Final Comprehensive Surface Water Management Plan Update

City of Newcastle, Washington

Adopted by the Newcastle City Council,
September 2017

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Acronyms and Abbreviations

AACE	American Association of Cost Engineers
ADT	Average Daily Traffic
ANSI	American National Standards Institute
AKART	All Known, Available, and Reasonable Treatments
BMP	Best Management Practice
BRE	Business Risk Exposure
CCTV	Closed Circuit Television
CIP	Capital Improvement Program
CMP	Corrugated Metal Pipe
COF	Consequence of Failure
CSWM	Comprehensive Surface Water Management
CWA	Clean Water Act
DSCR	Debt Service Coverage Ratio
Ecology	Washington State Department of Ecology
ECOSS	Environmental Coalition of South Seattle
EPA	U.S. Environmental Protection Agency
FTE	Full-time Equivalent
HSG	Hydrologic Soil Group
IDDE	Illicit Discharge Detection and Elimination
KCSWDM	King County Surface Water Design Manual
LID	Low Impact Development
LOS	Level of Service
MEP	Maximum Extent Practicable
MSL	Mean Sea Level
NMC	Newcastle Municipal Code
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
O&M	Operations and Maintenance
POF	Probability of Failure
RSAT	Rapid Stream Assessment Technique
ROW	Right-of-Way
SDP	Small Drainage Project
SOP	Standard Operating Procedure
SWM	City of Newcastle Stormwater Management Division
SWMP	Stormwater Management Program
TESC	Temporary Erosion Sediment Control
WDFW	Washington Department of Fish and Wildlife

Glossary

The terms below are used in the City of Newcastle's Comprehensive Stormwater Management Plan Update.

Basin: An area drained by a single stream or river system or the drainage areas that drain directly to a particular water body or Puget Sound.

Best Management Practices (BMPs): Schedules of activities, prohibitions of practices, capital improvement, maintenance procedures and other management practices that when used singly or in combination, prevent or reduce the release of pollutants and other adverse impacts to the waters of Washington state. BMPs also include, but are not limited to, treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or wastewater disposal, or drainage from raw material sludge.

Capital Improvement Program (CIP) pertaining to the stormwater system: A funded program intended to improve the drainage system, the performance of that system, and /or reduce site-specific or cumulative adverse stormwater impacts.

Flow Control: The act of temporarily detaining stormwater runoff collected from developed surfaces in a pond, tank, or vault, and releasing it back into the stormwater system at a pre-determined rate that is slower than what would have otherwise occurred.

Drainage System: A combination of facilities (e.g., ditches, pipes, conduits, storage facilities, trenches, etc.) and natural features (e.g. open streams, ponds, lakes) which operate together to convey surface water from the point of origin to an ultimate discharge point.

Low Impact Development (LID): A stormwater management and land development strategy applied at the parcel and subdivision scale that emphasizes conservation and use of on-site natural features integrated with engineered, small-scale hydrologic controls to more closely mimic pre-developed hydrologic functions.

Rapid Stream Assessment Technique (RSAT): A quantitative method developed by the United States Department of Fish and Wildlife Service to provide a high-level definition of stream corridor conditions. A tool to identify and prioritize poor quality corridors for additional, more detailed assessment and/or rehabilitation.

Runoff: Water that travels across the land surface and discharges to water bodies either directly or through a collection and conveyance system.

Secchi disk: An 8-inch-diameter disk painted black and white in alternating quarters and used as a visual measure of turbidity of lakes.

Stormwater: Runoff during and following precipitation and snowmelt events, including surface runoff and drainage.

Subbasin: A drainage area that drains to a watercourse or water body named and noted on common maps and which is contained with a basin. A basin or area that is part of a larger drainage basin or area. Also see basin.

Temporary Erosion and Sediment Control (TESC): A set of BMPs designed to prevent sediment from leaving a construction site and entering the storm system.

Turbidity: The cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air. The measurement of turbidity is a key test of water quality.

Executive Summary

Introduction

The City of Newcastle (City) 2017 Comprehensive Surface Water Management (CSWM) Plan Update evaluated the City's storm and surface water system, comprised of built and natural drainage assets. The City's Surface Water Management (SWM) Division sets policy to maintain and improve the quality of natural waterways, as well as address flooding concerns. In the course of preparing the 2017 CSWM Plan Update, it was concluded that much of the City's drainage system assets are functioning well; however, there are some capital and programmatic improvements needed to address localized issues and to continue to meet regulatory compliance as infrastructure ages and the population of Newcastle grows. Natural drainage courses exhibited encouraging stability ratings considering the urban setting. The open channel conditions are evidence of past successes in managing the storm and surface water systems and support the need to continue providing operational programs. Further analyses included in the 2017 CSWM Plan are an update to SWM's Capital Improvement Program (CIP), an evaluation of the City's National Pollutant Discharge Elimination System (NPDES) Stormwater Management Program (SWMP), and a SWM financial rate study.

Drainage Basin Characterization

The City is situated near the high-point of three major drainage basins—Coal Creek, May Creek, and East Lake Washington—all of which ultimately flow into Lake Washington. The relative percent of the City covered by its three major drainage basins, and their sizes in acres, is shown in Figure ES-1.

Stormwater runoff originating within the City limits eventually discharges into one of the three major drainage basins as it flows to Lake Washington. Urbanization of a drainage basin has a profound impact on stream hydrology; streams in urban areas often experience severe erosion that can cause flooding and property damage. As urbanization occurs, the ratio of impervious to pervious surfaces increases and leads to greater peak runoff flows and volumes (WDFW 2002). Due to the City's continued growth and the risks associated with increased impervious area, this 2017 CSWM Plan Update project included an open channel assessment for stream stability.

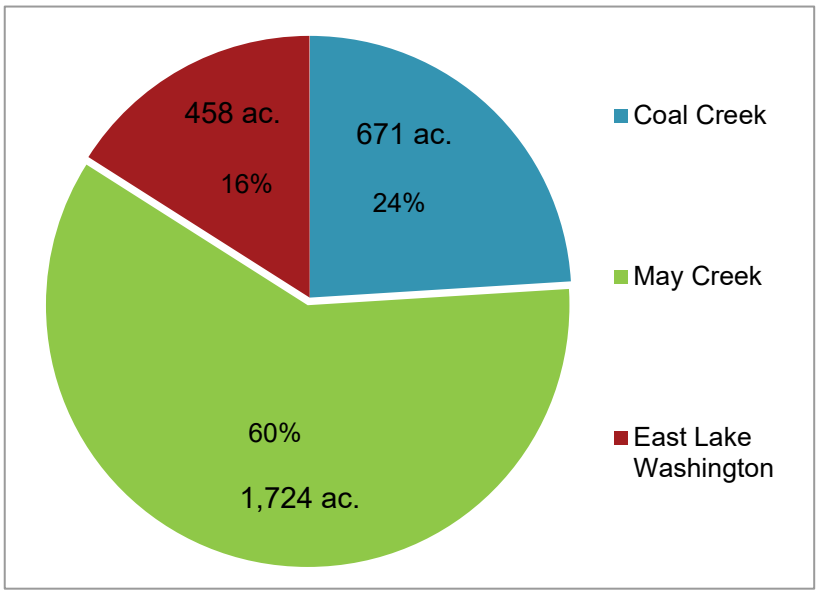

Figure ES-1. Newcastle Drainage Basin Areas

The three major drainage basins within the City were characterized and evaluated using a Rapid Stream Assessment Technique (RSAT) that provides stream quality condition assessments for habitat, erosion, and stream stability. The RSAT findings indicated an overall fair to good rating for stream stability for the stream segments that were evaluated within the City limits. These ratings are consistent with having stormwater regulations in place to off-set impacts to natural systems that would otherwise occur during urbanization of a drainage basin. Fully functioning and well-maintained detention ponds and water quality facilities are essential to maintaining healthy streams in Newcastle.

Basin Fact Sheets were prepared for each drainage basin and can be viewed in Chapter 2 of this CSWM Plan and on the City's website. Basin Fact Sheets include information about habitat, land cover, and zoning for each drainage basin.

Capital Improvement Program

The development of the City's SWM CIP followed the City's four-step process to identify stormwater related problems throughout the City and develop associated capital projects. The process included:

Step 1. Locate and document drainage concerns from four major sources. Drainage concerns were identified by examining drainage complaint records, interviewing City staff, conducting a public survey, and developing stormwater models.

Step 2. Perform initial categorization of concerns. Drainage issues were grouped by similarity and categorized as detention pond function, road drainage complaints, streambank erosion, and infrastructure condition assessment.

Step 3. Evaluate each identified drainage concern for CIP feasibility. Site visits, field verification, and validation by City staff were used to assess feasibility of conceptually designed solutions for each identified problem.

Step 4. Formulate, define, and rank CIP projects. Concept level cost estimates were developed for CIP projects. Priority ranking for completion of projects was provided by City staff based on the severity of problems, permitting requirements, and phasing of resources.

Following this process, a CIP Implementation Plan was developed to document revenue needs to support long-term capital project design and construction. The engineering details are included in Chapter 3 and the financial details are in Chapter 5. The proposed SWM CIP project list (including a potential schedule for expenditure of concept-level costs) is shown in Table ES-1.

Hydraulic modeling used to design two proposed flow control vaults do not include the Hazelwood Short Plat vaults upstream of the proposed South CIP vault. Records for the Hazelwood vaults were not made available to the consultant until after completion of the modeling and the final report. During the design phase of the vaults, it is recommended that the Hazelwood Short Plat vaults be factored into the design of the proposed CIP vaults (see addendum to Modeling Technical Memorandum in Appendix B).

Table ES-1. Proposed SWM CIP Project List and Annual Funding Recommendations

Capital Improvement Plan ($1,000s)	2018	2019	2020	2021	2022	2023	2024	2025	2026	TOTAL
Capital Improvement Plan										
Railroad Embankment Newport Hills Creek	$35	$0	$0	$0	$0	$0	$0	$0	$0	**$35**
Detention Pond Restoration Program	$25	$25	$26	$26	$27	$28	$29	$29	$30	**$245**
135th Place SE Culvert Inlet Retrofit	$0	$0	$0	$0	$0	$0	$0	$62	$0	**$62**
Storm Conveyance Rehabilitation Program	$100	$103	$105	$108	$110	$113	$116	$119	$122	**$995**
Landcastle Creek Streambank Restoration Project	$0	$0	$0	$0	$0	$0	$0	$176	$533	**$708**
116th Avenue SE and SE 72nd Street Flow Control Vault	$0	$0	$170	$370	$0	$0	$0	$0	$0	**$539**
116th Avenue SE and SE 76th Street Flow Control Vault	$0	$0	$0	$0	$143	$304	$0	$0	$0	**$447**
Roadway/Sidewalk Seepage Program	$62	$53	$43	$0	$45	$0	$48	$0	$50	**$301**
144th Place SE Culvert Replacement and Ditch Rehabilitation Project	$0	$0	$0	$0	$0	$0	$0	$0	$356	**$356**
SE 90th Street Drainage Improvement Project	$0	$0	$0	$0	$0	$193	$0	$0	$0	**$193**
SWM Participation in Transportation Capital Fund Projects [1]	$61	$143	$31	$203	$140	$0	$0	$0	$0	**$576**
CIP Total Annual Costs*	**$282**	**$323**	**$375**	**$706**	**$465**	**$637**	**$192**	**$386**	**$1,090**	**$4,456**

Note: Table Values in $1,000s

[1] SWM Participation in Transportation Capital Fund Projects is a capital expenditure but not technically a system improvement recommended earlier in this document. The capital costs were provided by the City representing projected capital equipment costs.

*Numbers do not always sum exactly to annual totals due to rounding

Explanatory worksheets, including conceptual opinions of cost are provided in Appendix D.

Stormwater Management Program

The City's NPDES Phase II Municipal Permit (NPDES Permit) authorizes discharge of stormwater runoff from the City's built drainage system to the Waters of the state[1]. Newcastle is one of 80 western Washington municipalities that have been issued an NPDES Permit by the state of Washington. Regulated by the Department of Ecology (Ecology), the NPDES program requires the municipalities to implement a Stormwater Management Program (SWMP) that is designed to meet the conditions of their permit. The City's SWM Division provides Ecology with annual updates to the City's SWMP activities, which includes:

- Information about detecting and eliminating illicit discharges
- Promoting opportunities for public involvement in stormwater matters
- Developing outreach materials to educate the public about water quality and habitat issues, development regulations, and low impact development (LID) requirements
- Other stormwater-related activities

As part of the City's 2017 CSMP update, HDR conducted a gap analysis of the City's SWMP and recommends the following:

- Develop labor tracking processes to collect data on implementing the various components of the Stormwater Management Program (S5.A.2). The objective is to identify which elements of the program are most effective at achieving permit goals and optimizing the implementation of the SWMP. The City's current tracking methods meet minimal permit conditions, and the recommendation is intended to highlight an opportunity for efficiencies within the City's Operations and Maintenance (O&M) Program.
- Review and update City ordinances as necessary to meet the NPDES Permit condition to identify the responsible party for implementing action items resulting from a site inspection (S5.C.4.c).
- Follow recommendations in the 2016 Ecology audit letter to develop and implement standardized practices, policies, and procedures that reduce stormwater impacts.
- Prepare standardized procedures to meet the standards described in the NPDES Permit.
- Institute formal procedures for documenting inspection results for City-owned maintenance facilities, to meet SWPPP requirements.

Recommendations to strengthen Illicit Discharge Detection and Elimination (IDDE) Program elements are:

- Document the standard procedures the City follows when addressing illicit discharges.
- Document the City's compliance strategy that includes informal actions (e.g., public education, technical assistance) and enforcement.

The NPDES Permit is reissued every 5 years with increasing demands on regulated jurisdictions with the issuance of each new permit. The City's current permit was originally scheduled to expire

[1] Revised Code of Washington (RCW) "Waters of the state" includes lakes, rivers, ponds, streams, inland waters, underground water, salt waters, estuaries, tidal flats, beaches and lands adjoining the seacoast of the state, sewers, and all other surface waters and watercourses within the jurisdiction of the state of Washington.

on July 31, 2018, until a May 2017 decision by Ecology extended the current permit for an additional 12 months. The revised expiration date is July 31, 2019.

Financial Rate Study

The City's SWM Division is fully funded by the SWM Utility, which adheres to the City's adopted financial policies. The SWM Utility is comprised of rates charged to property owners within City limits, and consists of ten rate classes that range from a per parcel charge for residential customers to per acre charges for non-residential customers. Non-residential customers are charged rates that are based on the amount of impervious surface per acre or per parcel, depending on the rate class.

The financial section of the CSWM Plan is intended to provide recommendations for the City on how to fund SWM operations, maintenance, and the capital program in a sustainable manner. Methods used for development of the funding plan follow generally accepted rate setting techniques and principles. As part of this analysis, several elements of the SWM Utility were analyzed, including past and present financial performance.

While the largest revenue source comes from rate revenue, 33% of SWM's revenue comes from other sources such as developer contributions, operating grants and stormwater review fees. Historically, SWM's largest expenses are salaries and benefits at 34%, and capital costs are 27% of total expenditures. The remainder of SWM's costs consists of intergovernmental and operating transfers, training, services, taxes and supplies.

The results of the analysis find that rates will need to be increased over the next 10-year period to maintain current levels of service, be in compliance with NPDES Permit requirements, and fund capital projects. The recommended rate adjustments are provided in Table ES-2 below.

Table ES-2. Recommended Rate Adjustment

	2018	2019	2020	2021	2022	2023	2024	2025	2026
Proposed Rate Adjustment	18.0%	18.0%	18.0%	16.0%	11.0%	4.0%	2.0%	2.0%	2.0%

The proposed rate adjustments were phased in over the 10-year period to minimize rate impacts to rate payers as much as possible without compromising the integrity of SWM's goals and objectives. Detailed tables supporting this summary are provided in Appendix I.

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Chapter 1 Introduction

When rain falls in forested or undeveloped areas, some of the rainfall is absorbed by trees and plants, and most seeps or infiltrates into the ground. In developed or urban areas, the hard surfaces (roofs, driveways, sidewalks, roadways, and even turf fields) do not allow the rain to infiltrate. Instead, the rain becomes stormwater runoff as it travels across hard or impervious surfaces, often picking up sediment and pollutants along the way. Stormwater flows across impervious surfaces, and into catch basins or other stormwater system infrastructure, through an underground network of pipes, and then into natural waterways. Managing surface flows and stormwater is a responsibility of most jurisdictions, and one that has become more challenging with increasingly stringent requirements by local, state, and federal regulations and permits.

Incorporated in 1994, the City of Newcastle (City) is a young, growing city faced with the challenges of meeting a multitude of local, state and federal demands on its resources. In the area of storm and surface water management, the City is required to have a National Pollutant Discharge Elimination System (NPDES) Phase II Western Washington Municipal Stormwater Permit (NPDES Permit), which is a requirement of the federal Clean Water Act (CWA). In some states, the federal Environmental Protection Agency (EPA) delegates permit authority to state environmental agencies. In Washington, the NPDES Permit authority is the Washington State Department of Ecology (Ecology). Along with numerous other municipalities in western Washington, the City received its first NPDES Permit in 2007 and has received updates in 2013 (see Chapter 4).

The City's Surface Water Management (SWM) Division operates and maintains its surface and stormwater systems to manage rainfall runoff in a manner that reduces flood risk, improves water quality, protects the environment, and meets NPDES Permit requirements. Other NPDES Permit requirements for the City include: development review for compliance with stormwater design and management standards, controlling pollutant sources, monitoring water quality, conducting infrastructure and illicit discharge inspections, and providing education and outreach opportunities.

Stormwater originating within the City limits flows by gravity through a series of pipes, creeks, and lakes that eventually drain to Lake Washington. There are three watersheds within the City; however, two major drainage basins—May Creek and Coal Creek—receive the preponderance of stormwater from the City's collection and conveyance systems. Once runoff reaches May Creek and Coal Creek, it flows westward to Lake Washington and then eventually to the Puget Sound via the Chittenden Ballard Locks. Figure 1-1 shows the City drainage basins.

The SWM Division adheres to adaptive management principles to meet its goals. SWM evaluates its programs at a minimum of once a year, typically while preparing the Annual Report to Ecology and the Stormwater Management Program (SWMP) Plan. In addition to reviewing its programs once a year, the City has a Comprehensive Surface Water Management (CSWM) Plan, which sets a 10-year framework for policies, maintenance programs, and SWM Capital Improvement Program (CIP). The CSWM Plan is typically updated every 6-10 years, and it includes SWM goals and objectives, as well as guidance on programs within SWM. This updated CSWM Plan continues the planning that began with the City's first Storm and Surface Water Comprehensive Plan developed in December 1999 and updated in 2010. This 2017 update of the CSWM Plan evaluates major drainage basin characteristics and recommends surface water projects within the CIP and program adjustments within SWM to improve system operation and consistency with the NPDES Permit. As typical for a CSWM Plan, the updated analyses and recommendations are the basis for a SWM utility rate study.

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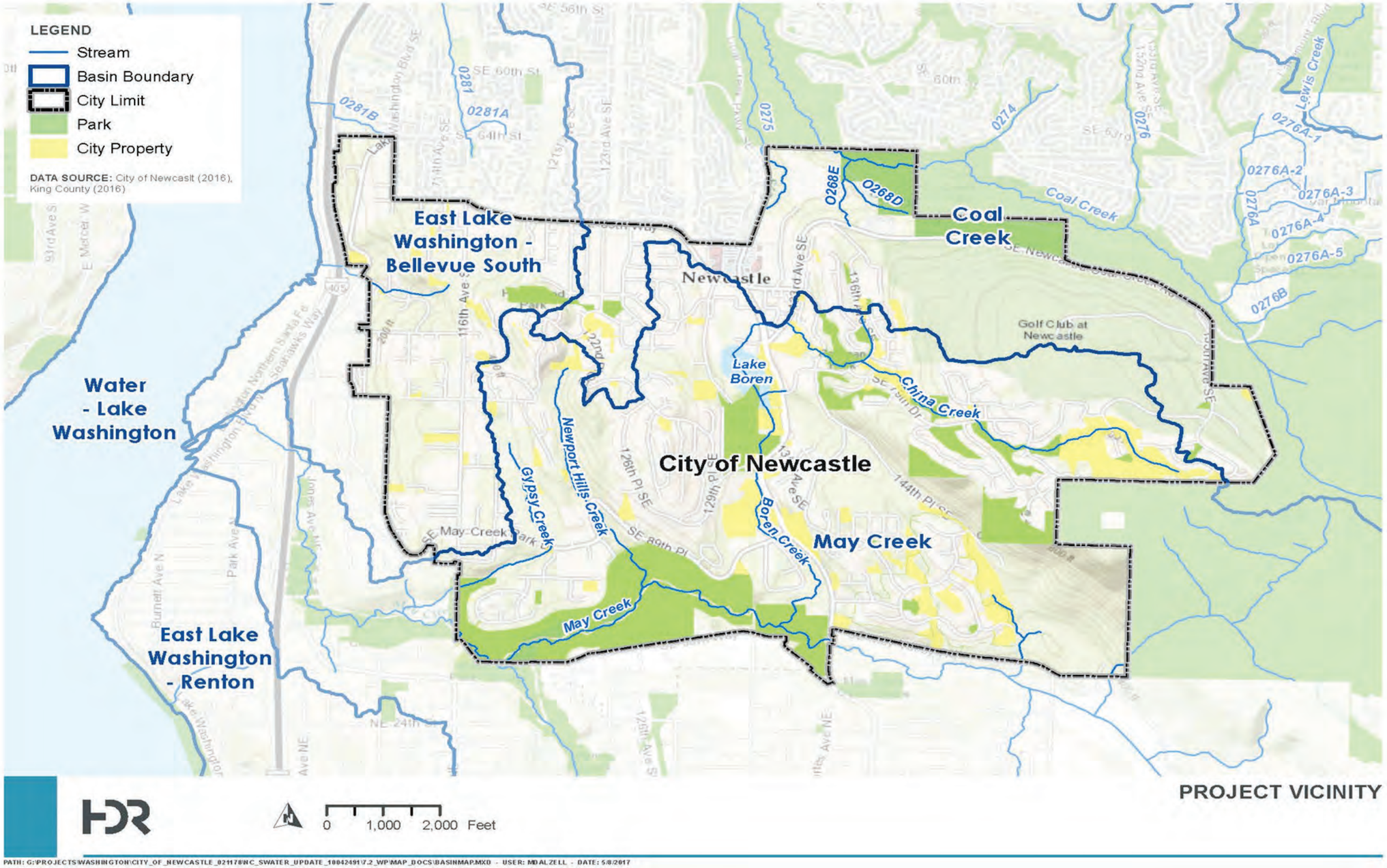

Figure 1-1. City of Newcastle Vicinity Map

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1.1 Stormwater Runoff and Its Effects

Stormwater runoff is the portion of rain or melting snow that flows across the land instead of seeping into the ground. Stormwater runoff is managed by the City's stormwater system. Stormwater follows topography from high points to low, crosses property boundary lines and even jurisdictional limits. As stormwater flows from one property owner to the next, each owner bears the responsibility to receive and convey stormwater across their property downstream to the next.

There is a direct relationship between runoff volume and impervious surface areas. As natural landscapes are converted to impervious urbanized areas, infiltration of rainfall into the ground diminishes, resulting in more stormwater runoff. Typical of most Puget Sound communities, Newcastle has experienced growth in its population and consequently in land development activity since incorporation; see Figure 1-2.

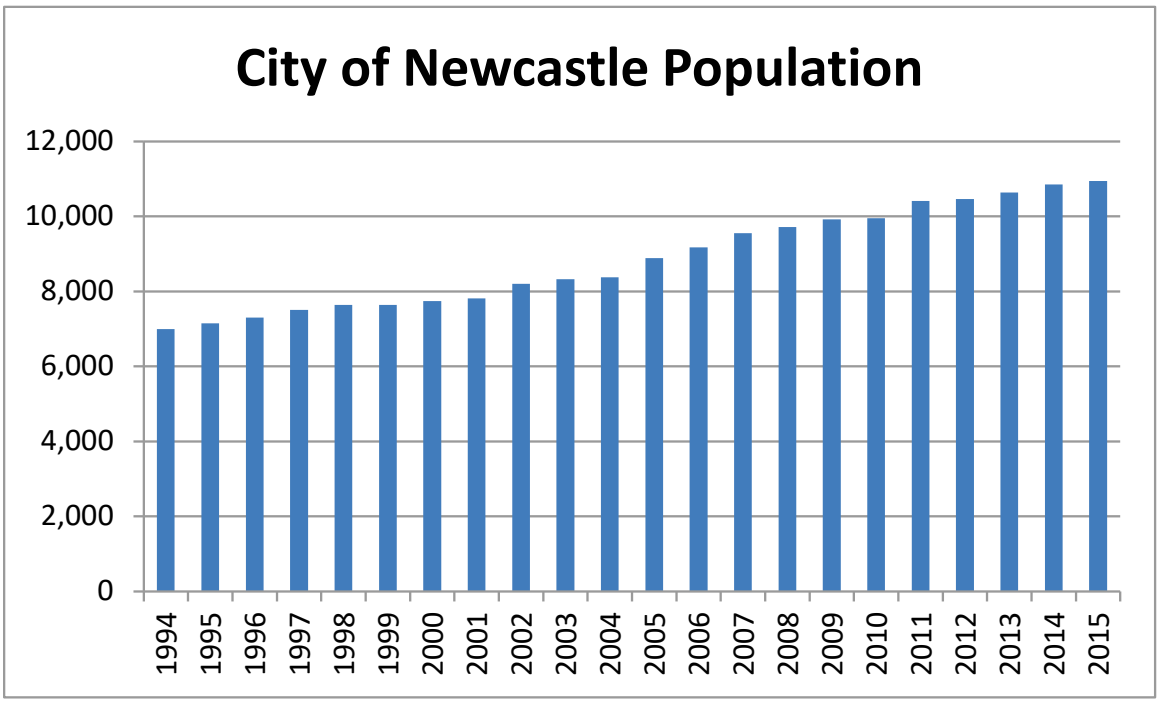


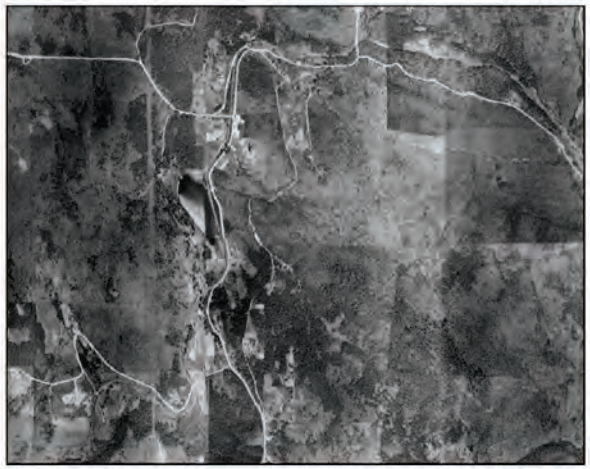
Figure 1-2. Newcastle Population

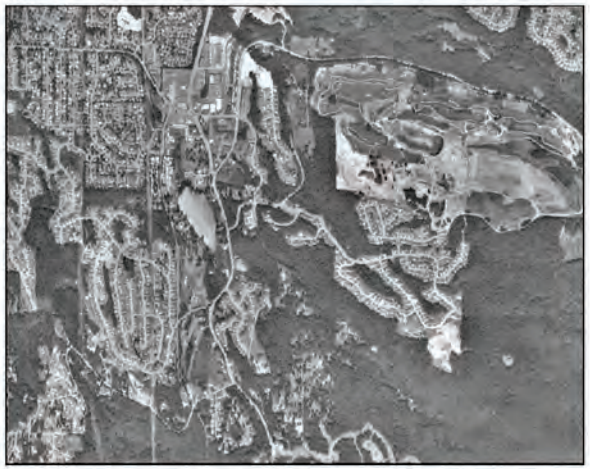
As land is converted from forest or permeable ground surface to impervious ground surface like roads, roofs, and parking lots, stormwater runoff carries a variety of pollutants to receiving waters, and the stormwater management challenge faced by the City's SWM Division is to collect, treat, and convey stormwater runoff safely and cost-effectively to nearby receiving waters while minimizing adverse impacts to waterways and private property.

Figure 1-3 provides aerial images of the City dating back to the early 20th century and demonstrates how the City's stormwater management system evolved.

1936

By 1936 much of the coal mining and logging in Newcastle had ceased. Surrounding land shows evidence of second-growth forest and shrubs returning to the area. In this undeveloped state, precipitation readily infiltrates into the soil or is consumed by plant uptake and evaporation. Nearby streams and lakes are supported by elevated groundwater and a small portion of rainwater.





1998

By the late twentieth-century, Newcastle had incorporated and the City's nascent stormwater utility prepared its first Stormwater Management Plan. Established neighborhoods can be seen north and west of Lake Boren. Newer development is being built to the east including The Golf Club at Newcastle. Newcastle inherited much of its drainage system from King County when the City incorporated. King County drainage standards have evolved over time from having no requirements in the 1960s and 70s to standards that today better protect receiving water from impacts that inherently occur with development.

2009

Newcastle updated its Stormwater Master Plan in 2010 as the city continued to grow. The City's stormwater utility manages numerous pipes, catch basins, and detention ponds. The City now has a water quality (NPDES) permit that dictates much of how the stormwater utility operates. Stormwater regulations are designed to mitigate impacts from development and the Utility is charged with operating the drainage system.

New Development

2015

Present-day land cover in Newcastle reflects what has become a typical landscape throughout western Washington. The state's Growth Management Act encourages development to stay in existing population centers which helps keep stormwater impacts from spreading to other undeveloped areas. Newcastle is updating its stormwater management plan in 2017, to facilitate the City's continued growth and management of the utility.

Figure 1-3. Historic Land Cover of Newcastle, Washington

1.2 Purpose of this Plan

The City's SWM Division is responsible for the implementation and continuation of the City's SWM programs, including:

- Operation & Maintenance (O&M) Program
- Education & Outreach Program
- Public Participation Program
- Illicit Discharge Detection Elimination (IDDE) and Spill Response Program
- Construction Site Runoff Program
- SWM CIP

Since most SWM programs are adaptively managed, updating the CSWM Plan every 6-10 years provides a framework for the SWM Division to prioritize CIP projects, update policies, review the effectiveness of existing programs, and assess the City's natural waterways. This update to the CSWM Plan:

- Describes the City's organizational approach to managing stormwater
- Provides an open channel assessment of the major streams in Newcastle
- Evaluates the proposed CIP program that supports the City's overall stormwater management goals
- Details the role and management programs instituted to carry out regulatory requirements stipulated in the City's NPDES Permit
- Describes LID techniques and opportunities for implementation within the City
- Recommends maintenance actions for restoring existing stormwater flow control facilities to their original design
- Is the basis for conducting a SWM utility rate study
- Serves as a guide to future users to help mitigate water quality impacts

1.3 Plan Development Methodology

Updating the City's 2010 Storm and Surface Water Comprehensive Plan started with reviewing the City's current surface water programs within the SWM Division, including: its activities for NPDES Permit compliance; identifying existing surface water issues; and developing potential solutions to address the identified issues. These analyses supported a SWM utility rate study.

1.3.1 Existing Data Review

As part of this SWM planning process, a variety of information was collected, reviewed, and analyzed. Sources of information included interviews with City staff and review of the City's financial policies and current budget, organizational charts, past capital facilities plans, the City's 1999 and 2010 Storm and Surface Water Comprehensive Plans, the 2008 and 2009 Lake Boren Water Quality Monitoring Reports, NPDES Permit Annual Reports, Operations and Maintenance activity database information, and the Ecology's 2016 audit of the City's NPDES Permit compliance activities.

