongoing maintenance, would likely exceed the cost of purchasing private properties.

Permitting

Permitting for sediment removal would require coordination and authorization from the Corps, the Washington State Departments of Ecology and Fish and Wildlife, and Kenmore Development Services pursuant to the City's Critical Areas regulations, SEPA, and the Shoreline Master Program.. Coordination with The Muckleshoot Indian Tribe is encouraged since they would comment on SEPA decisions and Corps permits. Prolonged analysis and discussion of dredging techniques, alternatives and effects on species of concern/listed species, and cultural resource impacts should be anticipated. Mitigation for impacts in the form of environmental restoration projects will likely be required.

There are regional examples where dredging has been conducted for flood reduction, however, most are in rivers that are classified as navigable, such as the Cedar River in Renton. King County has conducted sediment removal on May Creek, east of Renton, on a few occasions and successfully obtained permits from the Corps (Permit #NWS-2010-158) and other regulatory agencies. Should this option be pursued, consultation with jurisdictions that have successfully negotiated the permitting process would be warranted.

The project would likely be permitted through the Corps' Individual Permit process, which requires a substantially higher level of analysis, documentation, and justification compared to the more streamlined Nationwide permits. Though cumbersome, the fact that the City of Kenmore has undertaken pro-active and less intrusive actions in the past (e.g., sediment ponds, road improvements, property acquisition) will aid in the justification argument.

5.3.4 By-pass Pipe Alternative

One additional alternative considered was the construction of a high-flow bypass pipe around Wetland #3. This alternative is not viable for a number of reasons that would result in project costs that would likely exceed property acquisition costs and require long-term on-going maintenance. These include:

- Flood frequency – Properties adjacent to Wetland #3 are impacted by flooding at flow events as small as the 2-year return frequency. A high-flow bypass would need to be sized to accommodate events between under the 2-year and the 100-year to provide flood reduction benefits (sized for over 500 cubic feet per second).
- Length and diameter of pipe – Based on the size of the flow events that would need to be contained, a bypass pipe would need to be in excess of 5 feet in diameter. In order to bypass Wetland #3 where flooding is currently occuring, the pipe would need to extend from about Wallace Swamp Creek Park at the sediment pond to the Sammamish River, a distance of at least 8,000 feet depending on the route taken.
- Pipe maintenance and sediment management – Significant volumes of sediment are transported from upstream Swamp Creek reaches to the lower Swamp Creek reaches. The Wallace Swamp Creek sediment pond collects an average of 1,400 cubic yards of sediment each year and an additional large volume of sediment is transported downstream to Wetland #3 and beyond. The bypass pipe would have to be sized and sloped to accommodate sediment transport as well, or a larger sedimentation facility at the upstream end of the pipe would be need to effectively settle out material so that primarily only water was routed through the bypass pipe.
- Utility conflicts – There are a number of large utility corridors that transect the City of Kenmore, including Seattle's Tolt water pipeline and King County's brightwater effluent conveyance pipe. Potential conflicts with these and other utilities would require careful planning and may add cost to what would already be a very expensive endevour.

6. References

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Appendix B:

Basin Characteristic Summary Sheets

Tributary 0056

Basin Characteristics

Kenmore area: 407 acres
Other basin jurisdictions: Lake Forest Park

Highest elevation in Kenmore: 342 feet
Lowest elevation in Kenmore: 20 feet

Stream channel length in Kenmore: 2.6 miles

Wetland area: 5.7 acres

Zoning

Commercial: <1%
Neighborhood business, public/semi-public and regional business: 1.2%
Parks: 2%
Residential (R24): <1%
Residential (R6): 94%

Land Cover

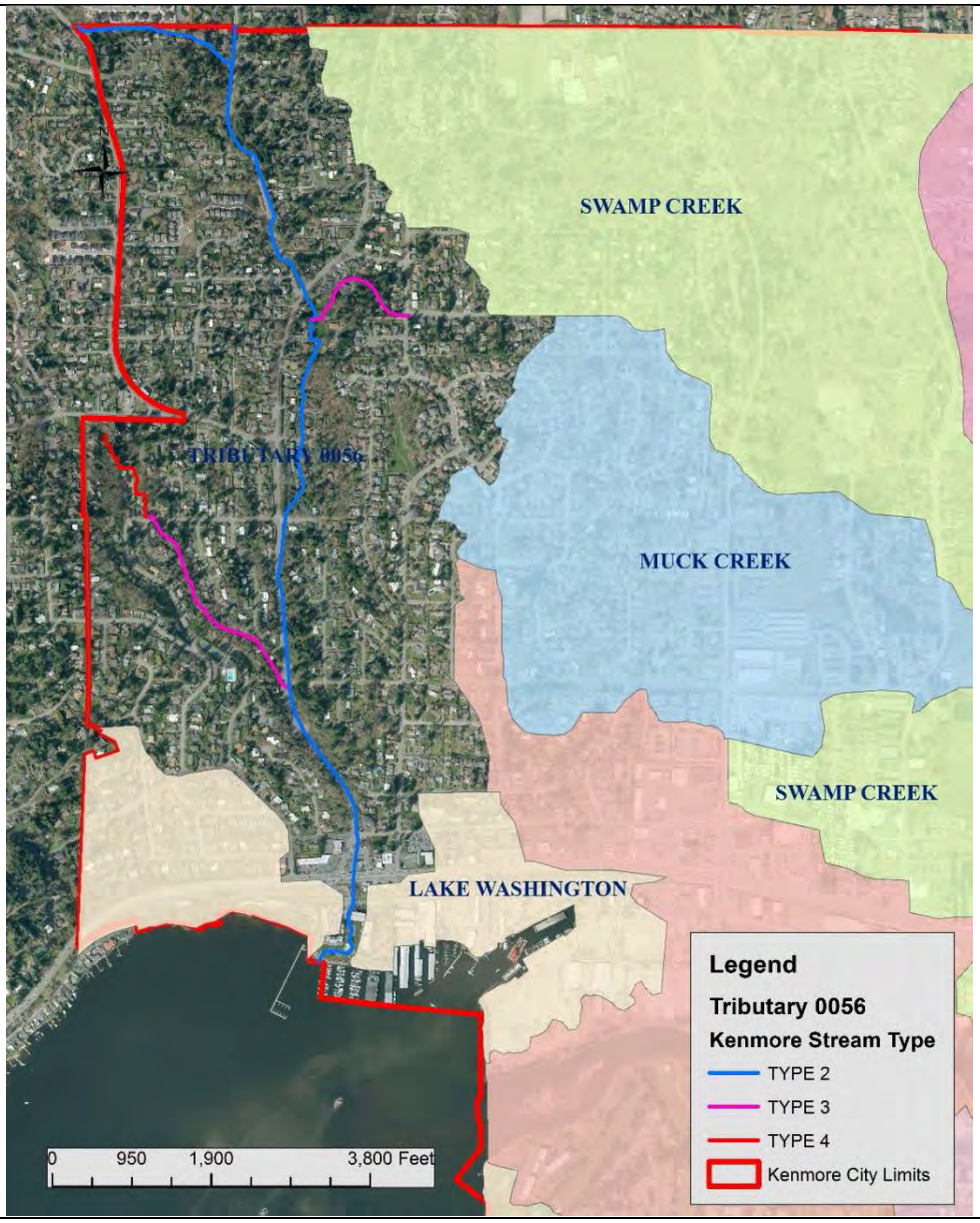
Roads: 50.9 acres
Roofs: 63.9 acres
Other impervious: 45.2 acres
Vegetated: 247 acres

Drainage System Characteristics

Open conveyance: 3.5 miles
Closed conveyance: 13.6 miles

Catch basins: 677
Manholes: 8

Private stormwater facilities: 6
Public stormwater facilities: 14



Tributary 0057

Basin Characteristics

Kenmore area: 333 acres
Other basin jurisdictions: none

Highest elevation: 500 feet
Lowest elevation: 18 feet

Stream channel length: 2.9 miles

Wetland area: 15.9 acres

Zoning

Parks: 1%
Public/semi-public: 2%
Residential (R4): 52%
Residential (R6): 45%

Land Cover

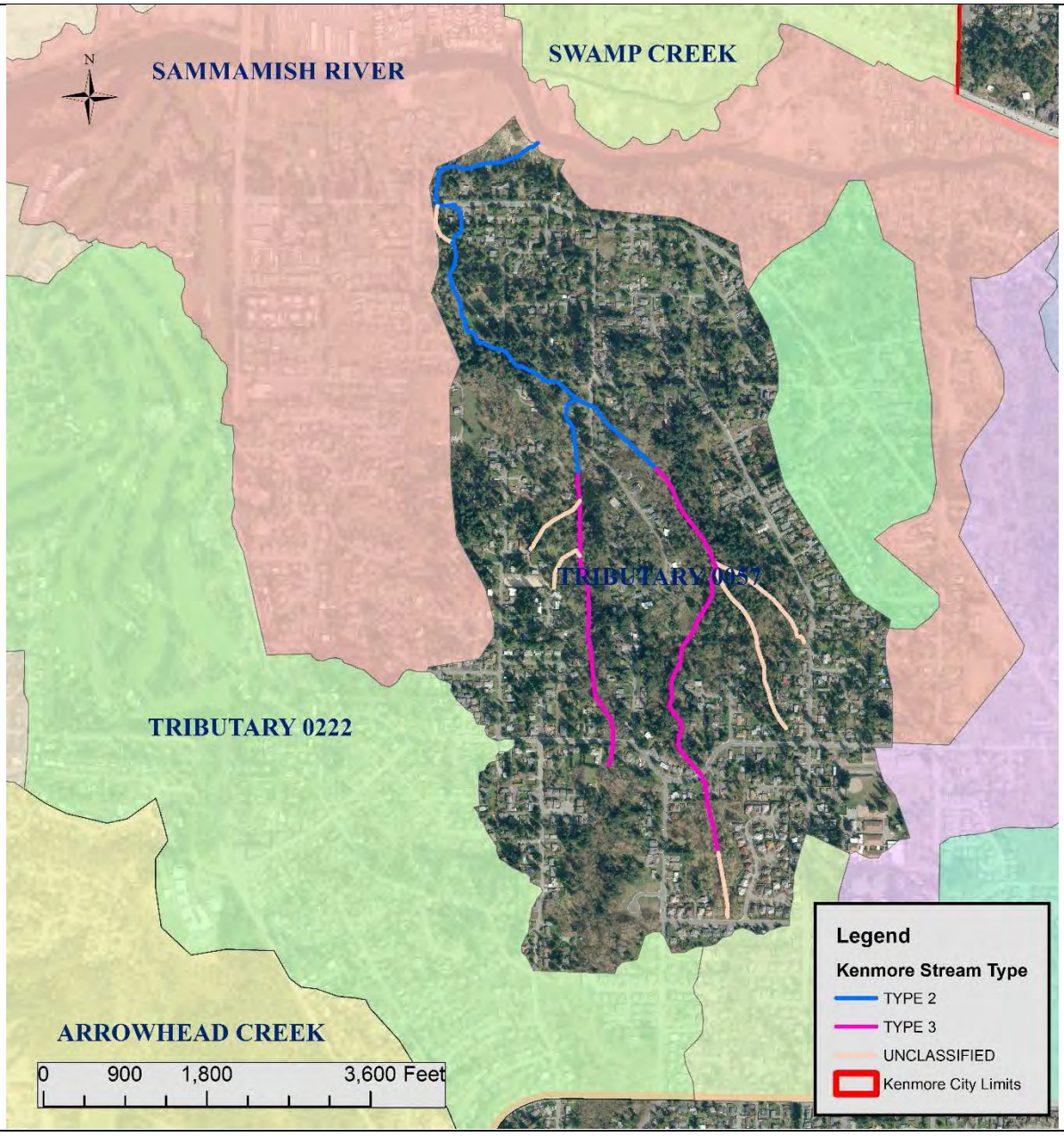
Roads: 20.6 acres
Roofs: 36.3 acres
Other impervious: 30.5 acres
Vegetated: ~245 acres

Drainage System Characteristics

Open conveyance: ~1.8 miles
Closed conveyance: ~7.2 miles

Catch basins: 351
Manholes: 2

Private stormwater facilities: 3
Public stormwater facilities: 17



Arrowhead Creek

Basin Characteristics

Kenmore area: 251 acres
Other basin jurisdictions: none

Highest elevation: 464 feet
Lowest elevation: 20 feet

Stream channel length: 1.1 miles

Wetland area: no wetlands mapped

Zoning

Parks: 45%
Public/semi-public: 21 %
Residential (R4): 27%
Residential (R6): 8%

Land Cover

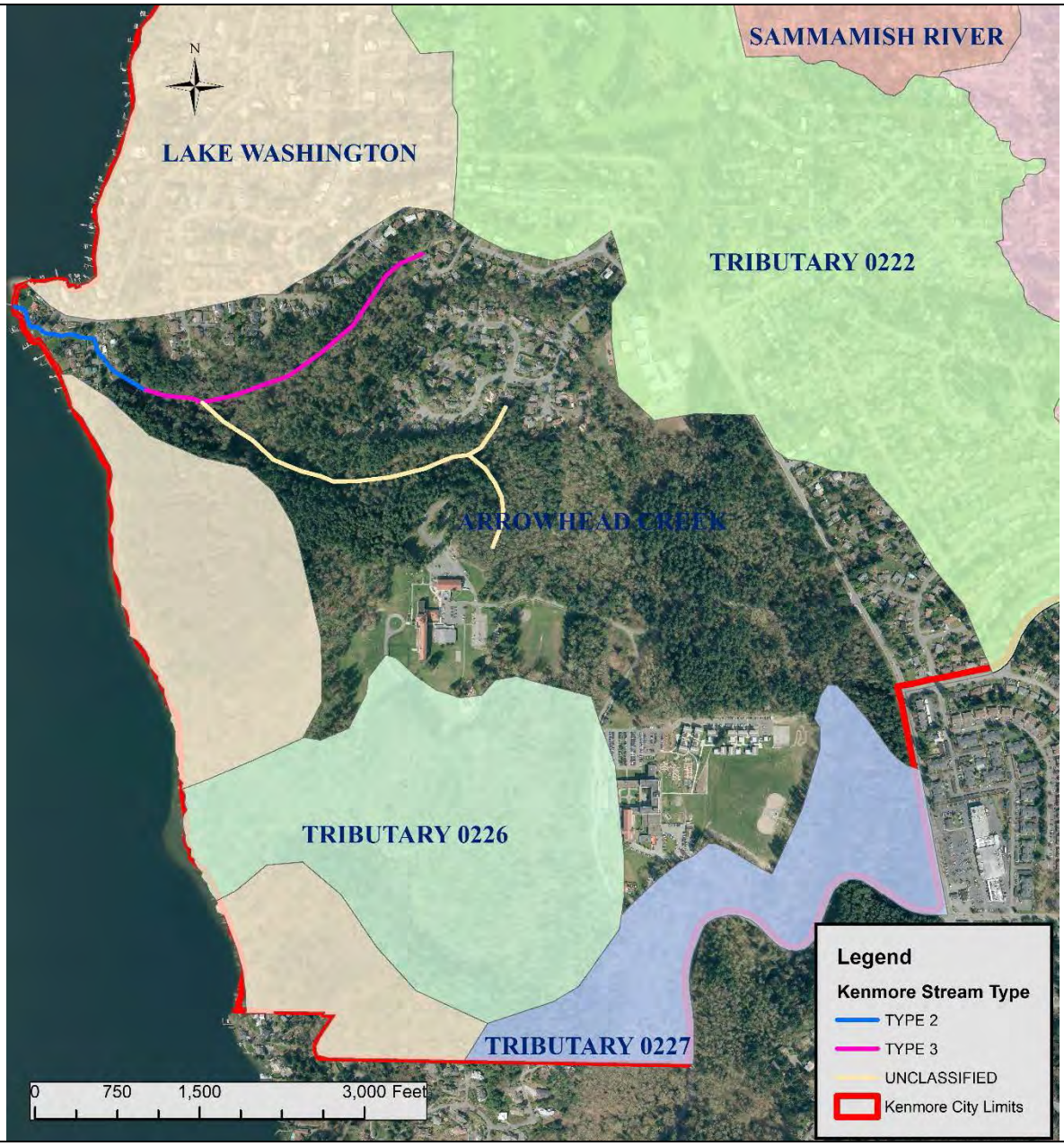
Roads: 11 acres
Roofs: 14 acres
Other impervious: 17 acres
Vegetated: 209 acres

Drainage System Characteristics

Open conveyance: 0.5 miles
Closed conveyance: ~3.9 miles

Catch basins: 184
Manholes: 1

Private stormwater facilities: 2
Public stormwater facilities: 4



Juanita Creek

Basin Characteristics

Kenmore area: 118 acres
Other basin jurisdictions: Kirkland

Highest elevation in Kenmore: 498 feet
Lowest elevation in Kenmore: 362 feet

Stream channel length in Kenmore: 0.41 miles

Wetland area: 1.56 acres

Zoning

Residential (R4): 2%
Residential (R6): 98%

Land Cover

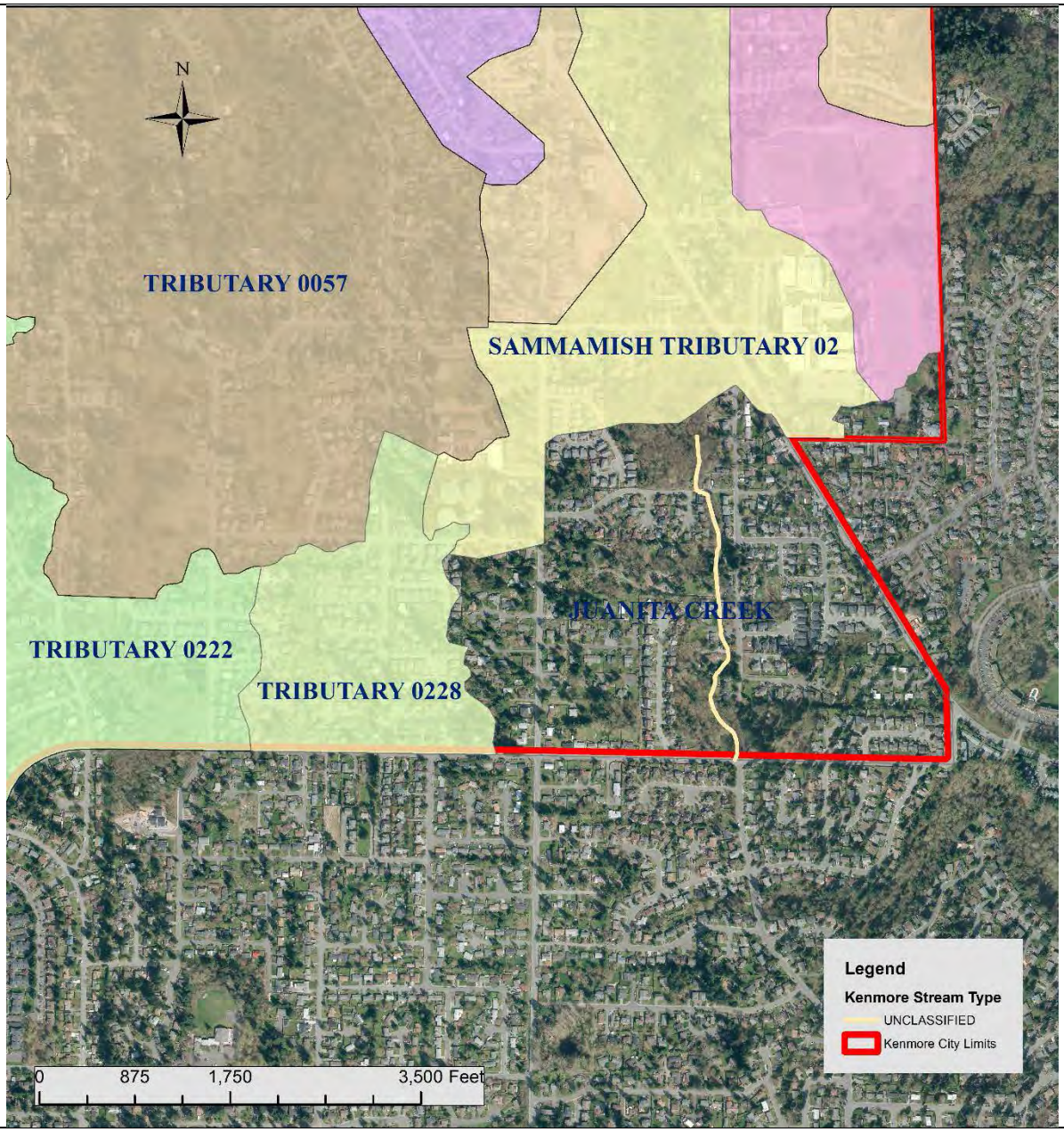
Roads: 11.5 acres
Roofs: 18.4 acres
Other impervious: 12.4 acres
Vegetated: ~75.7 acres

Drainage System Characteristics

Open conveyance: ~0.6 miles
Closed conveyance: ~3.6 miles

Catch basins: 204
Manholes: 2

Private stormwater facilities: 0
Public stormwater facilities: 13



Lake Washington Drainages

Basin Characteristics

Kenmore area: 303 acres
Other basin jurisdictions: many

Highest elevation in Kenmore: 400 feet
Lowest elevation in Kenmore: 18 feet

Stream channel length: no typed streams

Wetland area: 3.2 acres

Zoning

Commercial/regional business: 18%
Golf course: 2%
Parks: 26%
Public/semi-public: <1%
Residential (R24): 1%
Residential (R4): 8%
Residential (R6): 44%

Land Cover

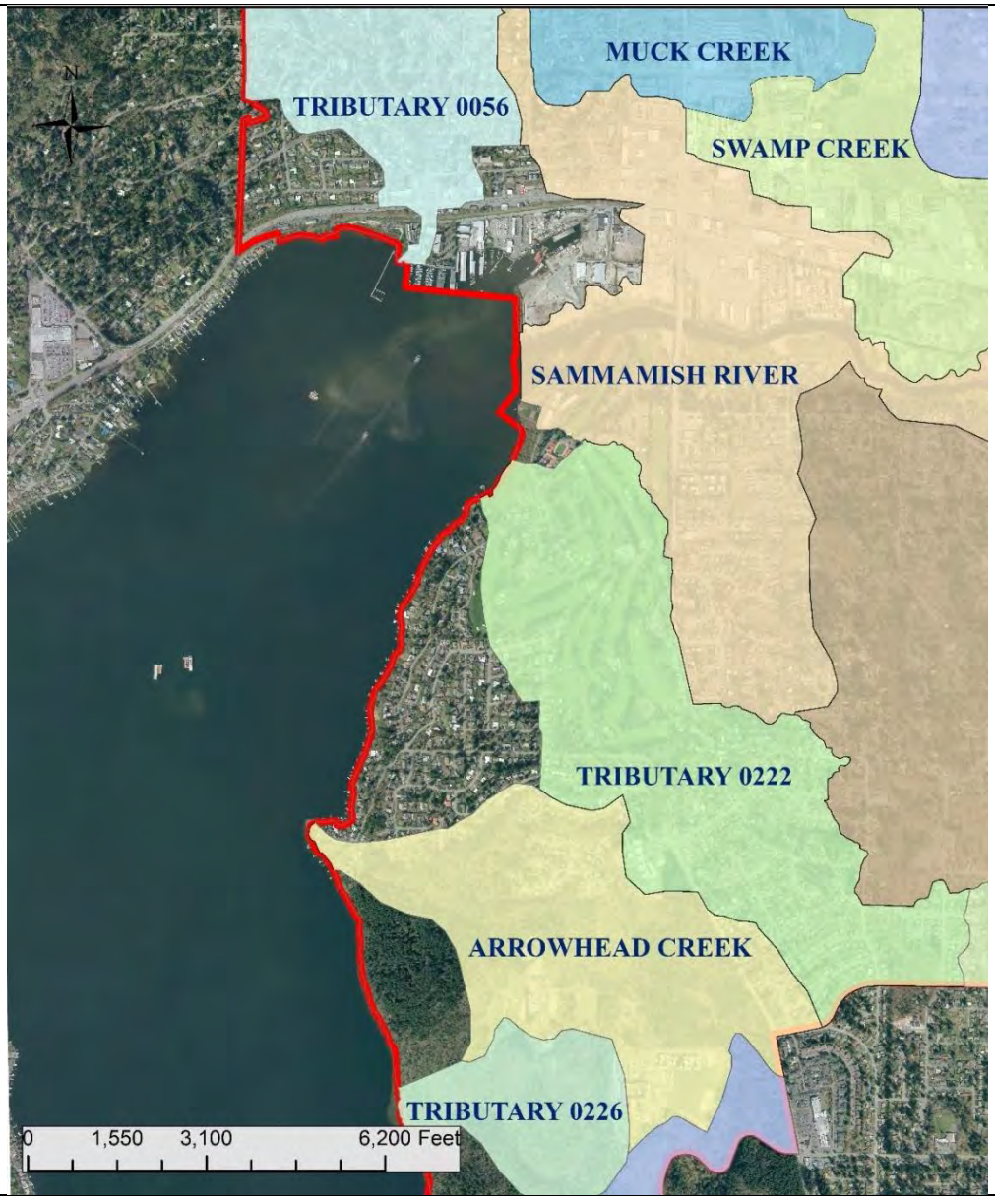
Roads: 26 acres
Roofs: 35 acres
Other impervious: 42 acres
Vegetated: 200 acres

Drainage System Characteristics

Open conveyance: 1.7 miles
Closed conveyance: ~7.0 miles

Catch basins: 353
Manholes: 3

Private stormwater facilities: 3
Public stormwater facilities: 2



Little Swamp Creek

Basin Characteristics

Kenmore area: 330 acres
Other basin jurisdictions:
Unincorporated Snohomish County