1.3.2 Newcastle Municipal Code

Sections of the Newcastle Municipal Code (NMC) relevant to SWM's regular operations include:

- Chapter 13.05 Water Pollution
- Chapter 13.10 Surface Water Management Code
- Chapter 13.15 Storm and Surface Water Utility Rates
- Chapter 14.05.290 Environmentally Critical Areas
- Chapter 14.10 Shoreline Management
- Chapter 14.15 Property Grading

1.3.3 Surface Water Management Program

HDR evaluated the City's activities to meet NPDES Permit requirements to identify program gaps. Chapter 4 presents the findings from this analysis, involving a step by step review of the City's SWM programs as detailed in its SWMP to Ecology. The comprehensive gap analysis was based on current levels of service compared to program requirements stipulated by the NPDES Permit. The 2016 Ecology program gap analysis was incorporated into the larger comprehensive review of the City's programs.

1.3.4 City SWM Programs

SWM has grown over the years to accommodate increasingly stringent NPDES Permit requirements as well as an increase in stormwater infrastructure from private and public development within the City. The City's goals with respect to storm and surface water are to: reduce flood risk and property damage, improve water quality, protect the environment, and meet NPDES Permit requirements. Each program within SWM has been developed and implemented around those overarching goals. Details of the City's Stormwater Management Program are described in Chapter 4.

In summary, the City's SWM programs consist of:

- O&M Program that includes maintaining the proper function of stormwater conveyance, detention, and water quality facilities through regular inspections, cleaning, mowing, repair and replacement activities, and street sweeping. Inspections and repairs are tracked using the City's asset management system, Cartegraph.
- Complaint Response. The City's SWM Program is responsible for responding to drainage concerns through maintenance referrals or requests submitted by residents on <yourgov.cartegraph.com>. Depending on the nature and magnitude of the problem, City staff either addresses it internally or calls for assistance from outside agencies or contractors.
- Education & Outreach Programs effectively enlist community members to help the City achieve its water quality and stormwater management objectives. The City regularly shares written material to foster the public's understanding of stormwater.
- Public Participation Programs include opportunities to volunteer and participate on City Commissions; with an open agenda for each City Council meeting, the public is encouraged to engage with staff and elected officials. Public participation is key to shaping the City's stormwater management program.

- IDDE & Spill Response Program. The elements that comprise the IDDE & Spill Response Program are part of the City's NPDES Permit requirements. The City is actively engaged in regular IDDE inspections, as well as providing public outreach opportunities for IDDE and spill prevention and preparedness. This program is designed to educate the public and eventually cultivate a broader understanding of how the public can help improve water quality in nearby streams and lakes by employing best management practices (BMPs), and reporting spills to the City and to Ecology. The SWM Division has a spill-reporting hot-line, and is trained to respond to spills along with Ecology and other agencies as needed.
- Construction Site Runoff Program. This program includes stormwater development review, pre-construction meetings, and erosion control inspections. Enforcement of the City's construction site runoff program is also the responsibility of SWM. Sediment-laden runoff from construction sites can cause damage to streams and lakes as well as clogging stormwater infrastructure. The Construction Site Runoff Program also includes coordinating and conducting inspections of privately maintained stormwater systems. The program includes the incorporation of LID into City codes, development, and enforcement.
- SWM CIP. SWM implements a CIP program intended to reduce flooding risk, improve water quality, and preserve habitat. Many practices and technologies have been developed that help reduce stormwater runoff volumes, safely convey stormwater to natural water bodies, prevent pollutants from collecting in stormwater, and remove the pollutants entrained in stormwater. SWM is also responsible for implementing such practices and technologies, and incorporating them into each SWM program as necessary to address stormwater-related issues throughout the City.

1.3.5 Organization & Staffing

The City's Public Works Department is organized into three major divisions, including SWM, Engineering, and Maintenance. SWM is responsible for NPDES Permit compliance, surface and stormwater system operations and maintenance, SWM CIP, and other programs described in section 1.3.4. SWM is administered by 1 Full Time Equivalent (FTE), the Surface Water Program Manager, who is responsible for NPDES Permit implementation, organizing and implementing CIP, and helping SWM maintenance staff prioritize their activities.

SWM currently has a 0.5 FTE SWM Inspector that is responsible for inspecting City owned and/or maintained stormwater infrastructure, including catch basins, flow control facilities, and water quality facilities or treatment systems. The SWM Inspector is also responsible for inspecting Temporary Erosion Sediment Control (TESC) measures on construction sites, newly built stormwater infrastructure, and privately maintained stormwater systems.

The City's SWM Maintenance Technicians are responsible for cleaning and maintaining the City's built infrastructure components including catch basins, tanks, vaults, pipes, ditches, detention ponds, culverts, and water quality facilities. SWM Maintenance also responds to small capital improvement needs like catch basin repairs, curb inlet adjustments, and spot repairs to pipe networks, as well as spill response. These ongoing and regular programs are implemented with 2 FTE staff personnel, as well as support for scheduling and prioritization from the Maintenance Infrastructure Manager.

SWM is also supported by the Public Works Director, seasonal employees, and an intern. Drainage review of proposed development applications is another component of SWM, and an integral part of land development activities and regulatory implementation that includes LID principles and NDPES Permit requirements. These duties are in part supported by application fees and are the responsibility of the Community Development Department.

1.3.6 Applicable Policies and Regulations

The purpose of the City's 2017 Comprehensive Plan is to provide a comprehensive statement of City goals and policies to focus, direct and coordinate the efforts of the departments within the City government. The Comprehensive Plan covers all City departments and divisions, whereas this Comprehensive Stormwater Management Plan Update is specific to the SWM division. The Comprehensive Plan is a basic source of reference for officials as they consider enactment of ordinances or regulations affecting the community's physical and economic development. The Comprehensive Plan has several elements, each with a goal and several policies that are designed to help achieve the goals. The excerpts below are a partial list of policies that apply to the SWM Division and its programs.

Land Use Goals

LU-G8 The City should strive to preserve and enhance the natural environment, including air quality, water resources, natural features that contribute to the City's scenic beauty, and critical areas as defined by the Growth Management Act.

LU-G9 The City should, through the use of Best Available Science and the application of Best Management Practices, manage the natural and built environments to preserve, enhance and sustain environmental quality while minimizing public and private costs.

LU-G10 The City should promote community-wide stewardship of the natural environment to preserve environmental quality for future generations.

LU-G11 The City should protect and enhance habitat that contributes to the maintenance and restoration of threatened or endangered species.

Land Use Water Resource Policies

LU-P49 Development in the City shall utilize surface water management in a manner that supports the continued ecological and hydrologic functioning of water resources and avoids significant adverse impacts on water quality and quantity for both the City and nearby jurisdictions.

LU-P53 The City shall protect groundwater recharge quantity by promoting infiltration where site conditions permit and where potential groundwater contamination can be avoided through pollution source controls and stormwater pretreatment.

LU-P59 Hardening and armoring of stream banks shall be avoided unless necessary for the protection of existing legal structures that are subject to imminent threat of damage and where no reasonable alternative measures with lesser impacts on habitats are available. The City shall encourage the use of vegetation for stream bank stabilization.

LU-P60 The City shall protect Lake Boren through management of its watershed and associated shoreline habitats, including control of nutrients that stimulate algae growth and aquatic plant growth.

Floodplain Policies

LU-P73 The existing hydraulic (flood storage and conveyance) and ecological functions of floodplains shall be protected, and where possible, enhanced or restored.

LU-P74 The City floodplain land use and floodplain management activities shall be carried out in accordance with the King County Flood Hazard Reduction Plan or its successor.

Storm and Surface Water Policies

CF-P16 The City shall encourage concurrent installations of storm water and surface water facilities in order to minimize construction-related disruptions to the public and to minimize the costs of system deliveries.

CF-P17 The City shall require surface water conveyance systems in all new development, including transportation facilities.

CF-P18 The City shall require surface water conveyance systems so as to contain and convey storm water and surface water out of the City.

CF-P19 The City should update, as needed, its storm water and flood hazard regulations and programs.

CF-P20 The City shall implement procedures to ensure that public and private stormwater collection, retention/detention, and treatment systems are properly maintained.

1.4 Surface Water Capital Improvement Plan

The Surface Water CIP was developed by identifying City drainage issues brought forward by City staff, public input, and from system modeling. Projects were identified and ranked through the City's CIP process. Details of the CIP can be found in Chapter 4.

1.5 Public Involvement Conducted for this Plan

As part of the 2017 CSWM Plan development, the City advertised their plans to update the CSWM Plan on its website and in the December 2, 2016 edition of the Newcastle News. The half-page article (see Figure 1-4) announced the City's intention to update its CSWM Plan, explained the public's role in helping the City adopt policies, develop maintenance schedules, and prioritize capital improvement projects. The public was also invited to participate in a "drainage problem" survey to alert the City of drainage problems like water quality issues, flooding and other issues related to stormwater in the City. The survey, made available on the City's website, described in the newspaper, was open for public input for 4 weeks. Businesses and residents were invited to provide detailed information on drainage problems that could be considered in the updated CSWM Plan.

Additional opportunities for the public to provide the City with input regarding future SWM programs and projects took place during the City Council adoption process of the 2017 CSWM Plan update.

NEWCASTLE NEWS FRIDAY, DECEMBER 2, 2016 • 9

SPONSORED STORY

The City Wants Your Input on Our New Surface Water Plan

More rain fell in our area during October this year than any other year on record, which means we saw an unusual amount of stormwater runoff. When rain flows across impervious surfaces like rooftops, pavement and sidewalks, it picks up sediment and pollutants before it flows into our stormwater system (a network of catch basins, pipes, detention tanks, vaults, and ponds) and into our natural waterways.

Stormwater runoff has a big impact on Newcastle's streets, neighborhoods, businesses and the natural environment because it can degrade water quality and cause flooding. The City of Newcastle wants to hear from you about how stormwater has impacted your area of the city. Your input will help us improve the way we manage stormwater and surface water in our efforts to reduce flooding and improve our natural waterways.

The city has started the process of updating its comprehensive plan for managing surface water. This plan is an essential tool and your input is necessary for identifying surface water challenges and creating successful, adaptive solutions. A survey is now available at https://tinyurl.com/hhaewfz for you to provide your feedback on:

- **Drainage or flooding concerns around your property, street, or neighborhood**
- **Concerns about water quality in any of our natural waterways**
- **Questions about riparian or aquatic habitat, or critical areas within the city**
- **Ideas or feedback on surface water public education and outreach efforts**
- **Input for storm or surface water program improvements**

Newcastle's Comprehensive Surface Water Management Plan sets a framework for policies, maintenance schedules and surface water capital improvement projects. It includes program goals, and guidance on maintenance action items and operations, development review and inspections, surface water capital improvement programs, education/outreach programs, as well as regional coordination efforts.

With your participation and partnerships with other governmental agencies, the city can enhance its Surface Water Management Program. Together we can continue to improve both Newcastle's built environment and the water quality within our drainage basins. In an effort to increase our public outreach and participation efforts, we're in the process of scheduling an Open House early next year for additonal input on the Comprehensive Surface Water Management Plan. In the meantime, please give us your feedback by filling out the survey, or contact Audrie Starsy, the city's Surface Water Program Manager at Audries@ci.newcastle.wa.us or (425) 649-4444 ext. 111.

Survey now available at https://tinyurl.com/hhaewfz

Survey ends Dec. 31st, 2016.

Figure 1-4. Reduced-Size Copy of Newcastle News Announcement

Chapter 2 Background

Chapter 2 describes the City's built stormwater system components, as well as watersheds and natural drainage systems within the City. A general description of land use in the City's drainage basins includes: topography, soils, major water features, drainage paths, and major stormwater facilities.

The three major watersheds within the City were characterized/evaluated using a Rapid Stream Assessment Technique (RSAT) to evaluate general stream quality conditions for habitat, erosion, and stream stability.

For Lake Boren, the City's only main large water body, water quality information collected and maintained by King County was included in this review as well.

2.1 Built Stormwater Assets

Figure 2-1. Example of Built Stormwater Asset

Built stormwater assets are the man-made components of a drainage system. They include the intricate system of catch basins, maintenance holes, pipes, ditches, flow control and water quality facilities that collect and convey stormwater runoff from built surfaces like roads and parking lots to receiving waters. Property boundary lines determine asset ownership. Built drainage assets located in the public right-of-way, on City-owned property or on private property where drainage easements dedicate the assets to the City are the City's responsibility for maintenance and eventual replacement. Drainage assets located on private property are the responsibility of the property owner. NMC states that drainage assets that service 2 or more private residential properties are the City's responsibilities; those assets are dedicated to the City in drainage easements. Drainage assets on commercial property are the responsibility of the property owner. Collectively, the publicly and privately owned drainage assets function to provide drainage for the City.

Stormwater assets that are owned and/or maintained by the City are tracked in Cartegraph, a geo-referenced asset management system that identifies the asset class, installation date, location, and other components. Cartegraph also tracks the inspection and maintenance tasks per asset, associated resources, and condition indicators.

Table 2-1 summarizes the City's built stormwater assets, determined from the City's GIS database system.

Table 2-1. Built Stormwater Assets

Facility Type	Number
Detention ponds	47
Detention vaults	43
Detention tanks (enlarged pipes with flow control)	48
Sand filters	2
Infiltration Facility	1
Storm Filter Systems	10
Catch Basins	3,259
Green Stormwater Infrastructure	26

Table 2-2 is a list of storm drainage pipe lengths by diameter class in the City.

Table 2-2. Storm Drainage Pipe Length by Diameter Class

Pipe Diameter	Length (feet)
<12"	9,309
12”-24”	122,054
24"-36"	7,272
36"-48"	3,204
>48"	207
Not Recorded	121,994
Total	264,040

Figure 2-2 is a map showing the City’s built assets.

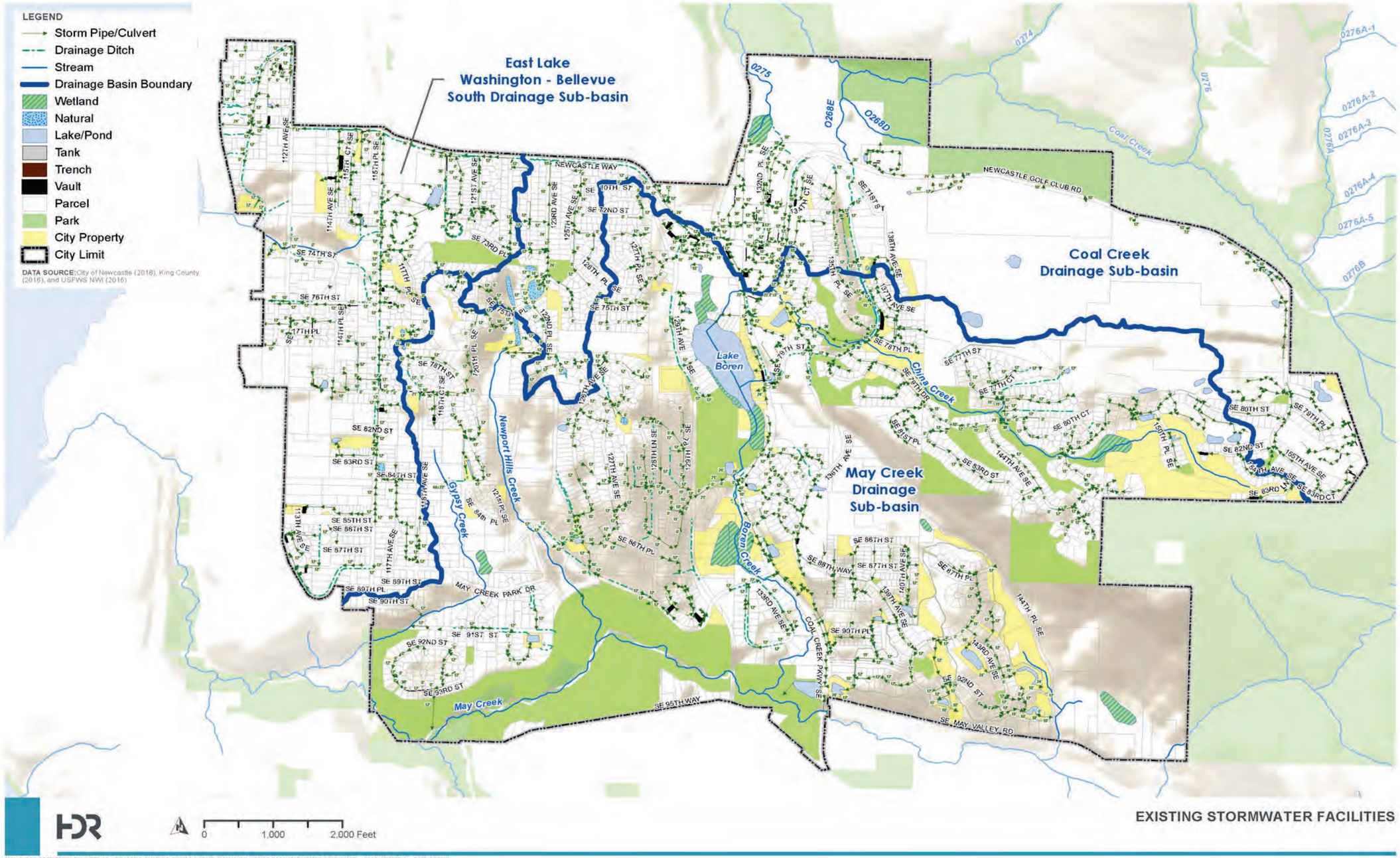


Figure 2-2. Stormwater Facility Map

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2.2 Characteristics of the Study Area

The City lies within portions of three major watersheds. The Coal Creek basin makes up the northeastern portion of the City, covering 24% of the City's land area. The East Lake Washington basin makes up the west portion of the City, covering 16% of the City's land area. The largest drainage basin is May Creek, which makes up the remainder of the City, covering 60% of the City's land area. The May Creek basin is composed of four primary subbasins: China Creek/Lake Boren, Boren Creek, Newport Hills Creek, and Gypsy Creek. Refer back to Figure 2-2 for a map of the City's drainage basins.

Land use in the City is predominantly residential or in the case of the Coal Creek basin, Open Space/Parks. Land use distribution for Newcastle is documented in Table 2-3.

Table 2-3. Land Use Categories by Basin

Land Use	May Creek		East Lake Washington		Coal Creek	
	Acres	Percent of Total	Acres	Percent of Total	Acres	Percent of Total
Commercial	2.70	0.2	1.00	0.2	15.30	2.3
General Mixed Use	19.00	1.1	0.00	0.0	20.70	3.1
Multi-family Residential	18.20	1.1	4.40	1.0	22.70	3.4
Office	4.40	0.3	0.00	0.0	1.10	0.2
Park/Trail/Open Space/Golf	260.20	15.1	0.00	0.0	315.20	46.9
Right-of-Way (ROW)	171.60	9.9	62.40	13.6	51.80	7.7
Single Family residential	1249.30	72.4	390.10	85.2	193.20	28.8
Mixed Use, Commercial, Residential	0.00	0.0	0.00	0.0	51.40	7.7
Total	**1725.40**	**100**	**457.90**	**100**	**671.40**	**100**

Note: Calculations based on 2016 GIS data.

2.2.1 May Creek

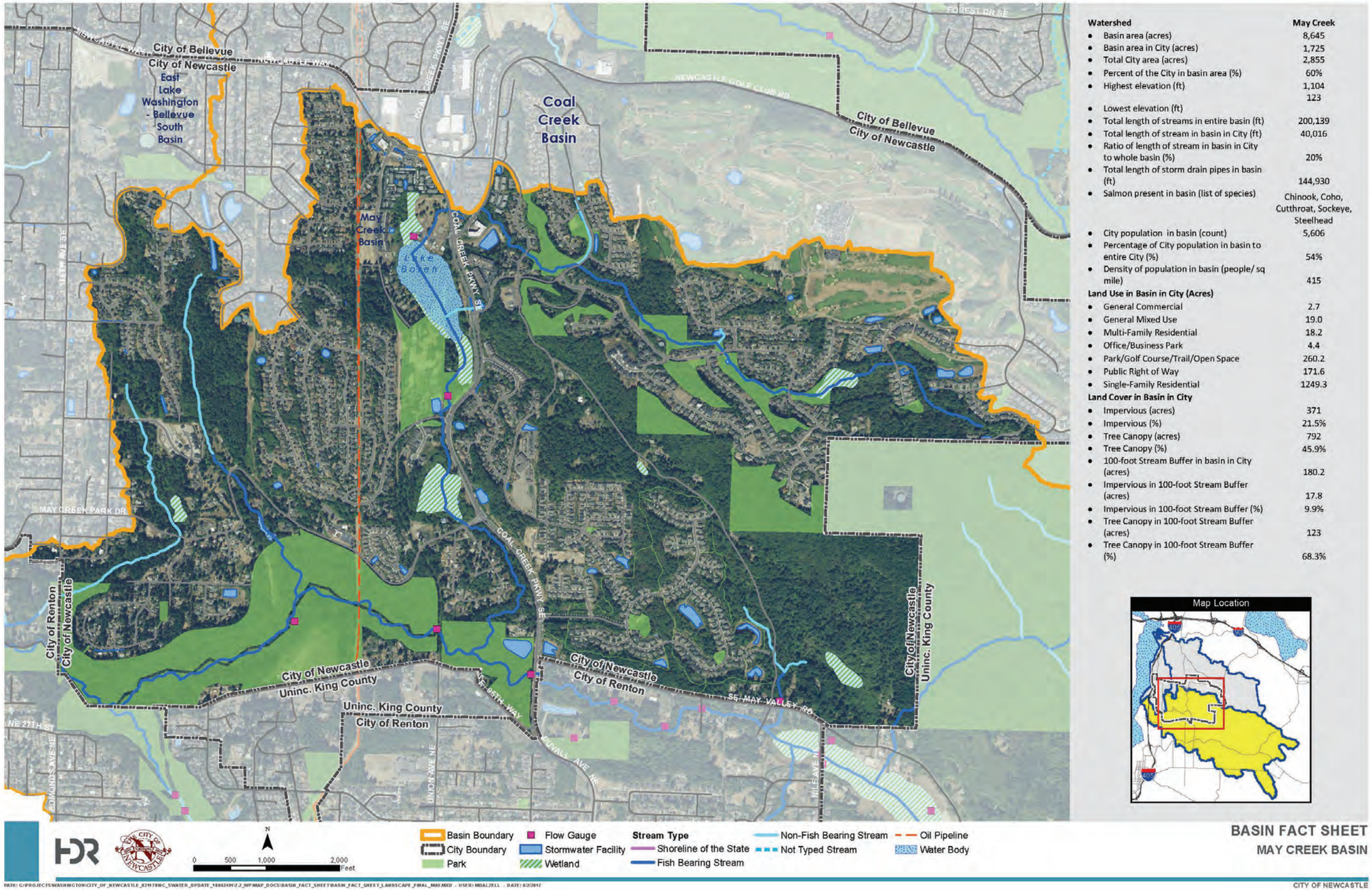
The May Creek drainage basin is 8,645 acres and drains portions of Newcastle, Renton, and unincorporated King County, as shown in Figure 2-3. May Creek is a tributary to Lake Washington and provides habitat for anadromous fish, some of which are listed as a threatened species. Approximately 1,724 acres, or 20% of the total basin area, are within the Newcastle city limits. Within the city limits, May Creek receives flow from Lake Boren, Newport Hills Creek, Gypsy Creek, and several unnamed tributaries.

Most of the tributaries of May Creek have intact forested canopies along the streams. Newer residential homes are built in the upper ridge-tops. Lake Boren, a 15 acre lake, is the major drainage feature in the basin. Key land use features that influence stormwater runoff quantities and quality are:

- Impervious area: Impervious areas that affect how much stormwater runoff occurs includes roadways, rooftops, driveways, and parking lots. In total, there are 371 acres of impervious

area; this is about 21.5% of the total land area. Impervious area has a direct relationship to peak runoff flow rates; the greater the value, the higher and flashier the stream flows.

- Tree canopy: Forty-six percent (46%) of the May Creek basin is covered by tree canopy. An intact tree canopy is indicative of watershed health because trees intercept and store precipitation on their leaves and branches and uptake moisture stored in soil. These biological processes have inherent benefits to stream ecology because they reduce peak flows that otherwise flow to streams.
- Tree canopy within 100 feet of stream: Sixty-eight percent (68%) of the land area within 100 feet of May Creek and its tributaries have an intact tree canopy. This metric is important because a tree canopy directly adjacent to a stream offers shade, habitat for insects, and filtration of runoff en route to the stream.



Watershed	May Creek
• Basin area (acres)	8,645
• Basin area in City (acres)	1,725
• Total City area (acres)	2,855
• Percent of the City in basin area (%)	60%
• Highest elevation (ft)	1,104
• Lowest elevation (ft)	123
• Total length of streams in entire basin (ft)	200,139
• Total length of stream in basin in City (ft)	40,016
• Ratio of length of stream in basin in City to whole basin (%)	20%
• Total length of storm drain pipes in basin (ft)	144,930
• Salmon present in basin (list of species)	Chinook, Coho, Cutthroat, Sockeye, Steelhead
• City population in basin (count)	5,606
• Percentage of City population in basin to entire City (%)	54%
• Density of population in basin (people/ sq mile)	415
Land Use in Basin in City (Acres)	
• General Commercial	2.7
• General Mixed Use	19.0
• Multi-Family Residential	18.2
• Office/Business Park	4.4
• Park/Golf Course/Trail/Open Space	260.2
• Public Right of Way	171.6
• Single-Family Residential	1249.3
Land Cover in Basin in City	
• Impervious (acres)	371
• Impervious (%)	21.5%
• Tree Canopy (acres)	792
• Tree Canopy (%)	45.9%
• 100-foot Stream Buffer in basin in City (acres)	180.2
• Impervious in 100-foot Stream Buffer (acres)	17.8
• Impervious in 100-foot Stream Buffer (%)	9.9%
• Tree Canopy in 100-foot Stream Buffer (acres)	123
• Tree Canopy in 100-foot Stream Buffer (%)	68.3%

Figure 2-3. May Creek Drainage Basin and Land Use Information

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2.2.2 East Lake Washington

The East Lake Washington drainage basin is approximately 1,345 acres and is made up of areas from Newcastle, Bellevue, Renton, and unincorporated King County, see Figure 2-4. Of the 1,354 acres, 458 acres lies within the City. Stormwater within Newcastle is collected and conveyed through its stormwater system, ultimately discharging to Lake Washington. There is only one stream present in the East Lake Washington drainage basin, and it includes no known salmon species and does not provide habitat for anadromous fish.

Predominant land use in the East Lake Washington drainage basin is single-family residential and public right-of-way. Key land use features that influence stormwater runoff quantities and quality are:

- Impervious area: There are approximately 124 acres of impervious area within the drainage basin, making up 27% of the total area. Impervious area has a direct relationship to peak runoff flow rates; as the impervious area increases, stream flows become higher and flashier.
- Tree canopy: Approximately 42% of the basin is covered by tree canopy. An intact tree canopy is indicative of watershed health because trees intercept and store precipitation on their leaves and branches and uptake moisture stored in soil. These biological processes have inherent benefits to stream ecology because they reduce peak flows that otherwise flow to streams.
- Tree canopy within 100 feet of stream: Approximately 60% of the land area within 100 feet of any streams has an intact tree canopy. This metric is important because a tree canopy directly adjacent to a stream offers shade, habitat for insects, and filtration of runoff en route to the stream.

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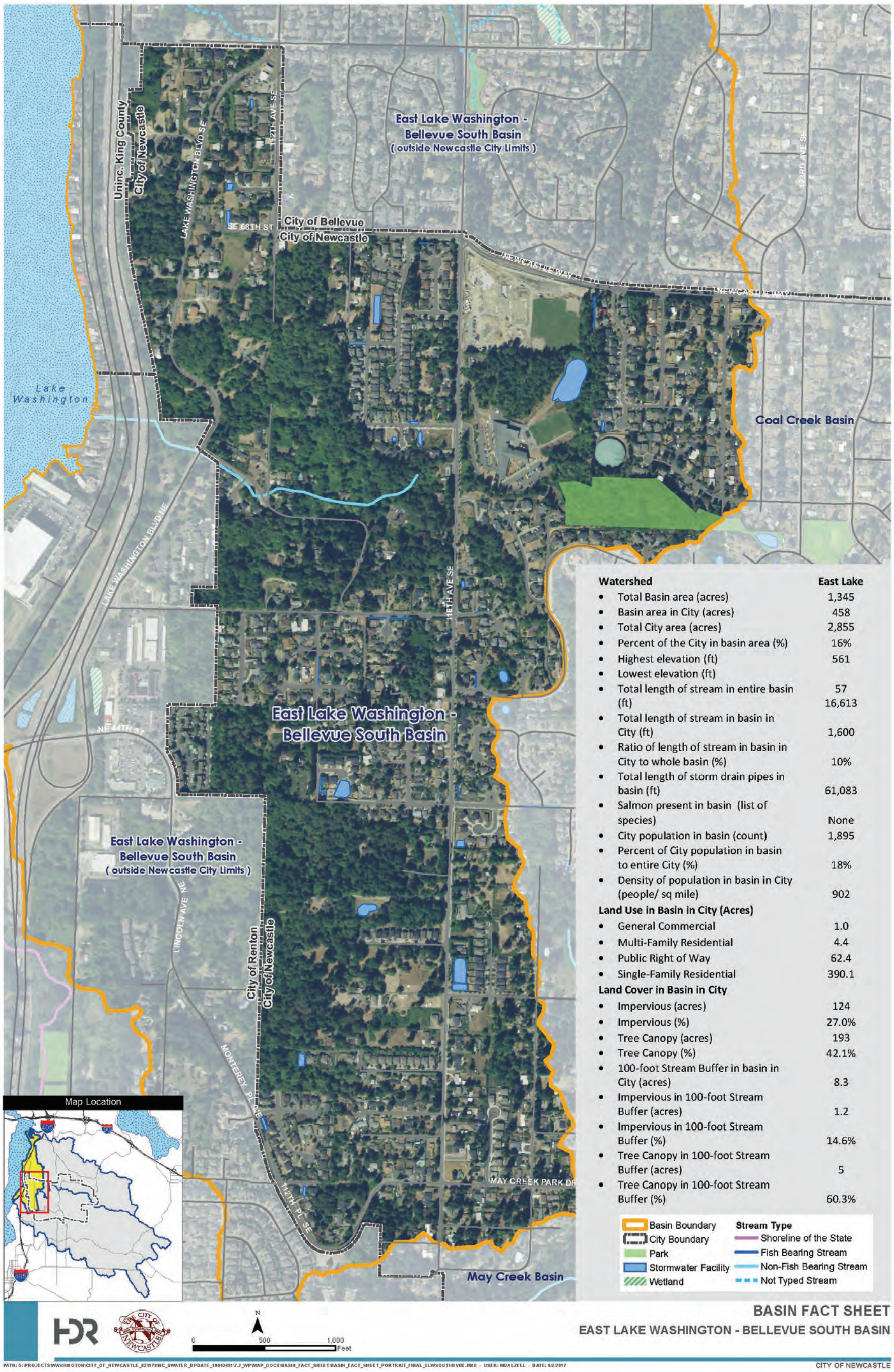

Watershed	East Lake
• Total Basin area (acres)	1,345
• Basin area in City (acres)	458
• Total City area (acres)	2,855
• Percent of the City in basin area (%)	16%
• Highest elevation (ft)	561
• Lowest elevation (ft)	57
• Total length of stream in entire basin (ft)	16,613
• Total length of stream in basin in City (ft)	1,600
• Ratio of length of stream in basin in City to whole basin (%)	10%
• Total length of storm drain pipes in basin (ft)	61,083
• Salmon present in basin (list of species)	None
• City population in basin (count)	1,895
• Percent of City population in basin to entire City (%)	18%
• Density of population in basin in City (people/ sq mile)	902
Land Use in Basin in City (Acres)	
• General Commercial	1.0
• Multi-Family Residential	4.4
• Public Right of Way	62.4
• Single-Family Residential	390.1
Land Cover in Basin in City	
• Impervious (acres)	124
• Impervious (%)	27.0%
• Tree Canopy (acres)	193
• Tree Canopy (%)	42.1%
• 100-foot Stream Buffer in basin in City (acres)	8.3
• Impervious in 100-foot Stream Buffer (acres)	1.2
• Impervious in 100-foot Stream Buffer (%)	14.6%
• Tree Canopy in 100-foot Stream Buffer (acres)	5
• Tree Canopy in 100-foot Stream Buffer (%)	60.3%

Basin Boundary
City Boundary
Park
Stormwater Facility
Wetland

Stream Type
Shoreline of the State
Fish Bearing Stream
Non-Fish Bearing Stream
Not Typed Stream

Figure 2-4. East Lake Washington Basin Fact Sheet

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2.2.3 Coal Creek

The Coal Creek drainage basin is approximately 4,477 acres, and is comprised of areas from Newcastle, Bellevue, and unincorporated King County, see Figure 2-5. Approximately 671 acres of this area lies within the City limits. A portion of Coal Creek, a fish bearing stream, flows through the Coal Creek basin. This stream provides habitat to salmon species including Chinook, Coho, Cutthroat, Sockeye, and Steelhead. Within the City limits, Coal Creek receives flow from a non-fish bearing unnamed tributary and the creek ultimately discharges to Lake Washington.

Land use in the Coal Creek basin is predominately park/golf course/trail/open space. Other large land use areas include single-family residential, mixed use commercial/residential, and public right-of-way. Key land use features that influence stormwater runoff quantities and quality are:

- Impervious area: There are approximately 174 acres of impervious area within the drainage basin, making up 26% of the total area. Impervious area has a direct relationship to peak runoff flow rates; as the impervious area increases, stream flows become higher and flashier.
- Tree canopy: Approximately 26% of the basin is covered by tree canopy. An intact tree canopy is indicative of watershed health because trees intercept and store precipitation on their leaves and branches and uptake moisture stored in soil. These biological processes have inherent benefits to stream ecology because they reduce peak flows that otherwise flow to streams.
- Tree canopy within 100 feet of Coal Creek: There are approximately 29 acres of land adjacent to Coal Creek with an intact canopy. This metric is important because a tree canopy directly adjacent to a stream offers shade, habitat for insects, and filtration of runoff en route to the stream.

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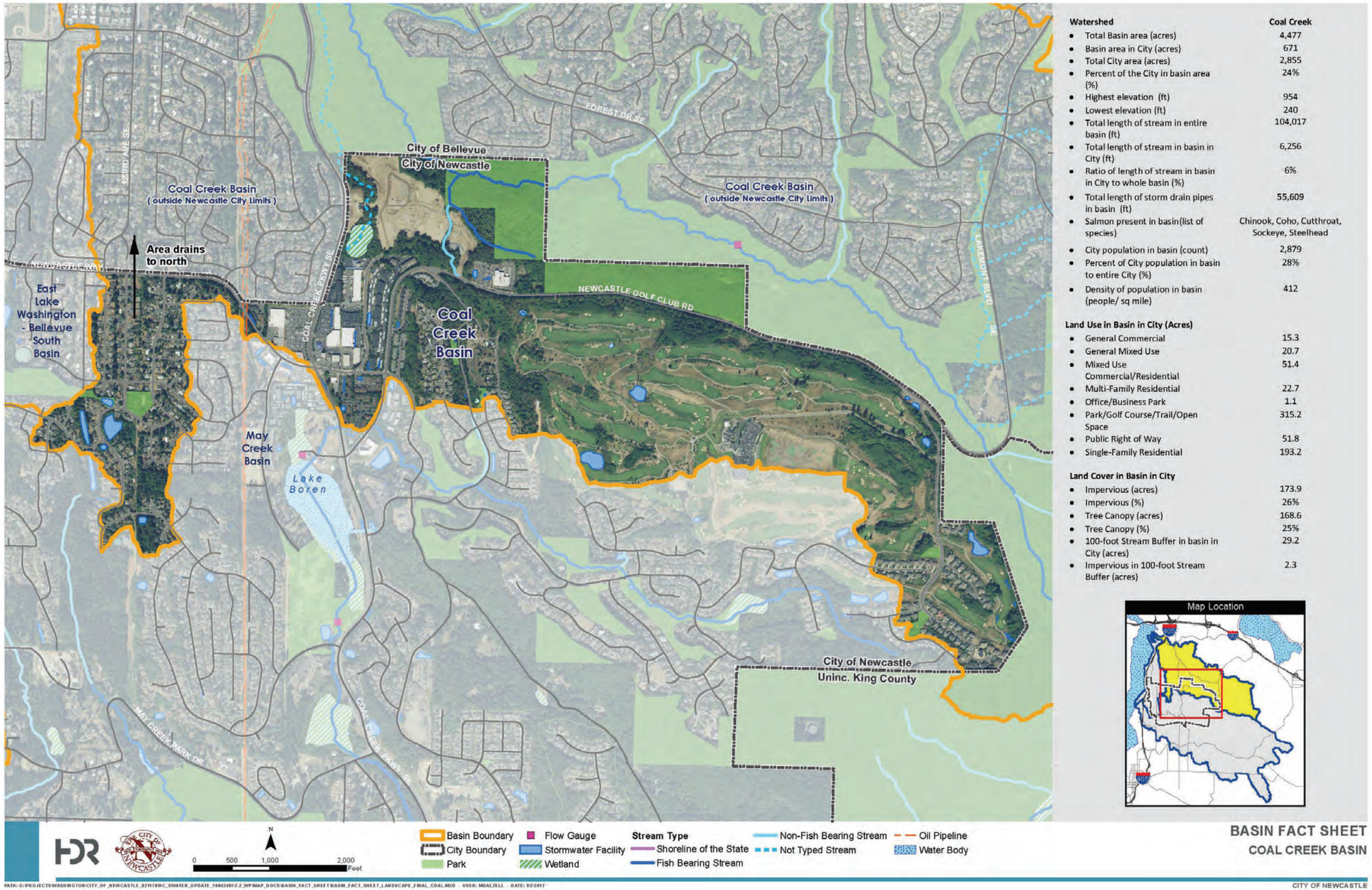

Watershed	Coal Creek
• Total Basin area (acres)	4,477
• Basin area in City (acres)	671
• Total City area (acres)	2,855
• Percent of the City in basin area (%)	24%
• Highest elevation (ft)	954
• Lowest elevation (ft)	240
• Total length of stream in entire basin (ft)	104,017
• Total length of stream in basin in City (ft)	6,256
• Ratio of length of stream in basin in City to whole basin (%)	6%
• Total length of storm drain pipes in basin (ft)	55,609
• Salmon present in basin(list of species)	Chinook, Coho, Cutthroat, Sockeye, Steelhead
• City population in basin (count)	2,879
• Percent of City population in basin to entire City (%)	28%
• Density of population in basin (people/ sq mile)	412
Land Use in Basin in City (Acres)	
• General Commercial	15.3
• General Mixed Use	20.7
• Mixed Use Commercial/Residential	51.4
• Multi-Family Residential	22.7
• Office/Business Park	1.1
• Park/Golf Course/Trail/Open Space	315.2
• Public Right of Way	51.8
• Single-Family Residential	193.2
Land Cover in Basin in City	
• Impervious (acres)	173.9
• Impervious (%)	26%
• Tree Canopy (acres)	168.6
• Tree Canopy (%)	25%
• 100-foot Stream Buffer in basin in City (acres)	29.2
• Impervious in 100-foot Stream Buffer (acres)	2.3

Figure 2-5. Coal Creek Basin Fact Sheet

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2.2.4 Lake Boren

Lake Boren, shown in Figure 2-6, is a central surface water feature in the City located in the May Creek basin. Upstream, 660 acres comprised primarily of residential homes drain toward the lake. The lake's outlet is located on its south shore and flows to May Creek via Boren Creek. Lake Boren has a surface area of 15 acres, is 34 feet at its deepest point (mean depth of 18 feet), and has been the subject of volunteer water quality monitoring since the 1980s. Documented water quality monitoring data for water clarity (Secchi disk measurement) and temperature data are kept at King County:

Figure 2-6. Lake Boren

(http://green2.kingcounty.gov/smalllakes/LakePage.aspx#WaterQualityData).

As described on King County's Lake Management stewardship web site, Lake Boren is lightly colored, moderately buffered against pH change, and mid-range in primary productivity (mesotrophic) with good water quality that appears stable. Total nitrogen appears to be increasing over time. Thermal stratification is stable in the summer, and sediments release some phosphorus to deep water, where ammonia build-up signals low oxygen. Nitrogen to phosphorus ratios often fall below 25:1 in late summer, which can favor cyanobacterial growth. No toxic strains have been identified to date.

Lakes are classified and evaluated according to their trophic state. Trophic means nutrition or growth and there are three categories: 1) well-nourished (eutrophic) is a lake with high nutrient loads and high plant growth; 2) oligotrophic lakes have low nutrient concentrations and low plant growth; and 3) mesotrophic lakes fall somewhere in between eutrophic and oligotrophic lakes. While lakes may be categorized into a few trophic classes, each lake has a unique set of attributes that contribute to its trophic status. Three main factors regulate the trophic state of a lake:

1. Rate of nutrient supply. Upland watershed inputs from septic systems, fertilizer, and other inputs from runoff entering a lake contribute to this factor.
2. Climate. Air temperatures, precipitation, and wind affect a lake's trophic state.
3. Shape of the lake basin. Physical features such as shape, depth, and water clarity contribute to a lake's mixing and turn-over rates that affect trophic states.

Lake Boren's trophic status is considered mesotrophic (see Figure 2-7).

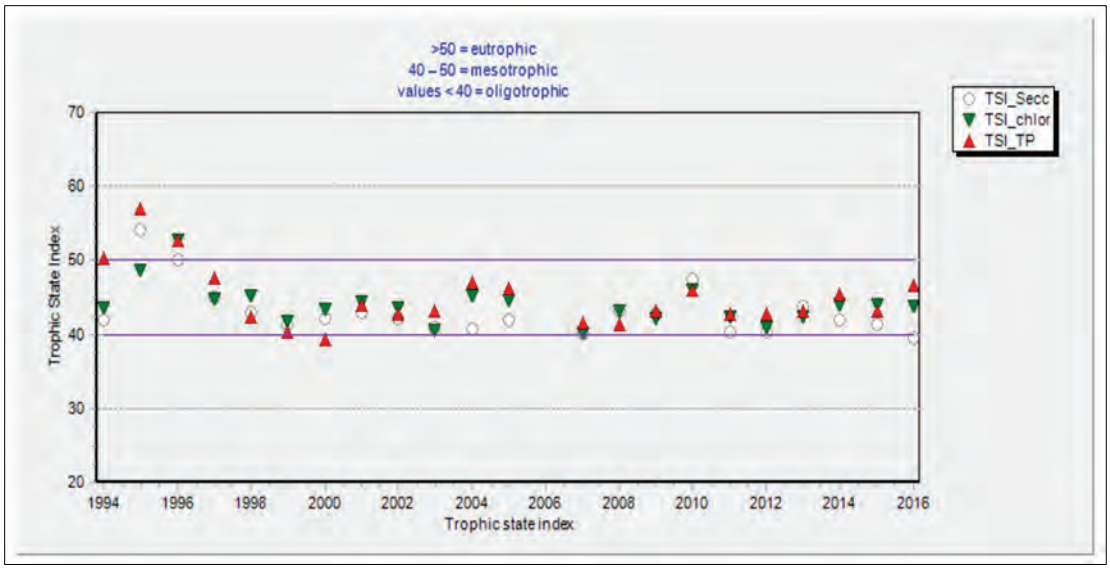

Figure 2-7. Lake Boren Trophic State

Lake Boren's trophic state is comprised of three water quality data sets, Secchi disk transparency, chlorophyll-a, and total Phosphorus concentrations.

The Secchi disk is an eight-inch diameter disk painted black and white in alternating quarters. It is attached to a fiberglass measuring tape marked in tenths of feet. The disk is lowered into the water column until it can no longer be seen, at which point the depth measurement is recorded. The deeper the disk, the clearer the water.

Chlorophyll-a is the photosynthetic pigment that causes the green color in algae and plants. The concentration of chlorophyll-a present in the water is directly related to the amount of algae living in the water. Excessive concentrations of algae give lakes an undesirable "pea soup" appearance and eventually depletes the water of dissolved oxygen after the plants die and begin to decompose. The water quality characteristics of a lake largely determine which types of algae will be present. Lakes with high nutrient enrichment will tend to support larger numbers of algae than lakes with low nutrient enrichment. Other factors such as water temperature, depth, pH, and alkalinity also influence the species and numbers of algae found in a lake.

Phosphorus is often the key nutrient in determining the amount of phytoplankton (algae) in a lake. In comparison to other nutrients, phosphorus is usually the first element to limit biological productivity. The determination of total phosphorus is a measure of all forms of phosphorus potentially available to algae. Phosphorus enters a lake from rainfall, incoming streams, overland runoff, groundwater, and direct discharges. Phosphorus is contributed to a lake by human activity in the watershed, direct discharge of wastes, runoff from agriculture, or poorly maintained septic systems.

2.3 Stream Assessment

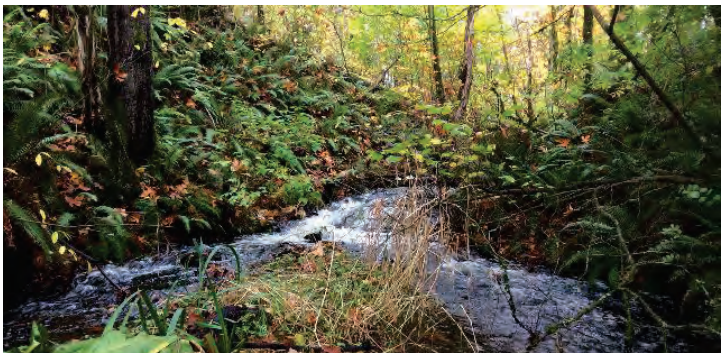

Figure 2-8. Urban Stream Example: China Creek

Urban streams can exhibit physical characteristics such as over-steepened banks, head-cuts, and unusually large sediment deposits that indicate physical responses to urbanization. Figure 2-8 provides a photograph of an urban stream in the City of Newcastle. In support of developing a comprehensive understanding of the City's drainage system, HDR conducted visual inspections of two different stream corridors within the city limits to assess their condition and stability using a RSAT to supplement the visual assessment. Appendix A.1 provides a summary description of the RSAT methodology. A third stream corridor in the Landcastle Area was also assessed in support of hydrologic and hydraulic modeling efforts. Because it was the subject of a detailed survey and analysis, the generalized RSAT assessment was not applied. RSAT employs an integrated numerical scoring and verbal ranking approach to assess stream stability. Overall stream quality is evaluated based on the following six categories and uses a 0 to 50 point scoring system to rank the overall quality of the stream. A higher score indicates a higher stream quality condition. The following categories are considered in the evaluation:

1. Channel Stability: Indicative of hydrologic flow regime alteration and physical aquatic habitat. Provides insight into past, present, and future changes in channel morphology. Look for:
    - Evidence of bank sloughing, slumping or failure
    - Outer-bank heights greater than 2 feet above stream channel
    - Exposed tree roots
    - Erodible material, plant/soil matrix in lower 1/3 of bank
    - Natural U- or V-shaped channel cross-sections.
2. Channel Scouring/Sediment Deposition: Relates to level of uncontrolled stormwater runoff, sediment load and transport and degradation of instream habitat. Look for:
    - Riffle embeddedness of sand and silt
    - Number of pools
    - Streambank streak marks and /or banana-shaped sediment deposit
    - Fresh, large sand deposits in channel
    - Point bars
3. Physical Instream Habitat: Relates to the ability of a stream to meet basic physical requirements necessary for the support of a well-balanced aquatic community (e.g., depth of flow, water-velocity, water temperature, substrate type and quality). Look for:
    - Wetted perimeter
    - Riffles, runs, and pool habitat distribution
    - Substrate composition (mix of cobble, gravel, rubble and sand)
    - Channel alterations

- Water temperatures

4. Water Quality: Indicative of watershed perturbations and general level of human activity, point and non-point sources of pollution loading. Look for:
   - Substrate fouling – cobble sized stones lying free on streambed, coated with a biological film or growth
   - Water clarity
   - Odor
5. Riparian Habitat Conditions: Provides insight into changes in stream energetics, temperature regime, and both aquatic and terrestrial habitat conditions. Look for:
   - Mature forested buffer and overhead canopy
6. Biological Indicators (macro-invertebrates): Best overall indication of stream health and level of watershed perturbation. This metric was not explicitly evaluated during the stream assessments in Newcastle; however, King County conducts a regional sampling program that includes one monitoring station in May Creek. Typical of many urban streams in western Washington, Benthic Index of Biological Integrity (B-IBI)[2] scores in May Creek are considered fair (http://www.kingcounty.gov/services/environment/data-and-trends/monitoring-data/stream-bugs/stream-data.aspx).

Table 2-4 summarizes the overall stream quality ranking point ranges. Channel Stability was weighed slightly more heavily than the other five categories to reflect the major influence that the stream flow regime exerts on all six evaluation categories.

Table 2-4. RSAT Categories and Score Range Definitions

RSAT Evaluation Category	Verbal Rating Categories and Associated Point Ranges			
	Excellent	Good	Fair	Poor
Channel Stability	9-11	6-8	3-5	0-2
Scouring/Deposition	7-8	5-6	3-4	0-2
Physical Instream Habitat	7-8	5-6	3-4	0-2
Water Quality	7-8	5-6	3-4	0-2
Riparian Habitat	7-8	5-6	3-4	0-2
Biological Indicators	7-8	5-6	3-4	0-2
Total	**42-50**	**30-41**	**16-29**	**<16**

[2] B-IBI: An Index of Biological Integrity (IBI) is a synthesis of diverse biological information which numerically depicts associations between human influence and biological attributes. It is composed of several biological attributes or 'metrics' that are sensitive to changes in biological integrity caused by human activities. The multi-metric (a compilation of metrics) approach compares what is found at a monitoring site to what is expected using a regional baseline condition that reflects little or no human impact (Karr 1996b). Multi-metric biological indexes include the following benthic macroinvertebrate information:
- Pollution tolerance/intolerance taxa
- Taxonomic composition (number and abundance of taxa)
- Population attributes (e.g., number of predators)

2.3.1 China Creek

Figure 2-9. Falls along China Creek

The China Creek stream assessment extended from the upstream end of the Coal Creek Parkway culvert upstream to 144th Place SE, a distance of approximately 5,000 feet. Figure 2-9 shows the stunning natural features in the creek, and Figures 2-10 through 2-12 detail the stream survey locations. China Creek can be characterized as having an urbanized residential watershed, developed in the late 1980s and 1990s after stormwater regulations were implemented. Several flow control detention ponds and an intact overhead forest canopy contribute to the Good to Excellent RSAT scores. Eight (8) RSAT assessments were completed in the reach with a total scoring range of 21-37 RSAT points. The site with the lowest score, located on a developed lot near Coal Creek Parkway, exhibited vertical stream banks that appeared to be a source of sediment and had signs of active erosion. RSAT scores for water quality were uniformly scored with a good rating at each site as no obvious signs of water quality degradation were observed. Similarly, a uniform score for biological indicators was given at each site relying on King County's B-IBI score for May Creek as a reference. Table 2-5 shows the average of the eight sites and the range of scores. Appendix A.2 includes the individual scores for each site and category.

Table 2-5. China Creek RSAT Scores

	Average of Eight Sites	Range
Channel Stability	7.3	2-9 (Poor to Excellent)
Channel Scouring/Deposition	5.6	2-6 (Poor to Good)
Physical Instream Habitat	5.6	3-7 (Fair to Excellent)
Water Quality	6.0	6 (Good)
Riparian Habitat Conditions	6.4	4-7 (Fair to Excellent)
Biological Indicators (macroinvertebrates)	4.0	4 (Fair)
Total score	**34.9**	**21-38**

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Figure 2-10. China Creek Assessment - Lower Reach

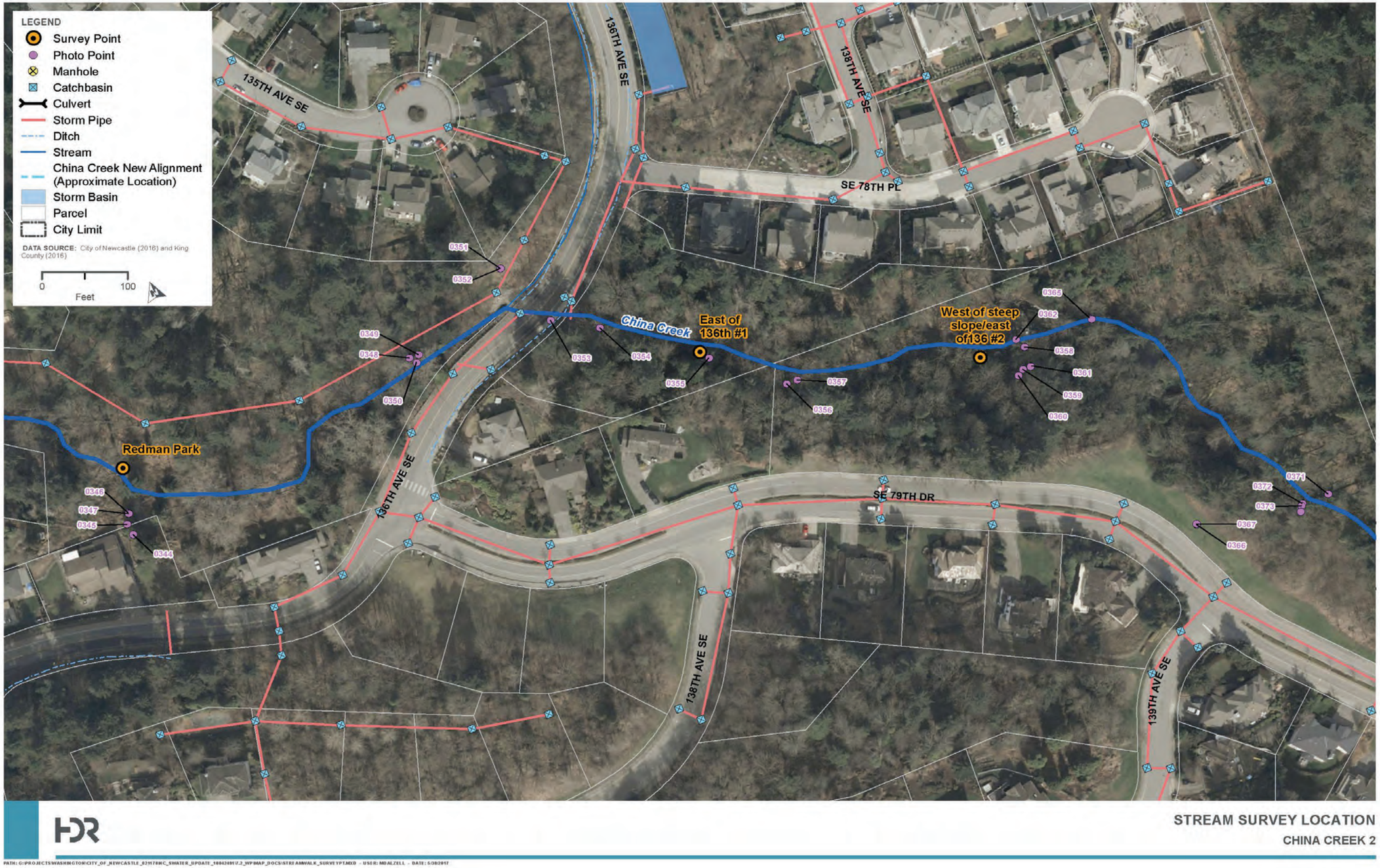

Figure 2-11. China Creek Assessment - Middle Reach

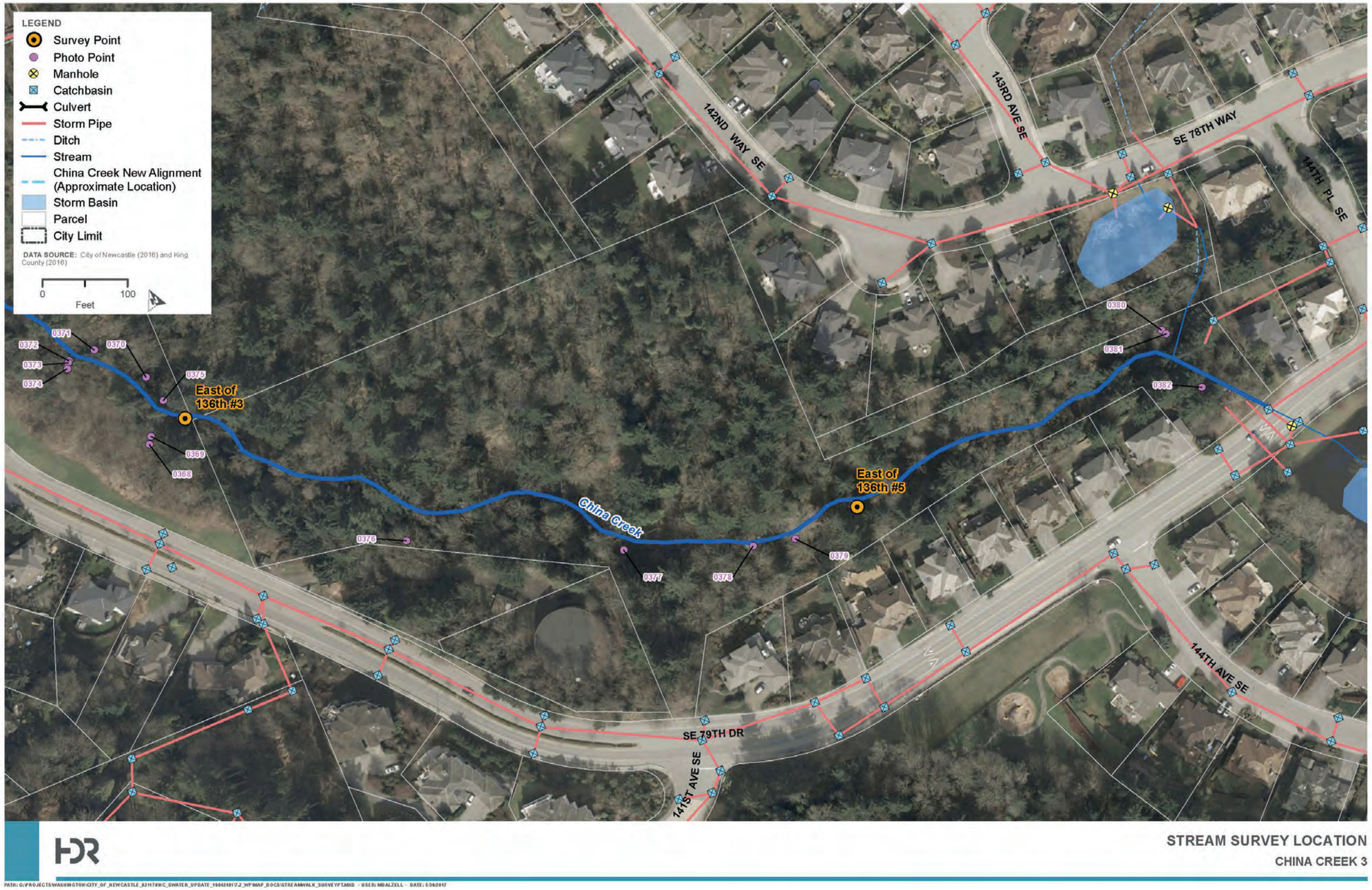

Figure 2-12. China Creek Stream Assessment - Upper Reach

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2.3.2 Boren Creek

The Boren Creek stream assessment extended from SE 84th Way upstream to Lake Boren, covering a distance of about 1,000 feet. The assessment also included the re-designed section of the Lake Boren inlet channel flowing across the Aegis property up to the Coal Creek Parkway culvert, see Figures 2-13 and 2-14. A total of five RSAT evaluations were made in the channels, three on the outlet channel downstream of the lake, and two upstream of the lake. RSAT scores for both channels indicate the stream condition is fair. These scores were driven by a lack of channel complexity, lack of overhead forest canopy, and prevalence of scoured stream beds. Appendix A.2 has the individual ratings for all five RSAT evaluations. Table 2-6 shows the average scores and the range of scores by category for the five Boren Creek sampling locations.

Table 2-6. Boren Creek RSAT Scores

	Average of Five Sites	Range
Channel Stability	6.6	3-9 (Fair to Excellent)
Channel Scouring/Deposition	3.4	1-6 (Poor to Good)
Physical Instream Habitat	3.8	2-6 (Fair to Excellent)
Water Quality	5.2	4-6 (Fair to Good)
Riparian Habitat Conditions	3.8	3-5 (Fair to Good)
Biological Indicators (macroinvertebrates)	4.0	4 (Fair)
Total score	**26.8**	**20-33**

2.3.3 Landcastle Area

The Landcastle Area is located within the East Lake Washington drainage basin between 116th Avenue SE and Lake Washington Boulevard. An unnamed tributary stream flows west from 116th Avenue SE towards Lake Washington and was the subject of a detailed evaluation for erosion. A RSAT evaluation was not performed on the un-named tributary in the Landcastle area because the creek and drainage basin was the subject of hydrologic and hydraulic modeling analyses. A stream assessment was made of the unnamed tributary with the objective of identifying erosion sites along the stream channel. Similar to Boren and China Creeks, the assessment identified problem sites and documented each problem site with photographs. The sites are indicated in Figure 2-15. See Section 3.1.1 for a summary of modeling details and Appendix B for the detailed modeling report.

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Figure 2-13. Boren Creek Stream Assessment - Upper Reach

STREAM SURVEY LOCATION
BOREN CREEK

PATH: G:\PROJECTS\WASHINGTON\CITY_OF_NEWCASTLE_82917\INC_SWATER_UPDATE_100424917.2_WP\MAP_DOCS\STREAMWALK_SURVEYPT.MXD - USER: MDALZELL - DATE: 5/30/2017

Figure 2-14. Boren Creek Stream Assessment - Lower Reach

Figure 2-15. Landcastle Area Modeling Reach

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Chapter 3 Problem Identification and Solution Development

This chapter recommends approaches to managing and improving the City's drainage system. The approaches include identifying CIP to address drainage problems, discussing a condition assessment program for identifying asset renewal and replacement, and a retro-fit program using LID to improve water quality and improve flood protection. Below is a description of each approach.

3.1 Capital Improvement Program

A major component of this CSWM Plan is the development of an updated stormwater CIP project list. The updated CIP includes projects that rehabilitate infrastructure, provide streambank erosion, reduce operating and maintenance cost, provide flood protection, preserve habitat, and improve water quality.

The development of the City's stormwater CIP followed a four-step process to identify stormwater related problems throughout the City and develop associated capital projects. The process is depicted in Figure 3-1, and it included:

Step 1. Locate and document drainage concerns from four major sources. Drainage concerns were identified by examining drainage compliant records, interviewing City staff, conducting a public survey, and developing stormwater models.

Step 2. Perform initial categorization of concerns. Drainage issues were grouped by similarity and categorized as detention pond function, road drainage complaints, streambank erosion, and infrastructure condition assessment.

Step 3. Evaluate each identified drainage concern for CIP feasibility. Site visits, field verification, and validation by City staff were used to assess feasibility of concept engineered solutions for each identified problem.

Step 4. Formulate, define, and rank CIP projects. Concept level cost estimates were developed for CIP projects. Priority ranking for completion of projects was provided by City staff based on the severity of problems, permitting requirements, and phasing of resources.

Following this process, a CIP Implementation Plan was developed to document revenue needs to support long-term capital project design and construction (see Chapter 5). The CIP implementation plan is focused on new projects developed with this study.

This chapter describes the process of identifying CIP projects, a discussion of the types of CIP projects and how they were evaluated, a recommended CIP project list, and recommendations on programs to address identified drainage issues.

Figure 3-1. CIP Project Development Process

3.1.1 Step 1: Locate and Document Drainage Concerns

The stormwater CIP is designed to use engineering methods to address persistent drainage problems that cannot be solved by maintenance practices alone. CIP projects were identified by interviewing Public Works staff, conducting a public survey, reviewing the City's drainage complaint database, and developing hydrologic and hydraulic models.

City Drainage Concerns

City staff interviews and a review of the City's drainage complaint records resulted in the identification of five CIP projects. They include projects to modify a culvert inlet, slip-lining 500 feet of storm drain pipe, and preventing roadway flooding. CIP projects 2, 3, 7, 8, and 9 were identified with this process.