Highest elevation in Kenmore:
244 feet
Lowest elevation in Kenmore:
24 feet

Stream channel length in Kenmore: 2.5 miles

Wetland area: ~30 acres

Zoning

Parks: 9 %
Residential (R1): 11%
Residential (R4): 13%
Residential (R6): 60%

Land Cover

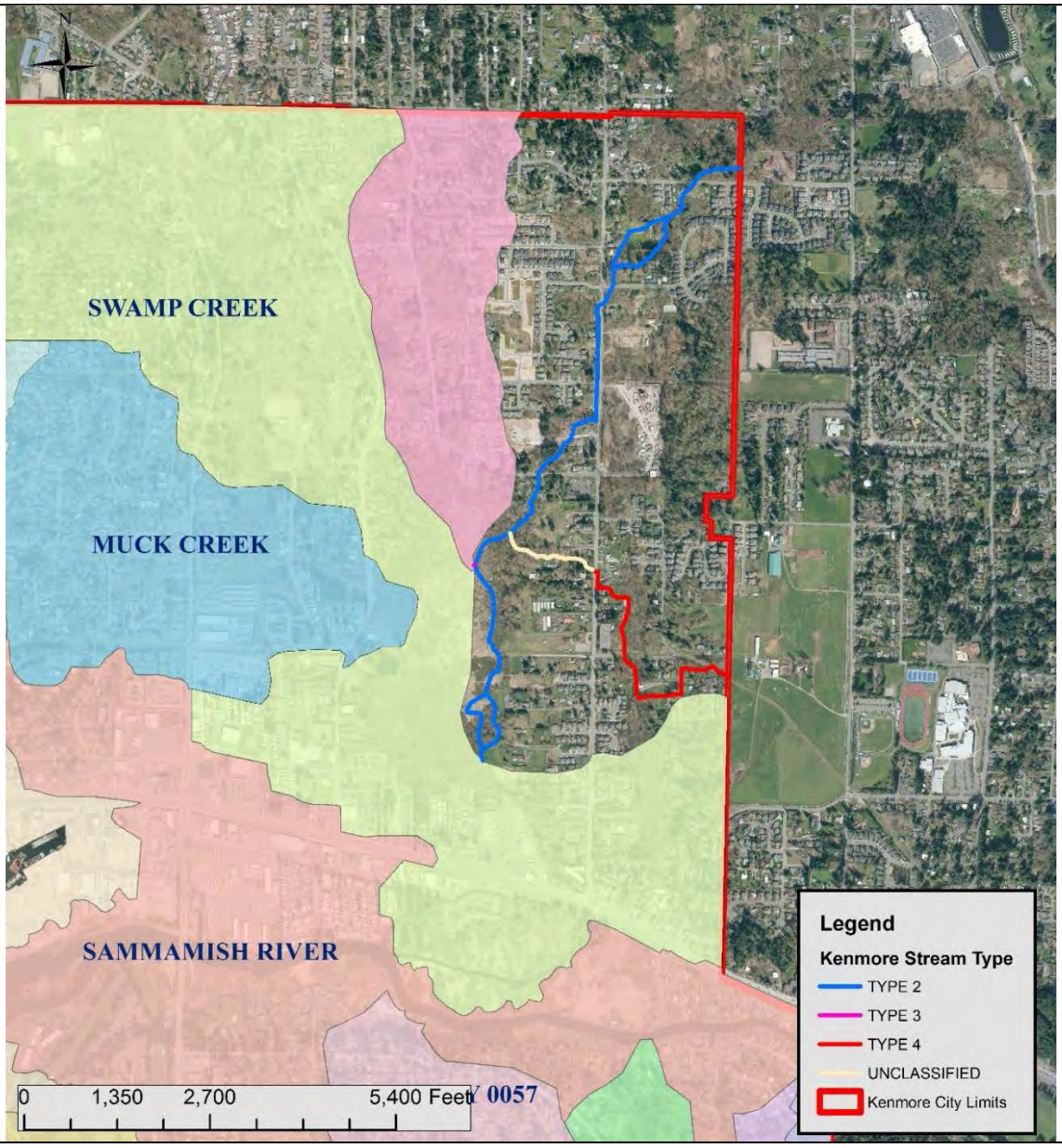
Roads: 23 acres
Roofs: 29 acres
Other impervious: 25 acres
Vegetated: 253 acres

Drainage System Characteristics

Open conveyance: 2.6 miles
Closed conveyance: ~10.1 miles

Catch basins: 568
Manholes: 5

Private stormwater facilities: 1
Public stormwater facilities: 23



Little Swamp Creek Tributary 01

Basin Characteristics

Kenmore area: 114 acres
Other basin jurisdictions: Unincorporated Snohomish County

Highest elevation in Kenmore: 244 feet
Lowest elevation in Kenmore: 34 feet

Stream channel length in Kenmore: 0.76 miles

Wetland area: ~11 acres

Zoning

Parks: <1 %
Residential (R1): 17%
Residential (R6): 83%

Land Cover

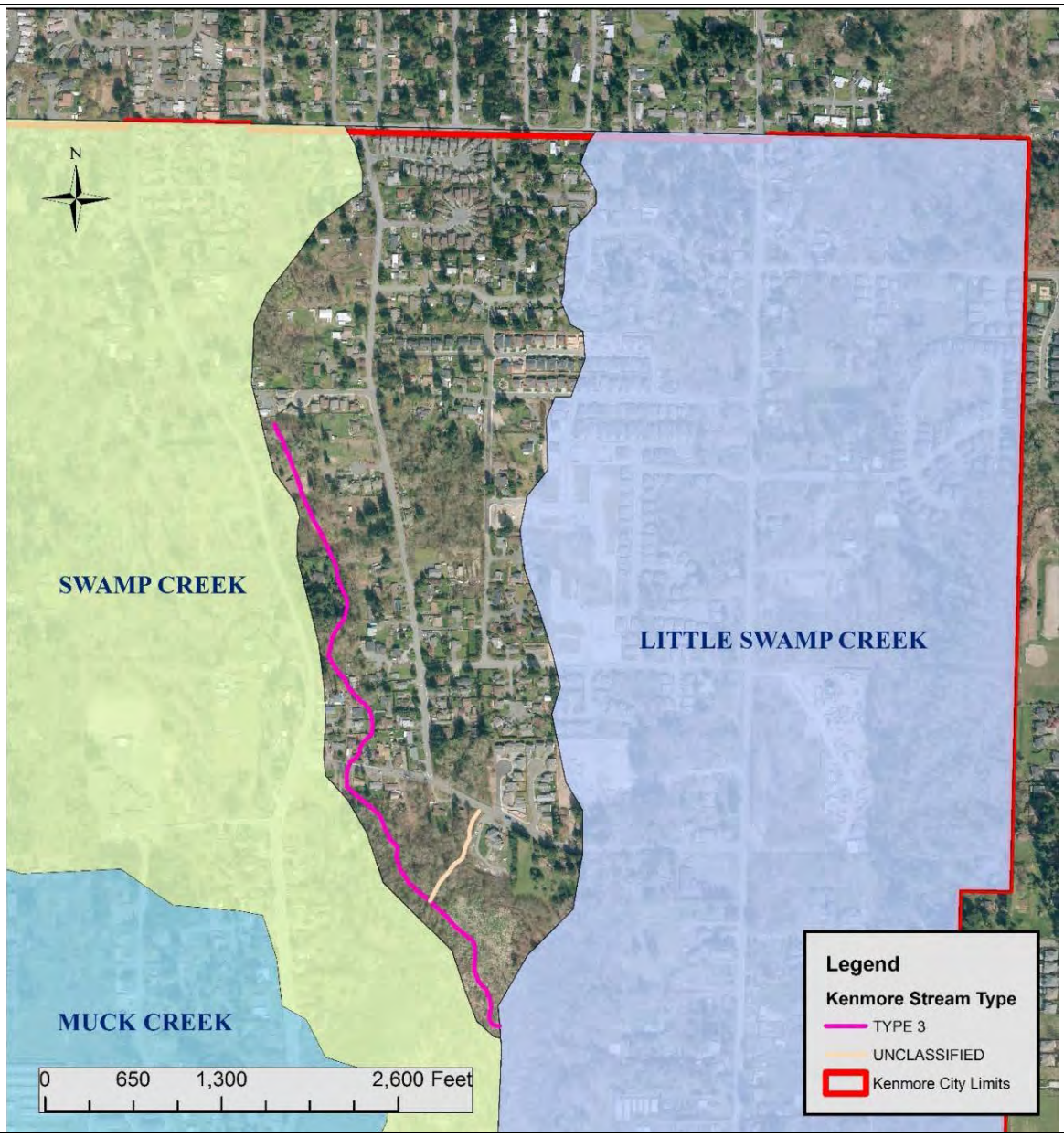
Roads: ~10 acres
Roofs: ~14 acres
Other impervious: ~10 acres
Vegetated: ~80 acres

Drainage System Characteristics

Open conveyance: 0.2 miles
Closed conveyance: 3.5 miles

Catch basins: 183
Manholes: 1

Private stormwater facilities: 1
Public stormwater facilities: 14



Muck Creek

Basin Characteristics

Kenmore area: 206 acres
Other basin jurisdictions: none

Highest elevation: 332 feet
Lowest elevation: 34 feet

Stream channel length: 0.7 miles

Wetland area: 19.3 acres

Zoning

Parks: 2%
Public/semi-public and regional business: 4%
Residential (downtown): 4%
Residential (R1): 7%
Residential (R6): 55%
Residential (R12-R48): 27%

Land Cover

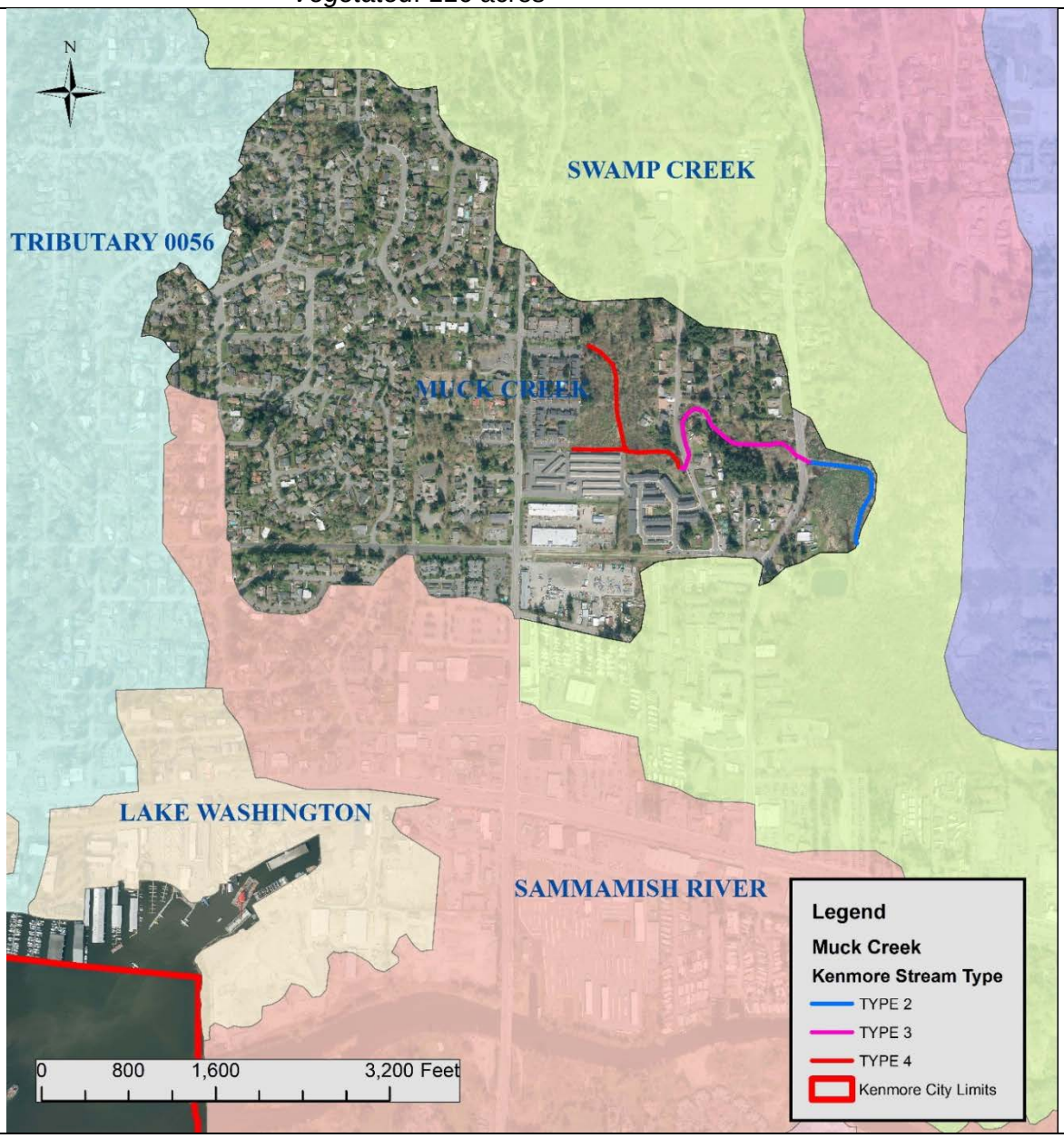
Roads: 21 acres
Roofs: 34 acres
Other impervious: 35 acres
Vegetated: 116 acres

Drainage System Characteristics

Open conveyance: ~1.0 mile
Closed conveyance: 8.7 miles

Catch basins: 494
Manholes: 3

Private stormwater facilities: 9
Public stormwater facilities: 11



Sammamish River Tributary 01

Basin Characteristics

Kenmore area: 65 acres
Other basin jurisdictions: none

Highest elevation: 424 feet
Lowest elevation: 20 feet

Stream channel length: 0.35 miles

Wetland area: no wetlands mapped

Zoning

Residential (R1): <1%
Residential (R4): 31%
Residential (R6): 69%

Land Cover

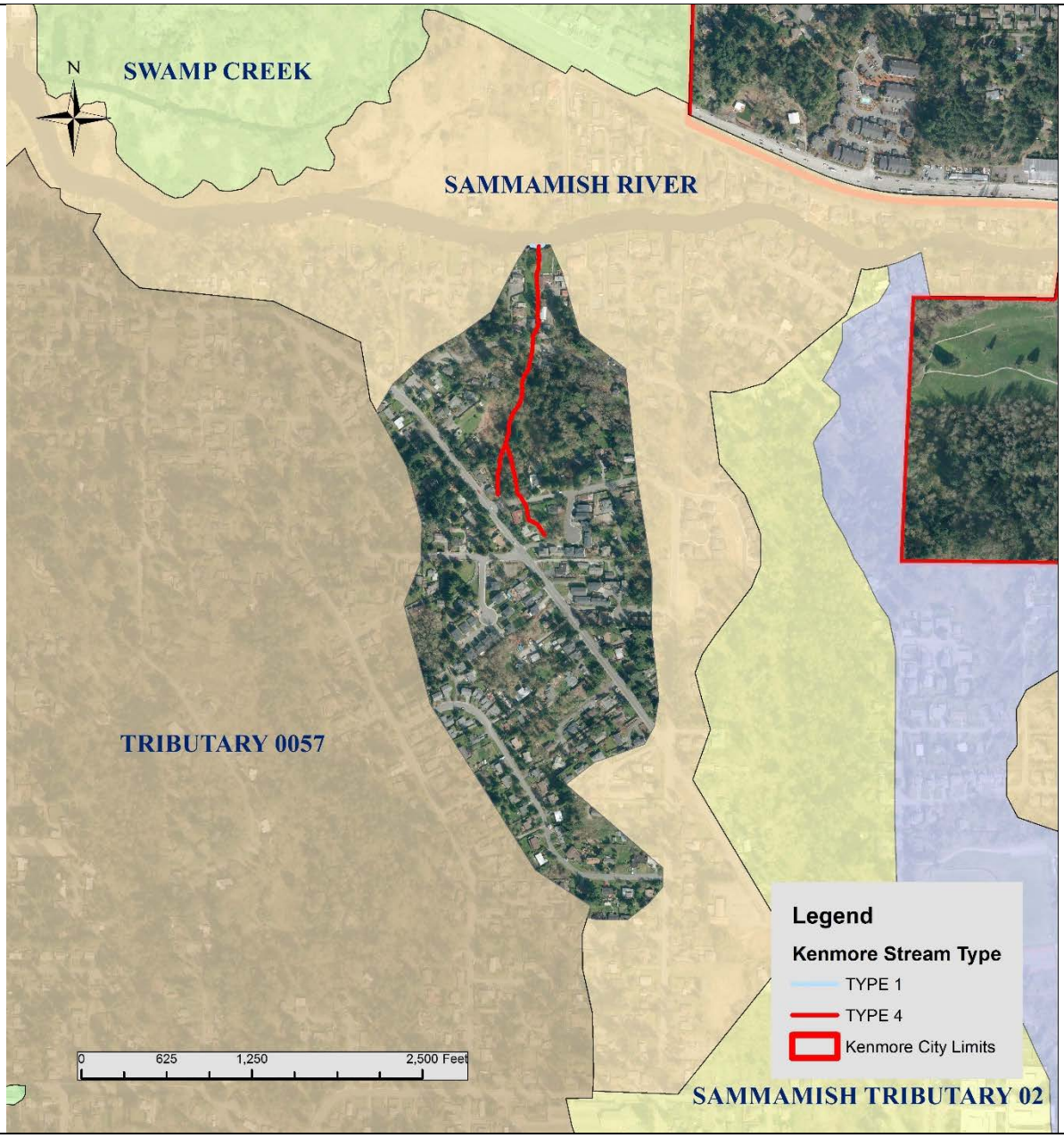
Roads: 5.6 acres
Roofs: 8.96 acres
Other impervious: 7.4 acres
Vegetated: 43 acres

Drainage System Characteristics

Open conveyance: 0.3 miles
Closed conveyance: ~2.9 miles

Catch basins: 157
Manholes: 1

Private stormwater facilities: 0
Public stormwater facilities: 9



Sammamish Tributary 02

Basin Characteristics

Kenmore area: 112 acres
Other basin jurisdictions: none

Highest elevation: 500 feet
Lowest elevation: 20 feet

Stream channel length: 0.93 miles

Wetland area: 1.40 acres

Zoning

Parks: 2%
Public/semi-public: 21 %
Residential (R1): <1%
Residential (R4): 68%
Residential (R6): 9%

Land Cover

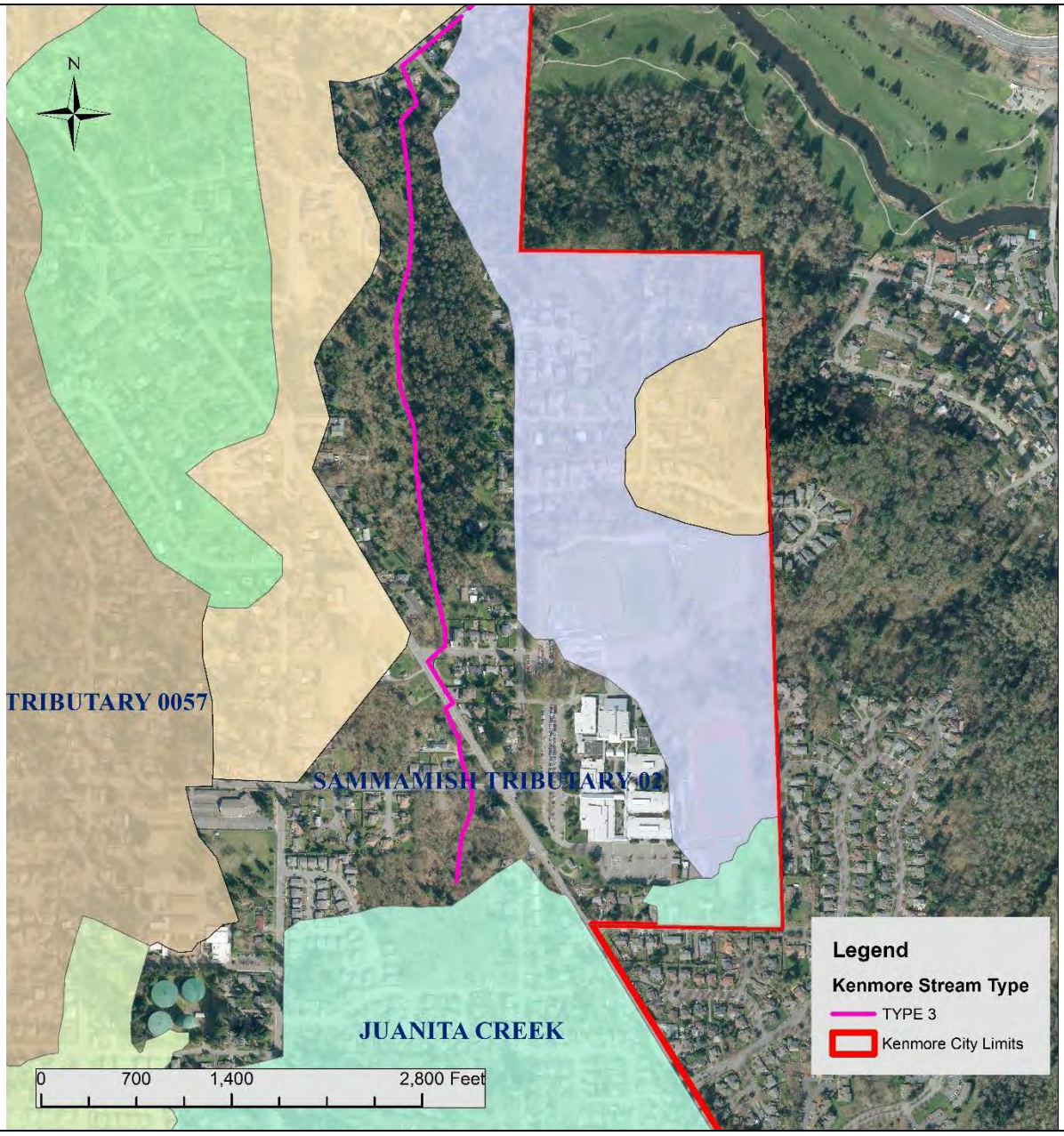
Roads: 7.1 acres
Roofs: 13.3 acres
Other impervious: 12.8 acres
Vegetated: ~79 acres

Drainage System Characteristics

Open conveyance: ~0.4 miles
Closed conveyance: ~3.5 miles

Catch basins: 176
Manholes: 13

Private stormwater facilities: 4
Public stormwater facilities: 8



Sammamish River Tributary 03

Basin Characteristics

Kenmore area: 69 acres
Other basin jurisdictions: none

Highest elevation: 450 feet
Lowest elevation: 20 feet

Stream channel length: 0.52 miles

Wetland area: no wetlands mapped

Zoning

Public/semi-public: 48%
Residential (R1): 1%
Residential (R4): 50%

Land Cover

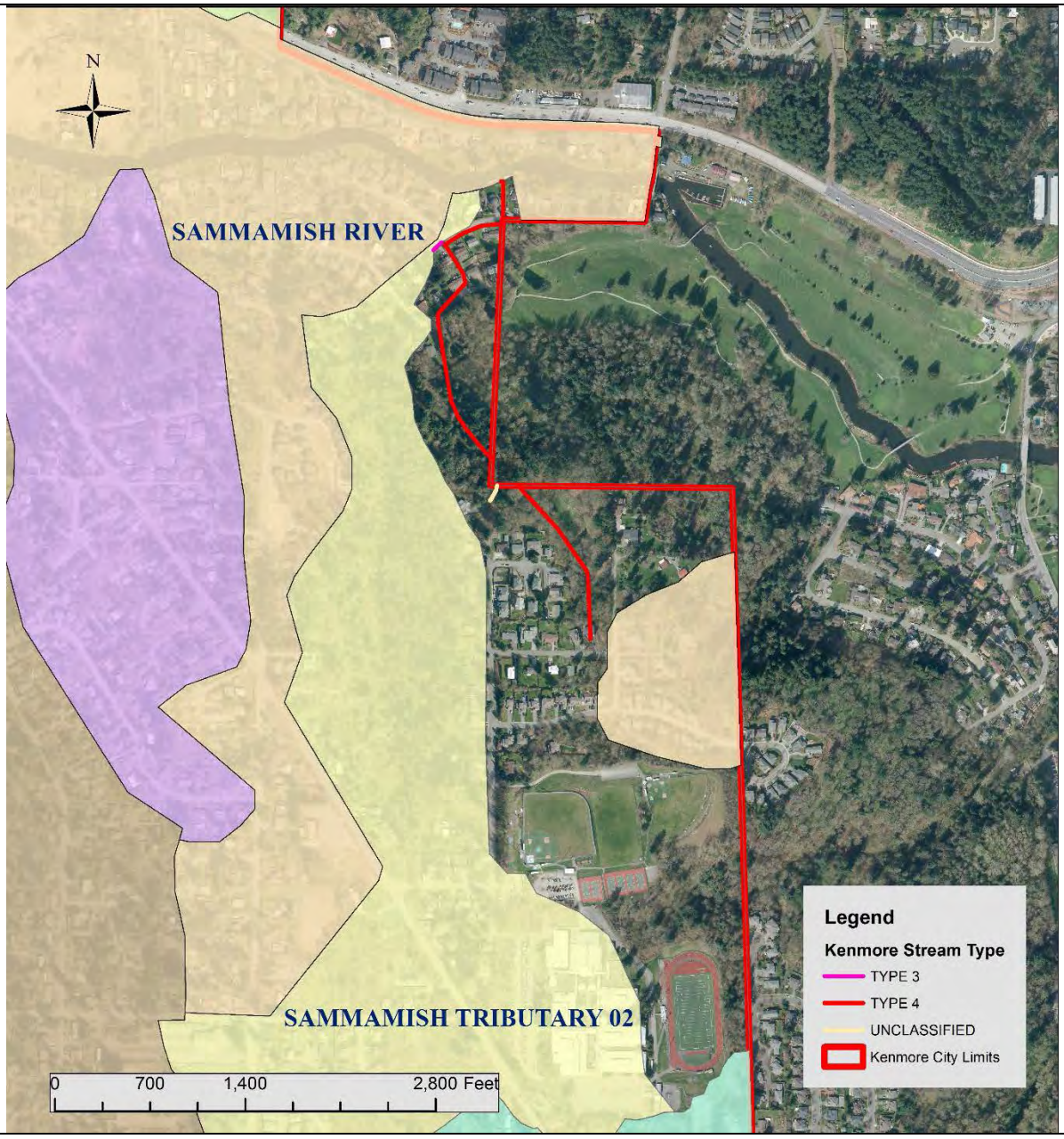
Roads: 2.6 acres
Roofs: 3.3 acres
Other impervious: 10.7 acres
Vegetated: 52 acres

Drainage System Characteristics

Open conveyance: 0.3 miles
Closed conveyance: ~2.1 miles

Catch basins: 102
Manholes: 2

Private stormwater facilities: 1
Public stormwater facilities: 4



Sammamish River

Basin Characteristics

Kenmore area: 534 acres
Other basin jurisdictions: Redmond, Bothell, Kirkland, and Bellevue

Highest elevation in Kenmore: 486 feet
Lowest elevation in Kenmore: 18 feet

Stream channel length in Kenmore: 2.1 miles

Wetland area: 32.8 acres

Zoning

Commercial/residential (downtown): 7%
Commercial/neighborhood/regional business: 14%
Parks/golf course: 14%
Public/semi-public: <1%
Residential (R1): 9%
Residential (R4): 20%
Residential (R6): 29%
Residential (R12/R18/R24): 8%

Land Cover

Roads: 48 acres
Roofs: 68 acres
Other impervious: 98 acres
Vegetated: 320 acres

Drainage System Characteristics

Open conveyance: 2.3 miles
Closed conveyance: ~20.9 miles

Catch basins: 1,228
Manholes: 19

Private stormwater facilities: 27
Public stormwater facilities: 21

Swamp Creek

Basin Characteristics

Kenmore area: 568 acres
Other basin jurisdictions: Brier, Lynnwood, and Unincorporated Snohomish County

Highest elevation in Kenmore: 294 feet
Lowest elevation in Kenmore: 18 feet

Stream channel length in Kenmore: 4.3 miles

Wetland area: ~74 acres

Zoning

Parks: 13%
Public/semi-public and regional business: 10%
Residential (downtown): 6%
Residential (R1): 23%
Residential (R4): 4%
Residential (R6): 31%
Residential (R12-R24): 10%

Land Cover

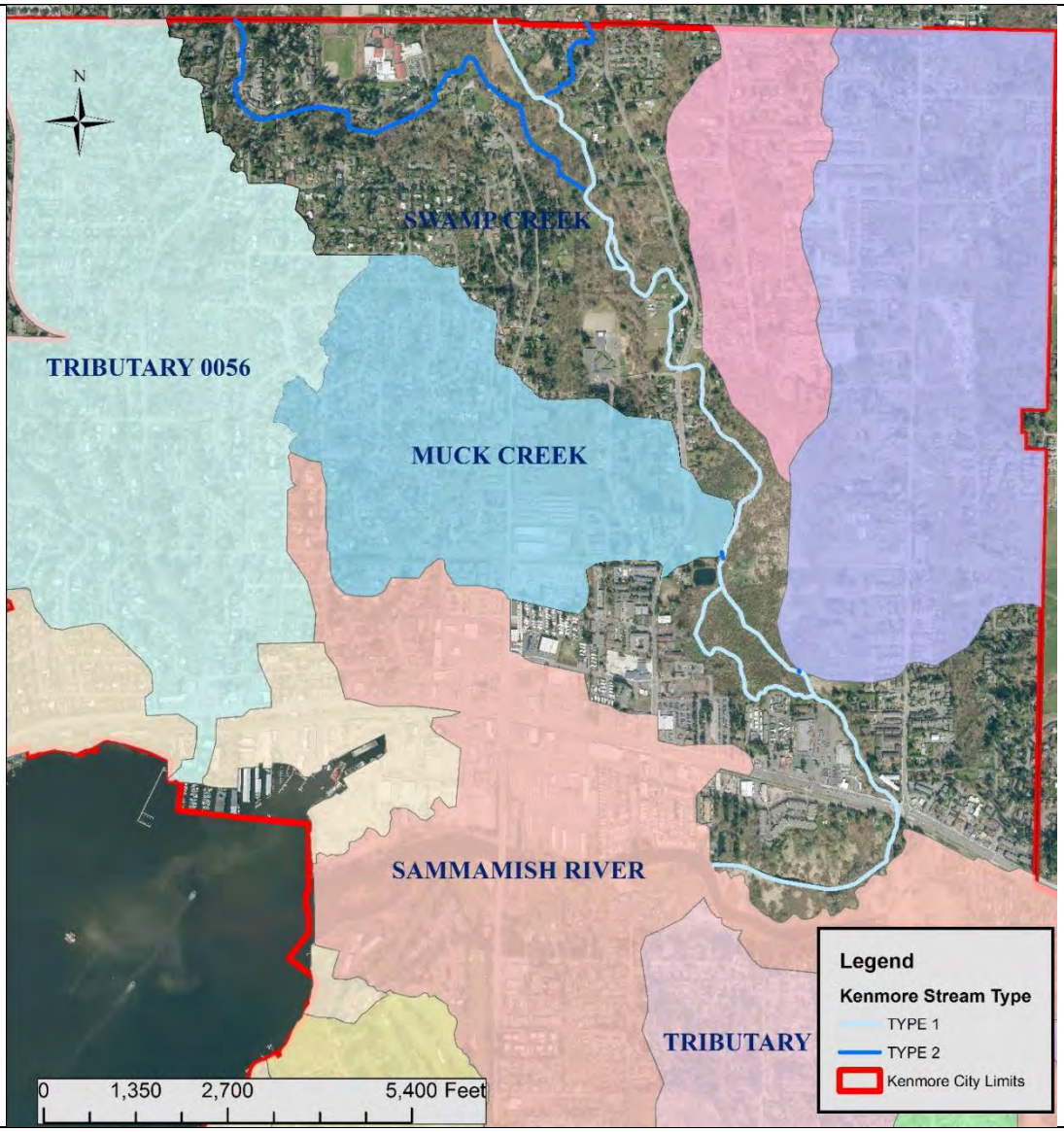
Roads: 39 acres
Roofs: 61 acres
Other impervious: 78 acres
Vegetated: 390 acres

Drainage System Characteristics

Open conveyance: 2.6 miles
Closed conveyance: ~15.8 miles

Catch basins: 1,037
Manholes: 15

Private stormwater facilities: 42
Public stormwater facilities: 10



Tributary 0222

Basin Characteristics

Kenmore area: 318 acres
Other basin jurisdictions: none

Highest elevation: 468 feet
Lowest elevation: 20 feet

Stream channel length: 2.4 miles

Wetland area: ~9 acres

Zoning

Golf course: 28%
Parks: 1 %
Neighborhood business: 28%
Public/semi-public: 1 %
Residential (R6): 41%
Residential (R12): <1%
Residential (R18): 1%

Land Cover

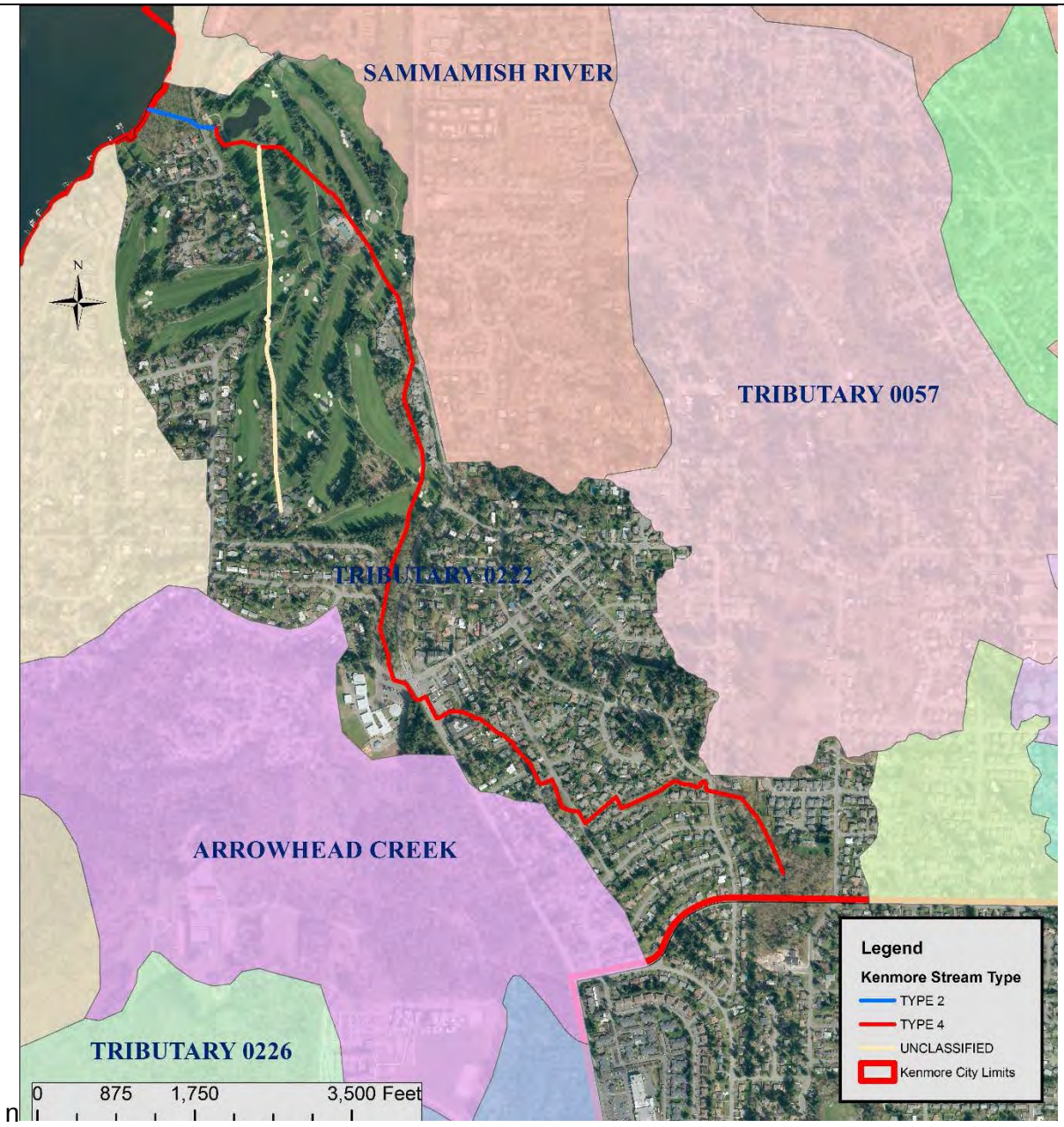
Roads: 24 acres
Roofs: 38 acres
Other impervious: 34 acres
Vegetated: 222 acres

Drainage System Characteristics

Open conveyance: 1.7 miles
Closed conveyance: ~8.6 miles

Catch basins: 408
Manholes: 2

Private stormwater facilities: 8
Public stormwater facilities: 12



Tributary 0226

Basin Characteristics

Kenmore area: ~86 acres
Other basin jurisdictions: none

Highest elevation: 438 feet
Lowest elevation: 18 feet

Stream channel length: 0.89 miles

Wetland area: no wetlands mapped

Zoning

Parks: 95%
Public/semi-public: 5%

Land Cover

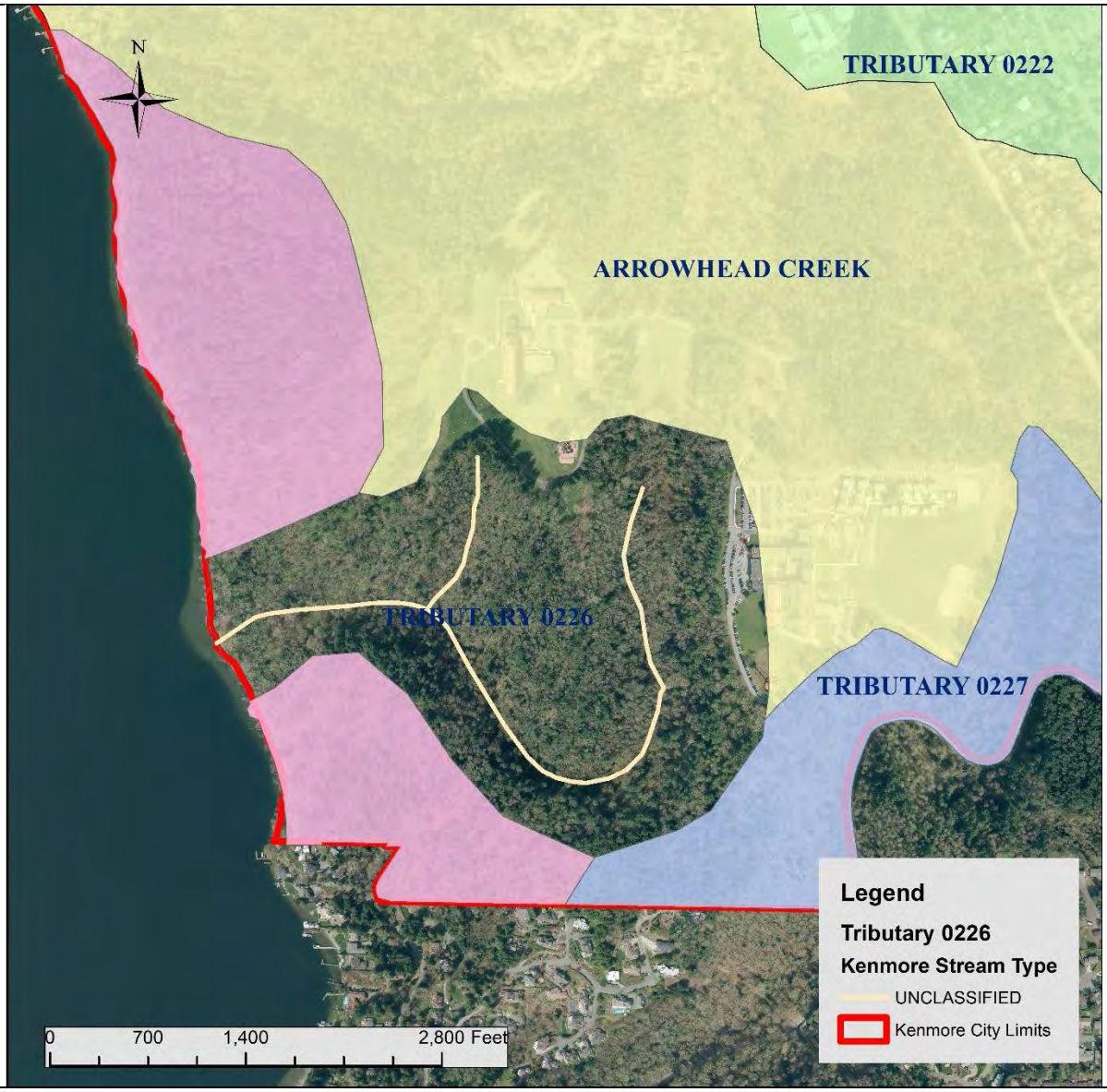
Roads: 0.5 acres
Roofs: 0.2 acres
Other impervious: 1.8 acres
Vegetated: ~83.5 acres

Drainage System Characteristics

Open conveyance: 0 miles
Closed conveyance: 0 miles

Catch basins: 5
Manholes: 0

Private stormwater facilities: 0
Public stormwater facilities: 0



Tributary 0227

Basin Characteristics

Kenmore area: ~46 acres
Other basin jurisdictions: Kirkland

Highest elevation in Kenmore: 452 feet
Lowest elevation in Kenmore: 192 feet

Stream channel length in Kenmore: 0.54 miles

Wetland area: no wetlands mapped

Zoning

Parks: 89%
Public/semi-public: 11%

Land Cover

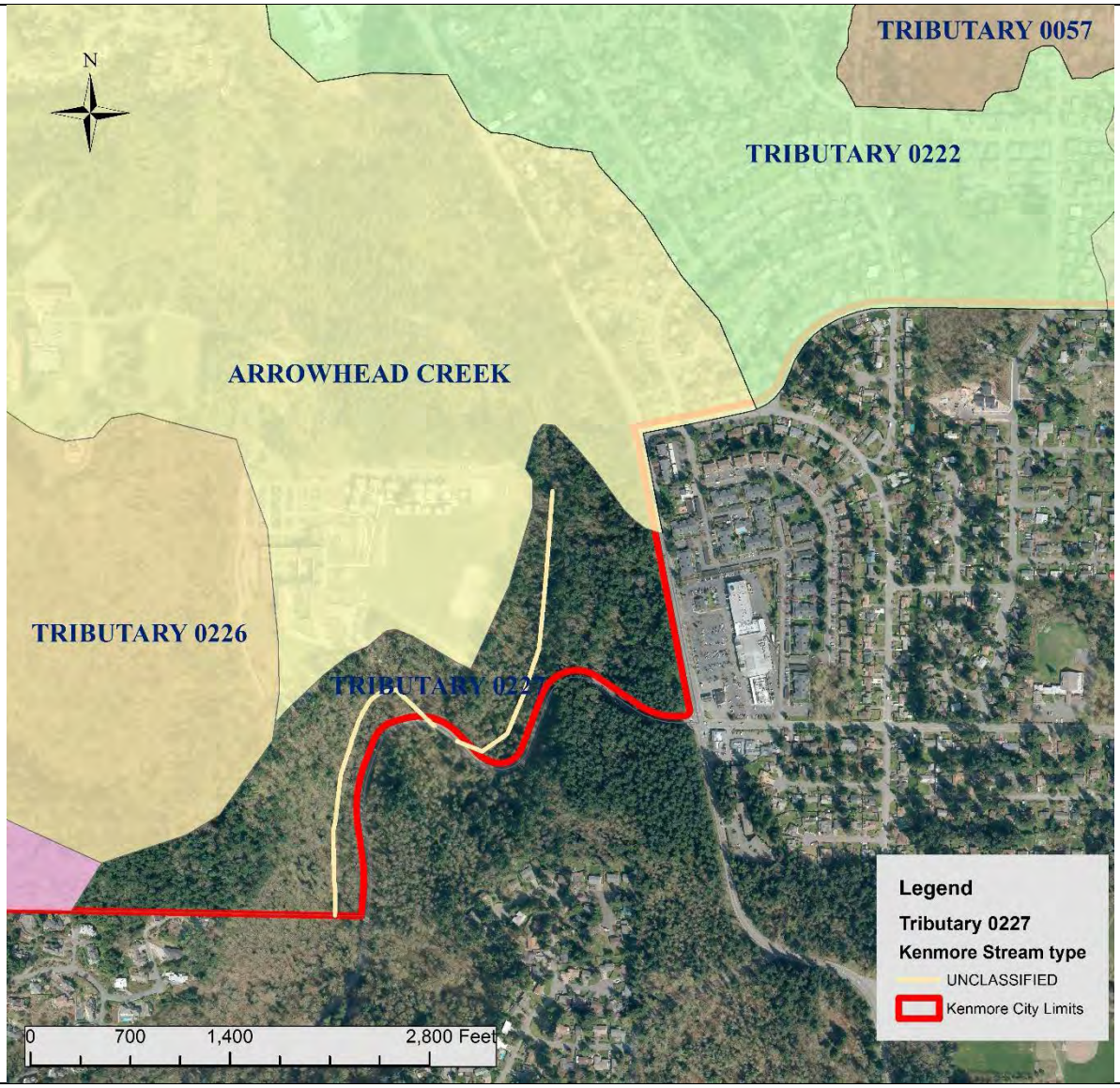
Roads: 0.4 acres
Roofs: 1 acre
Other impervious: 0.2 acre
Vegetated: 44.4 acres

Drainage System Characteristics

Open conveyance: 0 miles
Closed conveyance: 0 miles

Catch basins: 0
Manholes: 0

Private stormwater facilities: 0
Public stormwater facilities: 0



Tributary 0228

Basin Characteristics

Kenmore area: ~44 acres
Other basin jurisdictions: Kirkland

Highest elevation in Kenmore: 500 feet
Lowest elevation in Kenmore: 442 feet

Stream channel length in Kenmore: 0.21 miles

Wetland area: no wetlands mapped

Zoning

Public/semi-public: 3%
Residential (R4): 4%
Residential (R6): 93%

Land Cover

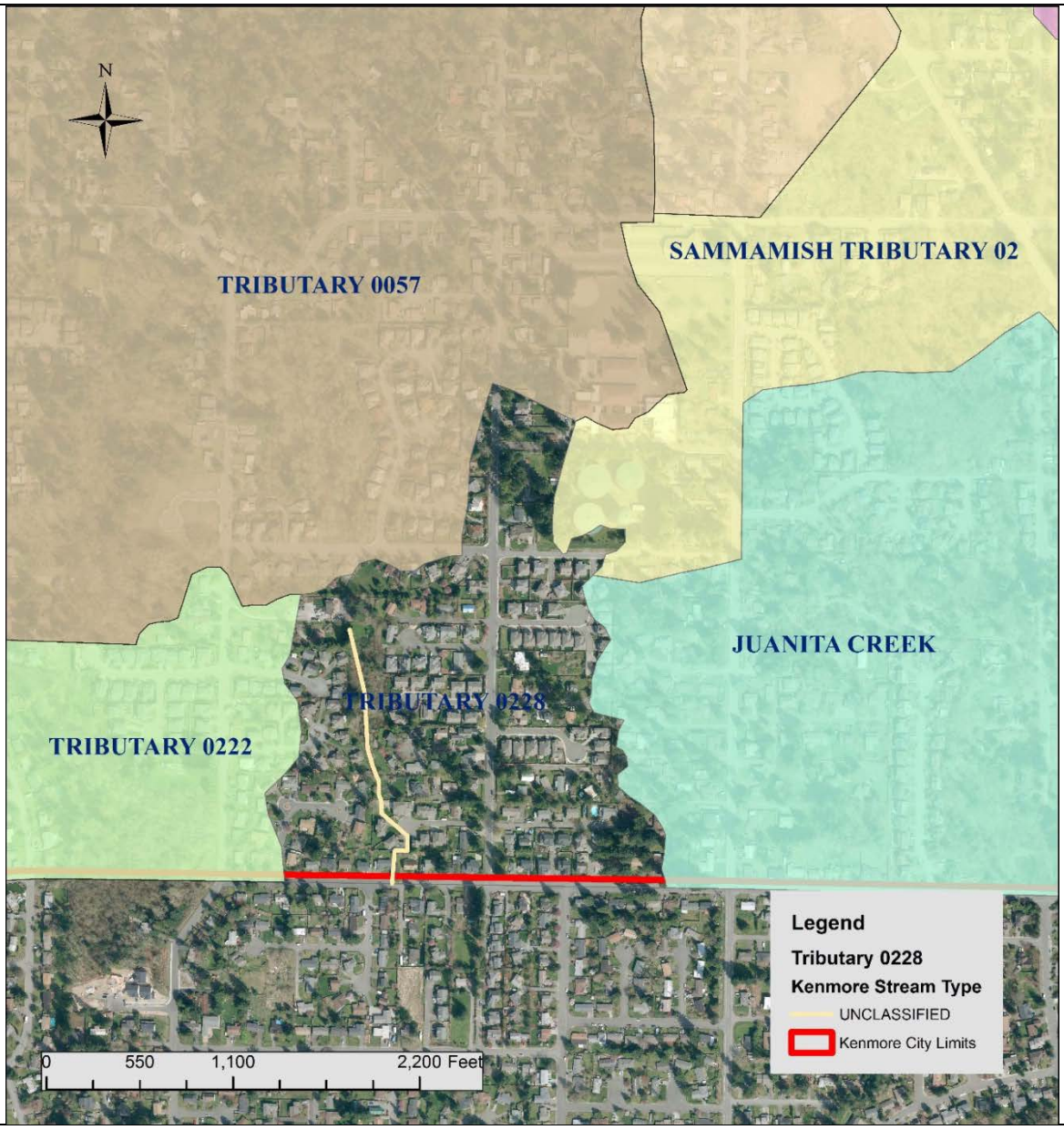
Roads: 5.9 acres
Roofs: 8.6 acres
Other impervious: 5 acres
Vegetated: ~24.5 acres

Drainage System Characteristics

Open conveyance: ~0.2 miles
Closed conveyance: ~2.2 miles

Catch basins: 153
Manholes: 2

Private stormwater facilities: 2
Public stormwater facilities: 21



Appendix C:

2014 Swamp Creek TMDL Monitoring Report

This report summarizes the Swamp Creek Fecal Coliform Total Maximum Daily Load (TMDL) program in Kenmore. The City conducted its first TMDL monitoring project from 2009 through 2013 under the 2007 Western Washington Phase II Municipal Stormwater Permit (Permit) and approved 2008 Quality Assurance Project Plan (QAPP). A second monitoring project will be conducted under the 2013 Permit and an approved 2015 QAPP.

Swamp Creek Basin

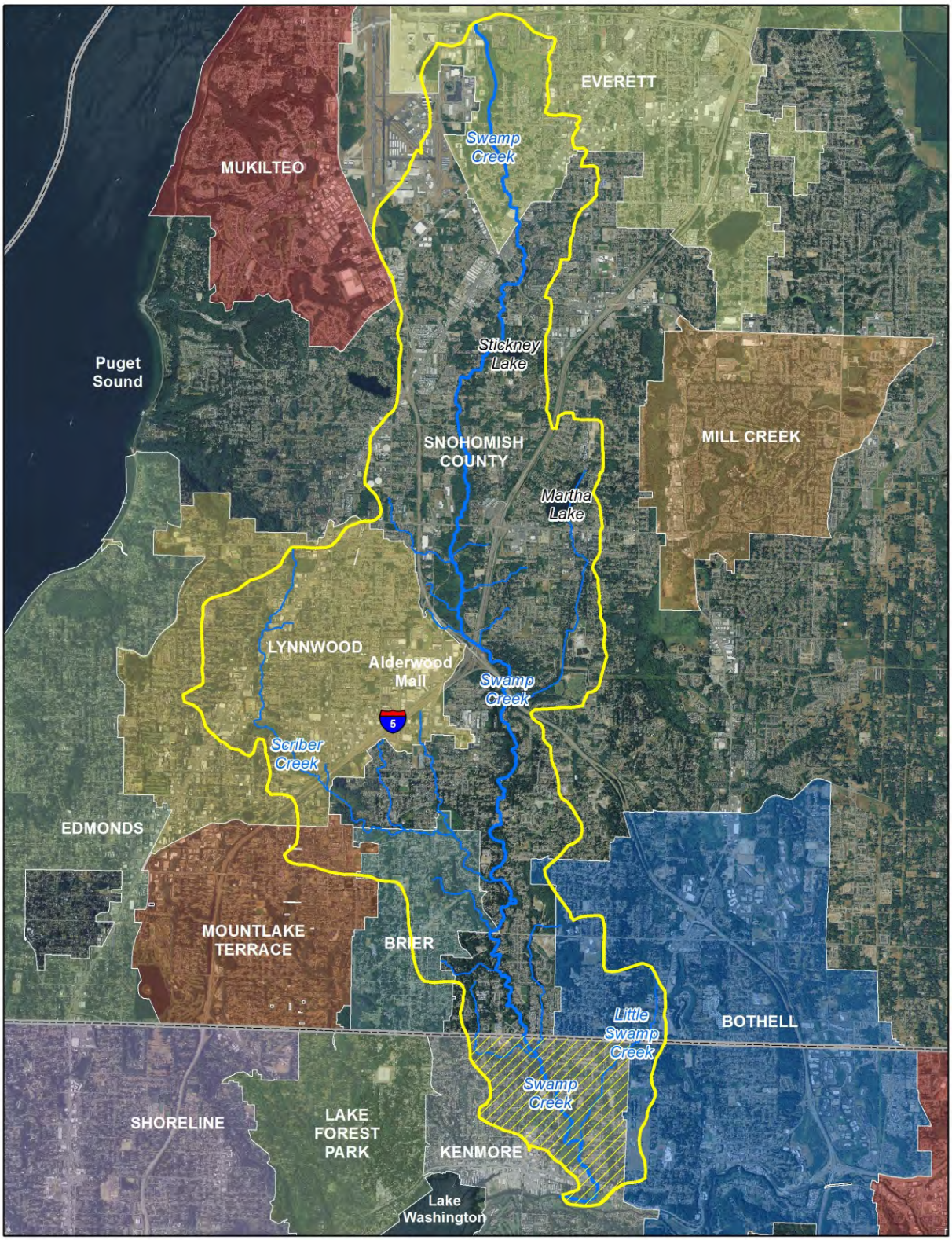
The 24 square mile Swamp Creek basin extends from its terminus at the Sammamish River in the City of Kenmore to its northern headwaters in the City of Everett. The watershed includes the Cities of Bothell, Brier, Everett, Lynnwood and Mountlake Terrace and unincorporated Snohomish County. Figure 1 shows the Swamp Creek Basin with Kenmore's portion hatched in yellow.

Swamp Creek is typical of Puget Sound lowland watersheds. In the gently sloping upper basin, Swamp Creek flows through a narrow valley which gradually broadens to a floodplain almost ¾ of a mile wide in the lower basin. The middle basin contains a narrow valley with steep slopes in excess of 15 percent just south of the I-405 and I-5 crossing. Elevation in the headwaters is approximately 520 feet, while the elevation at the mouth is about 20 feet above sea level. The stream gradient is flat, decreasing from about 50 feet per mile in the upper basin to less than 20 feet per mile near the mouth. Scriber Creek, Little Swamp Creek, and Martha Creek are the largest of the 19 streams tributary to Swamp Creek. Major lakes in the Swamp Creek watershed are Scriber Lake, Martha Lake, and Stickney Lake (Snohomish County SWM 1994, 2000).

Most of Swamp Creek and its tributaries are shallow and unsuitable for full-immersion swimming activities. However, several noteworthy exceptions are Martha Lake, and Stickney Lake. Wallace Swamp Creek Park in Kenmore and Scriber Lake in Lynnwood are both large enough and deep enough for swimming but this activity is not encouraged by Kenmore or Lynnwood. Although public access to the creek is largely limited to road crossings and a few parks, Swamp Creek is fully accessible to adjacent landowners, their children, and in some cases their neighbors. Limited boating opportunities exist where Swamp Creek meets the Sammamish River. The watershed is located within the US Census Defined Urbanized Area; therefore, it is expected that population growth and urban development will be concentrated in this area. Road density is highest in the Scriber Creek subbasin (Svrjcek 2006).