Maintenance Drainage Concerns

The City's SWM staff identified the need to restore function to the City's detention ponds. The City owns and operates numerous detention ponds and identified the need to conduct maintenance activities to remove woody vegetation, accumulated sediment, and cattails. SWM staff also requested the update of some of the SWM Division's policies as they pertain to detention pond inspection and maintenance procedures.

SWM staff also identified three neighborhood drainage systems with aging infrastructure that pose maintenance challenges. A Condition Assessment program was recommended based on staff input and a limited site visit (see Section 3.2).

Landcastle Modeling

The Landcastle area, located near the northwest corner of the City, is an 87.8 acre drainage basin, comprised of piped stormwater conveyance networks in the upper and lower sections of the basin with an open, unnamed stream channel section in between. Modeling techniques were used to identify project(s) that could address drainage issues in the Landcastle area. In a relatively short distance of about 1500 linear feet, topographic relief of the open channel section ranges from a high point of about 363 feet above mean sea level (MSL) to about 114 feet MSL

resulting is a relatively steep creek. The drainage concerns evaluated by the modeling were identified by SWM staff knowledge, drainage complaint records, and past flooding events primarily due to eroded sediment from the unnamed stream channel that deposits in downstream storm drain infrastructure. Stream flow, unable to move through the plugged drainage structures, escapes the storm conveyance network and floods streets and nearby houses.

EPA SWMM 5.0 (SWMM) and HEC-RAS 5.0.3 (HEC-RAS) models were created to understand the effect of upstream and downstream storm drainage systems contributing to stream flows responsible for the erosion, to assess the effect of existing conditions within the channel, to identify stream locations susceptible to erosion, and to evaluate potential projects for inclusion in the CIP.

The modeling report is included in Appendix B and recommends capital projects that reduce peak flows to address the erosion problems. Modeling results indicate that flows leaving the developed areas in the upper portions of the basin contribute to the erosion problem. Though there are some detention facilities in the basin, the total volume of storage within the basin is insufficient to prevent erosion in the steep creek, plus the existing detention facilities were not built to 2017 standards.

The proposed CIP projects resulting from the modeling are two flow control vaults located in the 116th Avenue SE ROW situated at the top of the two open channel tributaries in the Landcastle area drainage basin. Once built, these facilities will limit flows entering the active erosion site in the unnamed creek. The reduced flows can be expected to reduce or eliminate the erosional forces contributing to the sediment build-up in the downstream system. Note: these facilities were not sized to provide flow control for future upstream development and therefore do not meet the forested flow duration flow control standards required of permitted land-development projects. Because these facilities will retro-fit facilities and are not beholden to the City's regulations for sizing flow control, the vaults were sized as a "best fit" into the site, which was presumed to be one lane of the ROW, while reserving the other lane for transmission of buried utilities. The basin area contributing flow to the northern vault is 29.6 acres. The contributing area to the south vault is approximately 14.8 acres. Because they are retro-fit projects, they are designed to store water to the maximum extent practicable. Collectively, these projects are intended to address the erosion problems. Given the results of the modeling of existing conditions and proposed CIP projects (4, 5, and 6), the following recommendations are made:

- Implementation of two detention vaults decreases peak flow rates and associated velocities entering the unnamed stream and downstream storm drainage system, which reduces stream flow velocities and consequently reduces erosion along the streambank. Problematic sediment volumes depositing in the downstream conveyance system would be reduced and/or eliminated.
- Model results indicate that a stream channel stabilization project also has direct benefit to reducing erosion by lowering velocities in the channel by 30%-40% below existing condition velocities.

Public Survey

A public survey was created using Survey Monkey, an online survey development and analytics software tool, to collect the public's observations and concerns related to stormwater quantity, water quality, and erosion/sedimentation in the City. A link to the survey was provided in the December 2, 2016, publication of Newcastle News, and was posted on the City's website during a 30-day data collection period in December 2016. After seeing more rainfall in a month (October 2016), than any other year on record for the greater Seattle area, this was a timely questionnaire

regarding performance of the City's stormwater management programs for individuals and businesses. The survey resulted in 10 individual responses, as detailed in Appendix C.

There were no strong patterns, but there were maintenance issues for follow-up, and recommendations about policy. The public survey resulted in the identification of at least one location where groundwater seeps onto the public sidewalk. In response to this concern, a concept CIP approach was developed that would capture groundwater in an infiltration trench that has an outlet pipe beneath the sidewalk discharging to the curb and gutter system.

3.1.1 Step 2: Initial Categorization of Concerns

In the second step of CIP development, drainage issues were grouped by similarity and categorized accordingly. In this part of the process each drainage concern was visited in the field to review the nature of the problem and develop an initial categorization of the type of problem. The project team also used as-built drawings, aerial photos, and in some cases, follow-up site visits to develop a full understanding of the problem. After compiling the drainage concerns and completing the site reconnaissance, each concern was assigned into one of the categories below.

Private Issue

A drainage concern was categorized as a "private issue" if the concern was located on private property and the source of the surface water issue was on private property.

No Action Required

A drainage concern was categorized as "no action required" if a concern had already been addressed by a previous project or was currently being addressed by City maintenance crews or after inquiry was deemed to be properly functioning.

Maintenance Referral

A drainage concern was categorized as a "maintenance referral" if a concern could be addressed and the problem solved by maintenance crews through activities such as vegetation management, improving access to the facility, or removing debris to unclog drains. The maintenance referral concerns will become a work list for the City's maintenance crews.

Further Analysis Needed

A drainage concern was categorized as "further analysis needed" if the concern required specialized technical analysis beyond the scope of the CSWM Plan Update. In particular, this applied to the earthen embankment carried forward from the 2010 SWMP.

Small Drainage Project

A drainage concern was categorized as a "Small Drainage Project" (SDP) if the anticipated improvement was likely to be solved with minimal analysis or design by City staff. Factors considered for assignment to this category were magnitude of construction crew mobilization, presumed quantities of necessary material purchases, and presumed complexity of permit acquisition.

CIP Project

A drainage concern was categorized as a "CIP project" if the identified solution to the problem required a full engineering evaluation and detailed design drawings to develop a final solution and

complete construction. Detailed CIPs in Newcastle are typically designed by consultants and built by contractors.

3.1.2 Step 3: Concept Development and Cost Estimating

In the third step of CIP development, each project was evaluated with the City's CIP criteria for Public Safety and Flood Hazard, Pubic Health, Environmental/Regulatory/Permits, and Public Perception. Each drainage concern was evaluated and discussed with City personnel to determine if the drainage concern was a potential CIP project or not. The consultant team met with City staff to review and prioritize problem areas for development into either CIP projects or SDPs.

3.1.3 Step 4: Finalize CIP projects and Develop Revenue Needs

In the final step of the CIP development, the priority drainage concerns were developed into CIP projects.

Project concepts were developed along with concept-level opinions of cost[3] to address each of the problem areas. Projects include adding and upsizing inlets, replacing damaged pipes, retrofitting water quality or detention ponds, and installing new stormwater infrastructure (pipes, ditches, etc.).

3.1.4 Capital Project List

Additional details about each project were obtained during site visits made to most CIP sites. The list of drainage problems captured by this process was reviewed by City Public Works staff, and concept-level engineered CIP solutions and opinions of cost were drafted. Table 3-1 provides a list of the proposed CIP projects identified through the CSWM Plan update process, and provides a unit-cost approach for detention pond maintenance. Concept worksheets, including conceptual cost estimates, are provided in Appendix D.

[3] This opinion of cost is considered a "Class IV" estimate (see attached descriptions). The American Association of Cost Engineers (AACE) and the American National Standards Institute (ANSI) both define the expected accuracy of a "Class IV" estimate to be plus 30 percent or minus 30 percent.

Table 3-1. Proposed CIP Project List

Project #	Project Description	Concept-Level Cost[1]	Priority[2]
1	Detention Pond Restoration Program	$25,000[3]	1
2	135th Pl SE Culvert Inlet Retrofit	$51,000	7
3	Storm Conveyance Rehabilitation Program	$103,000[3]	3
4	Landcastle Creek Streambank Restoration Project.	$619,000	6
5	116th Ave SE and SE 72nd St. Flow Control Vault	$493,000	4
6	116th Ave SE and SE 76th St. Flow Control Vault	$389,000	5
7	Roadway/Sidewalk Seepage Program	$62,000	2
8	144th Pl SE Culvert Replacement and Ditch Rehabilitation	$240,000	8
	Total	**$1,982,000**	

[1] Cost includes design and construction in 2017 dollars.
[2] Priority ranking provided by City staff.
[3] Cost reflects annual cost for the program, in 2017 dollars.

3.1.5 Capital Projects

Project 1: Detention Pond Restoration Program

Near-term action (1-2 years): remove all woody vegetation from pond storage area, inspect and document findings of built infrastructure in each detention pond. Long-term actions: remove dead biomass (cattails) per Appendix A of the King County Surface Water Design Manual (KCSWDM) standards in ponds associated with traffic in excess of 15,000 Average Daily Traffic (ADT) counts. Compost or dispose of biomass away from nearby streams and/or lakes.

Figure 3-2. Detention Pond

Remove or dredge accumulated sediments once 10% of storage area is filled (assumed to be once every ten years). Cost estimate reflects Annual Action only. Removing sediment and vegetation, and clearing inlets and outlets will restore detention pond storage capacity and water quality treatment function. See Figure 3-2.

Project 2: 135th Place SE Culvert Inlet Retrofit

On 135th Place SE, the culvert inlet plugs due to lack of access for maintenance. Install riser on the inlet to allow water to pond and suspended solids to settle out before they get into the culvert. This will have the added benefit of providing a single maintenance point for SWM maintenance staff. See Figure 3-3.

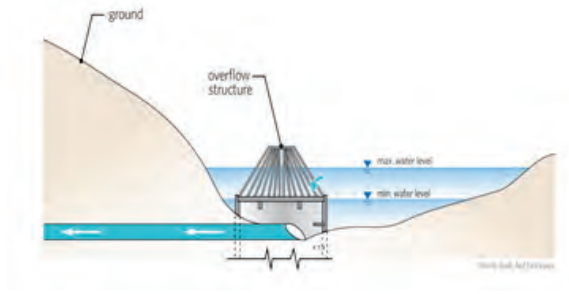

Figure 3-3. Riser Structure Concept

Project 3: Storm Conveyance Rehabilitation Program

Between 136th Avenue SE and 135th Avenue SE, the capacity of a corrugated metal pipe (CMP) is compromised due to clogging from sedimentation and tree roots that present flooding risk to nearby residential structures. This project is the first in the recommended Storm Conveyance Rehabilitation CIP which is paired with a proposed condition assessment program. Collectively, the Condition Assessment and Storm Conveyance Rehabilitation programs provide the City with a proactive approach to managing the City's built stormwater assets. The objectives of the program are to have an ongoing capital program with a steady funding source that can readily address defective storm conveyance pipes as they are identified. For the 136th Avenue SE project, the proposed solution is to slip-line the compromised CMP stormwater pipe and remove vegetation causing issues. Replant with grasses and shallow root shrubs.

Project 4: Landcastle Creek Streambank Stabilization Project

Streambank sediment erosion due to peak stormwater flows delivers eroded sediment downstream, clogging stormwater facilities. Clogged structures inhibit flow causing flooding and the need for more frequent maintenance. Install large woody debris structures along streambank to provide a roughened channel to help reduce flows and erosion. Woody debris will also provide additional shelter and habitat for wildlife.

Project 5: 116th Avenue SE and SE 72nd St. Flow Control Vault project.

Install a 36′x12′x8′ (3,500 CF) flow control vault within the right-of-way of 116th Avenue SE near the intersection of SE 72nd Street.

Project 6: 116th Avenue SE and SE 76th St. Flow Control Vault project.

Install a 36′x12′x8′ (3,300 CF) flow control vault within the right-of-way of 116th Avenue SE and SE 76th Street.

Project 7: Roadway/Sidewalk Seepage Program

At SE 76th Street Roadway, groundwater seeps onto the roadway resulting in a slipping hazard when water freezes. Groundwater seepage onto roads and/or sidewalks is a common occurrence throughout the City and this proposed new program is designed to provide the City with the flexibility to address the issues as they develop. The first project in this new program will address a long-standing seepage problem at SE 76th Street by installing an underdrain below the roadway to direct groundwater into an existing ditch/storm drain. See Figure 3-4.

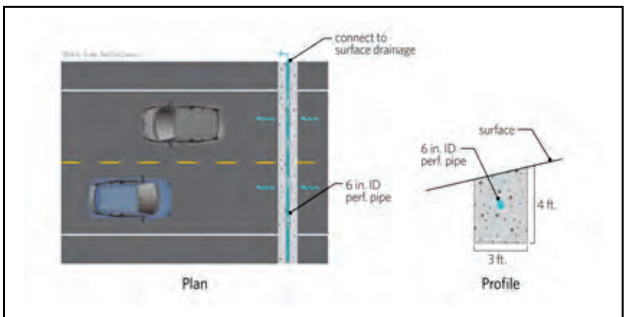

Figure 3-4. Road Seep Solution Concept

Project 8: 144th Place SE. Culvert Replacement and Ditch Rehabilitation Project.

Install a new 12-inch-diameter ductile iron culvert, 50 feet long to alleviate roadway flooding on 144th Place SE. Excavate roadside conveyance ditch and upsize the existing culvert at 144th Place SE.

Figure 3-5 show the recommended CIP projects discussed in this Chapter.

3.1.6 Project Requiring Further Analysis

A carry-forward project from the 2010 CSMP is project S-017 that concerns the earthen embankment fill in Newport Hills Creek. From the 2010 CSMP, the CIP description reads, “Seepage into the railroad embankment fill is causing a potential safety problem. A geotechnical investigation and engineering study is needed to define future project needs.” The 2010 recommendation to conduct a geotechnical investigation is reiterated in the 2017 update. A phased geotechnical assessment scope might include:

Phase 1 Assessment to supplement the findings from the 2012 Department of Ecology assessment of the impoundment (see Appendix E).

- Field inspection conducted by geotechnical engineering team.
- Regulatory state guidelines review.
- Desktop analyses of existing information, and calculation of impoundment area.
- Department of Ecology condition assessment checklist completed by geotechnical or dam safety engineers.
- Concluding with the identification of major safety issues.

Phase 2 Data Collection and Instrumentation: Determining seepage and settlement drives the type of instruments to install to monitor movement, data collection to identify piping, grain size distribution, and hand-auger borings into the earthen embankment to collect soil samples followed by a geotechnical evaluation to determine grain size and impoundment competency.

Phase 3: Design processes: Based on the findings of Phases 1 and 2, the project could formally move into the CIP where detailed cost estimates and project scoping for selecting a preferred alternative would occur.

Ecology's 2012 assessment provided the City with a set of recommendations for monitoring the impoundment primarily to watch for blockage of the culvert.

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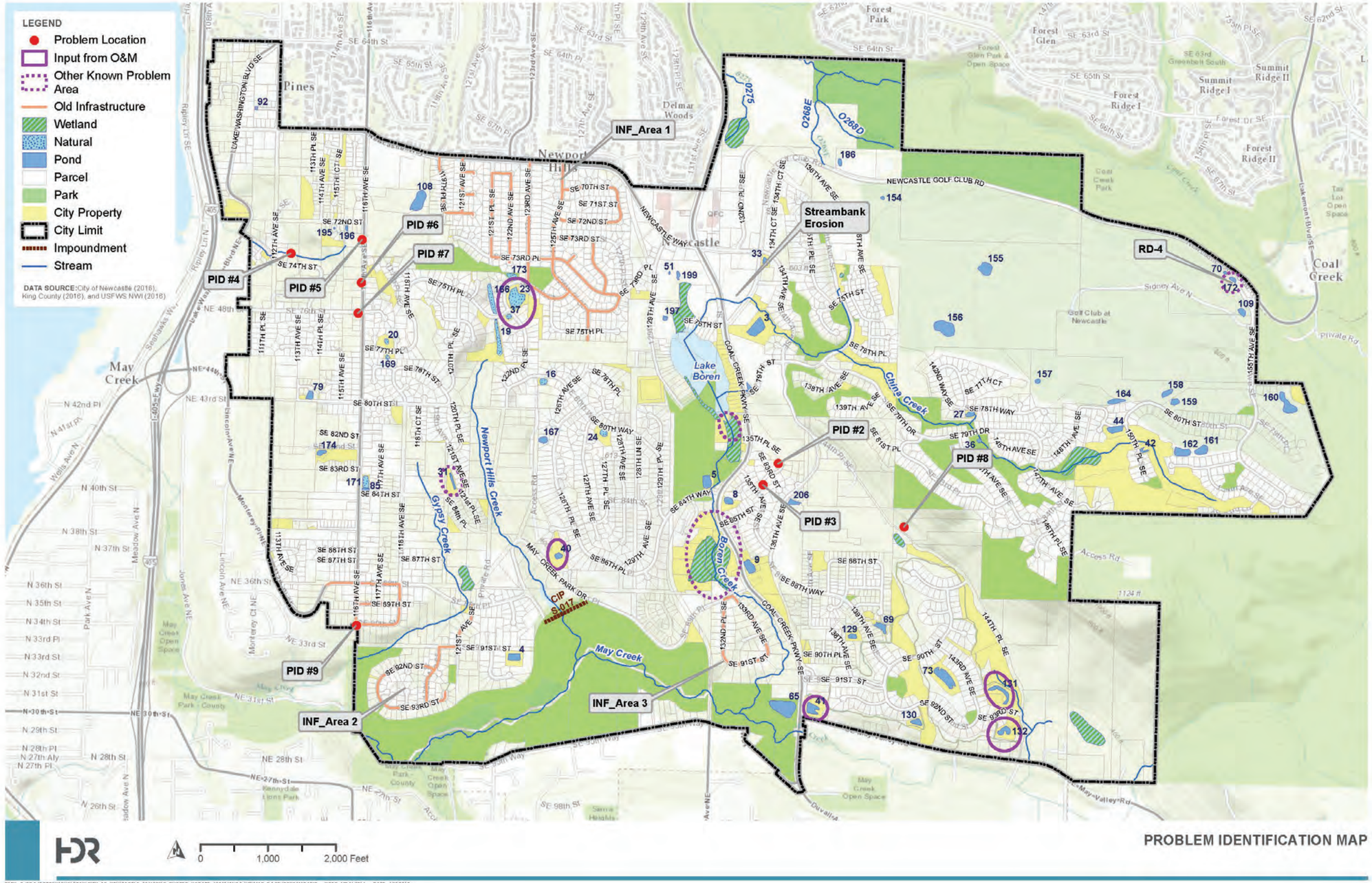

Figure 3-5. CIP Location Map

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3.2 Asset Management Program

City SWM staff identified three neighborhood areas (see Figure 3-5) with several concerns: 1) aging drainage infrastructure; 2) difficulties in accessing built drainage infrastructure; and 3) lack of maps or maintenance records. In response to this matter, a condition assessment of the three drainage areas is recommended for near-term (2-3 years) action. In this section, a detailed near-term approach to implementing an asset management program City-wide is discussed.

Asset condition is one of the key pieces of information needed to make asset management decisions. Condition information is used to determine how an asset should be operated and maintained and to estimate the probability of asset failure. This, taken together with the consequence of such a failure, can be used to predict future resource needs for rehabilitating or replacing an asset, the additional maintenance or inspection needs that may be required, and the potential impacts to the level of service to the utility customer and other stakeholders if no action is taken.

3.2.1 Program Recommendations

A near-term targeted condition assessment is proposed, and is broken into three parts:

1. Develop interim Probability of Failure (POF) criteria for three known areas, to be used in targeted condition assessment.
2. Develop interim Consequence of Failure (COF) factors for the system, to be used in assessing risk and prioritizing follow-up renewal or O&M activities.
3. Perform condition assessment of the three known areas using a combination of visual assessment and closed circuit television (CCTV). Use the established POF criteria and COF factors to determine the City's risk exposure and prioritize defects found for further action. Based on available funds and resources (staff, equipment, etc.), include the highest risk/worst condition defects in capital and O&M plans.

A targeted condition assessment could include an annual condition assessment program or use a formal strategy and decision logic process to identify mitigation actions to be performed based on POF and COF (together, Business Risk Exposure or BRE). Such an approach would be a longer-term solution, and be composed of the following steps:

1. Determine system-wide POF criteria, or "proxy criteria" (e.g. using age and expected useful life to approximate percent of life consumed of an asset, in place of known condition). POF criteria may go beyond structural condition to other causes of failure, like capacity failure, service level failure, or financial failure.
2. Determine system-wide COF factors based on available attribute information, and where possible, field verification of the relevancy of the criteria.
3. Establish risk mitigation actions and the circumstances under which they are to be applied (i.e. decision logic for follow-up actions based on condition assessment findings).
4. Develop a condition assessment plan. The plan may include a survey of a sample of the system, followed by extrapolation of the findings to the system as a whole, or a "desktop" analysis to assign initial values and prioritized areas to be assessed each year.
5. Use findings of the condition assessment program to project capital (rehabilitation, repair, or replacement) needs and O&M needs for budgeting and management purposes.

In the near-term, performing a targeted condition assessment of the three known areas shown on Figure 3-6 will allow the City to identify immediate risk and proactively address any critical issues for which failure could be imminent. Additionally, developing an interim set of POF criteria and COF factors will allow the City to begin to identify what asset information is available and may be used in assessing the risk exposure of the broader system. This information will serve as the basis for developing a system-wide condition assessment program.

Should the City pursue a system-wide condition assessment program, it will provide a basis of information for making asset management decisions based on risk, performance, and level of service. A condition assessment program informs and prioritizes funding and resource allocation decisions by balancing the physical condition of assets (and other non-structural causes of failure like O&M, capacity, etc.) with the risk posed should the asset fail. This will result in appropriately sized and timed capital and O&M programs that maximize asset life cycle costs.

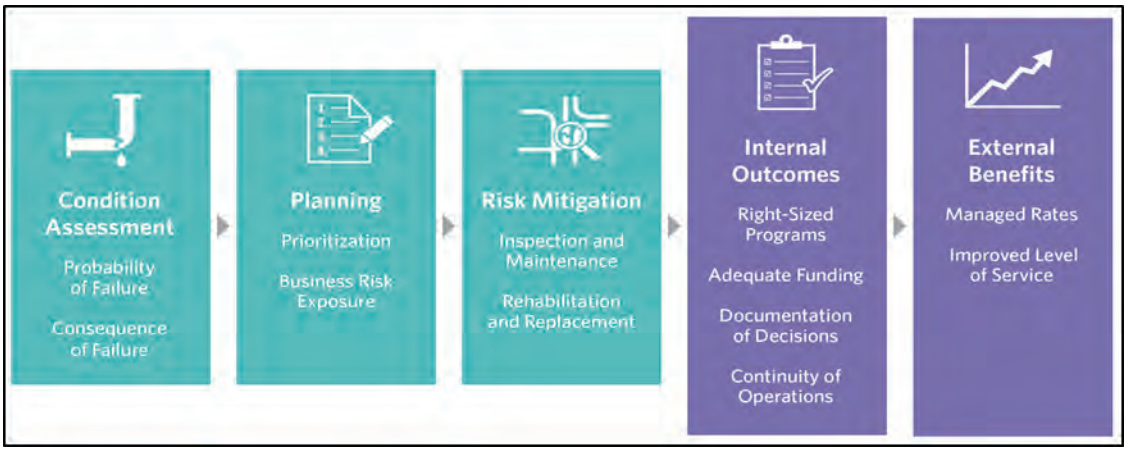

Figure 3-6. Condition Assessment Process

Table 3-2 is a cost summary of a planning level estimate of the expense required to perform a condition assessment of the three known areas identified for the near-term program, where assessment methods are comprised of visual inspection (drainage structures) and CCTV (pipes). Costs for developing interim criteria to determine probability and consequence of failure, along with risk exposure and decision logic for assigning mitigation measures is also provided (see Appendix F). Based on these criteria, a system-wide condition assessment program cost estimate may be developed for future years.

Table 3-2. Condition Assessment Concept Level Cost Estimate

Area	Concept Level Cost (2017$)
Area 1	$58,500
Area 2	$16,500
Area 3	$5,000
Subtotal – Condition Assessment	**$80,000**
Risk Exposure and Decision Logic	$50,000
Total	**$130,000**

3.3 Low Impact Development Solutions

Retrofit solutions for managing stormwater are approaches that typically use LID techniques to achieve goals of improving water quality and reducing peak flows to streams. LID best management practices (BMPs) reduce stormwater impacts, usually by infiltrating runoff near to where the precipitation strikes the ground using on-site management approaches like bioretention facilities, rain gardens, and permeable pavement. Retrofit programs are effective ways to improve drainage conditions and improve water quality in areas built prior to stormwater regulations requiring water quality and flow control BMPs as a condition of development. LID approaches to stormwater management are dependent on soils having “good to moderate” infiltration rates. Outwash soils with an “A” or “B” Hydrologic Soil Group (HSG) designation usually have favorable infiltration rates that facilitate an LID approach to stormwater management. Identifying specific retrofit projects is accomplished by undertaking a basin study to identify where favorable soil conditions exist for infiltration. The Natural Resources Conservation Service (NRCS) soils map for the City indicates that significant portions of the City (48%) have HSG-A or B soils.

Table 3-3 is a breakdown of the soil types in Newcastle according to NRCS data.

Table 3-3. Hydrologic Soil Group Area

Hydrologic Soil Group	Area (acres)	Percent of Total
A. Soils in this group have low runoff potential when thoroughly wet. Water is transmitted freely through the soil.	30	1.5
B. Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded.	913	46.9
C. Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted.	646	33.2
D. Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted.	0	0.0
Other (urban & water)	358	18.4
Total	**1,947**	**100**

Note: Total area of soil map covers a fraction of the total area within the city limits.

Figure 3-7 is a map of NRCS soil properties in Newcastle. HSG-A and HSG-B soils.

Given the preponderance of outwash soils throughout the City, future analyses for the viability of using a retro-fit approach to addressing stormwater issues shows promise. Ecology promotes the use of LID through a variety of grant and loan programs including the Centennial Clean Water Program, the Clean Water Act Section 319 Program, Stormwater Financial Assistance Program, and the Washington State Water Pollution Control Revolving Fund Programs.

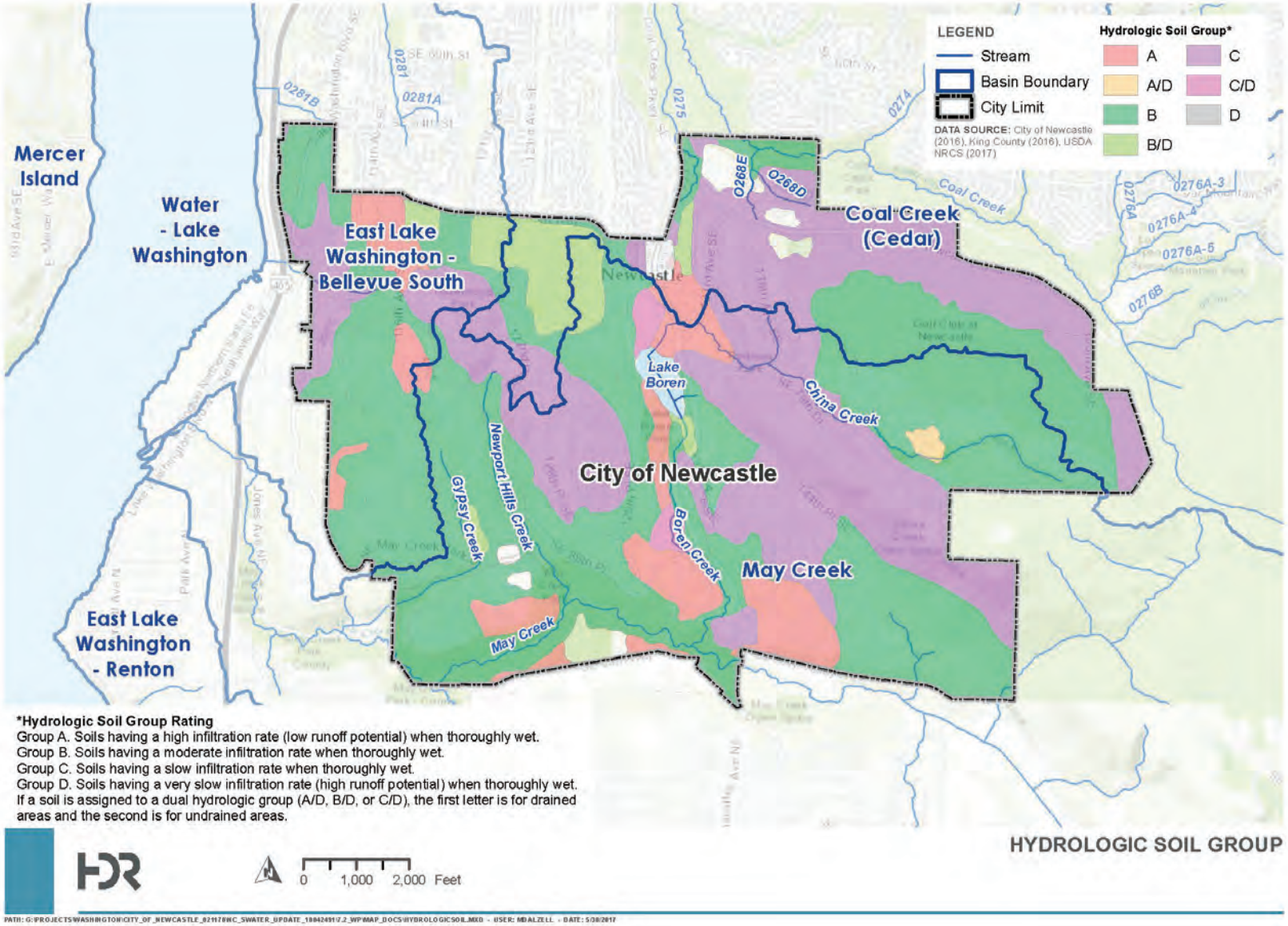

Figure 3-7. Soils Map with Hydrologic Group Designations

Chapter 4 Stormwater Management Program Evaluation

The City is one of 80 western Washington municipalities that is regulated by the NPDES Permit. The City's original NPDES Permit was issued in 2007 by the Ecology, as was the case for the other regulated jurisdictions in western Washington. The NPDES Permit is reissued every 5 years. The City's current permit was reissued on August 1, 2013 and was originally scheduled to expire on July 31, 2018, until a May 2017 decision by Ecology extended the current permit for an additional 12 months. The revised expiration date is July 31, 2019.

This chapter provides an overview of the NPDES Permit and evaluates the City's SWMP for compliance.

4.1 NPDES Phase II Municipal Stormwater Permit Overview

Like all NPDES permits in Western Washington, Newcastle's NPDES Permit is organized into Special Conditions and General Conditions, and with compliance it allows the regulated jurisdiction to discharge stormwater runoff from its municipal stormwater system (MS4) to the waters of the state. As a permit condition, each calendar year the City updates and publishes a SWMP Plan that describes the City's programs and documents how it meets the conditions of the permit. The City's SWMP is available on their website: http://www.newcastlewa.gov/departments/public_works/surface_water_management/.

Regulatory details of operating a stormwater management program are contained in sections S5, S8, and S9 of the SWMP. The following program evaluation and gap analysis is specific to these sections of the SWMP (see Section 4.2 of this CSWM Plan Update).

General permit conditions describe what actions a Permittee must take to meet permit requirements and the special conditions section describes how to implement the permit conditions. Special conditions are specific to each Permittee and are summarized in the sections below; whereas general conditions are listed in Appendix G. The special conditions sections are listed in Table 4-1.

Table 4-1. NPDES Permit Special Conditions

Permit Section	Program Component
S1	Permit Coverage Area and Permittees
S2	Authorized Discharges
S3	Responsibilities of Permittees
S4	Compliance with Standards
S5	Stormwater Management Program
S6	Stormwater Management for Secondary Permittees (not applicable to Newcastle)
S7	Total Maximum Daily Load (TMDL) (not applicable to Newcastle)
S8	Monitoring and Assessment
S9	Reporting and Record Keeping

4.1.1 Special Conditions

The special conditions section of the NPDES Permit are specific action items each regulated Permittee must undertake to allow permissible discharges to the waters of the state. Listed below is a brief description of each section.