Kenmore has a population of about 20,000 and is primarily a residential community, with a small commercial area along State Route 522. The City is located in King County, just upstream of the confluence of the Sammamish River and Lake Washington. Swamp Creek flows through the middle of the City and joins the Sammamish River at the southernmost boundary of the city. The City comprises about eight percent of the Swamp Creek watershed. It is located at the terminus of the Swamp Creek watershed and, consequently, all pollution generated upstream has the potential to flow through the City of Kenmore.

Figure 1: Swamp Creek Basin Map



History of Swamp Creek Bacterial Pollution

Swamp Creek is polluted by bacterial pollution from a variety of sources throughout the watershed. Fecal coliform pollution is usually generated from a combination of both point and non-point sources. Nationally, one of the major non-point source contributions is urban stormwater runoff, which includes municipal stormwater discharges currently covered by National Pollutant Discharge Elimination System (NPDES) stormwater permits.

Non-point water pollution most commonly results from land use related activities, such as inadequate agricultural practices, failing onsite septic systems, and untreated stormwater runoff that does not originate from municipal separate storm sewer systems (MS4s). In rural areas, stormwater may carry wastes from domesticated animals. Stormwater from urban areas is more likely to carry pet wastes directly into nearby streams. Hobby farms are common on larger parcels within the Swamp Creek watershed. Urban and suburban development is continuing in the Swamp Creek watershed, increasing the water quality impacts from stormwater runoff.

Snohomish County performed water quality studies in Swamp Creek in the early 1990s. One study was conducted above station SCLU (north of Lynnwood) and the other was done as part of a larger one-year urban monitoring program. The purpose of the study was to examine the quality of water coming from residential, mixed, or small farmland uses. Although it turned out to be difficult to clearly show the effect of each type of land use, none of the five locations monitored met state bacteria standards. Fourteen Swamp Creek sites were tested as part of the urban monitoring study - 11 out of the 14 sites exceeded state bacteria thresholds. Swamp Creek was included on Washington's 1996 303(d) list because of numerous exceedances of fecal coliform bacteria standards, as monitored and documented by Ecology (Svrjcek, 2006).

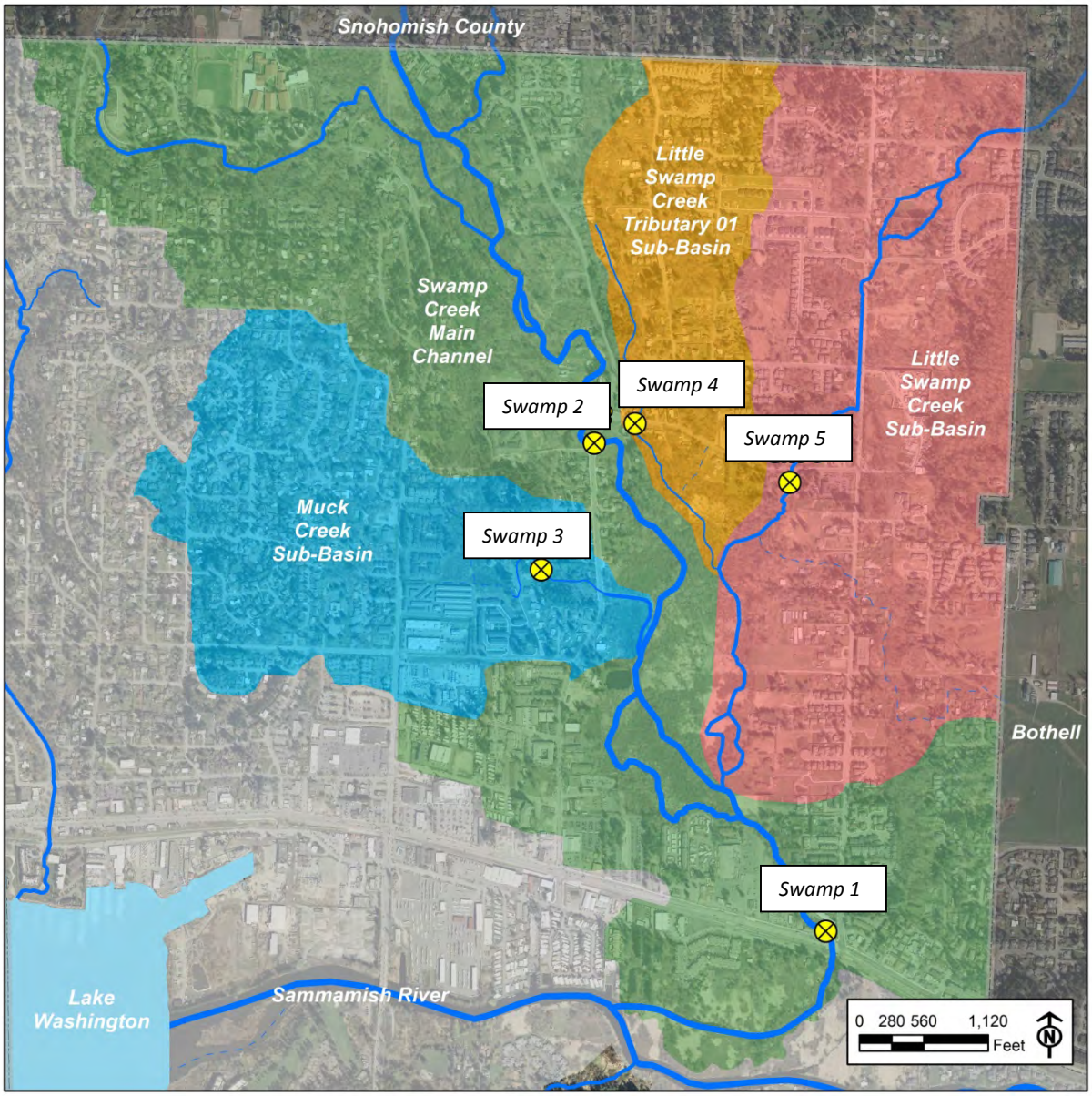
From 2000 to 2006, a consistent pattern of bacterial pollution was observed in Swamp Creek at each of the three long-term stations being monitored. The sites included SCLU north of Lynnwood, SCLD at the Kenmore/Snohomish County border and 0470 in Kenmore. All sites exceeded state criteria for bacteria at all times of the year. During the dry summer months when stream flows were low, bacteria levels rose far beyond both the geometric mean criterion of 50 cfu/100 mL and the 90th percentile criterion 100 cfu/100 mL. During the wetter months of the year, bacteria concentrations improved at each site (possibly due to dilution from increased runoff conditions), but not enough to meet state standards (Svrjcek, 2006).

As a result of the bacterial pollution problem, the Department of Ecology (Ecology) developed the Swamp Creek Fecal Coliform Total Maximum Daily Load Detailed Implementation Plan, (Svrjcek 2006). In this plan, Ecology established water quality monitoring requirements for local municipalities that collect, treat, and convey stormwater. Jurisdictions within the Swamp Creek basin, including Kenmore, were required to develop Quality Assurance Project Plans (QAPPs) to implement these TMDL requirements. Kenmore's first QAPP was developed and approved in 2008 and Swamp Creek fecal coliform concentrations were monitored from 2009 through 2013.

2009 – 2013 Swamp Creek Monitoring in Kenmore

The 2007 Permit required monitoring of fecal coliform bacteria concentrations in Swamp Creek. During this Permit period, sampling results in Swamp Creek continued to exceed State water quality standards for Permit holders, including Kenmore (Loch 2013, Lynnwood 2011, Kibbey 2013, Gaudette 2014, Shaw 2013). Kenmore monitored Swamp Creek bacteria concentrations from 2009 through 2013 at five sites shown below in Figure 2.

Figure 2: Kenmore Monitoring Sites



A total of 321 samples from the Swamp Creek basin were analyzed for fecal coliform concentrations between 2009 and 2013. The monitoring program included collection of 184 samples during the "wet season" months of October through April and collection of 137 samples during the "dry season" months of May through September. Table 1 provides fecal coliform concentration results from each sampling event during 2009 – 2013.

DATE	SWAMP 1		SWAMP 2		SWAMP 3		SWAMP 4		SWAMP 5	
	Fecal Coliform (CFU/100mL)		Fecal Coliform (CFU/100mL)		Fecal Coliform (CFU/100mL)		Fecal Coliform (CFU/100mL)		Fecal Coliform (CFU/100mL)	
		Replicate		*Replicate*		*Replicate*		*Replicate*		*Replicate*
1/2/2009	90		66		56		62		54	
2/23/2009	1060		47		258		72		20	
3/23/2009	2101		150		440		148		148	
4/23/2009	310		60		130		30		310	
5/8/2009	1100		130		72		18		210	
6/18/2009	78		150		230				520	
7/17/2009	240		180		350				150	
8/14/2009	1400		530		7100		4900		2700	
9/2/2009	380		220		1400		280		210	
10/2/2009	330		220		540		210		180	
11/4/2009	260		90		150		40		10	
12/11/2009	36		46		18		14		180	
1/19/2010	18		24		20		2		24	
2/18/2010	30		8		6		6		10	
3/11/2010	120		56		88		1700		250	
4/14/2010	22		32		48		2		36	
5/21/2010	110		120		100		10		140	
6/23/2010	40		5		220		20		95	
7/9/2010	38		22		42		28		6	
8/13/2010	40		25		60		5		40	
9/15/2010	94		22		220				46	
10/13/2010	140		4		110		16		6	
12/2/2010	130		8		10		2		4	
12/30/2010	190		12		2		2		16	
1/31/2010	200		14		8		2		6	
3/4/2011	470		8		20		2		86	
4/8/2011	260		58		34		2		54	
5/3/2011	440		190		120		26		200	
6/17/2011	90		40		220		15		460	
7/28/2011	180		160		80				200	
9/12/2011	380		170		75				70	
10/18/2011	580		120		210				50	
12/5/2011	580		35		70		10		15	
12/28/2011	2700		320		380		110		90	
1/31/2012	60		10		10		10		60	
3/5/2012	52		42		14		20		44	
3/27/2012	20		35		10		10		10	
4/20/2012	550	530	1200	1100	1600		340		1300	
5/16/2012	350	360	70	50	360		440	350	190	
6/27/2012	210	200	110	140	230		350		110	
8/1/2012	220	340	220	250	24				110	150
9/6/2012	35	95	370	100	140				200	
10/15/2012	200	220	260	100	560	360			160	180
12/20/2012	240		750		950		980		1400	
12/21/2012	320		410		80		10		50	
12/28/2012	100		160		120		10		50	
1/29/2013	60		30		340		30		60	
2/28/2013	100		110		100		40		120	
3/27/2013	84		12		140		12		24	
4/29/2013	78	80	50	58	1100	1200	14	12	50	48
5/21/2013	490	610	150	170	870	1000	240	220	1100	760
6/26/2013	200	240	240	190	220	150	10	10	220	190
7/24/2013	340	290	380	440	280	300			130	160
8/29/2013	1400	1300	1300	1300	3500	4500			4500	4000
9/27/2013	180	100	100	90	880	810			110	50
10/31/2013	94		26		420		62		80	
11/27/2013	140		50		20		30		80	
12/31/2013	16		32		56		140		84	

Table 1 *Fecal Coliform concentrations in Swamp Creek from 2009 – 2013*

During the first year of monitoring (2009), bacterial levels in Swamp Creek and tributaries to Swamp Creek exceeded water quality standards. All sites exceeded the geometric mean standard of 50 colonies/100 ml and all samples exceeded the "not-more-than-10 percent" (90th percentile) standard of 100 colonies/100ml. This was the case for both the dry season (May to September) and the wet season (October to April) samples. Consistent with the TMDL report, the bacteria concentrations of the dry weather samples exceeded the standard by a larger margin than did the samples taken during the wet season.

During the second year of monitoring (2010), bacterial levels in Swamp Creek and tributaries to Swamp Creek continued to exceed water quality standards at some sites. Two of the five sites exceeded the geometric mean standard of 50 colonies/100 ml during the dry season and one of five during the wet season. Three of the five sites exceeded the "not-more-than-10 percent" (90th percentile) standard of 100 colonies/100 ml during both the wet and dry seasons. This was an improvement from 2009 where all sites exceeded water quality standards all year.

During the third year of monitoring (2011), bacterial levels in Swamp Creek and tributaries to Swamp Creek continued to exceed water quality standards at some sites. Four of the five sites exceeded the geometric mean standard of 50 colonies/100 ml during the dry season and two of five during the wet season. Four of the five sites exceeded the "not-more-than-10 percent" (90th percentile) standard of 100 colonies/100 ml during the dry season and three of the five during the wet season.

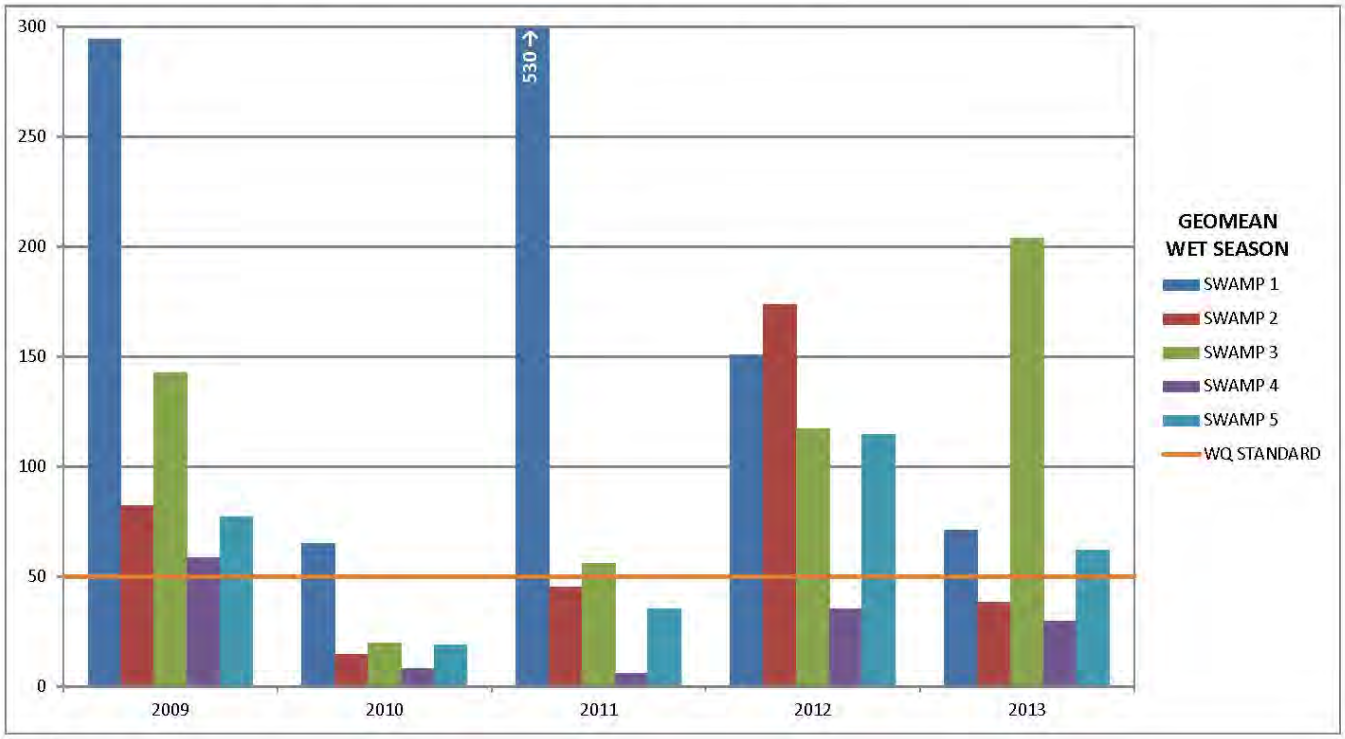
During the fourth year of monitoring (2012), bacterial levels in Swamp Creek and tributaries to Swamp Creek continued to exceed water quality standards at some sites. All five sites exceeded the geometric mean standard of 50 colonies/100 ml during the dry season and four of the five during the wet season. All five sites exceeded the "not-more-than-10-percent" (90th percentile) standard of 100 colonies/100 ml during both the dry and wet season.

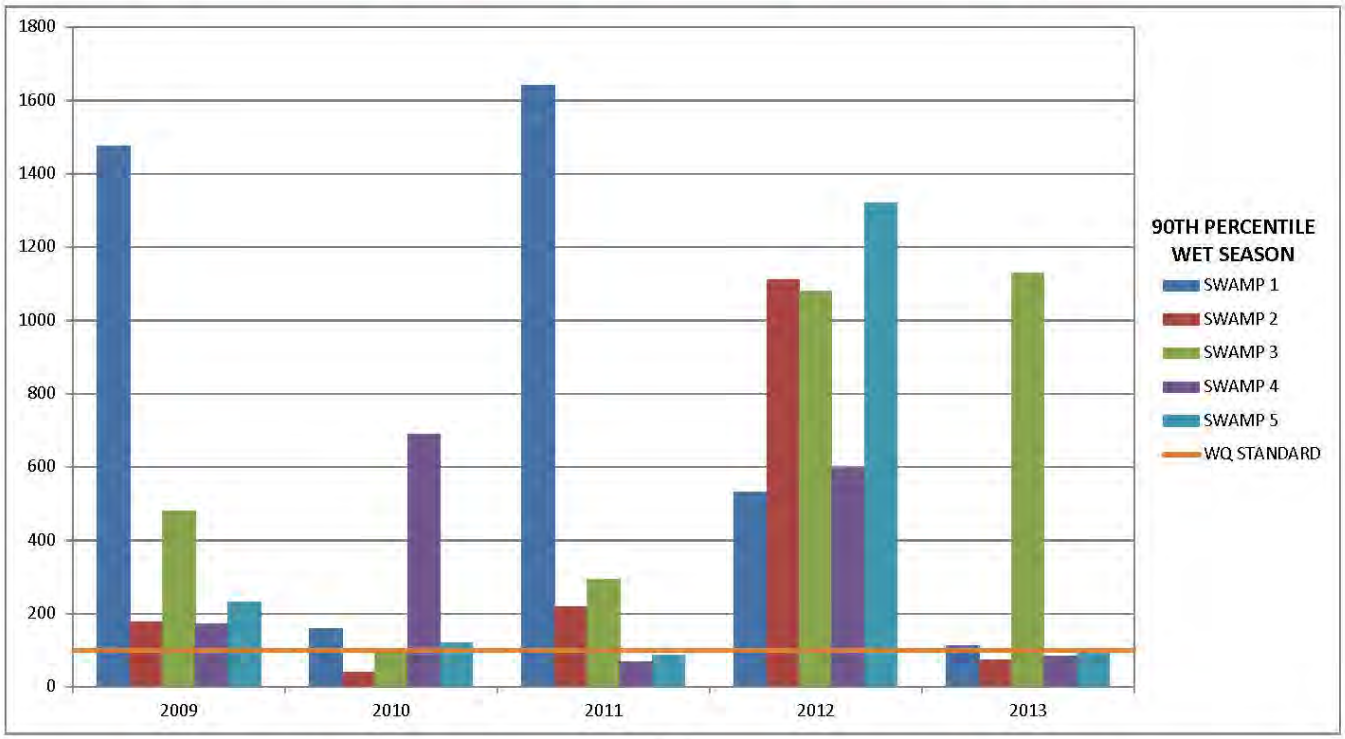
During the fifth and final year of monitoring (2013), bacterial levels in Swamp Creek and tributaries to Swamp Creek continued to exceed water quality standards at some sites. Four of the five sites exceeded the geometric mean standard of 50 colonies/100 ml during the dry season and three of five during the wet season. All five sites exceeded the "not-more-than-10-percent" (90th percentile) standard of 100 colonies/100ml during the dry season and two of the five during the wet season.

Forty three replicates (a second grab sample collected immediately following the first grab sample) at various sites were collected in order to evaluate variability in 2012 and 2013. Replicate sample variation between the first sample and the second sample had a range of 0 – 171 percent change with an average of 24 percent. The lab also performed duplicate analysis on random samples (total of 36 samples from 2009 - 2013) to determine variability within the same sample. Duplicate variation between the first sample and second sample had a range of 0 – 100 percent change with an average of 24%.

Figure 3 summarizes annual geomean and 90th percentile results collected during the wet season (October through April) for 2009 – 2013. Figure 4 summarizes annual geomean and 90th percentile results collected during the dry season (May through September) for 2009 – 2013.

FIGURE 3 Kenmore, WA Swamp Creek fecal coliform wet season results - 2009 through 2013.

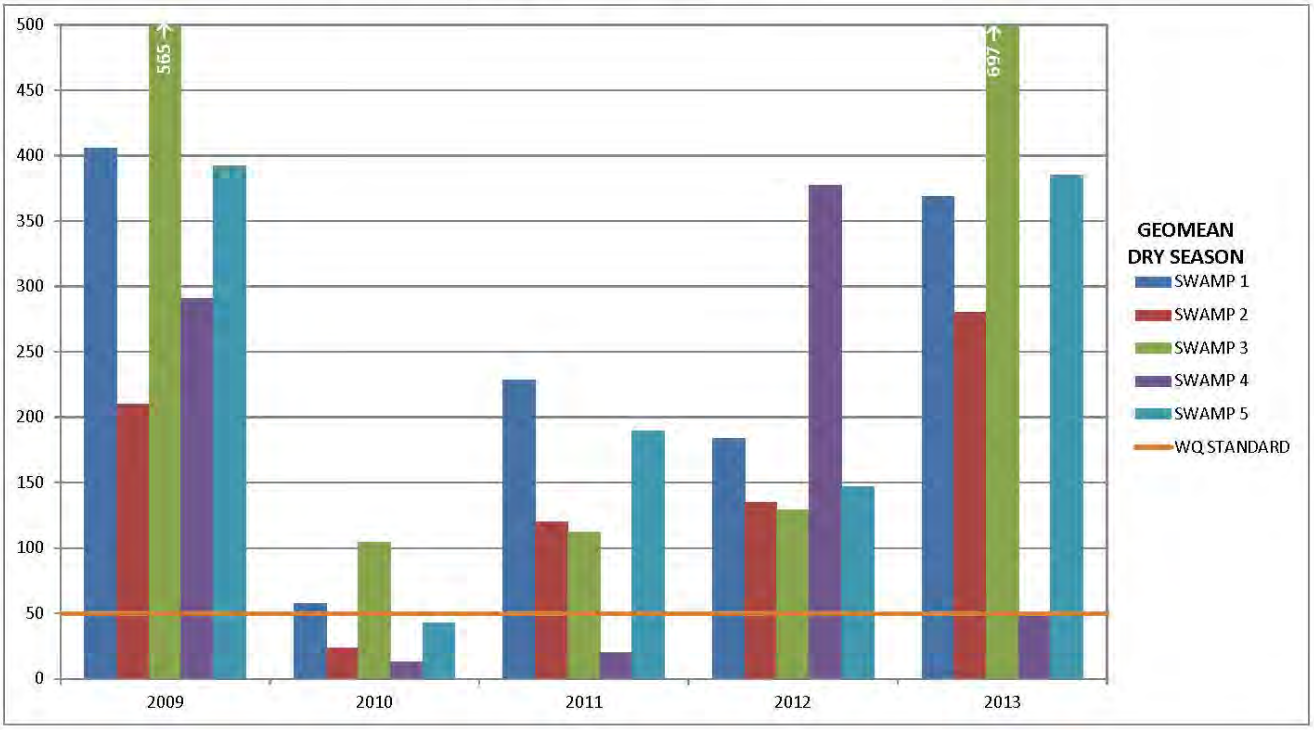


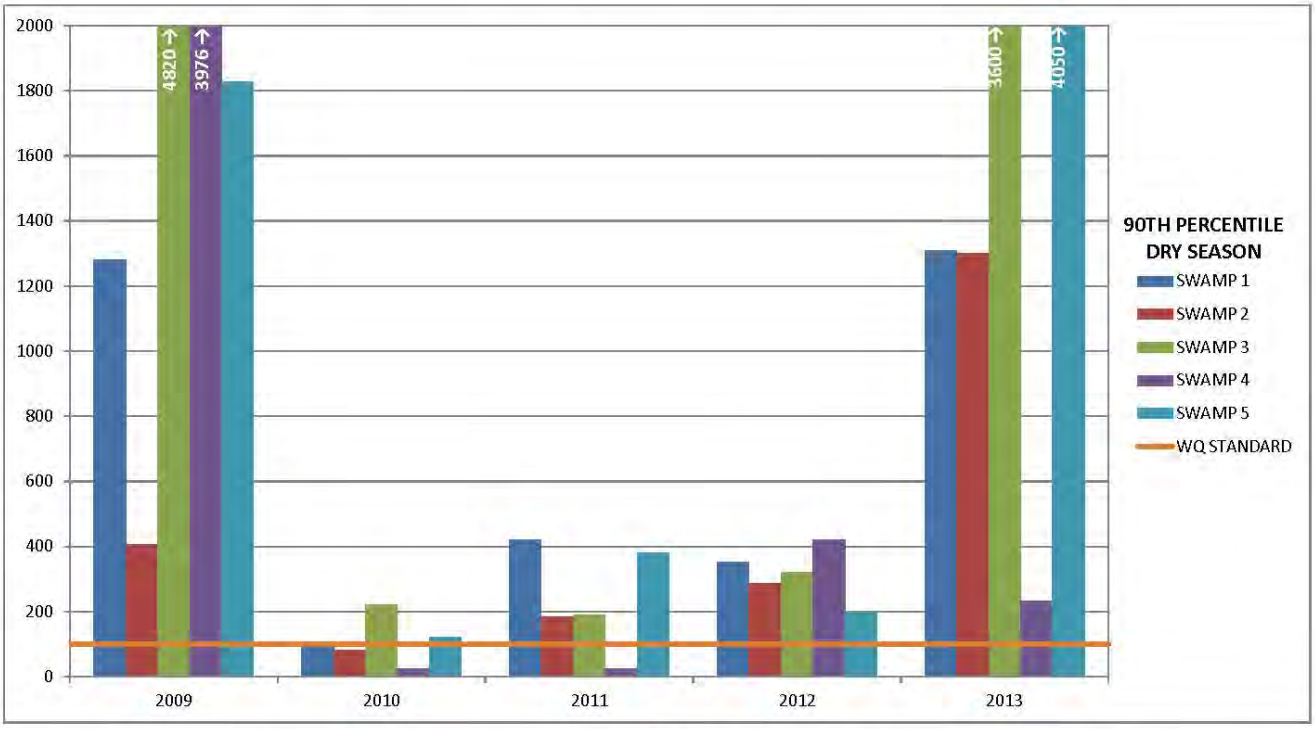


WET SEASON GEOMEAN					
	SWAMP 1	SWAMP 2	SWAMP 3	SWAMP 4	SWAMP 5
2009	294	82	143	58	77
2010	65	14	20	8	19
2011	530	45	56	6	35
2012	151	174	117	35	115
2013	71	38	204	30	62

WET SEASON 90TH PERCENTILE					
	SWAMP 1	SWAMP 2	SWAMP 3	SWAMP 4	SWAMP 5
2009	1476	178	480	173	232
2010	160	42	97	690	122
2011	1640	220	295	70	88
2012	532	1110	1080	596	1320
2013	112	74	1130	85	95

FIGURE 4 Kenmore, WA Swamp Creek fecal coliform dry season results - 2009 through 2013.





DRY SEASON GEOMEAN					
	SWAMP 1	SWAMP 2	SWAMP 3	SWAMP 4	SWAMP 5
2009	405	210	565	291	392
2010	58	24	104	13	43
2011	228	120	112	20	189
2012	184	135	129	378	147
2013	369	280	697	48	385

DRY SEASON 90TH PERCENTILE					
	SWAMP 1	SWAMP 2	SWAMP 3	SWAMP 4	SWAMP 5
2009	1280	406	4820	3976	1828
2010	104	82	220	26	122
2011	422	184	190	25	382
2012	353	286	321	422	196
2013	1310	1300	3600	234	4050

Table 3 provides a summary of the seasonal geomean and 90th percentile results over the entire five year monitoring program. Water quality standards were occasionally met depending on the season and site, but if all five years of data are combined and analyzed by season, then water quality standards for both geomean and 90th percentile values are exceeded except for the site Swamp 4 wet season geomean result.

		SWAMP 1	SWAMP 2	SWAMP 3	SWAMP 4	SWAMP 5
WET SEASON	GEOMEAN	152	56	87	22	55
	90TH PERCENTILE	580	347	716	191	208
DRY SEASON	GEOMEAN	222	136	289	64	203
	90TH PERCENTILE	1051	434	2030	395	1420

Table 3 *Geomean and 90th percentile fecal coliform values calculated from 2009 - 2013 data.*

Monitoring of fecal coliform concentrations in Swamp Creek from 2009 – 2013 revealed that water quality standards continued to be exceeded. Kenmore implemented several non-point source pollution controls within the City during this period, including:

- Public Education and involvement
- Management and maintenance of the City's storm sewer system
- Legal authorities and ordinances (i.e., pet wastes, illegal discharges, etc.)
- Pet waste management
- Assessment monitoring

Next Steps – 2015 and Beyond

Kenmore updated the Swamp Creek Fecal Coliform Bacteria TMDL QAPP as required by the 2013 Permit. A second monitoring project is required to begin by August 1, 2015 and monitoring is proposed at the same five sites as were proposed in the 2008 QAPP. Ongoing Swamp Creek TMDL activities in Kenmore include:

- Collect 12 fecal coliform samples at each site per calendar year (beginning by August 1, 2015).
- Targeted source identification and elimination activities will be conducted in the identified high priority area of Muck Creek (SWAMP 4).
- Inspect commercial animal handling areas and commercial composting facilities to ensure implementation of source control BMPs for bacteria.
- Conduct public education and outreach activities to increase awareness of bacterial pollution problems and promote proper pet waste management behavior.
- Install and maintain animal waste collection and/or educational stations at municipal parks and other Kenmore owned and operated lands reasonably expected to have substantial domestic animal (dog or horse) use and the potential for pollution of stormwater.
- Illicit Discharge Detection and Elimination (IDDE)-related field screening conducted under S5.C.3 of the Permit, which will include screening for bacteria sources in MS4 subbasins that discharge to Swamp Creek.

- Submit sample data to the Environmental Information Management System (EIM) database by May 31 of each year (beginning in 2016).
- Provide data summaries and narrative evaluation of the data in each annual report's TMDL summary to Ecology.

References

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Appendix D:

Stormwater Retrofit Memorandum

OSBORN CONSULTING INCORPORATED

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SUITE 220E
BELLEVUE, WA 98004
(425) 451-4009

Date:	April 7, 2015
To:	Erin Nelson, PE, LG Altaterra Consulting, LLC
From:	Laura Ruppert, PE and Marie Phelan Amundson, EIT Osborn Consulting, Inc.
Subject:	Kenmore Surface Water Master Plan Retrofit Strategy Memorandum

This memorandum documents the stormwater retrofit strategy for stormwater management and water quality treatment for the City of Kenmore.

EXISTING CONDITIONS

Osborn Consulting, Inc. (OCI) utilized the Geographic Information System (GIS) to conduct a review of existing conditions within the City of Kenmore related to stormwater management. The City provided OCI with GIS map layers including parcels, sensitive areas, zoning, impervious surfaces, basin boundaries, and stormwater pipes, channels, and existing treatment facilities. Existing stormwater treatment facility drainage areas were also provided. Each stormwater facility has a recorded installation year, with approximately 53% installed since 1998. Thirty percent of the land is impervious, with the majority of land zoned for residential use.

RETROFIT STRATEGY

The purpose of the stormwater retrofit strategy is to provide the City with a framework for identifying opportunities to improve and expand upon existing stormwater treatment. To facilitate this, parcels were placed into one of five categories, where “old” is defined as prior to the 1998 design manual, and “newer” is post-1998:

- Areas that are **built-out** and **untreated**.
- Areas that are **built-out** and have **old facilities**.
- Areas that have development potential and are untreated.
- Areas that have development potential and old facilities.
- Areas that have **newer facilities**.

Table 1 identifies the different stormwater retrofit strategies associated with a variety of existing condition scenarios.

Table 1: Stormwater Retrofit Strategies		
Existing Condition	(Re-)Development Potential Existing % Impervious is < Zoning Requirements	Built-Out* Existing % Impervious is ≥ Zoning Requirements
Untreated	Install new facilities • Regional facilities • Partnering opportunity • Rely on developers to provide treatment • Focus on treatment of right-of-way (ROW)	Install new facilities • Focus on treatment of ROW • Incentivize private property owners to install treatment
Old Treatment (Pre-1998)	Retrofit old facilities • Modify facility size and/or control structure Install new facilities • Regional facilities • Partnering opportunity • Rely on developers to provide treatment • Focus on treatment of ROW	Retrofit old facilities • Modify facility size and/or control structure Install new facilities • Focus on treatment of ROW • Incentivize private property owners to install treatment
"Newer" Treatment (1998-current)	No retrofit recommended - assumes adequate treatment is provided or that other areas should have higher priority	
*Properties may still re-develop but will not increase % impervious compared to existing condition.		

METHODOLOGY

Potential area-specific retrofit opportunities were identified through a GIS analysis of existing data using the following steps:

1. Create a development GIS layer that shows parcels that can or cannot be developed in the future, based on current zoning.
2. Modify the existing stormwater facility GIS layer to include general categories of installation year.
3. Combine the development and existing stormwater facility GIS layers to evaluate the existing condition scenarios described in **Table 1**.

The process is described below.

Development

A “Development” layer was created to display parcels that are built-out or have development potential based on current zoning. The parcel GIS layer was modified with the addition of a “Development” field with the two choices of “Can Be Developed” and “Cannot Be Developed,” according to current zoning.

OCI queried impervious surfaces and zoning categories. Impervious surfaces queried include rooflines, driveways, parking lots, patios/concrete pads, railroad yards, and walkways/sidewalks; ROW associated with roadways was not included in the query as ROW is not included in the zoning categories. The sum of the existing impervious area within each zoning category was divided by the total area of the zoning category to determine the average percent impervious. The average percent impervious was applied to each parcel within that zoning category. The City of Kenmore Zoning Code (Title 18) documents the maximum percent impervious allowable for each zoning category. OCI compared the average percent impervious calculated to the maximum allowable by the applicable zoning category to assess if there was potential for increased percent impervious. Parcels which did not meet the maximum allowable percent impervious were categorized as “Can Be Developed,” while parcels which met or exceeded the maximum allowable were categorized as “Cannot Be Developed.”

Several parcel-specific edits were made to the “Cannot Be Developed” parcels because of other conditions that would warrant them undevelopable, including the following:

- GIS information provided by the City for sensitive areas was used to identify areas where no future development will be allowed. These areas included wetlands, floodplains, and streams. Any parcel within a 150-foot buffer (which is the maximum width for wetlands and streams as shown in Chapter 18.55 Critical Areas of the Kenmore City Code) of these sensitive areas was removed from the query for development potential parcels and labeled “Cannot Be Developed.”
- Parcels in some zoning categories were also removed, including parks, golf courses, and public or semi-public areas. OCI assumed these dedicated zoning areas would remain relatively unchanged in the future. These parcels were labeled “Cannot Be Developed.”

The parcels remaining in the development potential query were labeled “Can Be Developed.” A few flaws should be noted in this strategy.

1. Existing residential neighborhoods may not be utilizing the maximum lot impervious surface allowed in the zoning code, but are not likely to develop on a large scale.
2. Downtown Kenmore already meets the maximum impervious surface coverage for existing zoning categories, but also has parking lots, staging areas, trailer parks, etc. which could still be redeveloped.

See **Figure 1** for a map of the “Development” layer.

Facility Drainage Areas

The City of Kenmore provided a GIS shapefile with stormwater treatment facility structures and their corresponding drainage areas named "Facility Drainage Areas." OCI updated the existing shapefile to include an attribute for installation year, which was noted in the existing facility ID provided in GIS by the City. Only public facilities were considered for retrofit as privately owned facilities must be maintained by the owner. To determine which facilities lie in the "old facilities" class, OCI grouped the facilities by their installation date. Installation years were broken into the following groups:

- <1998
- 1998-2008
- 2009-2016
- >2016

These year ranges were chosen to generally correspond with Department of Ecology Manual updates. A new manual update will be released in 2016, which will apply to future retrofit analyses. However, for the current analysis, only the first three categories are considered. This analysis considers "old" to be pre-1998 installation. See **Figure 2** for a map of the "Facility Drainage Areas" layer.

Retrofit Potential

A "Retrofit Potential" layer was also copied from the parcel shapefile, and joined with the "Development" layer and the "Facility Drainage Areas" shapefiles. By querying the "Development" and "Facility Drainage Areas" layers, OCI overlapped those parcels that met the conditions of interest with regard to retrofit potential as described below:

- "Cannot Be Developed" and non-treated parcels were labeled **Built-Out & Untreated**;
- "Cannot Be Developed" and "Facility Drainage Areas" prior to 1998 were labeled **Built-Out & Old Facilities**;
- "Can Be Developed" and non-treated parcels were labeled **Dev Potential & Untreated**; and
- "Can Be Developed" and "Facility Drainage Areas" prior to 1998 were labeled **Dev Potential & Old Facilities**.

All other parcels were labeled "Newer Treated" and are not recommended for retrofit. See **Figure 3** for a map of the "Retrofit Potential" layer.

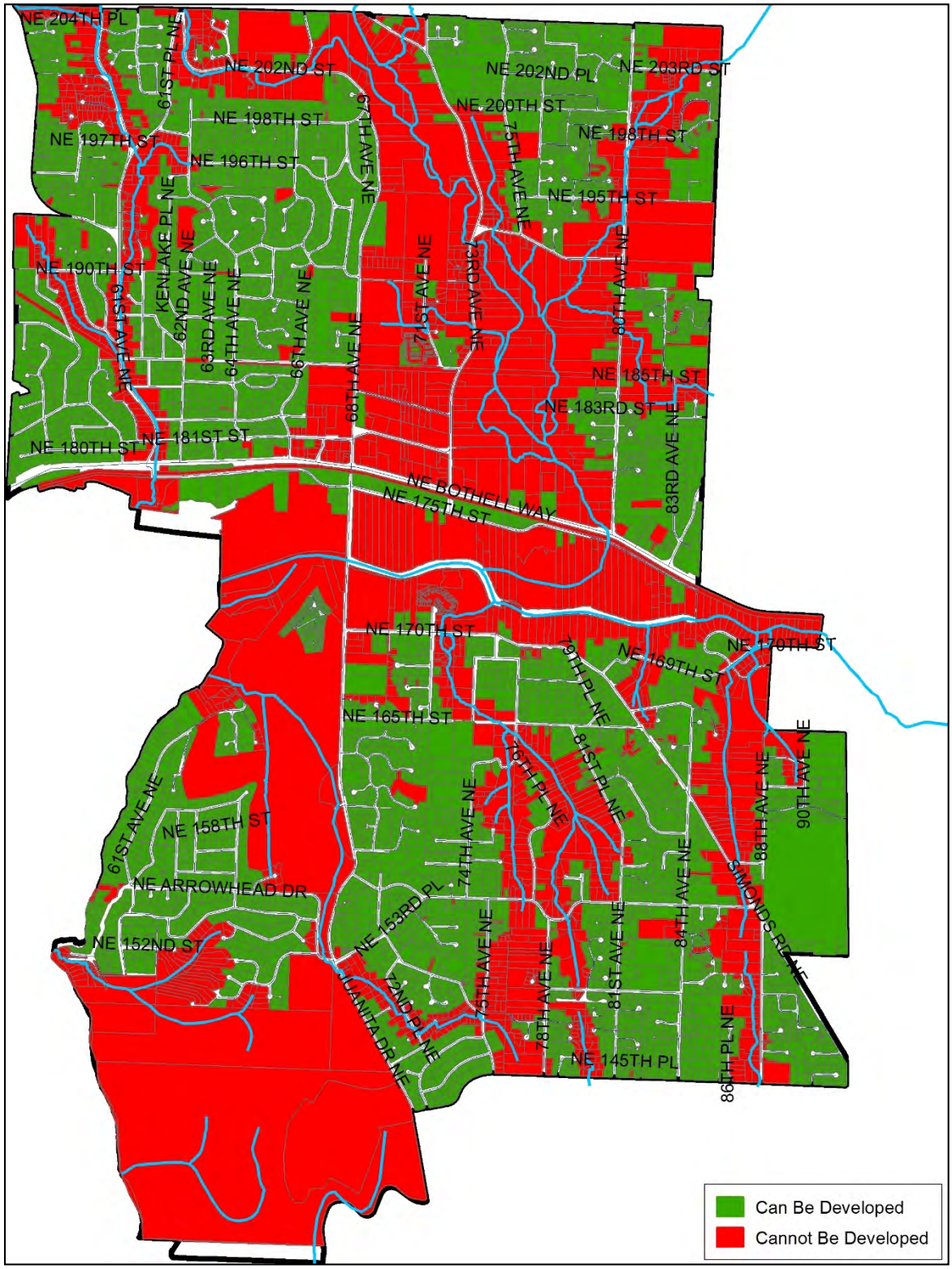


Figure 1: Development Layer

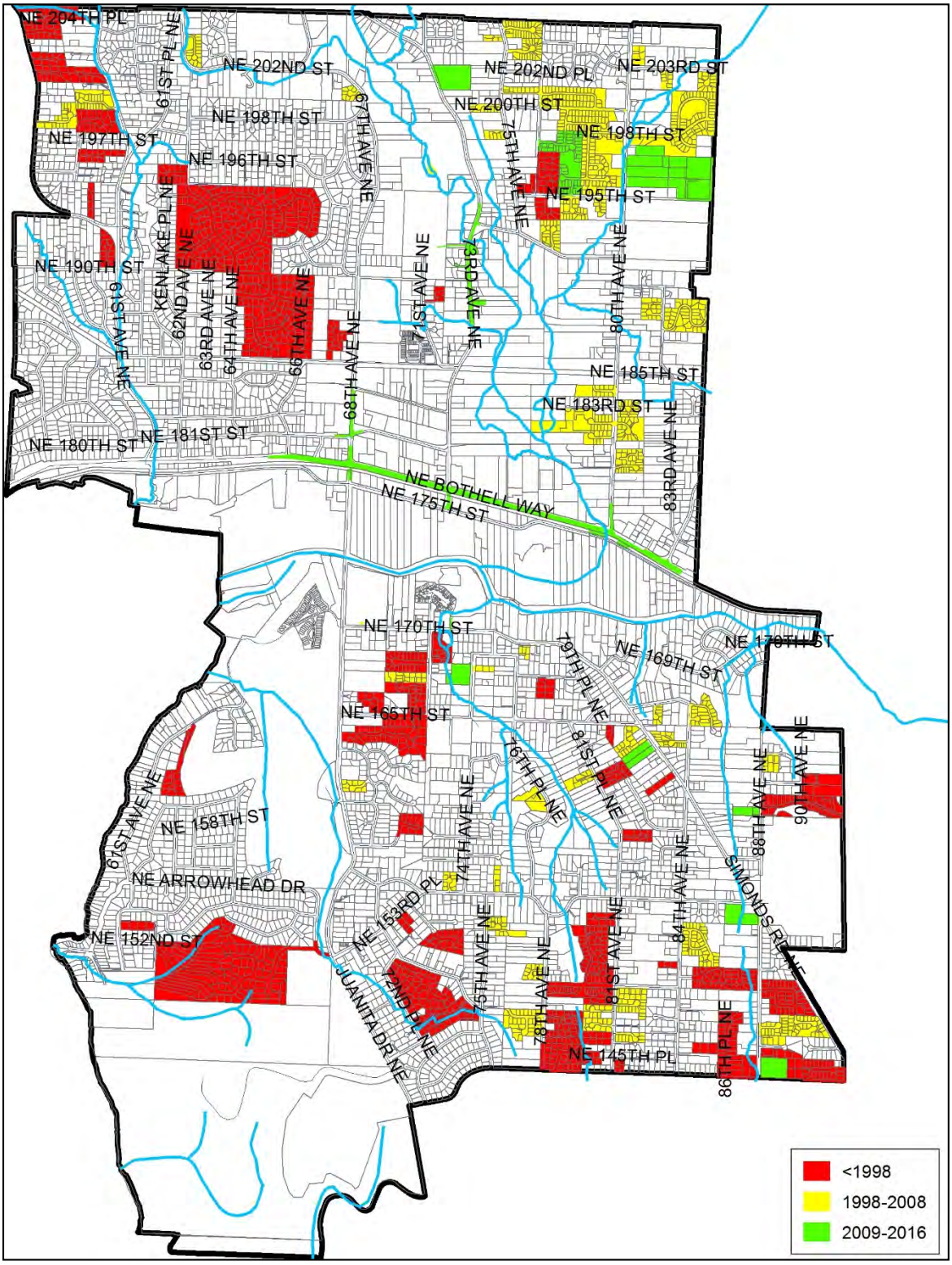


Figure 2: Facility Drainage Areas Layer

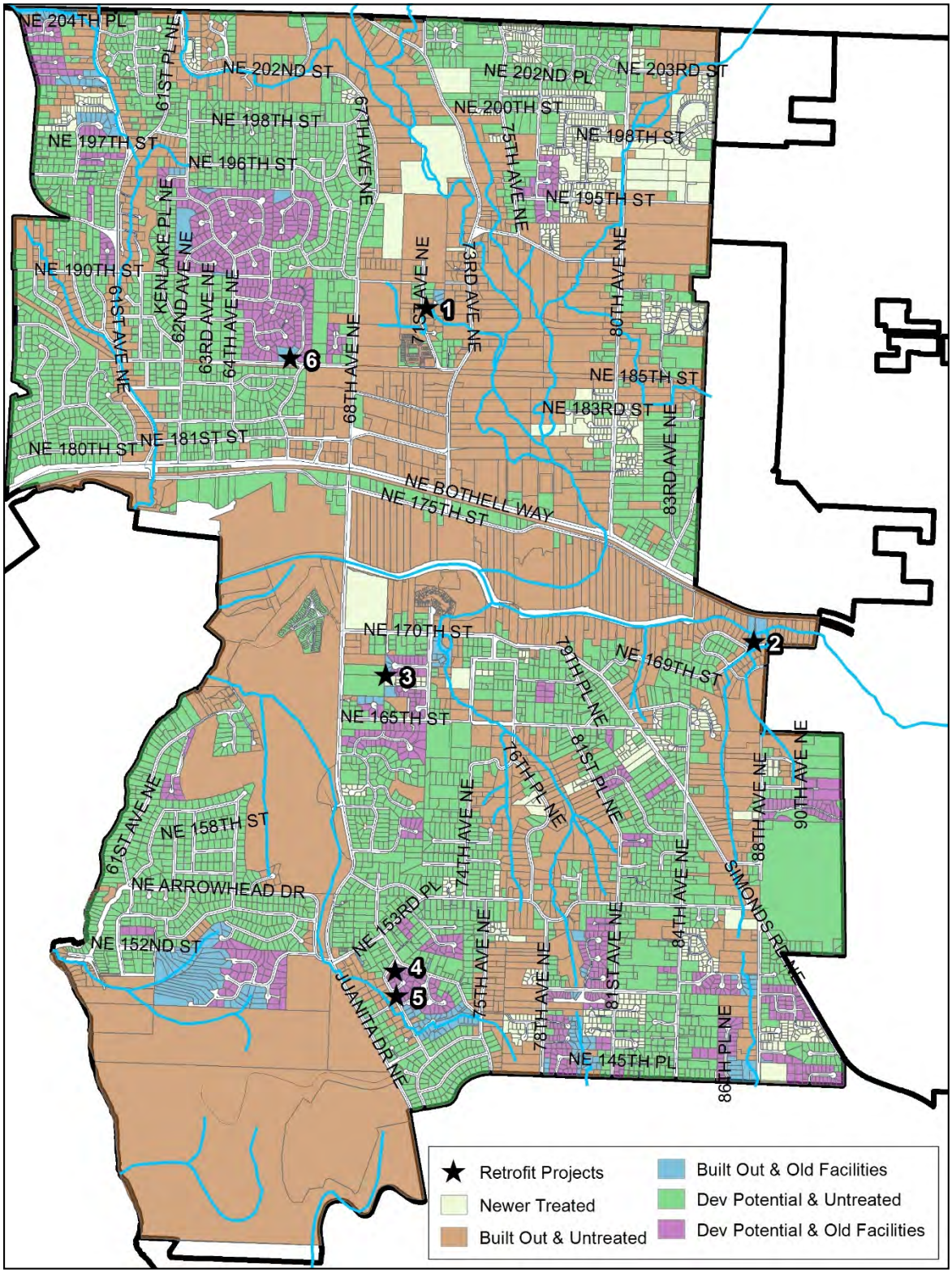


Figure 3: Retrofit Potential Layer

RETROFIT ANALYSIS

Using the layers developed above, it is possible to determine areas suitable for retrofit or installation of a new facility as described in **Table 1**. By reviewing ponds, vaults, and swales within the "Built Out & Old Facilities" and "Dev. Potential & Old Facilities" parcels, the City will be able to identify retrofit possibilities. The "Built Out & Untreated" and "Dev Potential & Untreated" parcels have the potential for new facilities. The City would need to provide treatment facilities for the "Built Out & Untreated" areas because existing developments are not required to install treatment facilities. "Dev Potential" parcels (a parcel which has not met or exceeded the maximum impervious area for the zoning designation), upon development or redevelopment, will require the developer to install facilities to meet current stormwater regulations.. Retrofit projects are typically less expensive and invasive than installing a new facility. Therefore, it is recommended that the City review the "Built Out" locations for potential retrofit projects, beginning with the old facilities before moving on to untreated locations requiring new facilities.

As an initial assessment, OCI focused on facilities located within the ROW or on City-owned properties adjacent to the "Old Facilities" parcels. Facilities within these parcels were analyzed for space and functionality of a retrofit project. Several meetings were conducted with the City to discuss problem areas, proposed development areas, and known capital improvement projects (CIPs). Six potential retrofit projects were developed with City input using the above process. These projects are outlined below in **Table 2**, and numbered on **Figure 3** above. The projects are preliminary examples of potential retrofit solutions within the City of Kenmore. As areas are developed or redeveloped, the City should reevaluate parcels using the process outlined in this report to develop and prioritize new projects as needed.

Table 2: Stormwater Retrofit Projects

Project Number	Project Name	Retrofit Potential
1	Muck Creek Duck Pond	Built Out & Old Facilities
2	Sammamish River Vaults	Built Out & Old Facilities
3	Inglewood Place Detention Pond	Built Out & Old Facilities
4	Bixby Knoll Pond 1	Dev Potential & Old Facilities
5	Bixby Knoll Pond 2	Dev Potential & Old Facilities
6	Northlake Heights Detention Pipes	Dev Potential & Old Facilities

1) Muck Creek Duck Pond

An existing pond on private property at 18810 71st Ave. NE serves as a duck pond (see **Figure 4**). The pond has filled with sediment and does not provide flow control. The pond may, however, provide water quality benefits. Potential retrofit options include converting the duck pond to a stormwater facility by dredging the pond to provide additional dead storage or adding a control structure to establish live storage.

Figure 4: Muck Creek Duck Pond

2) Sammamish River Vaults

Two existing vaults adjacent to the Sammamish River at NE 170th Street and NE 169th Place collect sediment from stormwater runoff that is routed to these facilities and require annual cleaning (see **Figure 5**). One vault is 6.5-feet by 12-feet, while the other is 6.5-feet by 10-feet. Inlet and outlet pipes are 30-inch diameter concrete pipes. The vaults were installed in 1990 and are likely undersized to meet current stormwater regulations. Replacing and upsizing the vaults, as well as replacing the 30-inch CMP pipes will provide increased storage capacity to improve water quality by allowing additional time for pollutants to settle.

Figure 5: Sammamish River Vaults

3) Inglewood Place Detention Pond

An existing detention pond was installed in 1988 (see **Figure 6**). The pond has an existing surface area of approximately 850 square feet, and is designed to treat runoff from NE 168th St. The pond outfalls to a piped conveyance system that flows to Juanita Drive NE, then to the Sammamish River. While the parcel is not large enough to extensively increase pond size, there is an opportunity to add water quality features, such as wetland vegetation or bio-filtration elements along NE 168th Street.

Figure 6: Inglewood Place Detention Pond

4) Bixby Knoll Pond 1

The Bixby Knoll Stormwater Pond 1 is located on 72nd Place NE, just west of NE 150th Street (see **Figure 7** for a photo of the pond exit). The pond was installed in 1977 and receives runoff from NE 150th Street and 73rd Avenue NE. The pond does not have a control structure, however a structure could be installed at the outlet to provide additional detention.

Figure 7: Bixby Knoll Stormwater Pond 1

5) Bixby Knoll Pond 2

The Bixby Knoll Stormwater Pond 2 is located at the corner of 72nd Place NE and NE 149th Place (see **Figure 8** for a photo of the pond outlet). The pond was installed in 1977 and receives runoff from NE 149th Place, NE 148th Place, and 72nd Place NE. No control structure is currently in place, however, a control structure could be installed at the outlet to provide additional detention. Water quality structures can be installed along 72nd Place NE to provide water quality treatment before runoff enters the pond.

Figure 8: Bixby Knoll Stormwater Pond 2

6) Northlake Heights Detention Pipes

Two 60-inch CMP detention pipes installed in 1978 are located at 66th Avenue NE and NE 185th Street (see **Figure 9**). A Department of Ecology grant-funded Low Impact Development (LID) project is currently being designed for the Northlake Heights Basin, which includes the detention pipes. The LID project may include detention pipe replacement as part of the project. Updated pipes and structures will provide flow control and contribute to water quality improvements proposed along NE 185th Street.