S1. PERMIT COVERAGE AREA AND PERMITTEES

Designates the areas in western Washington subject to the conditions of the permit. It includes areas located west of the eastern boundaries of the following counties: Whatcom, Skagit, Snohomish, King, Pierce, Lewis and Skamania. This NPDES Permit is applicable to owners or operators of regulated small municipal separate storm sewer systems (MS4s).

S2. AUTHORIZED DISCHARGES

Authorizes the discharge of stormwater to surface waters and to ground waters of the state from MS4s owned or operated by each Permittee covered under this permit, in the geographic area covered pursuant to S1.

S3. RESPONSIBILITIES OF PERMITTEES

Formally declares the responsibility of each Permittee for compliance with the terms of this Permit for the regulated small MS4s that they own or operate.

S4. COMPLIANCE WITH STANDARDS

Details applicable water quality standards and methods for achieving the standards. In summary this section:

- Prohibits the discharge of toxicants to waters of the state.
- Provides instructions to Permittees on specific actions they must take when a discharge occurs that is in violation of the permit.
- Allows Permittees to use practices that reduce the discharge of pollutants to the maximum extent practicable (MEP).
- Permits the use all known, available, and reasonable methods of prevention, control and treatment (AKART) to prevent and control pollution of waters of the state of Washington.
- Outlines actions each Permittee can take to remain compliant when prohibited discharges are unintentionally discharged to the waters of the state.

S5. STORMWATER MANAGEMENT PROGRAM

States that each Permittee will develop and implement a SWMP that includes a set of actions and activities the Permittee will undertake to meet the objectives of the NPDES program.

S6. STORMWATER MANAGEMENT PROGRAM FOR SECONDARY PERMITEES

Not applicable to the City of Newcastle because it is not listed as a secondary Permittee.

S7. COMPLIANCE WITH TOTAL MAXIMUM DAILY LOAD REQUIREMENTS

Not applicable to the City of Newcastle because there are no water bodies in its jurisdiction listed on Ecology's 303(d) list of impaired water bodies.

S8. MONITORING AND ASSESSMENT

Describes the requirements for permitted jurisdiction to conduct water quality monitoring of its MS4 discharge.

S9. REPORTING REQUIREMENTS

Standardizes reporting requirements for all regulated jurisdictions.

4.2 Stormwater Management Program Gap Analysis

The evaluation and gap analysis of the City's SWMP is focused on sections S5, S8 (monitoring), and S9 (reporting). Sections S1 through S4 are not part of the SWMP and are not part of the evaluation. S5 includes a set of "special conditions" for agencies responsible for operating a MS4 stormwater system. These responsible agencies implement the special conditions that will programmatically achieve the goals of the NPDES Permit. The Permittee is required to: "prepare and implement a Stormwater Management Program (SWMP) that includes a set of actions and activities designed to reduce the discharge of pollutants from regulated small MS4s to the MEP, meet state AKART (sic) requirements, and protect water quality."

Section S5 is subdivided into parts A, B, and C. Section A is the rules section of the permit stating that jurisdictions shall prepare a SWMP. Section B states the objectives of the SWMP, and Section C list the activities required in a SWMP. S5C describes the SWMP and is divided into five sub-parts. S8 and S9 are also part of the SWMP and were included in the gap analysis. Table 4-2 lists the sections of the NPDES Permit included in the evaluation.

Table 4-2. Permit Sections and Program Components Analyzed

Permit Section	Program Component
S5.C.1	Public Education and Outreach
S5.C.2	Public Involvement and Participation
S5.C.3	Illicit Discharge Detection and Elimination (IDDE)
S5.C.4	Controlling Runoff from New Development, Redevelopment, and Construction
S5.C.5	Municipal Operations and Maintenance
S8	Monitoring and Assessment
S9	Reporting Requirements

4.2.1 SWMP Evaluation

HDR reviewed 79 individual permit requirements in S5 and an additional 12 conditions in S8 and S9. To assess possible program gaps with respect to these requirements, HDR reviewed the City's existing SWMP, O&M manuals, and the City's website. In addition, interviews with staff supplemented the available information when more details were needed, along with review of

Ecology's audit report, dated April 11, 2016. This information was compared to the requirements of the NPDES Permit to identify program gaps.

S5.C.1-Public Education and Outreach

Figure 4-1. Stormwater Storage Pond Sign in the City Educating Residents about the Importance of Stormwater Facilities

The City's website is the main portal for disseminating information to the public about stormwater and stewardship of the City's natural resources. The topic of Stormwater Management and how the public can contribute to the City's mission of protecting water quality is prominently displayed there. This evaluation is consistent with Ecology's audit and found no gaps in the City's public education and outreach programs. The City's education and outreach efforts are summarized below. See Figure 4-1 for an example of the City's outreach materials.

Volunteering

- Potential Eagle Scouts can complete a Project Statement of Commitment to help fulfill scouting badge requirements.
- Citizen-led groups that would like to organize a volunteer project with the City, may refer to the Community Group Volunteer Guide for procedural details and Volunteer Services Agreement for legal consideration.
- Volunteer events gather a community together and help educate, enlighten and foster community pride. Newcastle's events occur mostly in the spring, summer and fall months. Updates are provided in the Events page on the Community section of the City's website. See Figure 4-2.

Figure 4-2. Volunteers Improve Park Plants

- Clean-up events help keep Newcastle's parks, trails, wetlands, and open spaces properly cared for and accessible for residents and visitors to enjoy. Opportunities can include: weeding, mulching, picking up trash, pruning, restoration and planting, as well as trail construction.

Protecting Water Quality

Information available on the City's website:

- The Western Washington Rain Garden Manual (provides a step-wise approach to constructing a rain garden).

- Encouragement to fix oil leaks from automobile.
- How to rent car wash kits to keep soapy water out of streams and lakes.
- How to recognize and report water quality violations using the City's hotline.

Elementary School Programs

The City, in conjunction with King Conservation District, is providing a new hands-on learning program to educate school-aged children in Newcastle. Learning objectives include the importance of clean water, water pollution and where it comes from, and methods of reducing pollution from human activities. Participants in the program will sign a pledge stating how they're going to prevent water pollution in their daily lives.

Outreach to Businesses

The City is contracting with the Environmental Coalition of South Seattle (ECOSS), a local environmental non-profit organization that specializes in bridging knowledge and cultural gaps, serving the interests of residents, industry, and government, and providing outreach to businesses. The Puget Sound Spill Kit Program goals are to increase awareness and understanding of stormwater management among businesses, and to encourage businesses to practice pollution prevention and BMPs. In addition, ECOSS provides a spill kit and training to each business. See Figure 4-3 for an outreach display example.

Figure 4-3. Public Outreach Materials

The City will work with ECOSS and business owners for stormwater outreach and pollution prevention. This year, the City will be updating its IDDE educational brochures.

Low Impact Development

The City amended codes and adopted ordinances in December 2016 as part of the LID integration process. This year, the City is updating its Public Works standards to include LID features and design, as well as creating new outreach materials for developers, contractors, and property owners. These materials will explain the importance and usage of LID principles and BMPs. The City also adopted the 2016 King County Surface Water Design Manual (2016 KCSWDM) as part of the LID code integration process. In addition to adopting the 2016 KCSWDM, the City created a 2016 Addendum, which describes City-specific requirements.

Pet Waste

Newcastle, in partnership with Regional Animal Services of King County (RASKC), is providing additional outreach materials, including pet waste bags to each dog owner who pledges to pick up pet waste. This outreach will be done when pets are registered within the City, and it is intended to encourage behavior change among owners and pet care-providers walking dogs in areas that don't have stationary pet waste dispensers.

Additional Education and Outreach Activities

- Restoration events during Earth Week and scheduled throughout the year.
- Tree planting and maintenance workshop. Free tree to participants to increase Newcastle's tree canopy.
- Shorelines/riparian area workshops, offered in conjunction with KCD.
- Partnerships with organizations including Coal Creek Utility District, King Conservation District, WSU Master Gardeners, and Newcastle Weed Warriors Nature Stewards Program.
- Newcastle Spills Hotline for after-hours, non-emergency, public reporting of spills, other illicit discharges, and polluters.
- Storm drain markers containing the words "*Puget Sound Starts Here*" and "Dump No Pollutants."
- Outdoor doggie bag dispensers to provide a degradable alternative to plastic bags for pet owners.
- Continued control and removal of noxious weeds in riparian corridors, particularly knotweed. The City partners with KCD and Newcastle Weed Warriors Nature Stewards Program.

S5.C.2-Public Involvement and Participation

The City's Public Involvement and Participation Programs fully meet the special conditions of this permit element which are creating, publicizing, and documenting stewardship opportunities for the public and measuring the understanding of at least one target group. With this evaluation, no gaps were identified. The City's public involvement efforts are summarized below.

In summary, the City offers the public opportunities to provide input on the City's management of stormwater. Planning Commission meetings and City Council meetings continue to be weekly or monthly opportunities for the public to provide input. Additionally, in support of this CSWM Plan, a public survey was posted on the City's website. The public was invited to submit their observations and input regarding flooding, erosion/sediment problems, and water quality issues.

From the City's 2016 SWMP, prepared and updated annually:

- *Community feedback* – The City encourages public comment in the development and implementation of the City's SWMP. The process to obtain feedback continues at public meetings concerning NPDES Permit requirements and through email, in writing, or by phone as indicated by the participation memo. The latest program document and annual report are posted on the City's website.
- *LID Code Integration Process* – The City is developing a webpage to share information and receive feedback on this process. A survey will be created to get feedback from interested parties. The public can also give input at Planning Commission meetings when information is presented.
- *City of Newcastle City Clerk's Office, Newsletter, and Website* – The City uses the City Clerk's office for public notification of public meetings pertaining to Phase II requirements involving further development of the City's SWMP. The City uses the newsletter and website for notification of local stewardship and environmental activities/events/programs.

- *Stewardship promotion* – The City's storm drain marker program enlists volunteers to install a stamp on catch basins throughout the City labeling the inlet structure as a stormwater drain. Typical storm drain markers say "Noting but rain down the storm drain." In addition, the City makes Illicit discharge information available to business owners promoting business practices that are beneficial to water quality.

S5.C.3-Illicit Discharge Detection and Elimination

An Illicit Discharge Detention and Elimination (IDDE) Program is a special condition in the NPDES Permit that requires agencies operating a MS4 system to implement a systematic program to address the issue of illicit stormwater discharges, such as oil entering a stormwater inlet, as depicted in Figure 4-4. The analysis of the City's IDDE Program indicates that City stormwater staff are equipped and trained to respond to illicit discharges. City records support the conclusion that they also know the rules for follow-through with reporting to Ecology when illicit discharges are discovered. Further, the City has mapped its MS4 system, maintains training records, and has listed in its ordinance examples of illicit discharges. These actions meet the standards of this special condition element. No gaps in the City's IDDE Program were identified.

Figure 4-4. Example of an Oil Sheen Flowing into Stormwater Inlet

S5.C.4-Controlling Runoff for New Development, Redevelopment, and Construction Sites

The City's permitting process requires plan review and site inspections for development and redevelopment projects. This process fully meets the standards required by the permit. The City has adopted the 2016 King County Surface Water Design Manual (KCSWDM) that establishes regulatory minimum requirements for controlling runoff from development. Situations like the one shown in Figure 4-5 from an unknown jurisdiction are to be avoided. The KCSWDM is acknowledged by Ecology as being an equivalent manual to the Stormwater Management Manual for Western Washington (SMMWW), satisfying equivalency requirements. One gap was identified in the City's program. This unfulfilled requirement is updating the City's ordinance to identify the responsible party for bringing flow control and water quality BMPs up to standards.

Figure 4-5. Example of Runoff Control on the Brink of Failure

S5.C.5-Municipal Operation and Maintenance

NPDES Permit conditions stipulate that City maintenance standards must be equal to those in the SMMWW. It also requires standards be developed for practices that are not covered by the SMMWW. Rigorous inspection schedules and maintenance standards are required, and stormwater pollution prevention plans (SWPPPs) are required for certain categories of municipal sites.

Evaluating the City's maintenance and inspection manuals yielded a determination that they meet equivalency standards to the SMMWW and require the preparation of SWPPPs for all City facilities (Ecology 2016). The City conducts annual inspections of its stormwater treatment and flow control facilities.

S8-Stormwater Monitoring Strategy and Recommendations

The City's NPDES Permit requires the City to conduct water quality monitoring of stormwater discharging from its MS4 system. Phase II municipalities have the option of conducting their monitoring program or participating in the Stormwater Action Monitoring (SAM) program (known as the Regional Stormwater Monitoring Program [RSMP] prior to 2011). Newcastle has chosen to participate in the regional program, thus meeting the permit conditions for monitoring. The City meets this permit condition by annually contributing funds to the program. The SAM was established as a collaborative monitoring program for all participating western Washington municipal stormwater Permittees to use the results of monitoring and studies to inform policy decisions and identify the most effective stormwater management actions.

The monitoring program has goals and metrics to measure whether conditions are improving or worsening and identify patterns in healthy and impaired Puget Lowland streams and Puget Sound urban shoreline areas.

4.2.2 NPDES Permit Compliance Strategies and Recommendations

Appendix H provides the details of the gap analysis. The result of this program review was the identification of five (5) possible program improvements pertaining to the NPDES Permit special condition requirements. The five recommendations are:

- Develop labor tracking processes to collect data on implementing the various components of the Stormwater Management Program (S5.A.2). The objective is to identify which elements of the program are most effective at achieving permit goals and optimizing the implementation of the SWMP. The City's tracking methods meet minimal permit conditions, and the recommendation is intended to highlight an opportunity for additional efficiencies within the City's O&M Program.
- Review and update City ordinances as necessary to meet the NPDES Permit condition to identify the responsible party for implementing action items resulting from a site inspection (S5.C.4.c).
- Follow recommendations in the Ecology audit letter to develop and implement standardized practices, policies and procedures that reduce stormwater impacts.
- Prepare standardized procedures to meet the standards described in the NPDES Permit.
- Institute formal procedures for documenting inspection results for City-owned maintenance facilities, to meet SWPPP requirements.

Recommendations to strengthen IDDE Program elements are:

- Document the standard procedures the City follows when addressing illicit discharges.
- Document the City's compliance strategy that includes informal actions (e.g., public education, technical assistance) and enforcement.

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Chapter 5 Financial Program

5.1 Objective and Plan Content

The objective of the financial program chapter is to identify the total cost of operating and maintaining the City's SWM Division and its programs, provide adequate funding to meet the SWM utility improvement schedule, and assist in establishing sufficient fees for service.

The financial program is crucial to the successful implementation of the prescribed capital plan within the Surface Water Management Plan as well as ongoing operations. A comprehensive financial program provides a detailed account of methods to fund the capital plan and demonstrate the utility is funded in a financially sustainable manner over the course of the planning period.

The methods used in this study followed general industry guidelines for developing utility rates—rates must generate enough revenue to be self-supporting and financially viable, without undue discrimination toward or against any customer. Detailed exhibits are provided in Appendix I.

Legal authority for a city to operate a surface water utility comes from the Revised Code of Washington (RCW) Section 35.67.025, which states "any public entity and public property, including the state of Washington and state property shall be subject to rates and charge for storm water control facilities to the same extent private persons and private property are subject to such rate and charges." Additionally RCW 35.67.020 allows for cities "to fix, alter, regulate, and control the rates and charges for their use," which includes surface water management.

5.2 Past and Present Financial Status

The City formerly created their SWM program in 1994 to manage the stormwater runoff within the City's boundaries. The goals of the SWM program are to adhere to regulatory requirements as well as to protect public health and safety. Much like many other cities around the country, the City has been expanding their program to fulfill their goals and objectives. Since 1994 the residential rate has increased by an average of 3.4% per year. While the average annual increase has been 3.4%, the actual rate increases have seen annual increases of 20% or greater four separate times over 23 years. During the same time the average annual consumer price index for the Seattle-Tacoma-Bremerton metropolitan statistical area (MSA), or inflation rate is 2.5%. The detail of the rate changes in provided in Figure 5-1.

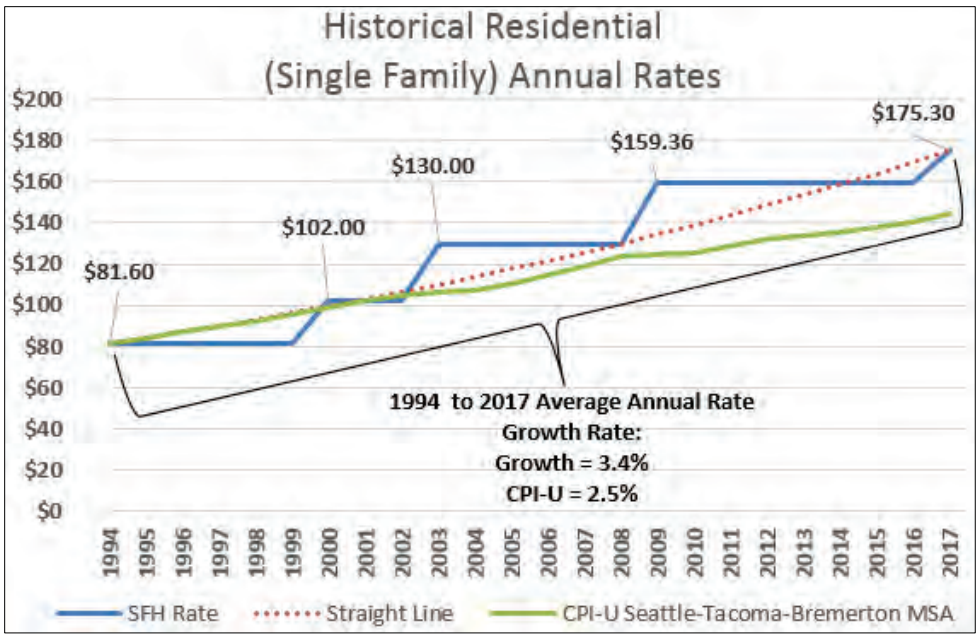

Figure 5-1. Historical Residential (Single Family) Annual Rates

The City operates the SWM Utility as a self-supporting entity and provides affordable SWM to its customers. Table 5-1 provides the City's historical revenue and expenditures over the last 4 years.

Table 5-1. Historical Revenue and Expenditures

Description	2013 Actuals	2014 Actuals	2015 Actuals	2016 Actuals
Beginning Fund Balance	**$1,711,071**	**$1,418,516**	**$2,043,530**	**$1,448,270**
Revenue				
Surface Water Rate Revenue	$762,148	$826,985	$810,004	$820,434
Other Revenue	$329,448	$643,556	$53,880	$571,658
Total Revenue	**$1,091,596**	**$1,470,541**	**$863,884**	**$1,392,092**
Expenditures				
Salary & Benefits	$109,439	$262,944	$311,391	$325,221
Supplies	$18,480	$10,212	$37,096	$26,806
Services	$107,129	$83,446	$89,399	$230,123
Training	$101	$638	$1,780	$636
Intergovernmental	$65,909	$65,833	$77,271	$81,758
Total Expenditures	**$301,058**	**$423,073**	**$516,937**	**$664,544**
Capital Costs	$807,846	$416,060	$879,960	$639,473
Operating Transfers	$280,364	$0	$60,000	$398,868
Change in Liability	$5,117	($6,859)	($2,247)	$0
Ending Fund Balance	**$1,418,516**	**$2,043,065**	**$1,448,270**	**$1,137,477**

SWM rate revenue is fairly consistent from year to year. Other revenue consists of right of way leases, operating grants, developer contributions, stormwater review fees, and fines and penalties. Total additional revenue may vary from year to year depending on the level of capital grants and developer contributions. Capital grants and developer contributions are generally restricted for capital funding.

The City's expenditures have increased annually based on the cost to provide service. The increase in expenditures does include some expenses that might be considered one time or intermittent such as professional services. In the last few years the ending fund balance has been declining due to the expenditures exceeding revenue in those years. This is a trend that will likely continue unless expenditures are reduced significantly or revenue is increased. Revenue increases are the recommended action as reducing expenditures will make it difficult, if not impossible, to meet requirements of the City's NPDES Permit and meet the overall SWM goals and objectives.

5.3 Current Rates

The City's current rate structure consists of ten rate classes (categories). Rate categories 1 and 2, or Residential and Very Light Development respectively, are charged a flat fee per parcel. The remaining rate classes, 3 through 7, are charged based on the percent of impervious service per total parcel acreage. Currently the City has three customer classes not in use. These classes are Minimum Rate, Discounted Light Rate, and Discounted Residential & Light Rate which are charged per parcel. Table 5-2 provides the current rates with their defined ranges of impervious surface if applicable.

Table 5-2. Current Annual Rate

Rate Category	Rate Description	Impervious Surface	2017	Type
1	Residential (Single Family)		$175.30	per parcel
2	Very Light	≤ 10%	$209.00	per parcel
3	Light	> 10% and ≤ 20%	$487.00	per acre
4	Moderate	> 20% and ≤ 45%	$1,010.00	per acre
5	Moderately Heavy	> 45% and ≤ 65%	$1,950.00	per acre
6	Heavy	> 65% and ≤ 85%	$2,472.00	per acre
7	Very Heavy	> 85%	$3,238.00	per acre
8	Minimum Rate		$174.00	per parcel
9	Discounted Light Rate		$174.00	per parcel
10	Discounted Residential & Very Light Rate		$87.00	per parcel

Financial Policies

Financial policies are an important component of the healthy management of a public utility. The City currently has many financial and budgeting policies which help guide the SWM utility in a sustainable direction. An extensive list of the City's financial policies can be found in the appendix of the City's annual budget documents. Additionally, bond rating agencies consider strong

financial policies as favorable when assessing the utility's bond rating. The City's financial policies most relevant to rate setting are:

- One-time resources shall be identified and shall be used to support one-time expenditures. Ongoing expenditure programs shall only be supported by ongoing resources.
- The minimum Fund Balance for the City's General, Street, and Surface Water Management Funds shall be targeted at 10% of total estimated current year revenue. Current year revenue is defined as total estimated (budgeted) resources less beginning fund balances.
- Staff shall provide for a periodic evaluation of the City's fees and charges to keep the fees and charges in line with Council-established cost recovery policies.
- Where the City has authority to set fees and charges, all such fees and charges shall be adjusted annually for inflation based on the change in the Seattle-Tacoma Urban Wage Earners Consumer Price Index for the twelve month period ending June 30, or other applicable index or measure as determined by the City Council.
- Upon the issuance of any debt, the Director of Finance will establish the appropriate procedures to assure compliance with bond/debt covenants and applicable federal, State and local laws, policies and regulations.

In addition to the above polices, this analysis utilized a few generally accepted guidelines used for rate making. The following financial guidelines were observed in the development of this analysis:

- *Enterprise Fund* – The Governmental Accounting Standards Board (GASB) defines an enterprise fund as a fund that operates a business like activity and is primarily funded by user fees, such as water rates. Due to Surface Water Utility's distinction as an enterprise fund, it must be self-sustaining and recover its operating and capital costs. Enterprise funds cannot be subsidized or subsidize another fund, including the City's General Fund. The City has managed the SWM utility as a self-supporting entity since its inception in 1994.
- *Reserve Levels* – Reserve balances are necessary to cover current costs as well as future capital expenditures. Adequate cash reserves help the utility run smoothly and maintain stable rates in the future. The City's current reserve level policy is that the fund will maintain a minimum balance of 10% of annual revenue. Currently the City has vastly more than the minimum ending reserve balance with over a full year of revenue.
    - Operating Reserves provide day-to-day funding of operations, and the balance must be sufficient to cover the utility's bills, payroll, and unexpected costs, taking into account the seasonal nature of surface water utility revenue. Common operating reserve targets range between 45 and 90 days of operations and maintenance (O&M) expense or between 12% and 25% annual O&M expense. For this analysis the operating reserve target balance was assumed to be 90 days of O&M.
    - A Capital Reserve holds funds for future capital improvements. The capital reserve commonly contains restricted cash flow as well as current revenue intended for current and future capital expenditures. The City does not currently maintain a separate fund for capital funding, but for this analysis a capital reserve was assumed to be half of the operating fund balance. The target fund balance for a capital reserve is often 1 to 2% of net book value or ongoing programmatic renewal and replacement type projects. For this analysis we assumed the City's capital reserve target balance should be $100,000 per year adjusted annually for inflation.

- *Capital Funded Through Rates* – The purpose of capital funding through rates is to provide for the replacement of aging system facilities to ensure sustainability of the system for ongoing operations. The current industry standard is to allocate an amount no less than annual depreciation expense from current revenue. The analysis provides for primarily funding capital with current rate revenue and fund balance. This strategy exceed the depreciation expense minimum standard.
- *Debt Service Coverage Ratio (DSCR)* – The City has not issued debt since the time the utility was created in 1994 and does not currently have debt service coverage policy. While the utility might not currently have debt for its surface water utility, HDR recommends setting a DSCR target in the event the utility needs to borrow to fund capital. The industry standard minimum coverage requirement on outstanding revenue bonds is 1.25 times annual revenue bond debt service, using the net revenues of the utility. DSCR is calculated by subtracting operations and maintenance, taxes and debt payments from revenue then dividing by current annual debt payments. Having a 1.25 DSCR provides that the utility has sufficient revenue to pay its debt service payments on an annual basis. If the City were to issue long-term debt the City's financial advisors would assist in determining the appropriate DSCR and calculation.

Some of the above guidelines are similar to, or complimentary of the City's existing financial policies. While the other guidelines are used as a framework to which the analysis is structured.

5.4 Sources and Uses of Funds

Sources of Funds

SWM revenue is derived from rate revenue and miscellaneous revenues such as stormwater review fees, developer contributions, bank earnings, and grants. Figure 5-2 below shows that the vast majority of the operating fund's revenue is received through rate revenue collections.

The Capital plan has been funded by a combination of available sources, cash transfers from the SWM Operating Fund, and additional rate revenue recommended in this plan.

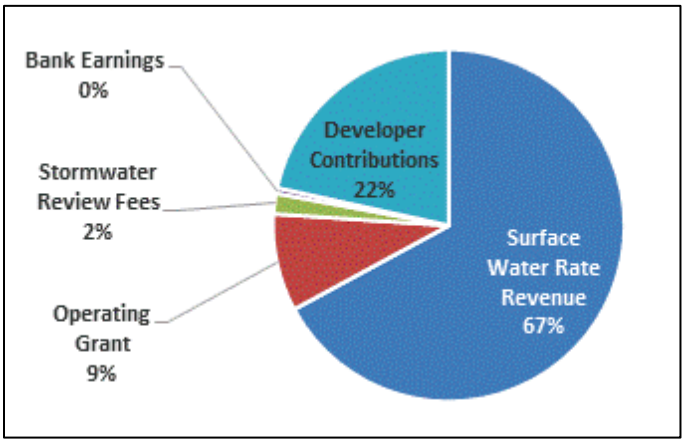

Figure 5-2. Revenue Sources 2017 Budget

Application of Funds

The SWM utility incurs a variety of expenditures, including operations and maintenance, capital funding, and taxes. Debt service is not uncommon for utilities, but the City's SWM utility does not carry it. Figure 5-3 shows the City's expected expenditures for 2017 service.

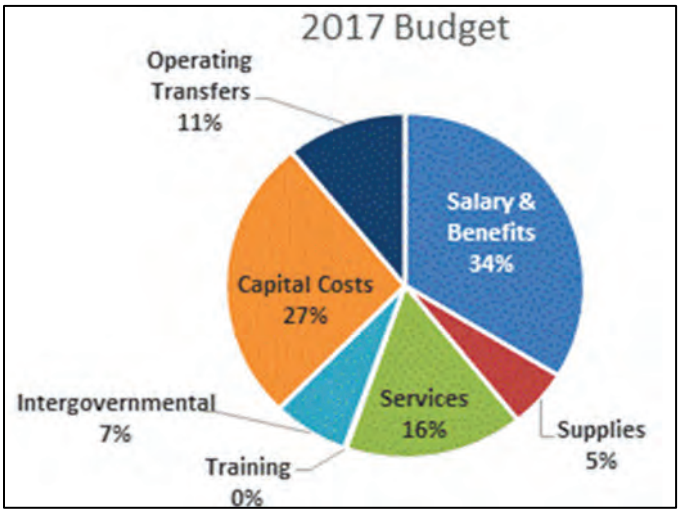

Figure 5-3. Expenditure by Type

Operations and Maintenance

O&M expenses are comprised of a variety of costs associated with the day-to-day operation and maintenance of the SWM. Salaries, benefits, supplies, inter-fund payments, and utilities are a few of the largest O&M expenses. Growth rates for these expenditures vary widely. Total salaries, the largest component of O&M, generally can only be reduced by reducing staff, as individual salaries generally rise with an index such as the consumer price index or something similar, often negotiated with union contract terms. Benefits comprise a wide range of items such as health insurance and pension. Historically, health benefits have been growing at a rate significantly higher than inflation.

Taxes

The utility pays a State tax of 1.5% which is charged to all surface water sales. The State tax is calculated as a percent of revenue; when rates are increased, additional State taxes are incurred.

Capital Funding

Utilities fund capital improvements in many ways, through rate revenues, impact fees, reserves, or long-term debt in the form of loans or bonds. Often utilities employ several means of funding capital projects and for a variety of reasons. At times capital funding mechanisms are restricted to certain uses such as funding capacity-related projects or possibly loans secured for particular projects. Bonds can also be restricted to what the utility stated they were going to fund with the bonds at the time the bond was issued.

Capital Funded Through Rate Revenue – Some utilities choose to fund their capital plan entirely through current revenue and reserve funds; however, this is rare because utilities are often discouraged from holding excess cash balances that they would need for variations in annual capital costs. Most utilities use a mix of capital funding mechanisms such as rate revenue and

long-term debt. As it happens, the amount of capital a utility funds through rates is indicative of the financial health of the utility.

Debt Service – Debt service is the payment of principal and interest on debt issued by the utility. Often when a utility issues debt, the issuer imposes covenants on the utility to ensure the utility is financially sound to be able to repay the debt. One common covenant imposed is DSCR, which is commonly stipulated at 1.25 for revenue bonds. This means after expenditures and taxes are paid the Utility has revenue equal to 125% of the debt service remaining.

$$\frac{Revenue - Expenditures - Taxes}{Debt\ Service} => 1.25$$

5.5 Capital Funding Plan and Projected Financial Results

As mentioned earlier, a major component of a capital plan is how it will be funded. To adequately determine how a capital plan will be funded, a financial plan must be undertaken. While there are a few generally accepted methods for conducting a financial plan, the cash basis for determining the revenue requirement is the most common method among public utilities.

The cash basis revenue requirement analysis is the comparison of projected revenue and revenue requirement to determine if the revenue is sufficient to responsibly manage the utility. The components of a cash basis revenue requirement are available funds or revenue, compared to expenditures for operations and maintenance, capital funded through rates, taxes, transfers, and debt service. Table 5-3 provides an overview of this concept.

Table 5-3. Overview of a Cash Basis Revenue Requirement

Overview of a Cash Basis Revenue Requirement
Available Funds
Application of Funds
Operations & Maintenance
Capital Funded Through Rates
Taxes and Transfers
Debt Service
= Application of Funds
(Available Funds) – (Application of Funds)
= Balance (Deficiency) of Funds

Capital projects funded through rates and debt service are the two areas where the capital funding plan affects the revenue requirements most. In a capital funding plan, bond issues or loans will increase the debt service in addition to an increased level of capital funding through rates. For this analysis, low interest loans were assumed for 2020 and 2022 to cover half of the two flow control vault projects. If low interest loans cannot be secured, those projects will not be done until funding is available.

The central purpose of this analysis is to develop a funding strategy for the capital plan developed for this CSWM Plan. To that end, the capital plan used for this analysis is a real dollar representation of the capital plan developed in the earlier section of this document. Table 5-4 is the proposed capital plan by project, with annual funding requirements escalated to real dollars.

Table 5-5 follows and is the suggested funding plan for the capital plan. Figure 5-4 shows current revenue in the City's SWM program as compared to projected revenue needs.