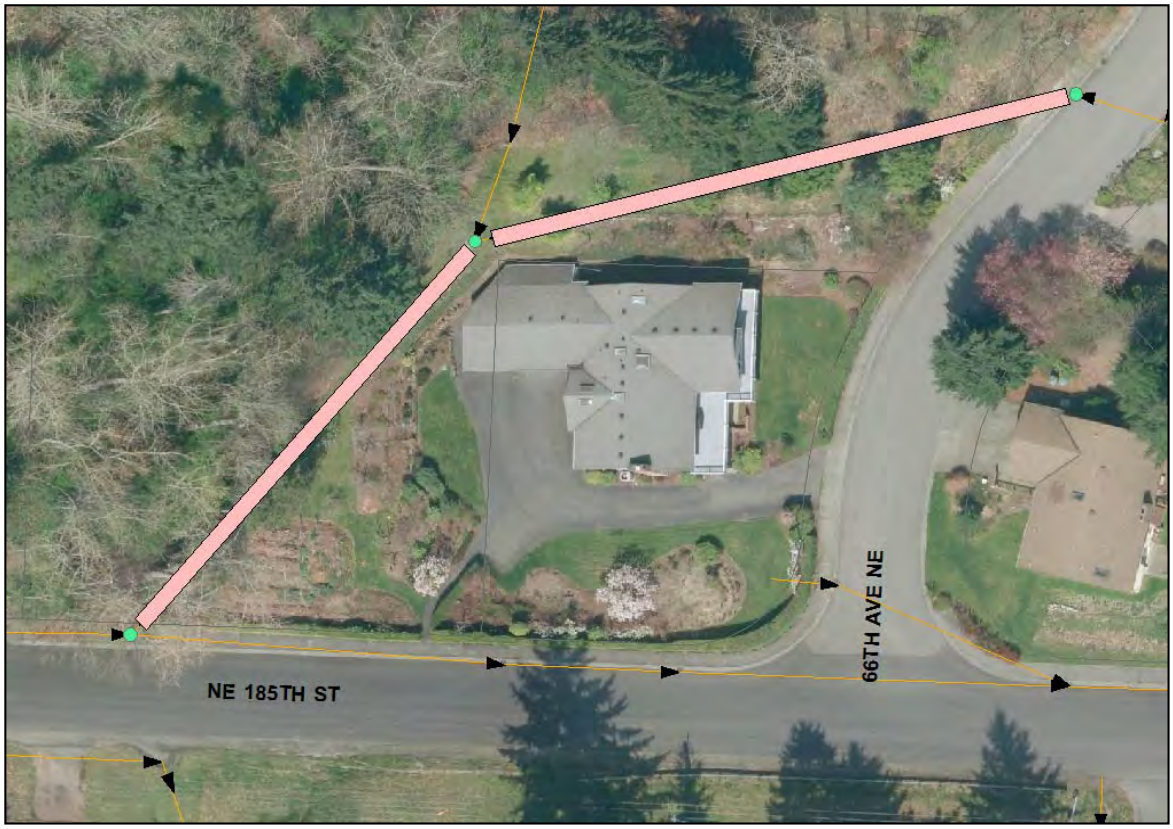


Figure 9: Detention Pipes along NE 185th Street

Appendix E:

Capital Improvement Project Summary Sheets

Project:	Tributary 0056 Erosion and Stream Repair		ID: SW-08
Location:	61st Avenue NE and NE 190th Street	Basin:	Tributary 0056
Project Type:	☐Water Quality ☐Fish Passage ☐Flow Control ☒Erosion ☐Drainage ☐Flooding	Preliminary Project Cost:	$1,111,000
Problem:	Stream channel and sidewalk erosion		

Project Overview

Tributary 0056 flows from north to south along the east side 61st Avenue NE. There are three problems where Tributary 0056 crosses NE 190th Street:

1. Stream channel bank erosion along a 155-LF section of rock wall has resulted in failed sections where rocks have fallen into the channel. The full extent of the damage is unclear.
2. Rock wall headwalls are at the inlet and outlet of the culvert and protect 61st Avenue NE from stream flow. Stream flows have eroded the existing slope and rock headwall north of NE 190th Street, resulting in an unstable headwall. Stream flows have been observed bypassing the culvert. It is unknown where the piping water goes.
3. Runoff from NE 190th Street concentrates at the northeast side of the street where the sidewalk transitions to gravel, causing the sidewalk to be undermined.

This project was identified by the City in 2013. A surface water field investigation report and recommendations were prepared by consultants in February 2013.

The preferred solutions include:

1. Conducting a geotechnical and structural evaluation of 155-LF of rock wall to determine stabilization measures necessary to protect 61st Avenue NE. If rock wall improvements are needed, stream improvements will likely be required for mitigation associated with stabilization of the rock wall and will also serve to redirect flow away from the stream bank.
2. Replacing the upstream culvert headwall with a concrete headwall in accordance with recommendations in the February 2013 surface water field investigation report.
3. Installing an asphalt berm along NE 190th Street from the existing curb to the edge of the first driveway to direct runoff to the stormwater system on 61st Avenue NE rather than the stream. This solution also involves filling the void under the existing sidewalk with grout or concrete.

Project benefits include protection of existing infrastructure (sidewalk and roadway) and improved stream habitat.

Rocks from wall that fell into the stream

Undercut sidewalk at NE 190th Street

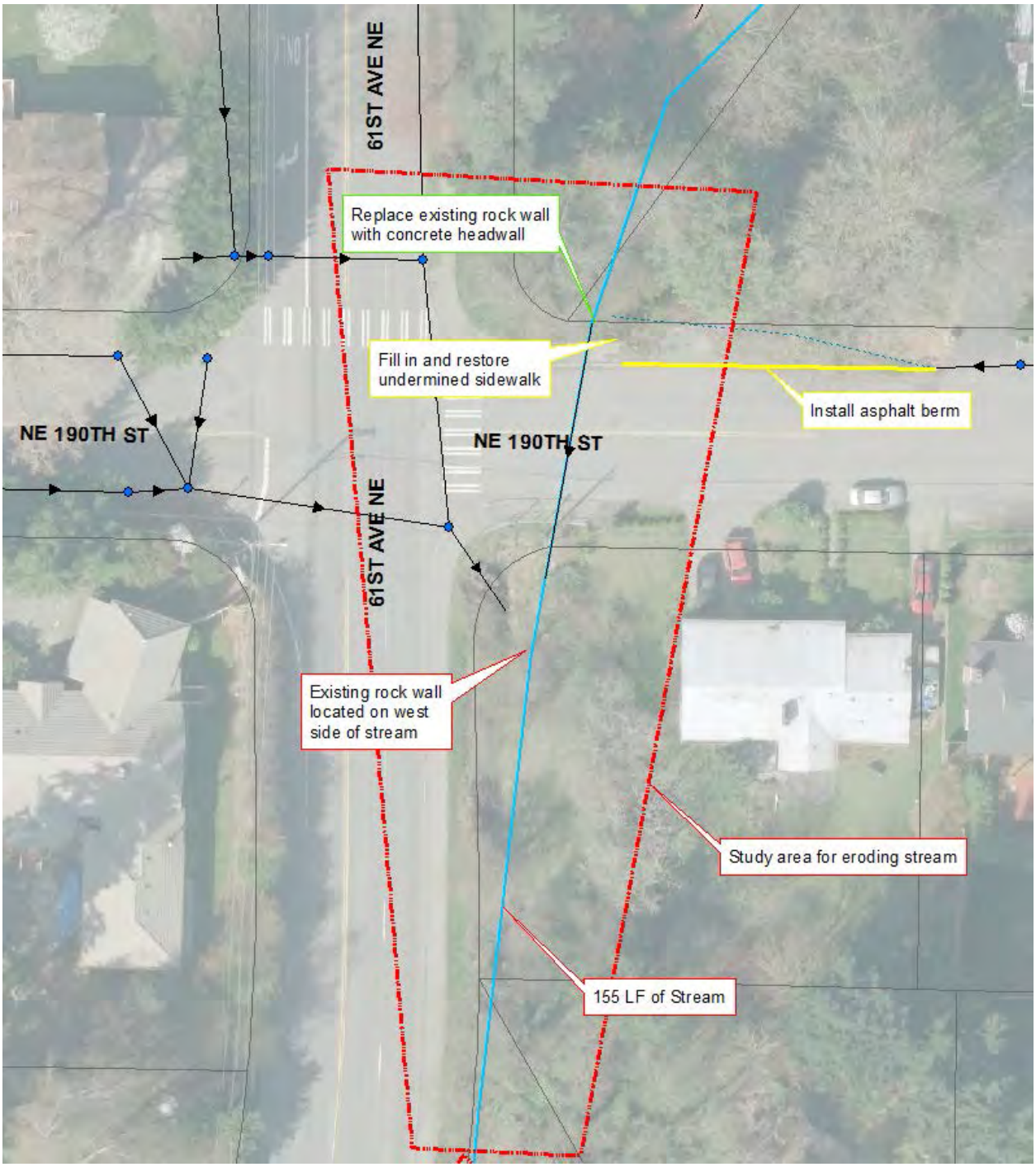
Conceptual Design

1 & 2. Conduct geotechnical and structural evaluations to determine the full extent of rock wall repair and mitigation necessary to protect existing infrastructure.

- The cost estimate assumes the entire 155-LF section of wall will need to be repaired. Geotechnical and structural evaluation will determine the actual amount of wall repair needed.
- Wall repairs below the stream's ordinary high water mark will likely require stream restoration mitigation, along the entire 155 LF. Stream restoration will include a modified channel cross-section that includes a floodplain bench, removal of invasive plant species, and installation of large woody debris and riparian planting.
- Resource agencies may encourage replacing the existing culvert with a wider, fish-passable culvert if headwall repairs are proposed. The cost estimate below assumes both headwalls are repaired and a new culvert is installed.
- The design schedule for stream restoration shall account for time to obtain temporary or permanent easements and in-water work permits from WDFW and USACE.

3. The preferred solution for the undermined sidewalk is to install an asphalt berm along the north side of NE 190th Street and fill in the damaged portion of the sidewalk with grout or concrete. A loss of parking will occur. This work is within the City ROW and above the stream's ordinary high water mark, so the solution can be designed and constructed faster than the in-water work described above.

Considerations for Implementation	
	• Bundle all improvements with work below the ordinary high water mark as one project with one set of permit documents. • Remove vegetation, with the exception of trees. If tree removal is necessary, a tree removal permit will be required. Environmental permitting will include a SEPA checklist, WDFW HPA, USACE permits, and Tribe coordination. • Temporary construction easements may be needed for in-stream work along 61st Avenue NE. Acquiring permanent easements will allow more flexibility in stream restoration design.


61ST AVE NE
Replace existing rock wall with concrete headwall
Fill in and restore undermined sidewalk
Install asphalt berm
NE 190TH ST
NE 190TH ST
61ST AVE NE
Existing rock wall located on west side of stream
Study area for eroding stream
155 LF of Stream

Planning-level Cost Estimate

Asphalt Berm				
Item	**Unit**	**Unit Cost**	**Quantity**	**Cost**
Water Pollution/Erosion Control	%	5%		$75
SPCC Plan	LS	$500	0	$0
Traffic Control	%	7%		$100
Clearing & Grubbing	SY	$5	20	$100
Extruded Curb	LF	$15	81	$1,215
Subtotal				$1,490
Contractor overhead, profit, and mobilization			10%	$149
Washington State Sales Tax			9.5%	$142
Construction Contingency			50%	$745
Subtotal Construction Costs				$2,526
City Staff Time			10%	$253
Administration and engineering design			20%	$505
Design Contingency			20%	$505
Permitting				$0
Land acquisition and easements	SF	$5	0	$0
Total Berm Cost				**$3,800**
Geotechnical/Structural Analysis				**$5,000**

Rock Wall and Stream work				
Item	**Unit**	**Unit Cost**	**Quantity**	**Cost**
Water Pollution/Erosion Control	%	5%		$21,000
SPCC Plan	LS	$500	1	$500
Traffic Control	%	7%		$29,000
Rock wall repair (along 61st Ave NE)	LF	$1,000	155	$155,000
Temporary Stream Bypass	LS	$24,000	1	$24,000
Stream restoration	LF	$460	155	$71,300
New Concrete Headwall	EA	$50,000	2	$100,000
HMA CL 1/2 IN PG 64-22	TON	$200	10	$2,000
Fish Passage Culvert (83-In. X 53-In.)	LF	$700	30	$21,000
Subtotal				$423,800
Contractor overhead, profit, and mobilization			10%	$42,380
Washington State Sales Tax			9.5%	$40,261
Construction Contingency			50%	$211,900
Subtotal Construction Costs				$718,341
City Staff Time			10%	$71,834
Administration and engineering design			20%	$143,668
Design Contingency			20%	$143,668
Permitting				$15,000
Land acquisition and easements	SF	$5	1,860	$9,300
Total Rock Wall and Stream Work Cost				**$1,101,900**
		Combined Total		**$ 1,111,000.00**

Project:	Little Swamp Creek Flooding		ID: SW-17
Location:	80th Avenue NE – Between NE 200th Street and NE 193rd Place	Basin:	Little Swamp Creek
Project Type:	☐Water Quality ☐Fish Passage ☐Flow Control ☐Erosion ☐Drainage ☒Flooding	Preliminary Project Cost:	$1,264,400
Problem:	Stream flooding roadway		

Project Overview

Little Swamp Creek flows from north to south along 80th Avenue NE and crosses from the east side to the west side of the street just south of NE 198th Street. The project site is located between NE 200th Street and NE 193rd Place. There are two problems at this location:

1. A channel on the west side of 80th Avenue NE overflows the culverts at NE 200th Street and NE 198th Street, causing roadway flooding. Culvert inlet capacity and debris clogs are the assumed problems.
2. Little Swamp Creek overtops multiple road and driveway culverts, flooding both public ROW and private properties between NE 198th Street and NE 193rd Place.

The City of Kenmore has begun to obtain additional ROW along the west side of 80th Avenue NE and will continue to do so as properties develop. The additional ROW allows room to modify the Little Swamp Creek cross section and alignment.

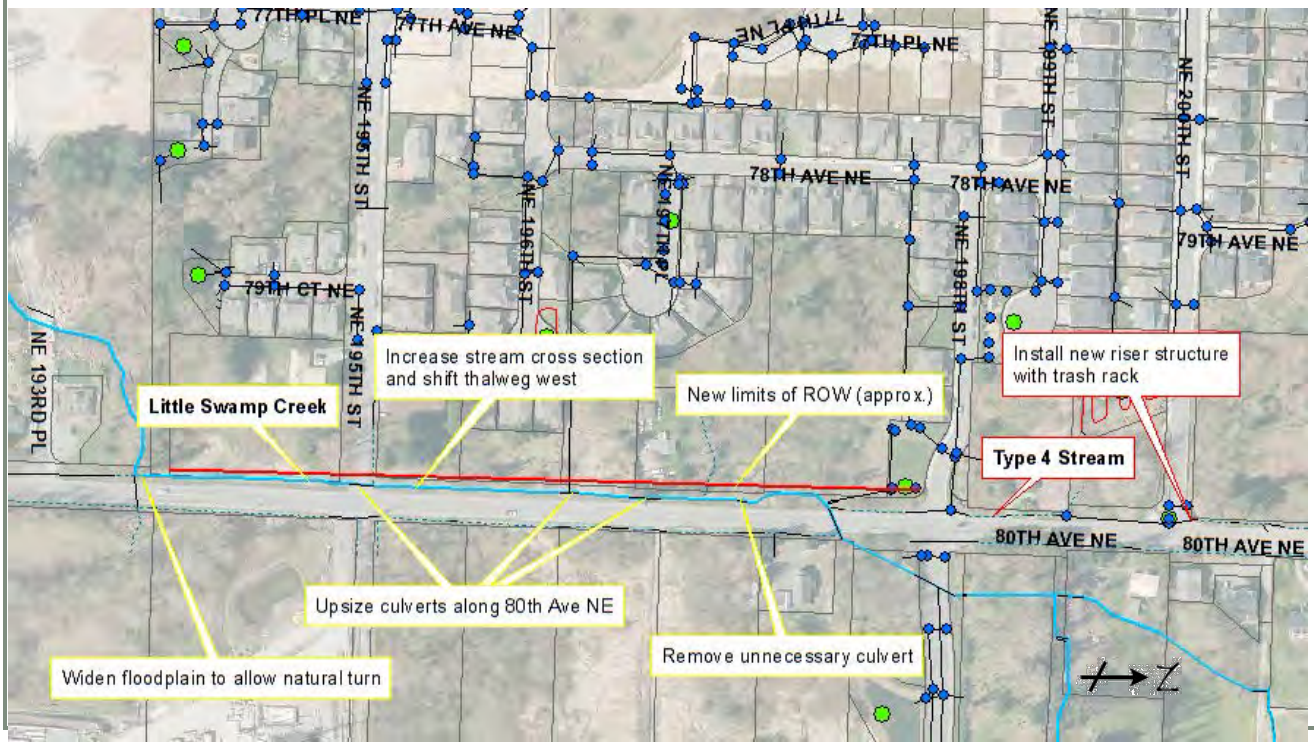
Solutions to the problems include:

1. Installing a trash rack/debris barrier at the NE 200th Street culvert inlet to prevent debris clogs and maintain inlet capacity. Mowing vegetation along the Type 4 stream banks to maintain channel conveyance capacity.
2. Removing 1 culvert and replacing 3 undersized culverts with larger, fish-passable culverts. Modifying the Little Swamp Creek cross section to include a floodplain bench. Installing riparian plantings and floodplain bench. Allowing channel to meander within the extended ROW.

Project benefits include flood reduction and improved stream habitat.

Existing stream channel along 80th Avenue NE

Conceptual Design	Solutions for flooding at Type 4 stream (indicated with red in the figure below): • Install a trash rack/debris barrier at the NE 200th Street culvert inlet to capture debris and prevent downstream system clogging. This solution assumes debris clogs reduce inlet capacity. • Verify conveyance capacity of the existing culverts (NE 200th Street and NE 198th Street). Solutions for flooding in Little Swamp Creek (indicated with yellow in the figure below): • Modify the Little Swamp Creek cross section to include the floodplain. Move the thalweg away from 80th Avenue NE and allow the stream to meander and fully utilize the newly obtained ROW. • Remove 1 unnecessary culvert (verify with property owner that field access is no longer needed). • Replace 3 existing undersized culverts with fish-passable culverts. • Widen the floodplain at the 90-degree bend in Little Swamp Creek downstream of NE 195th Street. Install large woody debris on the outside of the turn and install rocks to help facilitate the sharp turn.
Considerations for Implementation	• Environmental permitting will include a SEPA checklist, WDFW HPA, and USACE permits. • ROW acquisition will need to be completed before Little Swamp Creek stream restoration can commence. • Downstream analyses and coordination with downstream projects (e.g., the 192nd Culvert Options Analysis) will need to be conducted to ensure properties are not adversely affected, and the downstream culvert replacement project at NE 192nd Street is not impacted. The new channel will have increased roughness and floodplain, which will help to reduce stream velocity. The detention effect of the undersized culverts is assumed to be minimal as floodwater overtopped the culverts and remained in the creek. • Temporary stream bypass and fish exclusion should be used during construction. • Traffic control will be needed.



Cost Estimate

Item	Unit	Unit Cost	Quantity	Cost
Water Pollution/Erosion Control	%	5%		$17,000
SPCC Plan	LS	$500	1	$500
Traffic Control	%	5%		$17,000
Clearing & Grubbing	SY	$5	1700	$8,500
Excavation Incl. Haul	CY	$35	840	$29,400
Cement Conc. Sidewalk	SY	52	333.333333	$17,333
Temporary Stream Bypass	LS	$24,000	1	$24,000
Trash Rack / Debris Barrier	EA	$1,000	1	$1,000
HMA CL 1/2 IN PG 64-22	TON	$200	30	$6,000
Fish Passage Culvert (83-In. X 53-In.)	LF	$700	120	$84,000
Streambed Gravel	CY	$50	280	$14,000
Large Woody Debris	EA	$1,200	55	$66,000
Planting and Bioengineered Restoration	SY	$40	1700	$68,000
Subtotal				$352,733
Contractor overhead, profit, and mobilization			10%	$35,273
Washington State Sales Tax			9.5%	$33,510
Construction Contingency			50%	$176,367
Subtotal Construction Costs				$597,883
City Staff Time			10%	$59,788
Administration and engineering design			20%	$119,577
Design Contingency			20%	$119,577
Permitting				$15,000
ROW acquisition contingency				$352,500
Total Project Cost				**$1,264,400**

Project:	Little Swamp Creek Culvert Replacement at NE 192nd Street		ID: SW-19
Location:	NE 192nd Street – West of 80th Avenue NE	Basin:	Little Swamp Creek
Project Type: Problem:	☐Water Quality ☒Fish Passage ☐Flow Control ☐Erosion ☐Drainage ☒Flooding **Flooding at low point in road**	Preliminary Project Cost:	$395,000

Project Overview

Flooding occurs at the NE 192nd Street culvert carrying Little Swamp Creek at the low point in the road. Based on modeling results, the road floods at the 25-year event because the culvert is undersized. Modeling showed flooding to be as high as 1 foot on the roadway. This is the depth at which most cars and sport utility vehicles can float.

This project was identified by the City in 2006.

OCI was contracted in 2014 to develop the 192nd Culvert Final Options Analysis Report (OCI 2014). Several options were considered: high-flow bypass, existing culvert replacement with a fish-passable culvert, a street elevation increase, and a no-build alternative.

The preferred solution is to replace the existing culvert with a 12-foot by 3-foot fish-passable culvert.

Project benefits include flood reduction and improved fish passage.

Additional modeling or analysis may be needed to determine impacts to downstream Swamp Creek.

Culvert at NE 192nd Street (downstream side)

Conceptual Design

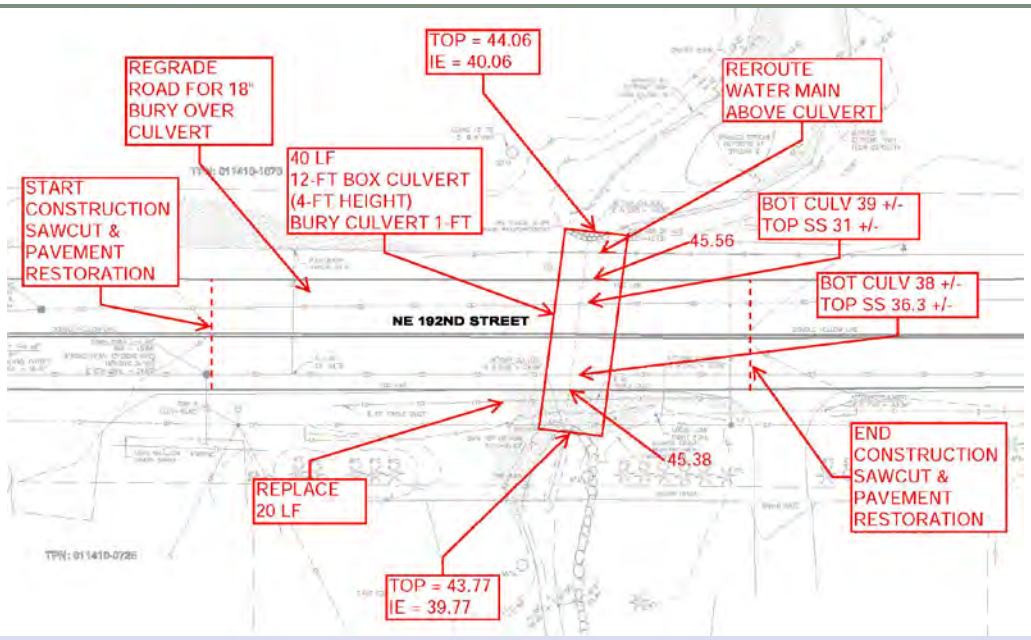
The preferred solution is installation of a 12-foot by 3-foot box culvert in place of the existing culvert. This size conveys the 100-year event without flooding or overtopping.

Other solutions considered:

- High-flow bypass
  - A 24-inch bypass culvert was considered in conjunction with a riser structure, which would convey flows in the 25-year event and higher.
  - This option will likely not be approved by WDFW because it does not meet code requirements for culvert depth.
- 1-foot road elevation increase
  - This option is not feasible because the water levels rise more than 5 feet during large storm events.
- No-build
  - This option would allow continued flooding and debris blockage of the culvert.

Considerations for Implementation

- Environmental permitting will require a SEPA checklist, WDFW HPA, and USACE permits.
- A geomorphologic assessment is recommended.
- A downstream analysis should be conducted to evaluate how or if downstream infrastructure or properties could be affected by improvements.
- Temporary stream bypass and fish exclusion should be used during construction.
- Coordination with the upstream Little Swamp Creek Flooding CIP (included in the SWMP as CIP #7) will need to be conducted to ensure upstream project is not adversely affected (no modeling or analysis has been performed to determine impacts of the preferred solution to the upstream or downstream system).
- Traffic control will be needed.
- Cost estimate is from the options analysis report discussed in the narrative above, with the addition of a geomorphologic analysis.



Cost Estimate

Item	Unit	Unit Cost	Quantity	Cost
Mobilization	LS		1	$13,275.10
Force Account	LS	$25,000	1	$25,000.00
Traffic Control	LS	$30,000	1	$30,000.00
Temporary Erosion and Sediment Control	LS	10%	1	$14,090.10
Removing Asphalt Conc. Pavement	SY	$20	342	$6,844.00
Removing 36-inch culvert	LF	$17	41	$697.00
12 WF x 40 LF x DF Box Culvert	LF	$1,100	40	$44,000.00
Structural Fill (Beneath culvert)	CY	$65	60	$3,900.00
Installation Box Culvert	LS	$44,000	1	$44,000.00
Replace Water Main	LF	$110	50	$5,500.00
Reroute Fiber Optic Duct Bank	LS	$5,000	1	$5,000.00
Crushed surfacing base course	TON	$50	106	$5,275.00
HMA CL ½ IN PG 64-22	TON	$150	117	$17,535.00
Structure Excavation Class B Incl. Haul	CY	$50	163	$8,150.00
			Subtotal	$223,266.20
		Washington State Sales Tax	9.5%	$21,210.29
		Subtotal Construction Line Item (+ tax)		**$244,476.49**
		Easement Acquisition		$0.00
		Engineering Design	40%	$89,306.48
		Permitting	15%	$33,489.93
		Construction Management	10%	$22,326.62
		Geomorphologist		$5,000
		Soft Cost Subtotal		**$150,123.03**
		Total Project Cost		**$395,000.00**

Project:	Small Works Projects		ID:	SW-20
Location:	**20-1: 61st Ave NE and NE 187th St.** **20-2: 64th Ave NE and NE 198th St.** **20-3: NE 182nd St. and 68th Ave NE** **20-4: NE 175th St., south of SR-522** **20-5: 61st Ave NE, south of NE 190th St.** **20-6: NE 185th St. and 61st Ave NE** **20-7: Connecting 60th Pl NE & 61st Ave NE**	Basin:	**Tributary 0056, Swamp Creek, and Muck Creek**	
Project Type:	☐Water Quality ☐Fish Passage ☐Flow Control ☒Erosion ☒Drainage ☒Flooding	Preliminary Project Cost:	**$50,000 per year**	
Problem:	**Erosion and drainage problems at various locations**			

Narrative

The annual small works projects will consist of an evolving list of projects. Several currently identified problem areas are included in this CIP as an example. New problem areas will be identified each year.

Seven locations (shown on the overview map on the next page) in Kenmore have erosion or drainage problems with solutions that City staff are capable of designing and constructing without outside assistance.

Three locations (numbers 1, 5, and 6) have issues with half pipes leading from private property to Tributary 0056. The half pipes are broken or deteriorating and causing erosion problems in the stream. A fourth location (number 7) with a deteriorating half pipe is impacting the City right-of-way by depositing debris onto the roadway.

Location number 2 is experiencing groundwater seepage issues resulting in surface water flow down the steep street. Flooding and icy roads are a concern in this area. (Note: photo at the right was taken during a period with no rainfall.) A private drive to the east of this location is experiencing similar issues.

At NE 182nd St. and 68th Ave NE (number 3), topography along NE 182ND St. conveys surface water northward onto private property, which is located in an enclosed depression.

Just south of SR-522 at NE 175th Street (number 4), a diversion structure has poor access and requires frequent maintenance. Maintenance crews have trouble with the gate, ladder, and fence. The diversion procedure also requires some modifications to improve functionality of the structure.

Potential solutions and benefits for each type of project are outlined in the following pages.

The annual budget for these types of projects is $50,000 per year.

Half pipe at location number 23.

Groundwater flows at location number 10.

Overview Map

Schedule

SW-20 Annual Small Works Projects	Annual Program											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Alternative Analysis												
Preliminary Design												
Permitting												
Final Design and PS&E												
Advertise and Contractor Procurement												
Construction												

Project:	Half Pipe Projects		ID: SW-20 (1,5,6,7)
Location:	**20-1: 61st Ave NE and NE 187th St.** **20-5: 61st Ave NE, south of NE 190th St.** **20-6: NE 185th St. and 61st Ave NE** **20-7: Connecting 60th Pl NE & 61st Ave NE**	Basin:	**Tributary 0056**
Project Type:	☐Water Quality ☐Fish Passage ☐Flow Control ☒Erosion ☒Drainage ☒Flooding	Preliminary Project Cost:	**N/A**
Problem:	**Erosion and deteriorating half pipes**		

Narrative

Three locations (numbers 1, 5, and 6) have issues with half pipes leading from private property to Tributary 0056. The half pipes are broken or deteriorating and causing erosion problems. A fourth location (number 7) with a deteriorating half pipe is impacting the City right-of-way by depositing debris onto the roadway.

These projects were identified by the City in 2013 during a field walk of Tributary 0056.

The preferred solution to resolve the issue of deteriorating half pipes is to replace the existing half pipes with new tightline pipes. Outfalls to Tributary 0056 shall be placed above the ordinary high water mark with energy dissipation to minimize erosion. Existing erosion damage shall be repaired to match the surrounding ground cover.

The existing half pipe between 60th Pl. NE and 61st Ave NE (number 7) is not within an easement. The proposed pipe shall be re-aligned through existing right-of-way or easement, establish a new easement or require the property owner to repair the system. The proposed pipe connects to the existing storm drainage system.

Project benefits include reduced erosion in and adjacent to Tributary 0056 and reduced debris deposition and flooding within the right-of-way.

Tributary 0056.

Conceptual Design

Preferred Solutions:

- Location numbers 1, 5, and 6:
  - Replace existing half pipe with 12-inch PVC or HDPE tightline.
  - Pipe anchors may be needed to ensure pipe does not move.
- Location number 7:
  - Establish a permanent easement for the tightline alignment.
  - Replace existing system with 12-inch PVC or HDPE tightline.
  - Pipe anchors may be needed to ensure pipe does not move.

Considerations for Implementation

- Proposed pipe sizes are based on the sizes of surrounding pipes. No analysis was conducted to verify conveyance capacity.
- Field visits should be conducted to assess if additional inlets should be added.
- Vegetation removal is necessary, but removing trees shall be avoided. If tree removal becomes necessary, a tree removal permit is required.
- Protect existing roadway, sidewalks, and property. Restore disturbed areas to original condition.
- Environmental permitting including SEPA checklist and WDFW HPA.
- Temporary construction easements may be needed for half pipe replacement on private property.
- In-stream work should be minimized.
- Traffic control may be needed.

Project:	Groundwater Seepage		ID: SW-20 (2)
Location:	20-2: 64th Ave NE and NE 198th St.	Basin:	Swamp Creek
Project Type:	☐Water Quality ☐Fish Passage ☐Flow Control ☐Erosion ☒Drainage ☒Flooding	Preliminary Project Cost:	N/A
Problem:	Groundwater seepage causing flooding		

Narrative

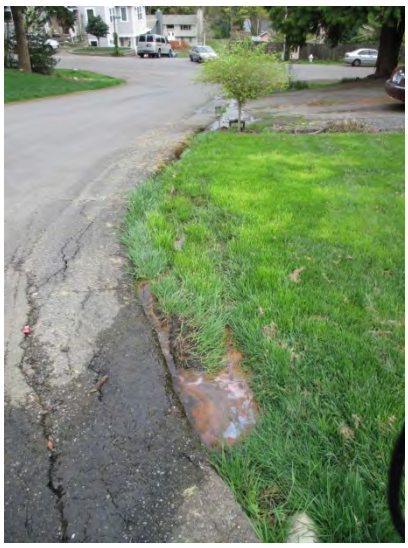
Location number 2, in the cul-de-sac of 64th Ave NE, is experiencing groundwater seepage issues, which send flow down the steeply sloped street. Flooding on private property and icy roads are a concern in this area.

This project was identified by the City in 2013 from complaints submitted by residents in the cul-de-sac.

The preferred solution for this project is to capture and convey the groundwater flow before it reaches the surface. One inlet is proposed to be installed in the grassy area between the driveways for 19704 64th Ave NE and 19712 64th Ave NE. A second inlet is proposed to be installed on the property of 19722 64th Ave NE, which is shown in the photo on the right side of this page. A series of pipes should lead from these inlets to the existing catch basin at NE 198th St.

Project benefits include reduced flooding and hazardous conditions on 64th Ave NE.

A similar issue is occurring at 64th Pl NE, a private drive to the east of 64th Ave NE. The City is not responsible for alleviating flooding on that roadway. However, this CIP design would work for this issue as well, should the residents wish to resolve the problem.



Groundwater seepage at 19722 64th Ave NE (looking north toward NE 198th St.).

Conceptual Design

Preferred Solution:

- Install two catch basins along 64th Ave NE at the locations mentioned in the narrative. Inlets shall be placed within the right of way where they can collect surface water from the yards.
- Install 12-inch PVC storm drain pipe connecting the proposed catch basins to the existing storm drain system at 64th Ave NE and NE 198th St. (CB 2627)
    - If additional groundwater collection is desired, PVC storm drain pipe may be replaced with an interceptor trench comprised of: perforated pipe in a gravel backfill trench wrapped in a non-woven geotextile fabric. Perform additional analysis to estimate the amount of groundwater that may be collected and verify the conveyance capacity of the downstream system prior to implementing this solution.

Considerations for Implementation

- Coordinate with adjacent properties mentioned in the narrative.
- All work will be performed within the right-of-way. Should any work be required on private property, temporary construction easements will be needed.
- Roadway and properties (including lawns, driveways, etc.) should be restored to original condition following construction.
- The 12-inch pipe diameter was assumed based on other pipes in the region. No analysis was conducted to determine the size required to convey the groundwater.

Project:	Stormwater Infrastructure Installation		ID: SW-20 (3)
Location:	**20-3: NE 182nd St. and 68th Ave NE**	Basin:	**Muck Creek**
Project Type:	☐Water Quality ☐Fish Passage ☐Flow Control ☐Erosion ☒Drainage ☒Flooding	Preliminary Project Cost:	**N/A**
Problem:	**Runoff from ROW flooding private property**		

Narrative

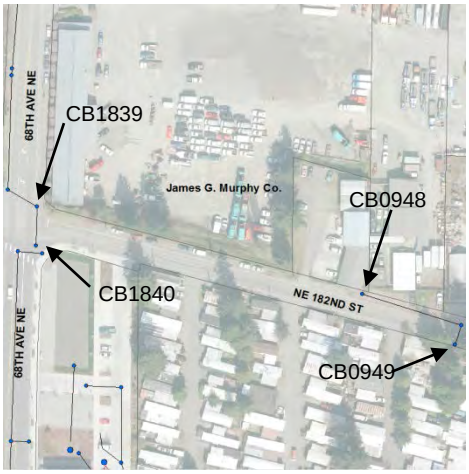
At NE 182nd St. and 68th Ave NE (location 15), runoff from the City right-of-way is flooding private property due to a lack of conveyance system. Drainage issue complaints have been filed at James G. Murphy Co. No other sites have reported issues, but may be experiencing flooding as well.

An recent City project constructed intersection improvements at NE 182nd St. and 68th Ave. NE in 2014. A stub out for a new system at the northeast corner (CB1839) may have been included with this work (to be confirmed by the City).

This project was identified by the City after complaints from the James G. Murphy Co. were filed.

The preferred solution includes adding a collection and conveyance system along NE 182nd St. in conjunction with the proposed intersection improvements. The City shall provide stub outs for businesses along NE 182nd St.

Project benefits include alleviating flooding on nearby properties. By combining the conveyance installation with improvements along NE 182nd, the City is saving money, resources, and time.



NE 182nd St. and 68th Ave NE., James G. Murphy Co. to the northwest.

Conceptual Design

Preferred Solution:

- Install conveyance system connecting existing catch basins on north side of NE 182nd St.
  - Install two 12-inch pipes and one catch basin type 1 between existing catch basins CB0948 and CB1839.
- Install conveyance system on the south side of NE 182nd St.
  - Install three 12-inch pipes and two catch basins type 1 between existing catch basins CB0949 and CB1840.

Considerations for Implementation

- No analysis has been conducted to size the conveyance system. Proposed sizes and types are assumed based on surrounding systems.
- All work should be within the City right-of-way.
- Coordinate with intersection improvement designers for construction.
- Traffic control is assumed to be part of the intersection improvement project.

Project:	Diversion Structure Improvement		ID: SW-20 (4)
Location:	20-4: NE 175th St., south of SR-522	Basin:	Tributary 0056
Project Type:	☐Water Quality ☐Fish Passage ☐Flow Control ☐Erosion ☒Drainage ☐Flooding	Preliminary Project Cost:	N/A
Problem:	Poor access and frequent maintenance issues		

Narrative

South of SR-522 at NE 175th St (location 4), a diversion structure has poor access and requires frequent maintenance. Maintenance crews have trouble with the gate, ladder, and fence. The diversion procedure also requires some improvements.

This project was identified by City maintenance crews in 2013.

Potential solutions include replacing the old and rusted flap gate, replacing the aging ladder, improving maintenance crew access, and developing an enhanced diversion procedure. Better access may include coordinating with King Co. on creating easier access to the diversion structure (i.e. a gate or opening in the fence with limited access).

Project benefits include easier maintenance for City crews, improved functionality of the diversion structure, improved safety for the maintenance crews, and prolonged life of the culverts in the area.

Diversion structure at Burke-Gilman Trail at NE 175th St., looking east.

Conceptual Design

Potential Solutions:

- Replace the existing flap gate.
- Replace the existing ladder with a new, more accessible ladder.
- Improve access to the diversion structure.
- Improve the diversion procedure. This may include adding a storage building that houses diversion materials (i.e. sand bags or a bladder dam on site.
- Update the O&M Manual to include the improvements.

Considerations for Implementation

- Coordinate with King Co. for any improvements to the fence.
- Environmental permitting may be required.
- The tree adjacent to the diversion structure shall not be affected by the project.
- Protect existing trail and roadway.
- Traffic control may be needed.

Project:	61st Avenue NE Ground Penetrating Radar Evaluation and Preliminary Design		ID: SW-21
Location:	61st Ave NE and NE 190th Street	Basin:	Tributary 0056
Project Type:	☐Water Quality ☐Fish Passage ☐Flow Control ☒Erosion ☐Drainage ☐Flooding	Preliminary Project Cost:	$100,000
Problem:	Stream eroding near roadway		

Narrative

Tributary 0056 flows from north to south along the east side 61st Ave NE. There are three problems where Tributary 0056 crosses NE 190th St.:

1. Stream channel bank erosion along a 155-LF section of rock wall has resulted in failed sections where rocks have fallen into the channel. The full extent of the damage is unclear.
2. Rock wall headwalls are at the inlet and outlet of the culvert and protect 61st Ave NE from stream flow. Stream flows have eroded the existing slope and rock headwall north of NE 190th St. resulting in an unstable headwall. Stream flows have been observed bypassing the culvert. It is unknown where the piping water goes.
3. Sidewalk on the northeast side of NE 190th St. is being undermined by runoff from NE 190th St. Runoff concentrates where the sidewalk transitions to gravel, causing the sidewalk to be undermined.

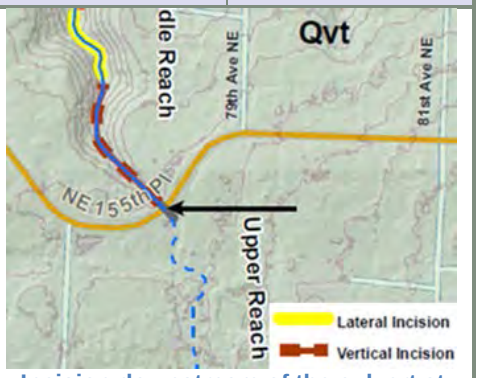
This project was identified by the City in 2013. A surface water field investigation report and recommendations was prepared by consultants in February 2013.

This project is to provide preliminary analysis and design necessary for repair of the rock wall adjacent to 61st Avenue NE using ground penetrating radar geophysical techniques that are minimally intrusive.

The preliminary cost estimate for this project is $100,000.

Rocks from wall which fell into the stream.

Undercut sidewalk at NE 190th St.

Project:	Tributary 0057 Perched Pipe		ID: SW-22
Location:	NE 155th Place – East of 78th Avenue NE	Basin:	Tributary 0057
Project Type: Problem:	☐Water Quality ☒Fish Passage ☐Flow Control ☒Erosion ☐Drainage ☐Flooding **Perched pipe eroding stream**	Preliminary Project Cost:	$25,000
Project Overview	A culvert carrying flows from Tributary 0057 is located at NE 155th Place. The culvert outfall is located roughly 10 feet above the stream bed, causing erosion and subsequent downstream sedimentation. This project was identified by the City in a previous CIP plan. This project requires additional analysis to determine the best solution and any risks to public infrastructure and downstream properties if nothing is done. Stream channel monitoring is recommended to evaluate the rate and severity of erosion and potential impacts on infrastructure and properties. The estimate for this work is approximately $25,000 ($5,000 for City staff time; $20,000 for a consultant to conduct stream channel geomorphic monitoring).	 **Incision downstream of the culvert at NE 155th Place** (Graphic courtesy of the Tributary 057 Sediment Study provided by Gray & Osborne, Inc.)	

Project:	Wallace Pond Beaver Deceiver		ID: SW-23
Location:	**Wallace Park** **19907 73rd Avenue NE**	Basin:	**Swamp Creek**
Project Type: Problem:	☐Water Quality ☐Fish Passage ☐Flow Control ☐Erosion ☐Drainage ☒Flooding **Beavers damming stream**	Preliminary Project Cost:	**$96,400**

Project Overview

Beavers have taken up residence in the Wallace Park Sediment Pond. The beavers dam the pond outlet weir, causing the pond water surface elevation to rise and more water to flow through the fish passage channel and/or overtop the berm separating the pond from the fish passage channel. (During a site visit that was conducted by OCI on April 8, 2014, evidence of a wash-out over the berm was observed.)

A bypass pipe system may have been installed when the sediment pond was constructed. This pipe could not be found during the site visit on April 8, 2014. Plans for the sediment pond will need to be reviewed to determine existence and location of the bypass pipe.

The preferred solution for the beaver dam problem includes installing a Beaver Deceiver near the pond outlet weir. The Beaver Deceiver (a trapezoidal-shaped culvert fence) would regulate the water level of the beaver dam and keep the outlet weir or culvert open.

Project benefits include maintaining the design flow distribution through the pond and the fish passage channel. The Beaver Deceiver will not deter the beavers from cutting down trees.

Beaver dam at weir outlet

Conceptual Design

The preferred solution is installation of a Beaver Deceiver around the weir outlet of sediment pond.

- Beaver Deceiver perimeter must be 40 feet or more.
- Wire fencing used for deceiver should extend at least 2 feet above the water surface elevation to ensure beavers do not climb over the fence.
- A footing of wire fencing should also be installed so beavers cannot dig under the Beaver Deceiver.
- If the beavers dam the length of the deceiver, it may be necessary to install a pipe under the water surface to allow flow through the deceiver.

Considerations for Implementation

- The schedule of this improvement is recommended to co-occur with sediment pond dredging to take advantage of shared permitting, bypass, and fish exclusion costs.
- Environmental permitting will include a SEPA checklist, WDFW HPA, and USACE permits. Design may also require mitigation for buffer impacts.
- Temporary stream bypass will be needed.
- Plans for sediment pond shall be reviewed to determine location of high-flow bypass pipe.
- May require beaver management during construction.
- Routine maintenance is suggested to ensure Beaver Deceiver is functioning properly.
- Wire fencing may be placed around individual trees or around the pond to protect trees from beavers. (Fencing needs to be 3 to 4 feet high and is not included in cost estimate.)

Cost Estimate

Item	Unit	Unit Cost	Quantity	Cost
Water Pollution/Erosion Control	%	5%		$1,500
SPCC Plan	LS	$500	1	$500
Clearing & Grubbing	SY	$5	200	$1,000
Temporary Stream Bypass	LS	$15,000	1	$15,000
Planting and Bioengineered Restoration	SY	$40	200	$8,000
Beaver Deceiver	EA	$6,000	1	$6,000
Subtotal				$32,000
Contractor overhead, profit, and mobilization			10%	$3,200
Washington State Sales Tax			9.5%	$3,040
Construction Contingency			50%	$16,000
Subtotal Construction Costs				$54,240
City Staff Time			10%	$5,424
Administration and engineering design			20%	$10,848
Design Contingency			20%	$10,848
Permitting				$15,000
Land acquisition and easements	SF	$5	0	$0
Total Project Cost				**$96,400**

Project:	Sammamish River Vaults		ID: SW-24
Location:	NE 170th Street and NE 169th Place	Basin:	Sammamish Tributary 02 and 03
Project Type: Problem:	☐Water Quality ☐Fish Passage ☐Flow Control ☐Erosion ☐Drainage ☒Flooding **Undersized vaults fill with sediment**	Preliminary Project Cost:	$25,000
Project Overview	Two existing vaults adjacent to the Sammamish River collect sediment and require annual cleaning. One vault is 6.5 feet by 12 feet, while the other is 6.5 feet by 10 feet. Inlet and outlet pipes are 30-inch diameter concrete pipes. The vaults were installed in 1990 and may be undersized. This project was identified by City maintenance crews because the vaults require frequent cleaning. Before a solution is recommended for these vaults, additional analyses are recommended to determine the source of sediment and whether upstream sediment controls could reduce maintenance frequency. The project cost assumptions include $5,000 for City staff time and $20,000 for a consultant to evaluate sediment sources in the system.	 Catch Basin Type 2 and Vaults (looking north toward the Sammamish River)	

Project:	Strawberry Hills Tank Replacement		ID: SW-25
Location:	72nd Avenue NE and NE 152nd Place	Basin:	Tributary 0222
Project Type: Problem:	☐Water Quality ☐Fish Passage ☐Flow Control ☐Erosion ☒Drainage ☐Flooding **Failing tank requires replacement**	Preliminary Project Cost:	$459,700

Project Overview

A 120-LF, 60-inch detention tank was installed in 1978 underneath 71st Place NE, a private road. In 1980, maintenance of the facility fell to King County. The natural drainage channel which was previously the outfall for the tank was deemed inadequate by King County because of erosion. Therefore, the downstream system was tightlined with two 12-inch CMP pipes to a pond at NE 152nd Court.

CCTV inspection performed by the City showed that the tank is failing. It has collapsed beams and water marks at the top of the pipe. Surface settling has also been reported at the upstream and downstream catch basins. The existing tank does not comply with current flow control standards (2005 Ecology). The City has received complaints of flooding at the downstream pond.

This project was identified by the City through video inspections and maintenance evaluations in 2013.

The preferred solution is to replace the failing detention tank with two 120 LF 60-inch detention tanks and replace the existing catch basin and restrictor with control structures.

Project benefits include improved stormwater flow control. Peak flows are reduced by 80 percent at the 2-year storm and 75 percent at the 50-year storm compared to the current, un-detained condition.

71st Place NE – location of underground detention tank

Conceptual Design

Preferred solution:

- Replace 120-LF failing 60-inch CMP tank with 2 (two) 120-LF, 60-inch PVC detention tanks.
- Install a new riser and flow control structure.

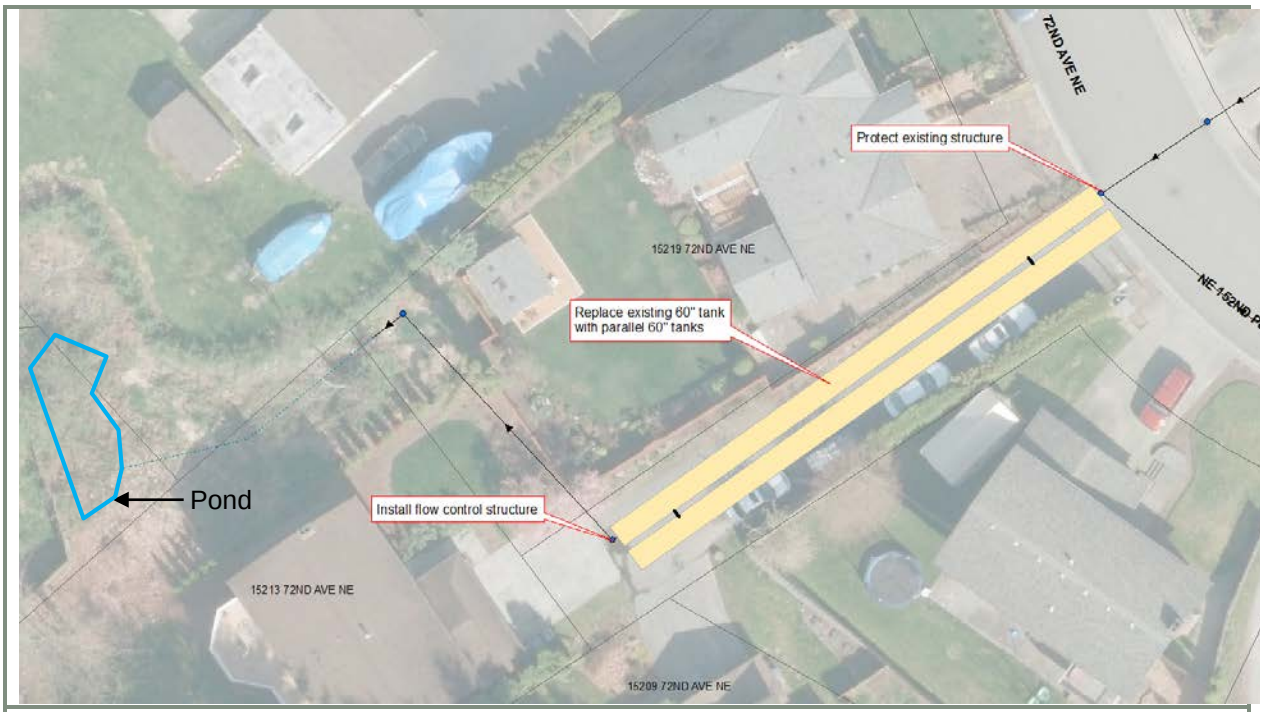
Other scenarios considered under the WWHM (see Appendix for results):

- Remove detention. This option was used for comparison.
- Replace existing detention tank with new tank of the same dimensions. Replace existing catch basin and restrictor with control structure. This option provides minimal detention.
- Size pond or tank to pass 2005 Ecology flow control requirements. There is not enough space at the site for this option.

Considerations for Implementation

Preferred solution:

- Protect existing homes, structures, and roadway during construction.
- Restore driveway to pre-project condition.
- CCTV the downstream conveyance system and evaluate the remaining life of those pipes.
- Coordinate with homeowners on installation and restoration of tank under private drive.
    - 15219 72nd Avenue NE
    - 15213 72nd Avenue NE
    - 15209 72nd Avenue NE
- The proposed solution will not provide a full retrofit for the existing basin due to the limited space available.



Cost Estimate

Item	Unit	Unit Cost	Quantity	Cost
Water Pollution/Erosion Control	%	5%		$9,000
SPCC Plan	LS	$500	1	$500
Traffic Control	%	7%		$12,700
Potholing	EST	$1,000	1	$1,000
Sawcut Pavement	LF	$5	290	$1,450
Remove Asphalt Conc. Pavement	SY	$28	280	$7,840
Roadway Excavation Incl. Haul	CY	$92	650	$59,800
Shoring or Extra Excavation Class B	SF	$1	900	$900
Catch Basin Type 2, 54 In. Diam. Flow Control Structure	EA	$6,000	1	$6,000
Schedule A 60" Storm Sewer Pipe	LF	$260	240	$62,400
HMA CL 1/2 IN PG 64-22	TON	$200	96	$19,200
Subtotal				$180,790
Contractor overhead, profit, and mobilization			10%	$18,079
Washington State Sales Tax			9.5%	$17,175
Construction Contingency			50%	$90,395
Subtotal Construction Costs				$306,439
City Staff Time			10%	$30,644
Administration and engineering design			20%	$61,288
Design Contingency			20%	$61,288
Permitting				$0
Land acquisition and easements	SF	$5	0	$0
Total Project Cost				**$459,700**

Project:	Opportunity Fund: Juanita Drive Detention Facility		ID: SW-26
Location:	NE 149th Street and Juanita Drive NE	Basin:	Arrowhead Creek
Project Type:	☐Water Quality ☐Fish Passage ☒Flow Control ☐Erosion ☒Drainage ☐Flooding	Preliminary Project Cost:	$698,200
Problem:	Control structure and tank system not functioning		

Project Overview

An existing 36-inch diameter pipe along Juanita Drive NE at NE 149th Street likely functioned as a detention facility until the control structure was removed (reason for removal is unknown). Approximately 15 acres east of Juanita Drive NE drain to the system, which then discharges to a natural drainage area.

A flooding complaint was received from a private lot downstream in 2010. Then, in 2013, this project was identified by the City during a maintenance stormwater infrastructure inspection.

The preferred solution includes replacing the control structure and upsizing the detention pipe for increased flow control.

Project benefits include increased detention compared to the current, un-detained condition: peak flows would be reduced by 67 percent at the 2-year storm and 52 percent at the 50-year storm. The preferred solution does not meet current flow control requirements (2005 Ecology). A larger detention tank and stormwater pond sized to retrofit the system to meet current flow control standards were considered; however, adequate space was not available.

vegetation along Juanita Drive NE

Conceptual Design

Preferred solution:

- Replace existing catch basin Type 2 – 54-inch with new control structure.
- Replace and relocate existing catch basin Type 2.
- Replace 57 LF of 36-inch CMP detention pipe with 715 LF of 60-inch detention pipe.
- Check condition of 12-inch CMP outlet pipe. If in poor condition, replace along with control structure and detention pipe. (Not included in the cost estimate.)