Table 5-4. Proposed SWM CIP Project List and Annual Funding Recommendations

Capital Improvement Plan ($1,000s)	2018	2019	2020	2021	2022	2023	2024	2025	2026	TOTAL
Capital Improvement Plan										
Railroad Embankment Newport Hills Creek	$35	$0	$0	$0	$0	$0	$0	$0	$0	**$35**
Detention Pond Restoration Program	$25	$25	$26	$26	$27	$28	$29	$29	$30	**$245**
135th Place SE Culvert Inlet Retrofit	$0	$0	$0	$0	$0	$0	$0	$62	$0	**$62**
Storm Conveyance Rehabilitation Program	$100	$103	$105	$108	$110	$113	$116	$119	$122	**$995**
Landcastle Creek Streambank Restoration Project	$0	$0	$0	$0	$0	$0	$0	$176	$533	**$708**
116th Avenue SE and SE 72nd Street Flow Control Vault	$0	$0	$170	$370	$0	$0	$0	$0	$0	**$539**
116th Avenue SE and SE 76th Street Flow Control Vault	$0	$0	$0	$0	$143	$304	$0	$0	$0	**$447**
Roadway/Sidewalk Seepage Program	$62	$53	$43	$0	$45	$0	$48	$0	$50	**$301**
144th Place SE Culvert Replacement and Ditch Rehabilitation Project	$0	$0	$0	$0	$0	$0	$0	$0	$356	**$356**
SE 90th Street Drainage Improvement Project	$0	$0	$0	$0	$0	$193	$0	$0	$0	**$193**
SWM Participation in Transportation Capital Fund Projects [1]	$61	$143	$31	$203	$140	$0	$0	$0	$0	**$576**
CIP Total Annual Costs*	**$282**	**$323**	**$375**	**$706**	**$465**	**$637**	**$192**	**$386**	**$1,090**	**$4,456**

Note: Table Values in $1,000s

[1] SWM Participation in Transportation Capital Fund Projects is a capital expenditure but not technically a system improvement recommended earlier in this document. The capital costs were provided by the City representing projected capital equipment costs.

*Numbers do not always sum exactly to annual totals due to rounding

Table 5-5. SWM Capital Improvement Funding Recommendations

Capital Improvement Funding ($1,000s)	2018	2019	2020	2021	2022	2023	2024	2025	2026
Beginning Capital Reserve Fund Balance	$478	$217	$25	$221	$15	$243	$183	$547	$743
Plus Funding Sources									
Use of Operating Reserve Funds	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capital Funded through Rates	20	130	400	500	550	575	550	575	600
Debt Issues	0	0	170	0	143	0	0	0	0
Interest Earning	1	0	1	0	1	2	5	7	3
Less Uses									
Capital Improvement Plan	($282)	($323)	($375)	($706)	($465)	($637)	($192)	($386)	($1,090)
Ending Capital Reserve Fund Balance	$217	$25	$221	$15	$243	$183	$547	$743	$255

Note: Table Values in $1,000s

For this analysis, the City's 2017 budget was used as a starting point for projecting the revenue requirement. Beyond 2017, escalation factors were used for the projections. Escalation factors ranged from 4.7% to as low as 0%, depending on the particular expense or revenue. Escalation factors are based on current growth rates for the Seattle-Tacoma-Bremerton Consumer Price Index and recent trends witnessed among other utilities. Table 5-6 provides the escalation factors used in the financial plan.

Table 5-6. Escalation Factors

Average Annual Escalation Factors	2018-2026
Revenue	
Rate Revenue Growth	1.0%
Connection Charges	0.0%
Miscellaneous Revenue	2.0%
Expenditures	
Salary	3.5%
Benefits	4.7%
Supplies and Equipment	2.9%
Chemicals	2.8%
Electricity	2.9%
Other Utilities	2.9%
Professional Services	2.9%
Miscellaneous	2.9%
Fuel	2.9%

Table 5-7 shows the revenue requirement analysis which is a balanced operations budget for the 10-year CIP as well as a plan for collecting the revenue necessary to maintain cash flow stability and to fund the CIP and emergency improvements if necessary. The revenue requirement analysis is designed around several assumptions, including industry standard financial policies as well as consideration for minimizing rates as much as possible for the City's customers.

Table 5-7. Revenue Requirement Analysis

	Forecast								
	2018	2019	2020	2021	2022	2023	2024	2025	2026
Revenue									
Surface Water Rate Revenue at Current Rates	$911	$920	$929	$938	$948	$957	$967	$976	$986
Non-Rate Revenue	$70	$71	$29	$30	$31	$31	$31	$32	$32
Total Revenue	$981	$990	$958	$968	$978	$988	$998	$1,008	$1,019
Expenditures									
Operating Expenses	$1,107	$1,201	$1,132	$1,272	$1,436	$1,496	$1,584	$1,624	$1,666
Capital Funded Through Rates	20	130	400	500	550	575	550	575	600
State Taxes	15	15	14	15	15	15	15	15	15
Debt Service	0	0	0	18	18	34	34	34	34
Total Expenditures	$1,142	$1,346	$1,546	$1,805	$2,019	$2,119	$2,183	$2,248	$2,315
Cumulative Balance (Deficiency) of Funds	($161)	($355)	($588)	($837)	($1,041)	($1,131)	($1,184)	($1,239)	($1,296)
Cumulative Bal.(Defic.) as a Percent of Rates	18.0%	39.2%	64.3%	90.6%	111.6%	120.0%	124.4%	128.9%	133.5%
Proposed Rate Adjustment	18.0%	18.0%	18.0%	16.0%	11.0%	4.0%	2.0%	2.0%	2.0%
Cumulative Proposed Rate Adjustment	18.0%	39.2%	64.3%	90.6%	111.6%	120.0%	124.4%	128.9%	133.5%
Rate Revenue After Adjustment	$1,075	$1,281	$1,527	$1,788	$2,005	$2,106	$2,170	$2,235	$2,303
Additional Taxes With Rate Adjustment	$3	$6	$9	$13	$16	$18	$19	$19	$20
Net Cash flow after Rate Adjustment	($0)	$0	$0	$0	$0	$0	$0	$0	($0)
Sample Residential Bill	$202.79	$239.29	$282.36	$327.54	$363.56	$378.11	$385.67	$393.38	$401.25
Annual Average Increase	$27.49	$36.50	$43.07	$45.18	$36.03	$14.54	$7.56	$7.71	$7.87

Note: Table Values in $1,000s

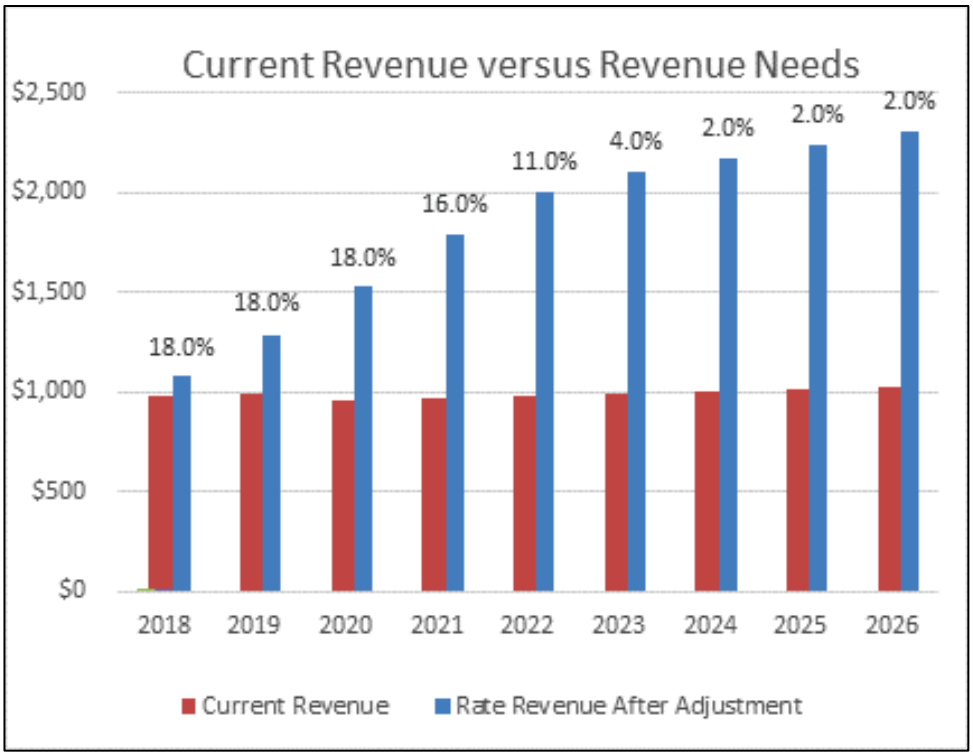

Figure 5-4. Current Revenue versus Revenue Needs

The results of the analysis showed the need for 18% annual rate increases for 2018 through 2020, 16% in 2021, 11% in 2022, 4% in 2023, then 2.0% per year thereafter. The aforementioned rate increases are primarily needed for funding the capital program while maintaining the current level of service and remaining compliant with the City's NPDES Permit. This analysis assumes small low interest loans to help mitigate rate impacts. Other alternative funding sources like grants were not assumed during the analysis period. If other alternative funding sources are identified and successfully awarded, it could reduce future overall rate adjustments.

Several of the financial policy metrics discussed earlier are contained in Table 5-8. The Operating Fund balance target is 90 days of O&M. This 90-day target means that the utility has cash on hand available to fund 3 months or 25% of annual operating expenditures. The analysis estimates that the City will be above their policy of 90 days of O&M expense throughout the analysis period. It is generally encouraged to maintain a capital reserve fund separate from operational monies. It is also common practice for rate studies to separate capital funds from operating funds to facilitate proper and continued capital funding. The City does not currently maintain a separate capital reserve, so for this analysis one was created for planning purposes. Ideally a capital reserve fund would have some funds available for unplanned capital projects as well as help smooth out rate impacts from swings in annual capital project costs. For this analysis, the target capital reserve fund balance was $100,000, adjusted for inflation annually, and the ending fund balance was projected to be approximately $255,000 at the end of the analysis period. At the end of the analysis the average over the 10-year period was approximately $292,000. It is expected the fund balance would fluctuate due to the uneven level of capital project costs year to year.

Table 5-8. Financial Policy Metrics

	Forecast								
	2018	2019	2020	2021	2022	2023	2024	2025	2026
Debt Service Coverage Ratio After Adjustment	0.00	0.00	0.00	28.12	30.84	17.94	17.21	17.94	18.68
Operating Fund									
Beginning Fund Balance	$570	$530	$543	$443	$333	$337	$351	$401	$438
Additions									
Balance of Revenue After Operating Costs	$0	$7	$0	$0	$1	$10	$46	$33	$19
Interest Earnings	$3	$5	$4	$3	$3	$3	$4	$4	$5
Uses									
Deficiency of Revenue After Operating Costs	($42)	$0	($104)	($113)	$0	$0	$0	$0	$0
Transfer to Capital Reserve	$0	$0	$0	$0	$0	$0	$0	$0	$0
Ending Fund Balance	$530	$543	$443	$333	$337	$351	$401	$438	$462
Days of O&M (Target = 90)	193	183	144	96	94	94	104	110	112

Note: Table Values in $1,000s

Table 5-8. Financial Policy Metrics (Continued)

	Forecast								
	2018	2019	2020	2021	2022	2023	2024	2025	2026
Capital Reserve Fund									
Beginning Fund Balance	$478	$217	$25	$221	$15	$243	$183	$547	$743
Additions									
Capital Funded Through Rates	$20	$130	$400	$500	$550	$575	$550	$575	$600
Capital Grant	$0	$0	$0	$0	$0	$0	$0	$0	$0
Opportunity Grant	$0	$0	$0	$0	$0	$0	$0	$0	$0
Transfer from Operating Fund	$0	$0	$0	$0	$0	$0	$0	$0	$0
Debt Issues	$0	$0	$170	$0	$143	$0	$0	$0	$0
Interest Earnings	$1	$0	$1	$0	$1	$2	$5	$7	$3
Uses									
Capital Expenditures	($282)	($323)	($375)	($706)	($465)	($637)	($192)	($386)	($1,090)
Ending Fund Balance	$217	$25	$221	$15	$243	$183	$547	$743	$255
CIP Target Balance	$103	$105	$108	$110	$113	$116	$119	$122	$125
Combined Beginning Fund Balance	$1,048	$748	$568	$664	$347	$581	$534	$948	$1,181
Combined Ending Fund Balance	$748	$568	$664	$347	$581	$534	$948	$1,181	$717

Note: Table Values in $1,000s

5.6 Cost of Service

In addition to the development of a financial plan for the CSWM Plan, a cost of service study was conducted. A cost of service analysis is an analysis that seeks to determine the adequacy of the existing rates by the utility's customer classes of service. While a financial plan or revenue requirement is a review over several future years, a cost of service analysis is a snapshot in time of the utility, so a test period must be selected as a basis of analysis. The test period is a single period chosen from the several future years of the financial plan. Additional assumptions used for the development of a cost of service are assumptions related to the design of the surface water system and customer characteristics.

A cost of service analysis generally consists of three parts, functionalization, classification and allocation of costs. Functionalization of costs is the process within the cost of service that arranges the expenses (and often assets) into major operating function. As an example, classification of costs is the determination of the expense incurred or the type of need being met. For this study, the following classifications were used in the development of the cost of service analysis:

Area (run-off) related costs: Area costs are the costs associated the amount of impervious area associated with each customer class. Impervious surfaces are the main driver behind the overall volume of stormwater that ultimately flows through the City's stormwater system.

Customer related costs: Some costs associated with the surface water utility may vary with the number of customers within the surface water system. They do not vary with system output or volume levels. An example of customer related costs are the costs related to producing customer bills.

Revenue related: Some costs associated with the surface water utility vary with the amount of revenue related costs. An example of this is state utility taxes, which are calculated based on gross revenue.

After costs are classified, those costs are then allocated to customer classes using allocation factors.

Table 5-9 provides the results of the classification of costs as well as the allocation of those costs to each customer class. The majority of costs were classified as impervious area, which is very common among surface water cost of service studies. The logic behind this method for cost classification is that if not for impervious surfaces the surface water drainage structures would not be necessary. While this may not be completely the case for every surface water system, it is the best way to quantify customer's impact on the surface water system. Customer and revenue related classified costs made up a much smaller portion of the total system costs.

Also in Table 5-9 is the allocation of the classified costs to the City's customer classes. As the table indicates, the majority of the impervious area costs are allocated to residential customer class. Since the impervious area costs are allocated based on the customer classes' total impervious area, it would indicate that the majority of the impervious acres are within the residential properties. The City currently charges Residential and Very Light customer classes per parcel while the remainder classifications are charged based on actual acres of land. For customers charged per acre, the rate classes are divided up based on the percentage of impervious area per acre.

Table 5-9. Allocation Summary

Classification	Impervious Area	Customer Related	Revenue Related	Direct Assignment	Allocation of Net Revenue Requirements
Residential	$547	$72	$17	$0	$636
Very Light	$47	$0	$0	$0	$48
Light	$7	$0	$0	$0	$7
Moderate	$108	$0	$3	$0	$111
Moderately Heavy	$110	$0	$3	$0	$113
Heavy	$103	$0	$3	$0	$106
Very Heavy	$48	$0	$2	$0	$50
Total	$970	$73	$28	$0	$1,072

Note: Table values in $1,000s

Table 5-10 provides the results of the cost of service analysis. The table compares the customer current revenue to the allocated revenue and provides the percent change in rate needed to bring the rate up to their cost of service. It is generally believed that if a customer class is within 5% of the overall rate adjustment, they are within an acceptable range to be considered at the cost of service. The Residential customer class is very close to their cost of service while the other classes of services are outside the generally acceptable range. The most notable result is the Very Light customer class that shows a need for a very high percentage change. The Very Light customer class is charged based on parcel rather than by acre. The majority of the customers in this class of service are golf courses which are often large parcels of land with little impervious surface. Table 5-11 provides some insight into the reasons for the results of the cost of service analysis. The current revenue per acre of the Very Light customer class is approximately $7.00 per acre while customers with twice the impervious area in the light customer classes are paying almost $500 per acre.

Table 5-10. Cost of Service Results

Cost of Service Summary	Revenues at Present Rates	Allocated Revenue Requirement	Additional Taxes with Adjustment	Balance/ (Deficiency) of Funds	Change Over Present Rates
Residential	$551	$636	$2	($86)	15.7%
Very Light	$3	$48	$0	($45)	1787.3%
Light	$8	$7	$0	$0	-2.1%
Moderate	$92	$111	$0	($19)	20.8%
Moderately Heavy	$106	$113	$0	($8)	7.7%
Heavy	$102	$106	$0	($5)	4.6%
Very Heavy	$50	$50	$0	($0)	0.6%
Total	$911	$1,072	$3	($164)	18.0%

Note: Table Values in $1,000s

The final component of a cost of service study is the development of unit costs. Table 5-11 also provides the unit costs for the cost of service results and is useful for comparing customer classes to each other on a common basis, such as their cost per acre of imperious surface area or their cost per acre in total.

Table 5-11. Unit Cost Summary

Unit Cost Summary	Current Revenue per Unit		Cost of Service Results per Unit			
	Current Revenue/ Acre	Current Revenue/ Customer	Impervious Area Cost/ Acre of Impervious	Customer & Revised Related Cost/ Customer	Total Cost/ Acre	Total Cost/ Customer
Residential	$525.55	$177.05	$3,477.52	$28.58	$606.46	$204.31
Very Light	$6.95	$211.09	$3,477.52	$29.64	$130.92	$3,974.05
Light	$491.87	$1,876.48	$3,477.52	$81.58	$480.25	$1,832.16
Moderate	$1,020.10	$8,399.13	$3,477.52	$284.99	$1,229.21	$10,120.88
Moderately Heavy	$1,969.50	$5,024.10	$3,477.52	$179.74	$2,116.78	$5,399.81
Heavy	$2,496.72	$7,830.10	$3,477.52	$267.24	$2,605.77	$8,172.11
Very Heavy	$3,270.38	$4,970.98	$3,477.52	$178.08	$3,281.25	$4,987.49
Total	$559.21	$285.96	$3,477.52	$31.97	$658.24	$336.60

Table 5-12 shows the number of customers per rate class as well as the number of acres and imperious area. These units were used to allocate the costs to each rate classes resulting in the classes allocated cost of service.

Table 5-12. Customer Units

Class	# of Customers	Acres	Impervious Acres	Area Impervious
Residential	3,114	1,049	157	15%
Very Light (≤ 10%)	12	364	14	4%
Light (> 10% and ≤ 20%)	4	15	2	13%
Moderate (> 20% and ≤ 45%)	11	91	31	34%
Moderately Heavy (> 45% and ≤ 65%)	21	54	32	59%
Heavy (> 65% and ≤ 85%)	13	41	30	72%
Very Heavy (> 85%)	10	15	14	91%
Total	3,185	1,629	279	17%

Table 5-13 shows the combined output of the revenue requirement and the cost of service analysis.

Table 5-13. Projected Rate Revenue by Customer Class

	2018 Rev Before Adjust.	Cost of Service Analysis Adjust.	2018	2019	2020	2021	2022	2023	2024	2025	2026
Overall Adjustments											
Increases				18.0%	18.0%	16.0%	11.0%	4.0%	2.0%	2.0%	2.0%
Cumulative Increase				39.2%	64.3%	90.6%	111.6%	120.0%	124.4%	128.9%	133.5%
Total Class Revenue Adjustments											
Residential	$551,343	15.7%	$637,768	$760,092	$905,878	$1,061,327	$1,189,853	$1,249,822	$1,287,567	$1,326,451	$1,366,510
Very Light (≤ 10%)	2,533	1787.3%	$47,806	$56,976	$67,903	$79,556	$89,190	$93,685	$96,514	$99,429	$102,432
Light (> 10% and ≤ 20%)	7,506	0.0%	$7,379	$8,794	$10,481	$12,280	$13,767	$14,461	$14,897	$15,347	$15,811
Moderate (> 20% and ≤ 45%)	92,390	20.8%	$111,601	$133,006	$158,517	$185,719	$208,209	$218,703	$225,308	$232,112	$239,122
Moderately Heavy (> 45% and ≤ 65%)	105,506	7.7%	$113,672	$135,475	$161,459	$189,165	$212,073	$222,762	$229,489	$236,419	$243,559
Heavy (> 65% and ≤ 85%)	101,791	4.6%	$106,496	$126,922	$151,266	$177,223	$198,685	$208,698	$215,001	$221,494	$228,183
Very Heavy (> 85%)	49,710	0.6%	$49,996	$59,586	$71,014	$83,200	$93,276	$97,977	$100,936	$103,984	$107,124
Total	$910,780	18.0%	$1,074,720	$1,280,851	$1,526,519	$1,788,469	$2,005,053	$2,106,107	$2,169,712	$2,235,237	$2,302,741
Less Additional Taxes			($2,648)	($5,829)	($9,241)	($13,159)	($16,370)	($17,791)	($18,631)	($19,500)	($20,398)
Plus Misc. Revenue			$70,000	$70,500	$29,000	$30,000	$30,500	$31,000	$31,480	$31,970	$32,469
Total Revenue Requirement			$1,142,072	$1,345,522	$1,546,277	$1,805,310	$2,019,183	$2,119,316	$2,182,561	$2,247,707	$2,314,813

5.7 Assessment of Rates

Given the rate adjustment proposed in this section, the City should be able to adequately fund the capital program as well run its operations in a sustainable manner.

The existing rate structure consists of either a charge per parcel or a charge per acre based on the relative percent of impervious area. Table 5-14 provides a historical perspective of the City's rates from 1994 to 2017. The City has not significantly changed the structure of their rates since they were originally implemented.

Table 5-14. Historical Rate

			Res. 1994-43	Res. 2000-216	Res. 2008-430	Res. 2008-0430	Res. 2008-0430	Res. 2010-0481	Res. 2016-676
Rate Category	Rate Description	Impervious Surface	1994	2000	2003	2009	2010	2011	2017
1	Residential (Single Family)		$85.02	$102.00	$130.00	$159.36	$195.48	$159.36	$175.30
2	Very Light	≤ 10%	$85.02	$102.00	$130.00	$159.36	$195.48	$195.48	$209.00
3	Light	> 10% and ≤ 20%	$198.40	$238.02	$303.36	$371.95	$456.05	$456.05	$487.00
4	Moderate	> 20% and ≤ 45%	$410.98	$493.05	$628.40	$770.48	$944.69	$944.69	$1,010.00
5	Moderately Heavy	> 45% and ≤ 65%	$793.60	$952.06	$1,213.41	$1,487.76	$1,824.15	$1,824.15	$1,950.00
6	Heavy	> 65% and ≤ 85%	$1,006.16	$1,207.07	$1,538.42	$1,886.26	$2,312.74	$2,312.74	$2,472.00
7	Very Heavy	> 85%	$1,317.94	$1,581.14	$2,015.18	$24,070.81	$3,029.46	$3,029.46	$3,238.00
8	Minimum Rate		NA	NA	$108.36	$132.86	$151.98	$162.62	$174.00
9	Discounted Light Rate		NA	NA	$108.36	$132.86	$151.98	$162.62	$174.00
10	Discounted Residential & Very Light Rate		NA	NA	$54.18	$66.43	$75.99	$81.31	$87.00

Based on the revenue requirement and cost of service analysis, cost based rates can be prepared. The City's current rate structure consists of two classes of service that are charged per parcel and the remaining five classes charged per acre, based on a range of percent of impervious surface area. The City also has three classes of service that are not currently in use. Those classes of service not in use were not included in the cost of service study because they did not have the necessary customer data needed to perform the analysis.

The overall structure of Rates was not considered for this analysis. The current rate structure appears sufficient to allow for proper allocation of cost with a minor adjustment to the Very Light rate class. As mentioned before, the Very Light rate is currently charged per parcel regardless of the number of acres. The proposed rates includes a change for the Very Light rate class from a per parcel rate to a per acre rate. Table 5-15 provides the proposed rate adjustment for the SWM Utility. The first year consists of cost of service adjustments per customer class. The cost of service adjustments show Residential very near the overall adjustment of 18% while many others are somewhat outside the normal variance of industry standards.

The class of service most out-of-line with industry standards is the Very Light rate class, which, as mentioned earlier, is because that it is charged per parcel rather than per acre. To illustrate the costs differences between allocated costs and current revenue, Figure 5-5 shows a comparison of the current revenue per impervious area to the allocated costs per impervious area. As previously discussed, impervious area is the main basis for allocated costs in a cost of service analysis. This is based on the premise that a stormwater utility function is primarily to mitigate the impact of runoff from artificial impervious surfaces.

Figure 5-5 shows that the Very Light customer class is charged a small amount per impervious area compared to their allocated costs as well as compared to other customer classes.

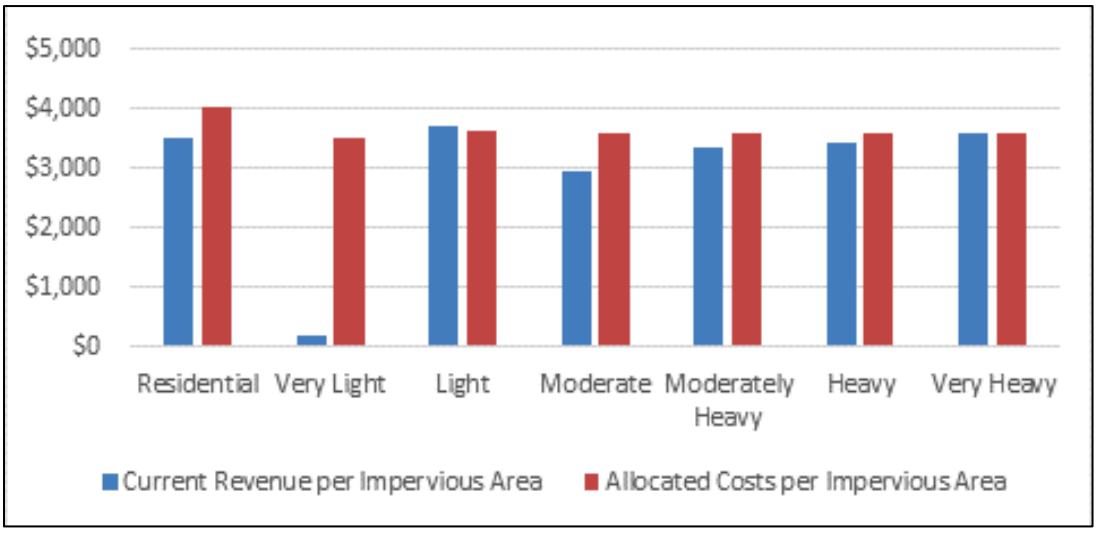

Figure 5-5. Revenue per Impervious Area Compared to Allocated Cost per Impervious Area

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Table 5-15. Projected Future Rates

Proposed Rate Adjustments						18.0%	18.0%	16.0%	11.0%	4.0%	2.0%	2.0%	2.0%	Unit
Rate Category	Rate Description	Impervious Surface	2017	Cost of Service Adjustments	2018	2019	2020	2021	2022	2023	2024	2025	2026	
1	Residential (Single Family)		$175.30	**15.7%**	$202.79	$239.29	$282.36	$327.54	$363.56	$378.11	$385.67	$393.38	$401.25	per parcel
2	Very Light	≤ 10%	209.00	**1787.3%**	$131.25	$154.87	$182.75	$211.99	$235.30	$244.72	$249.61	$254.60	$259.70	per acre
3	Light	> 10% and ≤ 20%	487.00	**0.0%**	$487.00	$574.66	$678.10	$786.59	$873.12	$908.04	$926.21	$944.73	$963.62	per acre
4	Moderate	> 20% and ≤ 45%	1,010.00	**20.8%**	$1,220.05	$1,439.66	$1,698.79	$1,970.60	$2,187.37	$2,274.86	$2,320.36	$2,366.77	$2,414.10	per acre
5	Moderately Heavy	> 45% and ≤ 65%	1,950.00	**7.7%**	$2,101.00	$2,479.18	$2,925.43	$3,393.50	$3,766.79	$3,917.46	$3,995.81	$4,075.73	$4,157.24	per acre
6	Heavy	> 65% and ≤ 85%	2,472.00	**4.6%**	$2,586.35	$3,051.89	$3,601.23	$4,177.43	$4,636.94	$4,822.42	$4,918.87	$5,017.25	$5,117.59	per acre
7	Very Heavy	> 85%	3,238.00	**0.6%**	$3,256.78	$3,843.00	$4,534.74	$5,260.30	$5,838.94	$6,072.49	$6,193.94	$6,317.82	$6,444.18	per acre
8	Minimum Rate		174.00	**16.5%**	$202.79	$239.29	$282.36	$327.54	$363.56	$378.11	$385.67	$393.38	$401.25	per parcel
9	Discounted Light Rate		174.00	**18.0%**	$205.32	$242.28	$285.89	$331.63	$368.11	$382.83	$390.49	$398.30	$406.27	per parcel
10	Discounted Residential & Very Light Rate		87.00	**18.0%**	$102.66	$121.14	$142.94	$165.81	$184.05	$191.42	$195.24	$199.15	$203.13	per parcel

* Since the cost of service results showed a change for the Light rate class that would not be materially different than zero no change was proposed for the 2018 rates.

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Chapter 6 Recommended Stormwater Management Actions

The purpose of this chapter is to present recommended approaches for addressing identified deficiencies and gaps in the City's SWM Division's programs. This chapter is a summary of recommendations, which include CIP projects, SWMP adjustments, and a recommendation to implement future renewal and replacement costs of built stormwater infrastructure based on condition assessment. Supporting details and background information are included in previous chapters and the appendices.

6.1 Capital Improvement Program

The following 10-year capital program recommends projects in a particular sequence that addresses the most imminent known flooding risks while meeting the City's financial policies (see Table 5-4 for proposed implementation schedule).

- Implement an annual maintenance program to restore detention pond function so that constructed stormwater facilities continue to function as designed. Prioritize maintenance work by first removing all woody vegetation from each of the ponds and inspecting the flow control components and embankments. Obtain programmatic maintenance permits for program efficiencies to distinguish work performed in stormwater facilities from work being performed in a critical area.
- Initiate the Roadway/Sidewalk Seepage Program and begin design of the first project in the program, the SE 76th Street Roadway Seepage Project. This project will improve public safety by routing groundwater away from the roadway. Continue to fund this program to address several other groundwater seepage problems throughout the City.
- Initiate the Storm Conveyance Pipe Rehabilitation Program and begin design of the first project at 136th Avenue SE. This project addresses an immediate threat to structural flooding and improves drainage function in the area. This program could potentially address ongoing drainage problems located at SE 90th Street.
- Beginning in 2020, implement the design and construction of three separate CIP projects (CIP Projects 5, 6, and 4) to address erosion and sedimentation issues in the Landcastle Area over a 6-year period. In the interim period between 2017 and construction of the final project, continue the present-day infrastructure inspection and maintenance program. Collectively, the proposed vaults retro-fit an upstream tributary area of 44.4 acres.
- The recommendation for the existing CIP project from the 2010 Plan, Railroad Embankment/Newport Hills Creek, is to proceed with a Phase 1 Assessment. A Phase 1 Assessment includes reviewing existing information, conducting a field reconnaissance inspection, and providing guidance for the second phase, which consists of geotechnical data collection such as borings, hand-auger sample collection, and grain size analyses.

6.2 Stormwater Management Program

The 2016 audit by Ecology of the City's SWMP made the following recommendations:

- Develop and implement standardized practices, policies and procedures that institute formal procedures for documenting inspection results and maintenance activities for City-owned

assets, including maintenance facilities within the designated timeframes stipulated in the City's NPDES Permit.

- Review the City's existing SWPPP and verify City maintenance activities follow procedures identified in the SWPPP. Document the results.
- Conduct a thorough review of the City's Standard Operating Procedures (SOP) documentation for compliance with NPDES Permit requirements. Current SOPs are "very abbreviated," according to the Ecology report.