Other scenarios considered under the WWHM (see Appendix for results):

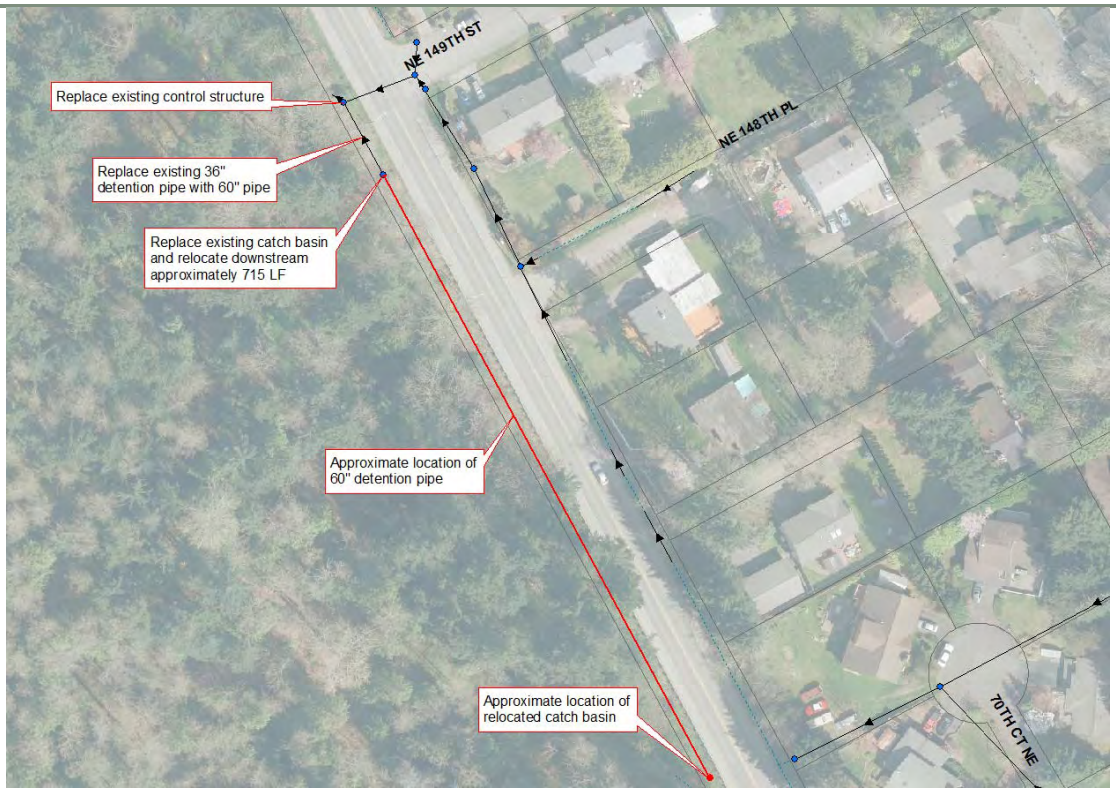
- No action: do not restore detention. This option was used for comparison.
- Replace both the flow control structure and the existing 57 LF 36-inch diameter detention tank. This option provides minimal detention benefits compared to the current condition.
- Size pond or detention pipe to pass 2005 Ecology flow control requirements. Preliminary sizing indicates there is not enough space at the site for this option.

Infiltration was not considered at this location due to its close proximity to the road and steep slopes.

Considerations for Implementation

Preferred solution:

- Assumed no easements will be needed.
- Traffic control will be needed.
- Tree removal will likely be necessary.
- This solution does not provide a full retrofit for the existing basin due to limited space available.


NE 149TH ST
Replace existing control structure
Replace existing 36" detention pipe with 60" pipe
Replace existing catch basin and relocate downstream approximately 715 LF
NE 148TH PL
Approximate location of 60" detention pipe
Approximate location of relocated catch basin
70TH CT NE

Cost Estimate

Item	Unit	Unit Cost	Quantity	Cost
Water Pollution/Erosion Control	%	5%		$13,700
SPCC Plan	LS	$500	1	$500
Traffic Control	%	7%		$19,200
Clearing & Grubbing	SY	$5	800	$4,000
Remove Tree	EA	$500	10	$5,000
Structure Excavation Cl B Incl. Haul	CY	$20	1320	$26,400
Shoring or Extra Excavation Class B	SF	$1	5075	$5,075
Catch Basin Type 2, 48 In. Diam.	EA	$4,000	1	$4,000
Catch Basin Type 2, 54 In. Diam. Flow Control Structure	EA	$6,000	1	$6,000
Schedule A 60" Storm Sewer Pipe	LF	$260	715	$185,900
Hydroseed	SY	$6	800	$4,800
Subtotal				$274,575
Contractor overhead, profit, and mobilization			10%	$27,458
Washington State Sales Tax			9.5%	$26,085
Construction Contingency			50%	$137,288
Subtotal Construction Costs				$465,405
City Staff Time			10%	$46,540
Administration and engineering design			20%	$93,081
Design Contingency			20%	$93,081
Permitting				$0
Land acquisition and easements	SF	$5	0	$0
Total Project Cost				**$698,200**

Project:	Northlake Heights LID Retrofit		ID:	SW-28
Location:	**NE 185TH Street between 64th Avenue NE and 68th Avenue NE**	**Basin:**		**Swamp Creek Muck Creek**
Project Type:	**☒Water Quality ☐Fish Passage ☒Flow Control ☐Erosion ☐Drainage ☒Flooding**	**Preliminary Project Cost:**		**$1,587,863**
Problem:	**No stormwater treatment**			

Project Description

Ecology provided a grant to the City to design a surface water project that LID techniques which will improve water quality and reduce flooding impacts in an area that currently has minimal surface water management in place.

Design of the project began in late 2013 and 90 percent plans were produced in 2014 with the intent to apply for construction grants in 2015.

The selected site drains the Northlake Heights neighborhood north of NE 185th Street, which is largely underserved in terms of flow control or water quality treatment. The basin flows east and discharges into Muck Creek and eventually Swamp Creek. The downstream end of this basin experiences localized flooding and sedimentation issues and the confluence of Muck Creek and Swamp Creek also experience flooding and sedimentation issues as well as high bacteria concentrations (Swamp Creek has a TMDL for fecal coliform).

This project will reduce flows and improve water quality in runoff from the Northlake Heights neighborhood as well as provide the City an opportunity to install and monitor LID facilities, which will become a regulatory requirement for the City by the end of 2017.

The Northlake Heights LID retrofit project offers opportunities to replace impervious areas with native vegetation, install LID facilities, and improve pedestrian access and safety along NE185th Street

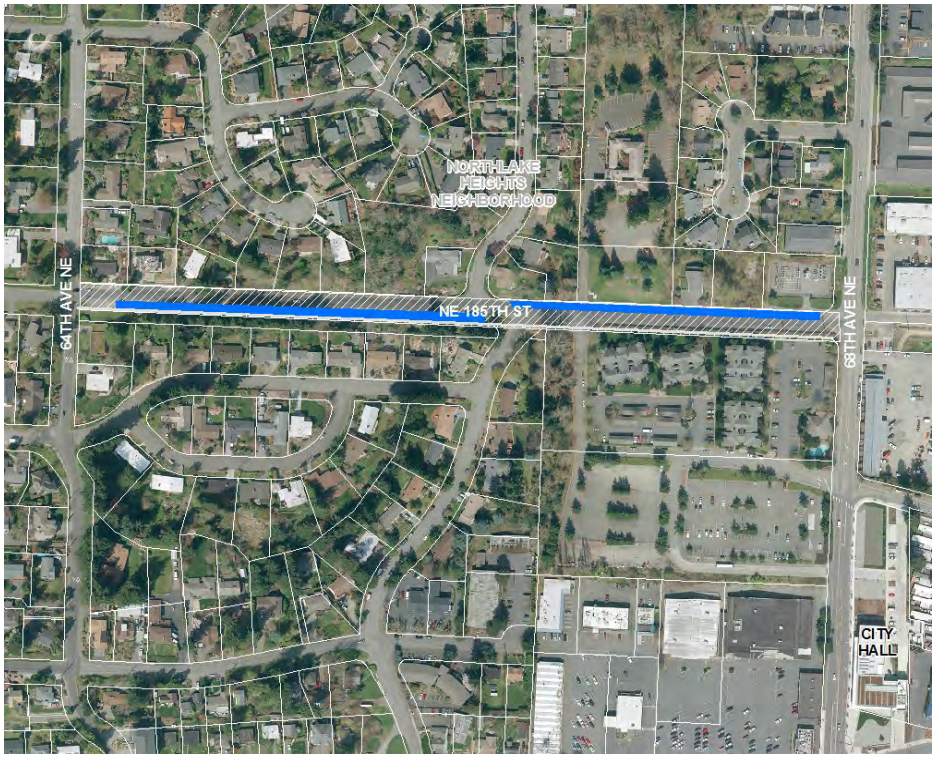
Conceptual Design

Conceptual design includes:

- Reducing impervious areas of NE 185th Street.
- Replacing impervious areas with native vegetation.
- Treating runoff with bioretention (NE 185th Street and maximum amount of off-site runoff that is practical).
- Installing sidewalk between 64th Avenue NE and 68th Avenue NE.

Considerations for Implementation

- Steep topography will require strategic placement of biofiltration facilities in order to control flows into the biofiltration facilities.
- Geotechnical analysis will be required to determine infiltration rates and groundwater levels near proposed sites of biofiltration.
- Traffic control will be needed.



Cost Estimate

Item	Unit	Unit Cost	Quantity	Cost
Water Pollution Erosion Control	%	5%	-	$35,000
Traffic Control	%	7%	-	$49,000
Clearing and Grubing	Acre	$15,000	0.8	$12,000
Bioretention	LF	$300	875	$262,500
Stormwater Detention Pipes	LF	$550	420	$231,000
Excavation Incl. Haul	CY	$50	740	$37,000
Landscaping and Establishment	SY	$52	1580	$82,160
Cement Conc. Sidewalk	SY	$40	750	$30,000
Cement Conc.Curb Ramp	EA	$1600	9	$14,400
Cement Conc. Curb & Gutter	LF	$30	920	$27,600
		Subtotal		**$780,660**
		Contractor overhead, profit, and mobilization	10%	$78,066
		Washington State Sales Tax	9.5%	$74,163
		Construction Contingency	50%	$390,330
		Subtotal Construction Costs		**$1,323,219**
		City Staff Time	0%	$0
		Administration and engineering design	20%	$264,644
		Design Contingency	0%	$0
		Permitting	0%	$0
		Land acquisition and easements	0%	$0
		Total Cost		**$1,587,863**

Schedule

	2015												2016											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Preliminary Design																								
Permitting																								
Final Design and PS&E																								
Advertise and Contractor Procurement																								
Construction																								

Project:	SR 522 Corridor Improvement Project Surface Water Component (West A)		ID: T-06
Location:	SR 522 between 61st Avenue NE and 65th Avenue NE	Basins:	Tributary 0056 and Lake Washington
Project Type:	☒Water Quality ☐Fish Passage ☐Flow Control ☐Erosion ☒Drainage ☐Flooding	Preliminary Project Cost:	$633,500
Problem:	Aged conveyance system with no water quality treatment		

Project Description

Surface water improvements are only a component of this transportation project; however, the improvements are significant enough to warrant mentioning in the surface water capital improvement program. This project is a continuation of previous completed phases of the SR 522 Corridor Improvement Project, which have already installed water quality treatment facilities and conveyance system improvements east of 65th Avenue NE to the eastern border of the City.

Currently, the project area discharges untreated stormwater runoff to Tributary 0056 and Lake Washington. The project will install several Filterra systems designed to remove pollutants such as total suspended solids, nutrients, dissolved metals, and oil from stormwater runoff. Much of the aged conveyance infrastructure will be replaced.

Project Location

Project Cost Estimate

Total Project Cost	$15,150,735
Surface Water Component:	
City Surface Water Funds	**$633,500**
Surface Water Grant Funds	$475,125
Total	$1,108,625

Schedule

	2014				2015				2016			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
ROW												
Final Design												
Construction												
Closeout												

Appendix F:

Programmatic Strategy Project Summary Sheets

Project:	LID Code Review		ID: SProg-01
Project Type:	NPDES compliance	Preliminary Project Cost:	$46,800
Deadline:	December 31, 2016		

Project Description

Permit Language

No later than December 31, 2016, permittees shall review, revise, and make effective their local development-related codes, rules, standards, or other enforceable documents to incorporate and require LID principles and LID BMPs. For permittees in Lewis and Cowlitz counties, the deadline for this requirement is no later than June 30, 2017; for the City of Aberdeen the deadline for this requirement is no later than June 30, 2018.

The intent of the revisions shall be to make LID the preferred and commonly used approach to site development. The revisions shall be designed to minimize impervious surfaces, native vegetation loss, and stormwater runoff in all types of development situations. Permittees shall conduct a similar review and revision process, and consider the range of issues, outlined in the following document: Integrating LID into Local Codes: A Guidebook for Local Governments (Puget Sound Partnership 2012).

Goal:
Allow LID, where feasible

How?
Revise codes and standards such that barriers to LID implementation are removed

Who?
City staff (planning, development review, engineering) and/or consultant

When?
Deadline for code revision is December 31, 2016

2014	2015				2016			
QTR4	QTR1	QTR2	QTR3	QTR4	QTR1	QTR2	QTR3	QTR4
Tasks: • Attend training • Make list of codes to review • Coordinate with other City staff (send a memo describing what needs to be done, or have a kick-off meeting. • Review comprehensive plan for LID policies	Tasks: • Begin code review. • Narrow list of codes that may require revisions. • Meet with relevant staff where code revisions may be necessary. • Jointly develop strategy for code revisions. • Determine public outreach and City Council schedule for revising codes.		Tasks: • Conduct first public and City Council outreach • Work with planning to ensure comprehensive Plan update is consistent with potential revised codes. • Draft proposed amendments, standard revisions, and implementation procedures		Tasks: • Public and Council review on draft amendments and standard revisions • Revise drafts based on feedback from the public and City Council		Tasks: • Finalize amendments and revisions. • Final Council Approval and Adoption.	

What?

The following Kenmore codes likely have some language that either supports implementation of LID, or would prevent implementation.

Code	Elements	Considerations
Critical Areas (Ch. 18.55)	All	Ensure compatibility with LID and allowances only where appropriate
Vehicles and Traffic (Title 10)	Fire Lanes (Ch. 10.30)	
	Parking (Ch. 10.20)	May need to add something for future LID facilities in ROW that may affect parking
Streets and Bridges (Title 12)	ROW (Ch. 12.35)	Access, covenants, etc.
	Street Standards (Ch. 12.50)	Street and driveway setbacks, widths, constructed drainage, etc.
	Utilities on City ROW (Ch. 12.55)	Utility conflicts with LID facilities (once in place), other potential issues?
	Sidewalks, Planting Strips, and Street Trees (Ch. 12.70)	Planting strips as LID facilities? Curb and gutter?
Utilities and Public Works (Title 13)	Side Sewer Connections (Ch. 13.05)	Restoration of LID facilities in ROW?
	Design, Installation, and Repair of Sewage Disposal Systems (Ch. 13.10)	Septic system placement relative to LID facilities?
	Surface Water Policy (Ch. 13.35)	New manual adoption
	Surface Water Management Program (Ch. 13.40)	Adjustments, incentives?
Buildings and Construction (Title 15)	Fire Code (Ch. 15.10)	Driveway, road dimensions?
	Building Codes (Ch. 15.20)	Roof loads----vegetated roofs? Plumbing for water reuse (cisterns?)
	Land Alterations (Ch. 15.25)	Vegetation, trees, and soil protection and restoration? Protection of LID facilities
Environment (Title 16)	Shorelines (all chapters)	Check for consistency that code doesn't preclude LID.
Land Division (Title 17)	Subdivisions and Short Subdivisions (Ch. 17.20)	Lot widths, configurations, clustered development, vegetation and soils preservation, etc.
Zoning (Title 18)	Landscaping Standards (Ch. 18.35)	Check for consistency with LID
	Parking and Circulation (Ch. 18.40	Access, parking spaces, widths
	Signs (Ch. 18.42)	Placement relative to LID facilities in ROW?
	Adequacy of Public Facilities and Services (Ch. 18.45)	Check for consistency relating adequacy (road widths, access, etc.) with LID
	Downtown Design Standards (Ch. 18.52)	Check for consistency---building, roads, access, parking, etc. to allow for LID
	Critical Areas (Ch. 18.55)	Ensure LID is consistent with critical areas codes, allowed where appropriate, disallowed where not
	Tree Management and Protection (Ch. 18.57)	Consistency for LID
	Animals (Ch. 18.70)	Manure management---away from LID facilities
	Density Incentives (Ch. 18.80)	LID?
	Site Plan Review (Ch. 18.105)	
	Master Plans (Ch. 18.120)	Impervious surface coverage, vegetation retention, open space, road and sidewalk widths, etc.
Land Use Policies and Procedures (Title 19)	Environmental Procedures (Ch. 19.35)	Review categorical exclusions, procedures, etc. related to LID

Cost Estimate

Task	Description	Estimated Level of Effort (hrs)	Personnel	Estimated Cost
1	Conduct Code Review	80	Staff and/or Consultant	$ 10,000.00
2	Develop strategy for revisions and public review	40	Staff and/or consultant	$ 6,000.00
3	Public outreach, council meetings	80	Staff	$ 8,000.00
4	Draft and Final Revisions to Codes	120	Staff	$ 12,000.00
			Subtotal	$ 36,000.00
			Contingency (30%)	$ 10,800.00
			TOTAL	$ 46,800.00

Project:	Stormwater Manual Adoption		ID: SProg-02
Project Type:	NPDES compliance	Preliminary Project Cost:	$28,600
Deadline:	December 31, 2016, for manual adoption		

Project Description

The NPDES Phase II Permit references Ecology's 2012 SWMMWW requirements and standards in numerous sections. In order for the City to comply with the permit, it will either have to adopt the 2012 Ecology manual or an equivalent manual (2015 King County Manual, in progress) by December 31, 2016.

This process will take time, not only to decide the most appropriate manual for Kenmore, but also to educate planning and development review staff and permit applicants about the new stormwater requirements. Implementation of LID techniques on a city-wide basis will likely take more time at first as this represents a paradigm shift from previous stormwater practices.

Goal:
Adopt a new stormwater management manual

How?
Review options and make a timely decision such that the necessary internal and external outreach can be conducted ahead of the implementation date

Who?
City staff (engineering, planning, and development review)

When?
Deadline for manual adoption is December 31, 2016.

Cost Estimate

Task	Description	Estimated Level of Effort (hrs)	Personnel	Total
1	Review and compare manual options	20	Staff	$ 2,000.00
2	Adoption Process	80	Staff	$ 8,000.00
3	Staff and community education and outreach	120	Staff	$ 12,000.00
			Subtotal	$ 22,000.00
			Contingency (30%)	$ 6,600.00
			TOTAL	$ 28,600.00

Project:	Develop LID Infeasibility Tools		ID: SProg-03
Project Type:	NPDES compliance support	Preliminary Project Cost:	$42,900
Deadline:	Not applicable		

Project Description

The NPDES Phase II Permit requires use of low impact development BMPs according to Ecology's 2012 SWMMWW unless it is not feasible according to infeasibility criteria outlined in the manual.

Kenmore may choose to help development review staff and applicants ahead of time by mapping those areas that are clearly not feasible for infiltrative LID because of steep slopes, landslide hazards, or high groundwater and wetland conditions.

This programmatic project creates a broad-scale map of the City, showing areas that should not be considered for infiltration, and those that based on mapped surficial geology would be considered high, medium, or low potential for infiltration.

Goal:

Develop a map of infiltration potential to help applicants and development review staff understand where to consider LID techniques

How?

Existing geologic mapping, landslide maps, and field visits

Who?

Consultant and/or City staff

When?

No specific deadline.

Cost Estimate

Task	Description	Estimated Level of Effort	Personnel	Total
1	Review Existing Data	40	Consultant/Staff	$ 6,000.00
2	Conduct GIS analysis	100	Consultant/Staff	$ 15,000.00
3	Field Validation	40	Consultant/Staff	$ 6,000.00
4	Map Preparation and Report	40	Consultant/Staff	$ 6,000.00
			Subtotal	$ 33,000.00
			Contingency (30%)	$ 9,900.00
			TOTAL	$ 42,900.00

Project:	Evaluation of Stormwater Incentive and Mini Grant Programs		ID: SProg-04
Project Type:	Volunteer Stormwater Retrofit	Preliminary Project Cost:	$14,300
Deadline:	Not applicable		

Project Description

Much of the City of Kenmore was developed prior to the requirement for any stormwater treatment. In order to reverse the impacts that have occurred from past development, stormwater facilities will need to be put in place to treat surfaces.

Many jurisdictions have voluntary incentive programs to encourage homeowners to install residential rain gardens to treat residential runoff on-site. This programmatic project evaluates and considers implementing such a program in Kenmore. The focus would be primarily on residential properties, but could be considered for other types of land uses as well.

In this evaluation, other incentive programs that are currently in place should be considered.

Goal:
Evaluate stormwater incentive and mini-grant programs

How?
Review other jurisdictions programs and successes, consolidate list of Kenmore's current incentives

Who?
City staff

When?
No specific deadline.

Cost Estimate

Task	Description	Estimated Level of Effort	Personnel	Total
1	Review Incentive Programs from Other Jurisdictions	20	Staff	$ 2,000.00
2	Consolidate list of Kenmore's incentives	10	Staff	$ 1,000.00
3	Prepare recommendation for Council	40	Staff	$ 4,000.00
4	Implement recommendation	40	Staff	$ 4,000.00
			Subtotal	$ 11,000.00
			Contingency (30%)	$ 3,300.00
			TOTAL	$ 14,300.00

Project:	Easement Management		ID: SProg-05
Project Type: Deadline:	**Policy** **Not applicable**	**Preliminary Project Cost:**	**$20,800**

Project Description

The City's stormwater infrastructure sometimes crosses private parcels for which a drainage easement has not been maintained or was never obtained. There are various situations that date back to before the City incorporated.

This situation can create challenges for maintenance and repair when problems arise at the interface of public and private property.

This programmatic project is to review existing drainage easements and determine how easements should be managed. Additionally, other solutions, such as moving public pipes into city ROW should be considered.

Goal:
Evaluate existing drainage easements

How?
Consider range of solutions for dealing with public infrastructure on private property.

Who?
City staff

When?
No specific deadline.

Cost Estimate

Task	Description	Estimated Level of Effort	Personnel	Total
1	Conduct GIS and paper analysis of drainage easements and public stormwater pipes	60	Staff	$ 6,000.00
2	Alternative evaluation and policy formulation	60	Staff	$ 6,000.00
3	Policy recommendation for Council	40	Staff	$ 4,000.00
			Subtotal	$ 16,000.00
			Contingency (30%)	$ 4,800.00
			TOTAL	$ 20,800.00

Project:	Stormwater Retrofit		ID: SProg-06
Project Type:	Accelerate stormwater retrofit through pursuit of identification and of grant-funding opportunities	Preliminary Project Cost:	$24,700
Deadline:	Not applicable		

Project Description

Much of the City of Kenmore was developed prior to the requirement for any stormwater treatment. In order to reverse the impacts that have occurred from past development, stormwater facilities will need to be put in place to treat surfaces.

In addition to encouraging voluntary stormwater retrofit, the City should undertake its own stormwater retrofit projects, where appropriate, taking advantage of available grant funding.

A retrofit strategy memorandum was prepared for this Plan and outlines areas of the City that would be good candidates for retrofit. Additionally, specific facilities were reviewed for potential retrofit as well. The retrofit memorandum is in Appendix D.

Goal:
Pursue regional stormwater retrofit grants for Kenmore projects

How?
Identify potential projects and prepare grant applications

Who?
City staff and consultants

When?
No specific deadline.

Cost Estimate

Task	Description	Estimated Level of Effort	Personnel	Total
1	Prepare list of candidate stormwater retrofit sites	20	Staff	$ 2,000.00
2	Develop prioritized short-list of sites that would be grant eligible	20	Staff	$ 2,000.00
3	Develop conceptual designs for grant applications	100	Consultant	$ 15,000.00
			Subtotal	$ 19,000.00
			Contingency (30%)	$ 5,700.00
			TOTAL	$ 24,700.00

Project:	Landslide and Groundwater Issues		ID: SProg-07
Project Type:	Evaluation of geologic issues associated with landslides and groundwater seepage	Preliminary Project Cost:	$31,200
Deadline:	Not applicable		

Project Description

Many of the drainage complaints received by the City were related to landslide or groundwater issues.

This programmatic project is to evaluate the areas of the City that are particularly susceptible to high groundwater, groundwater seepage, or landslides and develop possible strategies to mitigate impacts or prevent future problems.

Goal:
Evaluate landslide and groundwater issues in Kenmore

How?
Review drainage complaint data and geologic maps and conduct field investigations

Who?
City staff and consultants

When?
No specific deadline.

Cost Estimate

Task	Description	Estimated Level of Effort	Personnel	Total
1	Review drainage complaints and geologic maps	20	Staff/Consultant	$ 3,000.00
2	Conduct Field Investigations	40	Staff/Consultant	$ 6,000.00
3	Develop menu of strategies for dealing with similar types of problems	100	Staff/Consultant	$ 15,000.00
			Subtotal	$ 24,000.00
			Contingency (30%)	$ 7,200.00
			TOTAL	$ 31,200.00

Project:	Stream Culvert Assessment		ID: SProg-08
Project Type:	Conduct fish passage barrier analysis of streams in Kenmore	Preliminary Project Cost:	$16,500
Deadline:	Not applicable		

Project Description

The recent "Culvert Case" related to treaty rights has prompted Washington State Department of Transportation and other jurisdictions to review their culverts for fish passage and begin the process of prioritizing culverts for replacement.

This programmatic project is to conduct a review of Kenmore's culverts for streams that are presumed to have fish habitat according to Washington Department of Natural Resources (DNR). A prioritized list would be repaired for culverts to be replaced or modified as resources are available or other projects are conducted in the vicinity.

Goal:
Evaluate culverts for fish passability in Kenmore

How?
Conduct field assessment and rank culverts according to criteria established by DNR.

Who?
City staff and consultants

When?
No specific deadline.

Cost Estimate

Task	Description	Estimated Level of Effort	Personnel	Total
1	Overlay maps with DNR stream typing to determine presumed fish presence	8	Staff/Consultant	$ 1,000.00
2	Determine which streams need to be field screened	12	Staff/Consultant	$ 1,200.00
3	Field culvert evaluations	22	Staff/Consultant	$ 3,000.00
4	Analysis, prioritization, and report preparation and recommendations	55	Staff/Consultant	$ 7,500.00
			Subtotal	$ 12,700.00
			Contingency (30%)	$ 3,810.00
			TOTAL	$ 16,510.00

Project:	SEPA Notification for Upstream Projects		ID: SProg-09
Project Type:	Opportunities to provide input through SEPA process	Preliminary Project Cost:	$62,920
Deadline:	Not applicable		

Project Description

This project involves requesting jurisdictions upstream of Kenmore, particularly those within the Swamp Creek basin, to include the City on all projects requiring SEPA notification so that the City has an opportunity to provide input on projects that could impact surface water flows and/or water quality in Swamp Creek or other drainages.

For proposed upstream projects, particularly in the Swamp Creek basin, the City will strive to obtain flow control to the maximum extent feasible. This may be achieved through providing official comment on projects or appealing projects if needed.

Goal:
Establish mechanism for which City can be made aware and provide input on upstream projects.

How?
Request notification under State Environmental Policy Act (SEPA) for projects in upstream jurisdictions in the Swamp Creek drainage basin.

Who?
City staff

When?
No specific deadline. Except for Task 1, costs are expect to be incurred annually.

Cost Estimate

Task	Description	Estimated Level of Effort	Personnel	Total
1	Request SEPA notification for up to 8 jurisdictions	10	Staff	$ 1,000.00
2	Screen SEPA notifications (assume 10 per week)	130	Staff	$ 13,000.00
3	Review notices relevant to Swamp Creek or Surface Water issues (assume 2 per week)	104	Staff	$ 10,400.00
4	Provide comments on up to 24 projects per year	240	Staff	$ 24,000.00
			Subtotal	$ 48,400.00
			Contingency (30%)	$ 14,520.00
			TOTAL	$ 62,920.00