In addition, based on HDR's SWMP gap analysis the following recommendations are made:

- Review the City's ordinances and verify that they state that a responsible party is identified for implementing inspection results of stormwater facilities.
- Document anecdotal and/or visual observations of stormwater runoff from facilities to evaluate effectiveness of BMPs.
- Implement detailed labor tracking programs associated with cost to implement the SWMP. This data can be a resource for future resource allocations and facilitate prioritization of SWM activities.

6.3 Operating Program Recommendations

SWM maintenance staff identified three neighborhood areas (see Figure 3-4) where drainage infrastructure is difficult to maintain or is inaccessible. Based on site reconnaissance and SWM maintenance staff information, a condition assessment of these areas is recommended. Once completed, an ongoing CCTV inspection program is recommended to position the City with a proactive asset management program that provides intergenerational equity for City residents. The condition assessment will rely on CCTV inspection results to direct future action items of infrastructure renewal or rehabilitation.

6.4 Stormwater Management Program Funding

The financial analysis of the City's SWM Division considered the identified capital and NPDES program needs in conjunction with City financial policies to use SWM Utility rates to fund the program. Each year stormwater infrastructure is installed through public and private development, and with it comes the responsibility for its inspection, repair, and system operation. Regulatory demands associated with implementing the SWMP increase each year, and Ecology identified gaps in the City's SWMP as well. Given these demands, staff augmentation of 1 FTE in mid-2018 is recommended.

In 2019, Ecology will issue an updated NPDES Permit with added stormwater management conditions that will affect the City's existing resources. Considering the anticipation of NPDES demands and a full CIP implementation schedule by the midterm of the planning horizon, it is recommended that a re-evaluation of the FTE demands be scheduled.

The added 2018 FTE would conduct inspections of catch basins, flow control facilities, and water quality facilities as required by NPDES Permit requirements (0.5 FTE), as well as assist with other SWM programs (0.5 FTE). To help with the increased workload, an additional FTE was assumed in the analysis for 2021.

The financial analysis performed in association with this CSWM Plan recommends rate adjustments of 20% in 2018, 2019, 2020, and 2021 and 4% in 2022, primarily to pay for the capital program and additional staff needed to implement the recommended action items.

Thereafter, annual rate adjustments for 2023 through 2026 would be 2%. The recommended rate adjustments are designed to fully fund daily operations and maintenance as well as fully fund, with utility rates, the capital program provided in this CSWM Plan. Also provided in the financial chapter are cost-based individual customer class adjustments.

6.5 Conclusion

The City's 2017 CSMP update evaluated the City's storm and surface water system that is comprised of built and natural drainage assets. The City's SWM Division sets policies to maintain and improve the quality of the natural waterways as well as address flooding concerns. In the course of updating the 2017 CSWM Plan, it was concluded that much of the City's drainage system assets are functioning well; however, there are several capital and programmatic improvements needed to address localized issues and to continue to meet regulatory compliance as infrastructure ages and the population of Newcastle grows. Natural drainage courses exhibited encouraging stability considering the urban setting. The open channel conditions are evidence of past successes in managing the storm and surface water systems and support the need to continue providing operational programs. The 2017 update also identified capital projects and evaluated the City's NPDES SWMP that contributes to the City's Levels of Service (LOS) goals. Capital and operational needs were identified to support existing LOS goals and were the basis for the financial rate study that was also part of the update. The purpose of the financial rate study was to assess SWM's current financial condition as well as recommend a funding plan to meet its goals and objectives in the future. The findings of the analysis suggest that current funding levels are insufficient to meet the City's current operational and maintenance needs or meet anticipated NPDES Permit requirements. The proposed capital program is an additional financial strain that current funding rates do not support. In light of these deficiencies in the current funding levels, it is recommended that the City adopt the rate adjustments and schedule provided in Chapter 5.

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Appendix A – Basin Characterization Data

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Introduction

Recognizing a growing need to both quickly identify existing channel erosion problem areas and systematically evaluate general stream quality conditions on a watershed-wide scale, the Montgomery County Department of Environmental Protection (DEP) contracted the Metropolitan Washington Council of Governments (COG) to develop a set of rapid stream assessment protocols. In response, the Rapid Stream Assessment Technique (RSAT) was developed for Montgomery County, Maryland by COG in 1992. RSAT has been intentionally designed to provide a simple, rapid reconnaissance-level assessment of stream quality conditions.

The RSAT system represents a synthesis of US Environmental Protection Agency's Rapid Bioassessment Protocols (Plafkin, et.al. 1989), the Izaak Walton League and Save Our Streams stream survey techniques (Kellog, 1992), US Department of Agriculture, Water Quality Indicators Guide: Surface Waters (Terrell and Perfetti, 1989), together with COG staff's many years of local stream survey experience. Presently, the intended use and applicability of RSAT is limited to non-limestone Piedmont streams with drainage areas less than approximately 100-150 square miles. RSAT employs both a reference stream and an integrated numerical scoring and verbal ranking approach.[1] Major abiotic and biotic factors which influence overall stream quality have been streamlined, weighed and placed into the six following general RSAT evaluation categories:

1. Channel Stability;
2. Channel Scouring/Sediment Deposition;
3. Physical Instream Habitat;
4. Water Quality;
5. Riparian Habitat Conditions; and
6. Biological Indicators (macroinvertebrates).

In order to provide a quantitative measurement of the six preceding evaluation factors, the RSAT system employs a rigorous field evaluation protocol in which over 30 physical, chemical and biological parameters are measured at approximately 400 foot intervals along the stream (typically, 12-13 riffle transects per stream mile for smaller streams). Data is first recorded via field survey sheets and later transferred into a spreadsheet data base. Transect locations, the presence of storm drain outfalls, fish barriers, stream channel erosion problem areas and other noteworthy observations are additionally mapped onto topographic maps (preferably 1"=200' horizontal scale or larger). Last, photographic information (35mm color slide format) is catalogued so as to provide a permanent historical reference for stream areas surveyed.

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[1] Upper Rock Creek downstream of Fieldcrest Road was used as the RSAT reference site for stream areas <10 mi^2. Portions of the Gunpowder Falls, Patapsco and Patuxent Rivers were used to help characterize large mainstem reference conditions.

RSAT employs a riffle transect-based assessment approach for two main reasons: 1.) in Piedmont stream systems riffles are the principal macroinvertebrate-producing areas and 2.) riffles are both prominent and relatively permanent geomorphological features of a stream; thereby facilitating repeatable and comparable future stream assessment studies.

I. RSAT Evaluation Factors and Scoring System

An example of the 0-50 point RSAT scoring system, as applied in Montgomery County, Maryland to the Brooke Manor Country Club Branch of Rock Creek has been included as Table 1. As seen in Table 1, the channel stability evaluation category is weighed slightly more heavily than the other five categories. This was intentionally done to reflect the major influence which the stream flow regime exerts on all six evaluation categories.

Table 1. Example of RSAT Scoring for Brooke Manor Country Club Branch

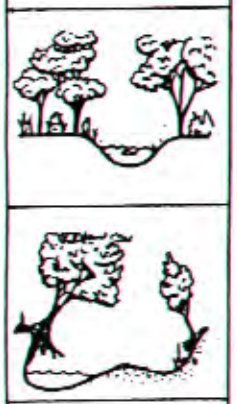
RSAT Evaluation Category	General Verbal Rating Categories and Associated Point Range				
	Excellent	Good	Fair	Poor	Points
1. Channel Stability	9-11	6-8	3-5	0-2	7
2. Channel Scouring/Deposition	7-8	5-6	3-4	0-2	4
3. Physical Instream Habitat	7-8	5-6	3-4	0-2	6
4. Water Quality	7-8	5-6	3-4	0-2	6
5. Riparian Habitat Conditions	6-7	4-5	2-3	0-2	5
6. Biological Indicators	7-8	5-6	3-4	0-2	8

Total Points	
42-50	Excellent
30-41	Good
16-29	Fair
< 16	Poor

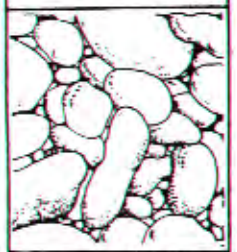
Verbal Ranking Good Total Score 36

A brief description of representative stream characteristics for each of the six preceding evaluation categories has been provided in Table 2. As seen in Table 2, necessary reference condition descriptor adjustments have been made in an attempt to account for differences associated with increased stream/catchment area size. While considerable variation often exists, large mainstem-type stream conditions generally become self-evident when drainage basin size approaches 10-15 square miles. These changes include but are not limited to the following: increased baseflow discharge, lower average stream gradient, wider channel widths and wetted perimeters, taller bank

Table 2. RSAT Evaluation Method - Representative Stream Characteristics[1]

Evaluation Category	Relative Significance	Excellent	Good	Fair	Poor
1. Channel Stability 	• Indicative of hydrologic/ flow regime alteration and general condition of physical aquatic habitat.	• > 80% of bank network stable. no evidence of bank sloughing, slumping or failure;	• 71-80% of bank network stable. infrequent signs of bank sloughing, slumping or failure;	• 50-70% of bank network stable. recent signs of bank sloughing, slumping or failure fairly common;	• <50% of bank network stable. recent bank sloughing, slumping or failure frequently observed ;
	• Provides insight into past, present and possible future changes in channel morphometry.	• stream bend areas are very stable. outerbank height <2 ft. above stream (**<4 ft. above stream for large mainstem areas**). bank overhang < 2 ft.;	• stream bend areas stable. outer bank height 2-3 ft. above stream bank (**4-5 ft. above stream bank for large mainstem areas**). overhang 2-2.5 ft.;	• stream bend areas unstable. outer bank height 3-4 ft. above stream (**5-7 ft. above stream for large mainstem areas**). bank overhang 2.5-3 ft.;	• stream bend areas highly unstable. outer bank height >4 ft. above stream. (**>7 ft. above stream for large mainstem areas**). overhang >3 ft.;
		• exposed tree roots old, large, and woody. generally 0-1 recent (large) tree falls/stream mile;	• exposed tree roots predominantly old and large, smaller young roots scarce. 2-3 recent (large) tree falls/ stream mile;	• young exposed tree roots common. 4-5 recent (large) tree falls/stream mile;	• young exposed tree roots abundant. ≥6 recent large tree falls/stream mile.;
		• bottom 1/3 of bank is generally highly resistant plant/soil matrix or material;	• bottom 1/3 of bank is generally highly resistant plant/soil matrix or material;	• bottom 1/3 of bank is generally highly erodible material; plant/soil matrix compromised;	• bottom 1/3 of bank is highly erodible material; plant/soil matrix severely compromised;

Evaluation Category	Relative Significance	Excellent	Good	Fair	Poor
1. Channel Stability (cont'd.)		*channel x-sect. is generally V or U-shaped.	*channel x-sect. is generally V or U-shaped.	*channel x-sect. is generally trapezoidally-shaped.	*channel x-sect. is generally trapezoidally-shaped.
Point Range		9-11	6-8	3-5	0-2

2. Channel Scouring/ Sediment Deposition 	• Relates to level of uncontrolled stormwater runoff, sediment load and transport and degradation of instream habitat.	• riffle embeddness <25% sand/silt **(<35% for large mainstem areas);**	• 25-49% embedded **(35-59% embedded for large mainstem areas);**	• 50-75% embedded **(60-85% embedded for large mainstem areas);**	• > 75% embedded **(>85% embedded for large mainstem areas);**
		• high number of deep pools ≥24" **(≥48" for large mainstem areas).** pool substrate <30% composed of sand/silt;	• moderate number of deep pools. pool substrate 30-59% sand/ silt;	• low-moderate number of deep pools. pool substrate 60-80% sand/silt;	• few, if any, deep pools. pool substrate >81% sand/silt;
		• streambed streak marks and/or banana-shaped sediment deposits absent;	• streak marks and/or "banana" deposits uncommon;	• streak marks and/or "banana" deposits common;	• streak marks and/or "banana" deposits common;

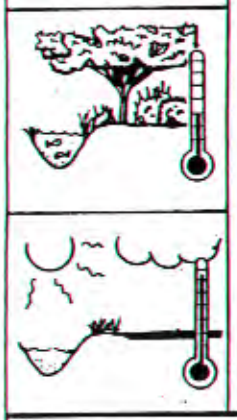
Evaluation Category	Relative Significance	Excellent	Good	Fair	Poor
2. Channel Scouring/ Sediment Deposition (cont'd.)		• fresh, large sand deposits in channel rare-absent. no evidence of fresh sediment deposition on overbank;	• fresh, large sand deposits in channel uncommon. small localized areas of fresh sand deposits along top of low banks;	• fresh, large sand deposits in channel common. small localized areas of fresh sand deposits along top of low banks;	• fresh, large sand deposits v. common in channel. moderate-heavy sand deposition along major portion of over-bank area v. common;
		• point bars few, small and stable, well vegetated and/ or armored with little or no fresh sand.	• point bars small and stable, well vegetated and/or armored with little or no fresh sand.	• point bars moderate-large and unstable with high amount of fresh sand common.	• point bars moderate-large and unstable with high amount of fresh sand present at most stream bends.
	Point Range	7-8	5-6	3-4	0-2

RSAT Evaluation Method - Representative Stream Characteristics (cont'd.)

Evaluation Category	Relative Significance	Excellent	Good	Fair	Poor
3. Physical Instream Habitat	• Relates to the ability of a stream to meet basic physical requirements necessary for the support of a well-balanced aquatic community (e.g. depth of flow, water-velocity, water temperature, substrate type and quality, etc.)	• wetted perimeter >85% of bottom channel width **(>90% for large mainstem areas);**	• wetted perimeter 61-85% of bottom width **(66-90% for large mainstem areas);**	• wetted perimeter 40-60% of bottom width **(45-65% for large mainstem areas);**	• wetted perimeter <40% of bottom width **(<45% for large mainstem areas);**
		• riffles, runs, and pool habitat present, diverse velocity and depth of flow present (i.e., slow, fast, shallow and deep water);	• good mix between riffles, runs and pools, relatively diverse velocity/ depth of flow;	• few pools present, riffles and runs dominant, velocity/ depth generally slow-shallow **(for large mainstem areas runs and pools dominant, velocity/depth diversity intermediate);**	• dominated by one habitat type (usually runs) and by one velocity/ depth condition (slow-shallow) **(for large mainstem areas few riffles present, runs and pools dominant, velocity/depth diversity low);**
		• riffle substrate composition - cobble, gravel, rubble, boulder mix with little sand, • (≥50% cobble);	• riffle substrate composition has good mix of gravel, cobble and rubble material • (25-49% cobble);	• riffle substrate composition predominantly small cobble, gravel and sand • (5-24% cobble);	• riffle substrate composition predominantly gravel with high percentage of sand • (<5% cobble);
		• riffle depth ≥ 8" for large mainstem areas;	**• riffle depth 6-7.9" for large mainstem area;**	**• riffle depth 4-5.9" for large mainstem area;**	**• riffle depth <4" for large mainstem area;**

Evaluation Category	Relative Significance	Excellent	Good	Fair	Poor
3. **Physical Instream Habitat (cont'd.)**		• large pools generally >24 in. deep **(>48 in. for large mainstem areas)** with good overhead cover/ structure;	• large pools generally 18-24 in. deep **(36-48 in. for large mainstem areas)** with some cover/structure;	• large pools generally 12-18 in. deep **(24-36 in. for large mainstem areas)** with little or no cover/structure;	• large pools generally <12 in. deep **(< 24 in. for large mainstem areas)** and devoid of cover/structure;
		• no channel alteration or significant point bar formation or enlargement;	• slight increase in point bar formation/ enlargement or slight amount of channel modification;	• moderate increase in points bars and/or in amount of channel modification;	• extensive channel alteration or point bar formation/ enlargement;
		* riffle/pool ratio- 0.9-1.1:1	* riffle/pool ratio- 0.7-0.89:1; 1.11-1.3:1	* riffle/pool ratio- 0.5-0.69:1; 1.31-1.5:1	* riffle/pool ratio- 0.49:1 ≤; ≥ 1.51:1
		* summer afternoon H_2O temp <68°F.	* summer afternoon H_2O temp 68-75°F.	* summer afternoon H_2O temp 75-80°F.	* summer afternoon H_2O temp >80°F.
Point Range		7-8	5-6	3-4	0-2

Evaluation Category	Relative Significance	Excellent	Good	Fair	Poor
4. Water Quality	• Indicative of: watershed perturbations/ general level of human activity, point and nonpoint source loads, and aquatic habitat conditions.	• substrate fouling[2] level 0-10% (rock underside).	• substrate fouling level - very light-light (11-20%).	• substrate fouling level - moderate (21-50%).	• substrate fouling level - high (>50%).
		•TDS[3]: <50 mg/L;	• TDS: 50-100 mg/L;	• TDS: 101-150 mg/L;	• TDS: >150 mg/L;
		• clear water - objects >3 ft. deep visible;	• objects visible down 1.5-3.0 ft.;	• objects visible down 0.5-1.5 ft.;	• objects visible to depth <0.5 ft.;
		• no odor;	• slight organic odor;	• slight-moderate odor;	• moderate-strong organic odor;
Point Range		7-8	5-6	3-4	0-2

5. Riparian Habitat Conditions 	• Provides insight into change(s) in stream energetics, temperature regime, and both aquatic and terrestrial habitat conditions.	• wide (>200') mature forested buffer along both banks;	• forested buffer generally more than 100 ft. wide along major portion of both banks;	• riparian area predominantly wooded but with major localized gaps;	• riparian area mostly non-woody vegetation, narrow-width riparian area;
		• canopy coverage; ≥80% shading **(≥60% for large mainstem areas).**	• canopy coverage; 60-79% shading **(45-59% for large mainstem areas).**	• canopy coverage; 50-60% shading **(30-44% for large mainstem areas).**	• canopy coverage; <50% shading **(<30% for large mainstem areas).**
Point Range		6-7	4-5	2-3	0-1

RSAT Evaluation Method - Representative Stream Characteristics (cont'd.)

Evaluation Category	Relative Significance	Excellent	Good	Fair	Poor
6. Biological Indicators	• Best overall indication of stream health and level of watershed perturbation.	• diverse macroinvertebrate community present, dominated by flat-head mayflies, stoneflies and cased caddisflies, very few snails, and/or leeches present;	• mayflies and caddisflies present (stoneflies absent), good overall diversity;	• pollution-tolerant caddisflies, snails, midgeflies, aquatic worms dominant;	• poor diversity generally dominated by midgeflies, aquatic worms and snails;
		• moderate-high number individuals.	• moderate-high number individuals.	• low-moderate number individuals.	• depauperate population - low number individuals.
Point Range		7-8	5-6	3-4	0-2

TOTAL SCORE: _____

Score	Verbal Stream Quality Ranking
42-50	**Excellent Condition**
30-41	**Good Condition**
16-30	**Fair Condition**
< 16	**Poor Condition**

[1] Bolded characteristics pertain to drainage areas generally ≥ approx. 10-15 mi².

[2] Substrate fouling = percentage of underside surface area of a cobble-sized stone (or larger), lying free on the streambed, which is coated with a biological film or growth.

[3] TDS = total dissolved solids. Note, natural background TDS level may sometimes be >50 mg/L due to geologic composition of water bearing strata.

heights, deeper riffles and pools, a general increase in instream large woody debris, a gradual reduction in canopy coverage, increased numbers of macroinvertebrate filter feeders such as clams, increased fish diversity, etc.

Under the RSAT system, the stream, including its channel network, is surveyed in its entirety in an upstream-downstream fashion. As implied by its name, RSAT is designed to provide a quick yet accurate assessment of stream conditions. For example, an experienced two-person monitoring team can under normal field conditions, generally survey 1.0 - 1.25 stream miles per day (roughly equivalent to 12-15 transects). Although a two-person team approach is strongly recommended, the RSAT survey can be performed satisfactorily by a single investigator.

City of Newcastle Comprehensive Surface Water Management Plan Update: Streamwalk Notes

Appendix A.2, Sheet #1

Basin	ObjectID	GlobalID	Site ID	1. Channel Stability	2. Channel Scouring/ Deposition	3. Physical Instream Habitat	4. Water Quality	5. Riparian Habitat Conditions	6. Biological Indicators (macro-invertebrates)	Comment	42-50 (Excellent) 30-41 (Good) 16-30 (Fair) <16 (Poor)	CreationDate	Creator	EditDate	Editor	x	y
China Creek	2	7f1a285f-23d8-4799-b615-71032dbab2e1	East of 136th #5	8	6	6	6	7	4	37	Good	10/21/2016 15:02	Maki.Dalzell@hdrinc.com_HDR	10/21/2016 15:02	Maki.Dalzell@hdrinc.com_HDR	-122.151	47.53064
China Creek	3	8033904b-18c0-43ec-a710-8d50b83c941b	East of 136th #5	8	6	6	6	7	4	37	Good	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	-122.151	47.53064
China Creek	4	134bc6bd-87cc-4894-bea7-cd73cc9f67a4	East of 136th #4	8	6	6	6	7	4	37	Good	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	-122.154	47.53955
China Creek	5	dee2dba5-007c-4a8f-9e04-efe68a5af2b6	East of 136th #3	8	6	6	6	7	4	37	Good	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	-122.154	47.5318
China Creek	6	246d7f73-17cc-4ffa-bceb-c96d03577f32	West of steep slope/east of136 #2	8	6	7	6	7	4	38	Good	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	-122.155	47.5328
China Creek	7	80ebf3b9-b2ba-4ebb-a861-158518b80fe7	East of 136th #1	9	6	6	6	7	4	38	Good	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	-122.157	47.53328
China Creek	8	72225088-6e5a-444d-94b9-37991be97584	Redman Park	8	6	6	6	7	4	37	Good	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	-122.159	47.53363
China Creek	9	539138f8-607a-433c-a6e6-ca1bc5c527e7	Near large detention pond inlet	7	6	4	6	5	4	32	Good	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	-122.161	47.53437
China Creek	10	0ed6c6fe-9ce8-4cc7-b79d-42adb6f10e89	East Coal Creek Culvert	2	2	3	6	4	4	21	Fair	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	-122.164	47.53551
Boren Lake	11	b62c6ca0-ed0e-416b-932b-a65682d520b1	Aegis channel floodplain	7	6	3	6	3	4	29	Fair	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	-122.166	47.53567
Boren Lake	12	8e4d9358-c757-47cd-823b-b8e2211778b8	Aegis Pond Outlet	3	2	2	6	3	4	20	Fair	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	10/21/2016 15:09	Maki.Dalzell@hdrinc.com_HDR	-122.165	47.53602
Boren Creek	13	61183098-dfb2-4b1c-8f03-7b0e28ee00be	SE 85th Way Culvert North	6	3	4	5	3	4	25	Fair	10/21/2016 22:24	Maki.Dalzell@hdrinc.com_HDR	10/21/2016 22:24	Maki.Dalzell@hdrinc.com_HDR	-122.164	47.5283
Boren Creek	14	1efdba16-5c2d-4693-82fc-8b13d615283e	Downstream of Beaver Dam	9	5	6	4	5	4	33	Good	10/21/2016 22:24	Maki.Dalzell@hdrinc.com_HDR	10/21/2016 22:24	Maki.Dalzell@hdrinc.com_HDR	-122.164	47.5292
	15	2de74618-bf63-480f-8d0d-fbfc2bc9b4ed	Beaver dam 2						Beaver dam blew out.			10/21/2016 22:24	Maki.Dalzell@hdrinc.com_HDR	10/21/2016 22:24	Maki.Dalzell@hdrinc.com_HDR	-122.164	47.52931
Boren Creek	16	0758b975-d323-40c1-b4dd-92a327ddb53d	Second South of Outfall	8	1	4	5	5	4	27	Fair	10/21/2016 22:24	Maki.Dalzell@hdrinc.com_HDR	10/21/2016 22:24	Maki.Dalzell@hdrinc.com_HDR	-122.163	47.5296
	17	28ca9fb8-055a-438d-b403-ce978045fe39										10/21/2016 22:24	Maki.Dalzell@hdrinc.com_HDR	10/21/2016 22:24	Maki.Dalzell@hdrinc.com_HDR	-122.164	47.53
	18	72e07e94-2cb7-4a16-ad8a-889dddf53eed	Boren outfall									10/21/2016 22:24	Maki.Dalzell@hdrinc.com_HDR	10/21/2016 22:24	Maki.Dalzell@hdrinc.com_HDR	-122.164	47.53044

City of Newcastle Comprehensive Surface Water Management Plan Update: Stream Assessment Ratings

Appendix A.2, Sheet #2

RSAT Scoring
Excellent: 42-50
Good: 30-41
Fair: 16-29
Poor: <16

	China Creek RSAT Scores											Boren Creek RSAT Scores						
Site ID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**			**1**	**2**	**3**	**4**	**5**		
	East Coal Creek Culvert	**Near large detention pond inlet**	**Redman Park**	**East of 136th #1**	**West of steep slope/east of 136 #2**	**East of 136th #3**	**East of 136th #4**	**East of 136th #5**	**East of 136th #5**	**Average**	**Range**	**Aegis channel floodplain**	**Aegis Pond Outlet**	**SE 85th Way Culvert North**	**Down-stream of Beaver Dam**	**Second South of Outfall**	**Average**	**Range**
Channel Stability	2	7	8	9	8	8	8	8	8	7.3	2-9	7	3	6	9	8	6.6	3-9
Channel Scouring/Deposition	2	6	6	6	6	6	6	6	6	5.6	2-6	6	2	3	5	1	3.4	1-6
Physical Instream Habitat	3	4	6	6	7	6	6	6	6	5.6	3-7	3	2	4	6	4	3.8	2-6
Water Quality	6	6	6	6	6	6	6	6	6	6.0	6	6	6	5	4	5	5.2	4-6
Riparian Habitat Conditions	4	5	7	7	7	7	7	7	7	6.4	4-7	3	3	3	5	5	3.8	3-5
Biological Indicators (macroinvertebrates)	4	4	4	4	4	4	4	4	4	4.0	4	4	4	4	4	4	4	4
Total	21	32	37	38	38	37	37	37	37	34.9	21-38	29	20	25	33	27	26.8	20-33
Rating	**Fair**	**Good**	**Good**	**Good**	**Good**	**Good**	**Good**	**Good**	**Good**	**Good**		**Fair**	**Fair**	**Fair**	**Good**	**Fair**	**Fair**	

Appendix B – Modeling Report

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Technical Memorandum

To: Audrie Starsy, SWM Manager City of Newcastle
From: Brian Ward, HDR
Date: July 13, 2017, *with July 27, 2018 Addendum*
Subject: Landcastle Area Stormwater Conveyance & Model Analysis

1 Introduction

This memo discusses the hydraulic and hydrologic analysis of an unnamed stream in the Landcastle neighborhood of the City of Newcastle, located in western Washington. The study area and Landcastle neighborhood are located in the northwest corner of the City of Newcastle, and are within the East Lake Washington – Bellevue South drainage basin (See City of Newcastle Comprehensive Surface Water Management Plan Update, Figure 1-1 Vicinity Map). The unnamed stream experiences high erosion and sediment transport rates resulting in large volumes of sediment depositing in downstream storm drainage infrastructure. Stream flow is unable to move through the plugged structures and floods streets and nearby houses. The stream lies within an 87.8 acre drainage basin comprised of piped stormwater conveyance networks on the upstream and downstream sections of the basin with an open channel section in between (see Figure 1, below). EPA SWMM 5.0 and HEC-RAS 5.0.3 models were created to assess the impacts of the upstream storm drainage system on the unnamed stream, identify stream locations susceptible to erosion, and evaluate potential projects for inclusion in the Capital Improvement Plan (CIP) which could reduce flooding issues.

The remainder of this section is organized as follows:

- **Section 2 – Model Input Data** – Summarizes the model input data received from the City, King County, and surveyors which was used to build the models.
- **Section 3 – SWMM Methods & Assumptions** – Documents the methods and assumptions used in the development of the SWMM models;
- **Section 4 – HEC-RAS Methods & Assumptions** – Documents the methods and assumptions used in the development of the HEC-RAS models;
- **Section 5 – Model Analysis & Results** – Documents and discusses the model results in terms of the issues observed in the basin and potential solutions;
- **Section 6 – Conclusions** – Provides recommendations for additional analyses.

2 Model Input Data

Input data for the development of the SWMM and HEC-RAS models included information from the City of Newcastle, King County, and field survey from Axis Survey & Mapping.

2.1.1 EPA SWMM Input Data

Storm drainage system data including catch basins, storm pipes, culverts, ditches, and storage facilities was obtained from the City's Cartegraph GIS database. Impervious land cover was also obtained from the database. The GIS data was used to supplement survey information from Axis Survey & Mapping, along with as-built information provided by the City.

2.1.2 HEC-RAS Input Data

Elevation and channel cross section data was provided by Axis Survey & Mapping for the unnamed stream, surrounding area, and rim elevations of 116th Avenue SE catch basins. Newcastle operations staff provided measure-down distances from the rims to pipe inverts. Additional parcel and Light Detection and Ranging (LiDAR) elevation data in the form of 3-foot contours and a Digital Elevation Model (DEM) were obtained from King County.

3 SWMM Methods & Assumptions

SWMM models were developed for the basin area upstream and downstream of the unnamed stream within the study area as shown in Figure 1. The SWMM models are referred to as the "upstream basin SWMM model" and "downstream basin SWMM model" in this memo. These segments are routed through closed storm drainage conveyance systems (the upstream storm drainage system and the downstream storm drainage system) which are connected in the middle by an open channel reach. The open channel reach of the unnamed stream starting near 114th Avenue SE and ending east of 112th Avenue SE was modeled using HEC-RAS, as it is more suited to simulating open channel flow. The HEC-RAS component is discussed later in this document. The following paragraphs describe the methods and assumptions used to perform the SWMM analysis.

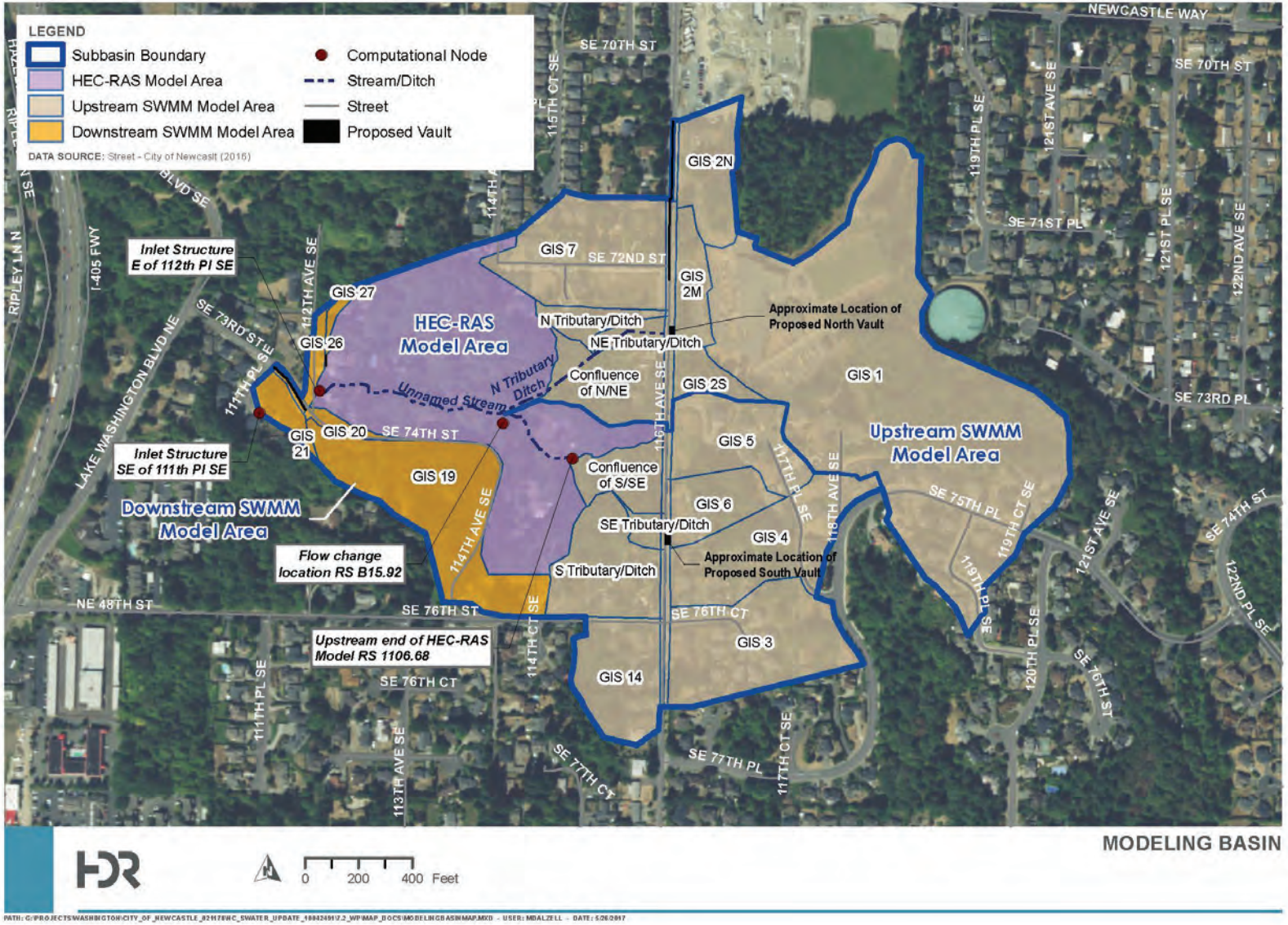

Figure 1. Modeling Extents and Drainage Basin Extents in the Landcastle Area

3.1 Subbasin Boundaries

SWMM uses subbasins to more accurately route runoff for areas with distinct drainage characteristics (i.e. slope, impervious area, etc.) within the larger drainage basin. Additionally, subbasins are delineated to be able to accurately route stormwater to the storm systems. In the upstream basin and downstream basin SWMM models, a range of drainage characteristics as well as storm systems were present. A preliminary full basin boundary for the unnamed stream, beginning at the inlet structure southeast of 111th Place SE, was generated using the StreamStats 4.0 application available from USGS. The StreamStats-generated boundary was then exported to ArcGIS and updated using King County 3-foot contour data and City of Newcastle storm drainage system data (Figure 1). The total area covered by the basin is 87.8 acres.

The full basin was then delineated into subbasins based on the contour data, storm system data, and field observations. The subbasins incorporated into the upstream basin SWMM model covered approximately 63.4 acres. The subbasins incorporated into the downstream basin SWMM model covered approximately 24.4 acres and included the subbasin draining directly to the unnamed stream, which was modeled independently in HEC-RAS.

3.2 Hydrologic Model Inputs

Inputs to the hydrologic component of the SWMM models included rainfall data, the subbasins' impervious area, roughness factors, subbasin width (a proxy for hydrograph response time), and subbasin slope. The following paragraphs describe the development of the information needed to run the model.

Storms simulated in the model followed a Type IA storm distribution, appropriate for western Washington. Rainfall depths for the 1-year, 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year events were applied to the distribution to create storm events to input into SWMM. Isopluvial maps provided in the 2016 City of Bellevue Surface Water Engineering Standards, when available, were used to obtain rainfall depths, as they are the closest jurisdiction with this data available. National Oceanic and Atmospheric Administration (NOAA) isopluvial maps of Western Washington provided rainfall depths for those storms not included in City of Bellevue isopluvial maps.

Impervious area was calculated for each subbasin using the City of Newcastle Cartegraph impervious surface data and ArcGIS to calculate the total impervious area contained within each subbasin. The areas were converted into percent impervious and input into each subbasin in SWMM.

Roughness factors (Manning's) were chosen according to the type of impervious and pervious land surfaces in SWMM. Aerial and field data were used to select appropriate roughness factors for each subbasin.

Subbasin width refers to the width of the overland flow path for sheet flow runoff. Width was estimated by dividing the total subbasin area by the length of the average maximum flowpath, in accordance with the EPA SWMM Manual.

Slope was measured in ArcGIS for each subbasin, and was measured along a representative path which captured the typical topography of the subbasin. Slope was measured perpendicular to the contours to capture grade changes for overland flow paths.

3.3 Hydraulic Model

3.3.1 Hydraulic Routing Method

The routing method chosen for the SWMM models was the Dynamic Wave method. This routing method solves the complete one-dimensional Saint Venant flow equation and is the most theoretically accurate routing method offered by SWMM. The method allows multiple pipe outlets from a single catch basin, and enables the user to more accurately model control structures with multiple orifices and weirs. Additionally, the Dynamic Wave method allows the user to simulate pressurized flow and the associated higher peak flows. Given the slopes of the pipes and channels in the storm drainage system, and the presence of storage and control structures within the basin, the Dynamic Wave method was chosen as the most appropriate routing method.

3.3.2 Conveyance System Information and Assumptions

The storm drainage system incorporated into the upstream basin SWMM model routes flow via an underground pipe network. West of 116th Avenue SE, flow is collected and routed towards the unnamed stream in steeply sloped (approximately 24% slope on average) conveyance ditches. The ditches route flow to outfalls in the upstream basin SWMM model, which generate peak flows that are used in the HEC-RAS model. Figure 2 includes a simplified schematic of the upstream storm drainage system.

Generally, the attributes (i.e., invert elevations, maximum depth, shapes, length) for pipes and catch basins used in the upstream basin SWMM model located along 116th Avenue SE between SE 72nd Street and SE 76th Street were obtained from survey and ArcGIS data. Pipe network attributes for pipes and catch basins outside of that area were obtained from as-built documentation. As-built documentation was available for the Hazelwood Elementary School and surrounding area, as well as 116th Avenue SE between SE 70th Street and SE 72nd Street. For upstream subbasins where pipe network information was unavailable or minimal, overland flow was assumed through the subbasin.

The attributes of the conveyance ditches in the upstream basin SWMM model and west of 116th Avenue SE were primarily obtained from analysis in ArcGIS. The shapes of the conveyance ditches were approximated from King County topographic data. Cross sections were obtained in ArcGIS at two to three grade break locations along each ditch to capture changes in conveyance area. Maximum depth, bank station locations, and channel roughness were obtained from ArcGIS and field data.

The storm drainage system incorporated into the downstream basin SWMM model routes flow via underground pipe network, a short section of open channel, and overland flow, as shown in Figure 2. Attributes for the downstream storm drainage system, including the open channel section, were obtained from ArcGIS and survey data. Inflow from the unnamed stream developed in the upstream basin SWMM model enters the downstream storm drainage system at the catch basin near 112th Avenue SE in the downstream basin SWMM model to match existing conditions and to estimate the downstream boundary condition for the HEC-RAS model.

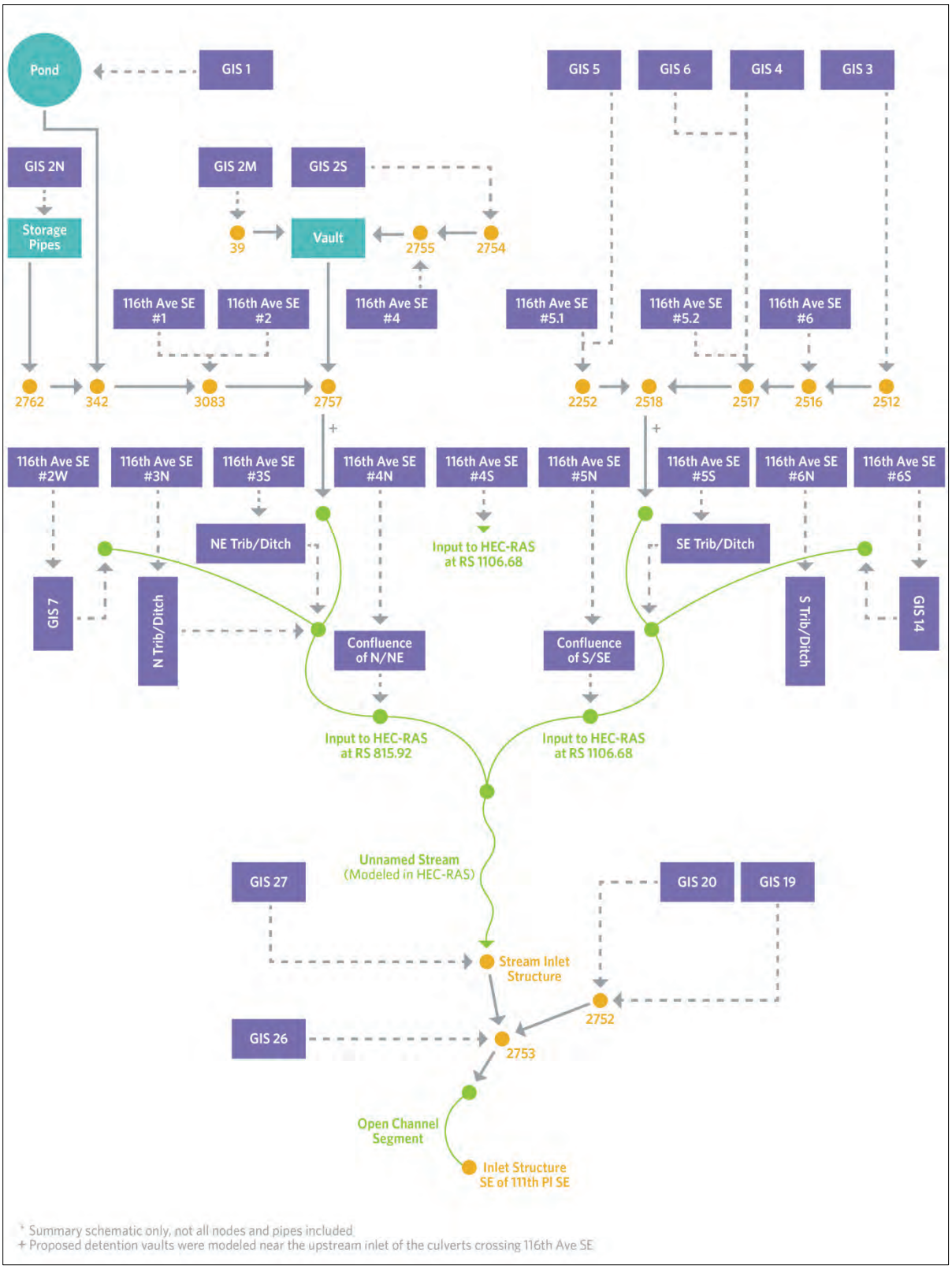

Figure 2. Simplified Model Schematic of Upstream Basin, Downstream Basin, and Open Channel Models

4 HEC-RAS Model Methods & Assumptions

The HEC-RAS model of the unnamed stream covers the reach of the stream approximately between 114th Avenue SE and 112th Avenue SE. The eastern (upstream) extent of the HEC-RAS model was dictated by channel slope to minimize error in the model computations as HEC-RAS generally loses computational stability as grades exceed 10%. Flow routing on these steeper slopes to the east can be computed stably in SWMM. The following paragraphs describe the methods and assumptions used to develop the HEC-RAS model.

4.1 HEC-GeoRAS Development

Survey data from Axis Survey & Mapping, King County elevation data (surface and contours), and aerial imaging formed the basis of the HEC-RAS modeling in the HEC-GeoRAS application, an extension of ArcGIS. The survey data was supplemented by the elevation and aerial data to identify the stream centerline, bank stations, and cross-section locations. Aerial imagery was used to determine ineffective areas, such as buildings, which would block flow outside of the channel. Survey data was combined with the King County Lidar DEM to create the longitudinal profile and channel cross sections of the stream in the grade shown in the DEM. The data was then imported into HEC-RAS.

4.2 HEC-RAS Model

Exported HEC-GeoRAS data was imported into HEC-RAS as a framework for the HEC-RAS model. Following the import, bridge and culvert information, Manning's roughness factors, bank stations, flow data, and boundary conditions were input into the model.

Bridge and culvert information was obtained from the Axis Survey & Mapping survey data, as well as field notes and photographs. Culvert inverts, lengths, and diameters, bridge low chords, and road surface width and elevations were provided by survey, and bridge deck thickness was determined by photographs survey. Culvert Manning's roughness factors and entrance and exit losses were chosen using field data to guide assumptions, as were the Manning's roughness factors and bank stations for the entire reach of the channel.

Flow data for the HEC-RAS model consisted of the peak flow rates for the 1-year, 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year events. Peak flows were obtained from the output of the SWMM model from the upstream basin. One flow change location was included at the confluence of the stream and a drainage ditch routing flow from the northeast portion of the upstream basin.

In the HEC-RAS model, the water surface elevation calculated in the downstream basin SWMM model at the inlet structure near 112th Avenue SE was used as a known water surface elevation downstream boundary condition. The slope of the channel immediately upstream of the HEC-RAS model extent was used as a normal depth boundary condition, representing the theoretical slope of the hydraulic grade line.

5 Model Analysis & Results

Following the development of the SWMM and HEC-RAS model, the model results were used to support conditions observed in the field and to locate existing areas where the existing storm

drainage system was undersized. Additionally, the models were used to assess the effect of proposed CIP projects within the unnamed stream basin. The following paragraphs discuss analysis of the results, the identified issues, and proposed CIP project effectiveness.

5.1 Existing System Issues Identified

From field observations it was apparent that the flows through the unnamed stream within the study area were causing erosion and sediment transport resulting in large volumes of sediment being deposited in downstream infrastructure. Additionally, the sediment deposition reduced the capacity of downstream infrastructure causing flooding of streets and nearby homes. The high flow and downstream flooding issues observed in the field were also indicated in the model results as illustrated in the following paragraphs.

5.1.1 Upstream & Downstream Basin Storm Drainage Systems

When the design rainfall events were run through the upstream basin and downstream basin SWMM models, surcharging and flooding occurred with a higher frequency in the downstream storm drainage system than the upstream storm drainage system. The models indicated that the downstream storm drainage system experiences surcharging or flooding for the 5-year through 100-year rainfall events at one or more catch basin structures, while the upstream storm drainage basin only experiences surcharging for the 100-year event. In particular, the inlet structure southeast of 111th Place SE at the furthest downstream end of the downstream basin SWMM model floods beginning at the 5-year rainfall event. Table 1 below summarizes for which rainfall events the inlet structure southeast of 111th Place SE floods, and summarizes flooding and surcharging for the location where the unnamed stream enters the downstream storm drainage system (Stream Inlet Structure East of 112th Ave SE).

Table 1. Occurrences of Surcharging and Flooding in the Existing Downstream Unnamed Stream Basin for All Events

	Inlet Structure Southeast of 111th Place SE		Stream Inlet Structure East of 112th Ave SE	
Rainfall Event	Structure Surcharging?	Structure Flooding?	Structure Surcharging?	Structure Flooding?
1-yr	No	No	No	No
2-yr	No	No	No	No
5-yr	No	No	No	Yes
10-yr	No	No	No	Yes
25-yr	No	No	No	Yes
50-yr	No	No	No	Yes
100-yr	Yes	No	No	Yes

Note: Surcharging occurs when water rises above the crown of the highest conduit entering the catch basin or inlet structure. Flooding occurs when water exceeds the maximum depth of the catch basin or inlet structure and overflows.

5.1.2 Unnamed Stream

High peak flows and high velocities within the unnamed stream are a potential cause of erosion and sediment transport between the upstream and downstream storm drainage basins. Base flow velocities within the existing channel are discussed in Section 5.2.2.

5.2 Modeled Proposed CIP Projects

CIP projects were proposed for the Landcastle area to improve issues related to erosion, sediment transport, and flooding within the unnamed stream basin. Two proposed detention vaults were simulated to measure their effect at reducing peak flows from the upstream storm drainage system and their effect at reducing velocities and erosion potential within the channel. The proposed CIP projects were included in the SWMM and HEC-RAS models. The following paragraphs discuss the CIP modeling results and assess the effectiveness of each project.

5.2.1 Detention Vaults

Detention vaults were proposed in order to reduce peak flows from the upstream basin SWMM model entering the unnamed stream channel. A detention vault was proposed near the inlet of each culvert crossing 116th Avenue SE and leading to the unnamed stream (see Figure 1 and Figure 2 for location and schematic). A majority of the upstream storm drainage system is routed to the culverts, so by placing the detention vaults at the inlets of the culverts most of the flow from the upstream basin could be routed to the vaults. Additionally, the easement provided available space for installation. Vaults were assumed to be 7 feet deep by 35.75 feet long by 12 feet wide (vault located on the north side of 116th Avenue SE) and 7.5 feet deep by 33.33 feet long by 12 feet wide (vault located on the south side of 116th Avenue SE) in order to fit site constraints and King County Stormwater Design Manual requirements for detention vaults.

Initial orifices and riser structure sizes were chosen to cause higher peak flow reductions for the more frequent rainfall events (i.e., 1-year, 2-year, 5-year, etc.) because in urban settings, minor flood flows that happen fairly frequently have the most profound impacts on streams (WDFW, 2002).

The storm events used to assess model existing conditions were used to analyze the ability of the vaults to lower peak flows in the existing unnamed stream channel. Table 2 below displays the peak flows in the channel for implementation of the vault on the north side of 116th Avenue SE (north vault), implementation of the vault on the south side of 116th Avenue SE (south vault), and implementation of both vaults.

Table 2. Peak Flow Reduction for Implementation of Detention Vaults in Upstream Storm Drainage System

	Flow in Unnamed Stream Channel (cfs)				Percent Change from Existing to Proposed Conditions		
Rainfall Event	Existing Conditions	North & South Vault Implemented	North Vault Implemented	South Vault Implemented	North & South Vaults Implemented	North Vault Implemented	South Vault Implemented
1-yr	4.22	3.62	3.92	3.92	-14.2%	-7.1%	-7.1%
2-yr	5.84	4.76	5.46	5.14	-18.6%	-6.6%	-12.0%
5-yr	7.53	6.16	7.03	6.65	-18.3%	-6.6%	-11.7%

	Flow in Unnamed Stream Channel (cfs)				Percent Change from Existing to Proposed Conditions		
Rainfall Event	Existing Conditions	North & South Vault Implemented	North Vault Implemented	South Vault Implemented	North & South Vaults Implemented	North Vault Implemented	South Vault Implemented
10-yr	9.28	7.27	8.68	7.88	-21.6%	-6.5%	-15.1%
25-yr	14.84	13.82	14.26	14.40	-6.8%	-3.9%	-2.9%
50-yr	16.98	16.24	16.51	16.71	-4.3%	-2.8%	-1.6%
100-yr	19.14	18.60	18.77	18.97	-2.8%	-1.9%	-0.9%

Note: The results of this table are not associated with a final vault design. Additional refinement of vault and control structure is recommended for design.

Peak flow reductions were greatest when both vaults were implemented, individually the north and south vaults cause similar percentage reductions in peak flow, while the south vault is more effective at reducing peak flows for the 2-year to 10-year storm events. With further design and orifice sizing, additional reductions are possible.

5.2.2 Stream Channel Stabilization

Stream channel stabilization is the third corrective approach analyzed to address erosion and sediment deposition problems in the area. Stream channel stabilization was assumed to consist of engineered large woody debris (LWD) structures embedded into adjacent stream banks near to where the erosional features were observed. In theory, proposed LWD structures can lower velocities and reduce shear stress along the banks of the channel, therefore limiting erosion and sediment transport downstream (WDFW 2002). Stream channel stabilization measures were approximated in HEC-RAS by using higher roughness values (a 0.070 Manning's n) within the channel of the unnamed stream for approximately 500 feet of reach length, between River Stations (RS) 917.17 and RS 413.41 (22 cross sections). This section of reach was chosen because higher velocities were expected due to the presence of steep slopes and a concrete-lined channel (note, at an unknown date, concrete was poured into a short section [approximately 130 feet] of the creek located on private property to reduce erosion).

The assessment of the proposed stream channel stabilization measures used the 1-year peak flow event and metrics of stream stabilization effectiveness (velocity, shear stress, and stream power in the channel). The 1-year flow event was selected because of its frequent occurrence and its channel-forming properties (Booth 1997). The 1-year peak flow event was assumed to be the base flow (Q_b); in addition, half of the base flow, a quarter of the base flow, and one tenth of the base flow were used to assess the stream channel stabilization measures over a range of lower flows.

The velocity, shear stress, and stream power results observed in the HEC-RAS model of the reach were selected to assess the effectiveness of stream channel stabilization measures for the 1-year and lower flows. Velocity in HEC-RAS is the averaged rate of stream flow between the channel banks and is a factor in shear stress and stream power calculations. Shear stress is the force per unit area acting parallel to a surface element such as a stream bank. The greater the shear stress value, the more erosive the forces against the stream banks. Shear stress values reported by the model are the average shear stress computed between the channel banks within a cross-section.

The metric is equal to the product of the specific weight of water, hydraulic radius, and energy grade line slope. Stream power is the rate of energy dissipation against the bed and banks of a river or stream per unit downstream length. It is the product of the average velocity and shear stress. Velocity, shear stress, and stream power are all output values calculated by HEC-RAS and provide a relative comparison of how the proposed stream channel stabilization measures will address erosion issues in the channel.

As compared to existing conditions without the stream channel stabilization measures, the average change in velocity, shear, and stream power in the channel due to stabilization are displayed in Table 3.

Table 3. Average Change Caused by Stream Channel Stabilization

	Average Percentage Change with Addition of Stream Channel Stabilization Measures		
Flow (cfs)	Velocity	Shear	Stream Power
Qb	-29%	161%	95%
0.50 Qb	-32%	142%	75%
0.25 Qb	-35%	119%	54%
0.10 Qb	-38%	95%	25%

It is important to note that the model results in the table above only include cross sections where the energy grade line slope was equal to 0.10 or less, because HEC-RAS results are not valid when energy grade line slopes are greater than 0.10. Additionally, HEC-RAS calculates water surface elevation (average water depth) using the Standard Step Backwater Method iteratively and the model defaults to critical depth if it is unable to converge on a calculated water surface elevation within a specified number of iterations. When the model defaults to critical depths, the velocity, shear, and stream power results are no longer valid for the stream channel stabilization conditions. Therefore, the data for those cross sections with energy grade line slopes greater than 0.10 and which defaulted to critical depth was not used in the analysis of the stream channel stabilization.

Model results indicate that velocities are decreased on average by 29 to 38 percent in the channel for 1-year or smaller peak flow events. It is important to note that HEC-RAS calculates shear as the product of the weight density of water, the average depth in the cross section, and energy grade line slope for the cross-section, and that the average depth and energy grade line slope are dependent on the Manning's n value selected for the channel. Because Manning's n (roughness coefficient) was used to approximate the presence of stream channel stabilization measures, the shear shown above likely represents the shear stress applied to the stabilization measures (e.g., large woody debris). Stream power values shown above also likely represent shear stress applied to the large woody debris, as the values are equal to the product of the velocity and shear stress. Additional analysis would be needed to better understand the shear stress and stream power reductions provided by stream channel stabilization measures, though the velocity reductions indicate the

stream channel stabilization measures would ultimately decrease shear stress and stream power on the channel banks.

Because the stream channel stabilization measures are located downstream of the detention vaults and could potentially benefit from their installation, stream channel stabilization measures were also assessed with vaults implemented. Table 4 displays the effect of stream stabilization measures, vaults, and stabilization measures in combination with vaults on velocities in the channel.

Table 4. Average Peak Flows in the Channel for Existing and CIP Implementation Conditions

	Average Peak Velocity (cfs) During Base Flow			
Flow (cfs)	Existing Conditions	Stream Bank Stabilization Conditions	Existing Conditions Plus Vaults	Stream Bank Stabilization Plus Vaults
Qb	3.0	2.1	2.8	2.0

Note: The results of this table assume both the north and south vaults are implemented.

Based on the results presented in Table 4, the stream channel stabilization measures more effectively decrease velocities within the channel compared to the implementation of vaults upstream. However additional analysis is recommended to better understand how well stream channel stabilization measures would decrease shear stress and stream power at the channel banks.

6 Conclusions

Given the results of the SWMM and HEC-RAS modeling of existing conditions and proposed CIP projects, the following conclusions are made:

Existing issues observed in the field were replicated by model results, flooding and surcharging occurred in the downstream storm drainage system beginning with the 5-year storm event, and the upstream storm drainage system was shown to contribute most of the flow entering the downstream storm drainage system.

Implementation of detention vaults is a method to decrease peak flow rates and associated velocities entering the unnamed stream and downstream storm drainage system. The upstream basin and downstream basin SWMM models indicated a decrease of peak flows up to 21.6 percent for the 10-year rainfall event for implementation of two vaults in the upstream basin. Implementation of a vault on the north side of 116th Ave SE was associated with approximately the same decrease in peak flows as implementation of a vault on the south side. Additional design and orifice sizing could raise the percentage decrease in peak flows leaving the upstream storm drainage system.

Model results indicate that a stream channel stabilization project has the most direct impact on velocities in the channel, and achieves 29 to 38 percent peak velocity reductions on average where implemented. However, more in-depth analysis is recommended to better understand the shear stress and stream power likely to occur at the channel banks.

7 Addendum to July 13, 2017 Landcastle Area Stormwater Conveyance Model

To: Audrie Starsy, SWM Manager City of Newcastle
From: Brian Ward, HDR
Date: July 27, 2018
Subject: Amendment #3 - Hazelwood Short Plat Stormwater Detention Vaults

At the conclusion of the City of Newcastle Comprehensive Surface Water Management (CSWM) Plan Update project, it was brought to HDR's attention that as-built drawings of two existing stormwater flow control vaults, built in 2002 were not transmitted to HDR during the data-gathering phase of the project. Consequently, when the modeling phase of the project commenced, these existing vaults were not included in the SWMM hydraulic model that was developed as a tool to identify possible solutions to in-stream erosion problems in the Landcastle area (see Section 3 of the July 13, 2017 technical memorandum). As documented in Section 5.2 of the above Landcastle Area Modeling Technical Memorandum, two separate flow control vaults are recommended in the City's Capital Improvement Program as a means of addressing an erosion problem in the downstream open channel system (CIP Project # 6, Flow Control Vault at 116th Avenue SE and SE 72nd Street and CIP Project #7, Flow Control Vault at 116th Avenue SE and SE 76th Street). The aforementioned existing vaults are part of the Hazelwood Short Plat and are located within the modeled area, upstream of the proposed CIP vault projects and could have an affect on the modeling results.

In consideration of these facts, the City of Newcastle amended HDR's contract to include a qualitative update of the SWMM modeling report and CSWM Plan Update to reflect this new information. Specifically, HDR is tasked with:

1. Reviewing project records documenting modeling approaches and assumptions and updating the CSWM Plan with this information, and
2. Updating the modeling documentation in the technical memorandum for the Landcastle Area to include an explanation of how the proposed CIP vaults were sized, to note the existence of the Hazelwood vaults, and to describe the stormwater asset connections to the Hazelwood Short Plat vaults.

The purpose of this addendum is to document the findings of this supplemental work.

The City of Newcastle transmitted to HDR as-built drawings of the Hazelwood Short Plat, dated February 1, 1999 as part of the amended contract. Given the as-built date, it's presumed that the Hazelwood Short Plat vaults were designed using the 1998 King County Surface Water Design Manual, which stipulated that flow control and water quality treatment facilities are required for the development resulting in two separate flow control vaults and a bioswale for the short plat. The bioswales is for water quality treatment and the vaults are for flow control, only the vaults have an appreciable effect on the hydraulics

The North Vault is located in the southeast corner of the intersection of SE 73rd Street and 116th Avenue SE, which is situated in within modeling sub-basin titled GIS 5. The South Vault is located about 250 feet north of the intersection of SE 76th Street and 116th Avenue SE and is part of the modeling basins titled GIS 4 and 6. If the Hazelwood vaults were added to the hydraulic model there locations are shown in the revised model schematic in Figure 3. The Hazelwood North Vault

(108’x27’x9’) and the South Vault (40’x20’x6.3’) having active storage volumes of 26,390 cubic feet and 5,040 cubic feet respectively, see Figures 4 and 5. The North Vault connects to the city’s public conveyance system via Pipe # 1594 and CB-2523. The South Vault connects to the public system via Pipe # 1586 and CB-2517.

The City of Newcastle has annual inspection records of both vaults and stated that they are in good working order.

Considering the volumes of the Hazelwood vaults, it stands to reason that they offer significant benefits to the downstream system by attenuating peak flows, so including them in a future model update is advisable. However, it’s worth noting that even with the vaults providing downstream benefits and being in good working order, the erosion problems were still evident. This suggeststhat increasingstorage to attenuate more runoff and implementing the streambank stabilization CIP project would have merit.

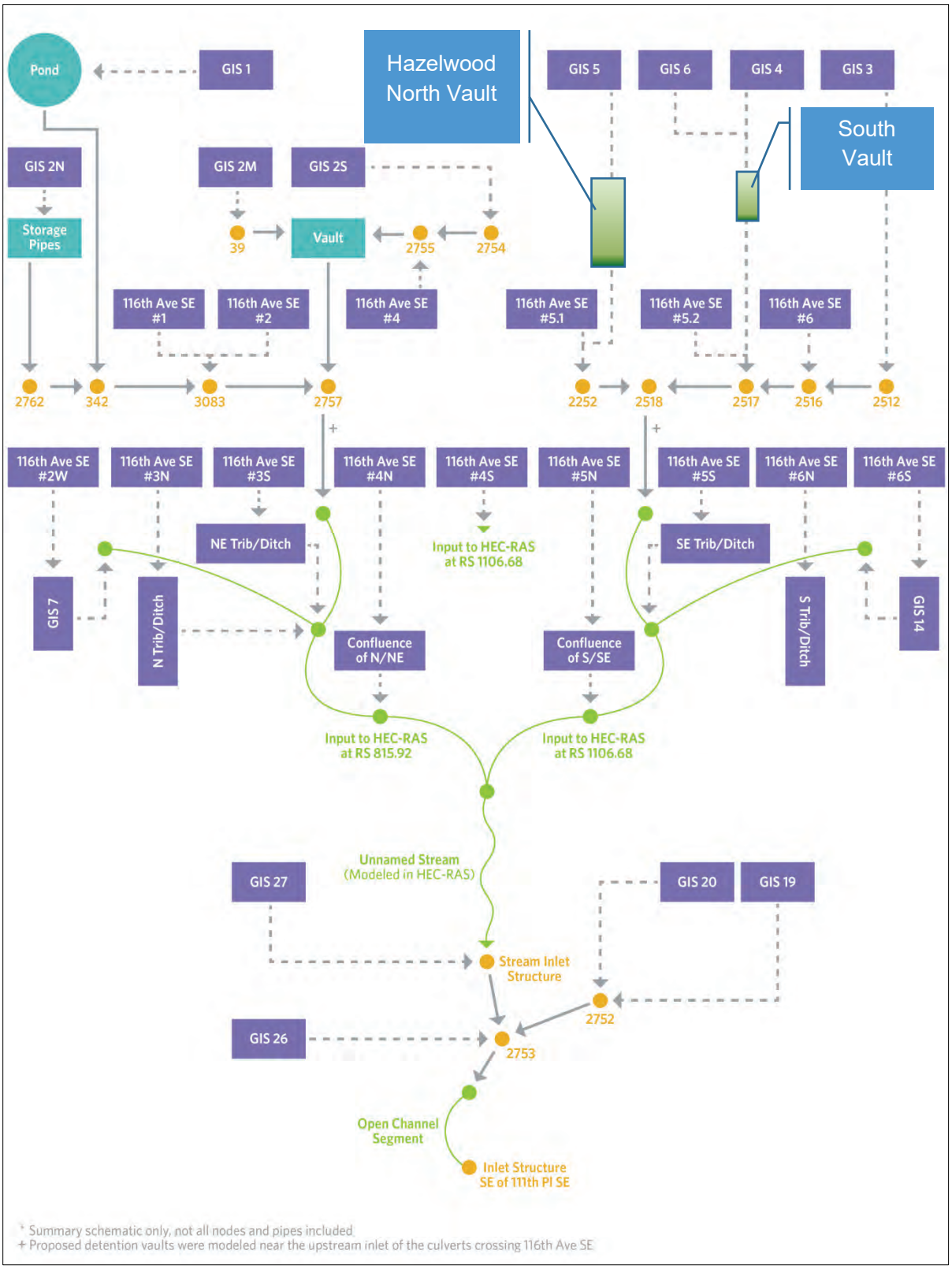

Figure 3. Revised Model Schematic

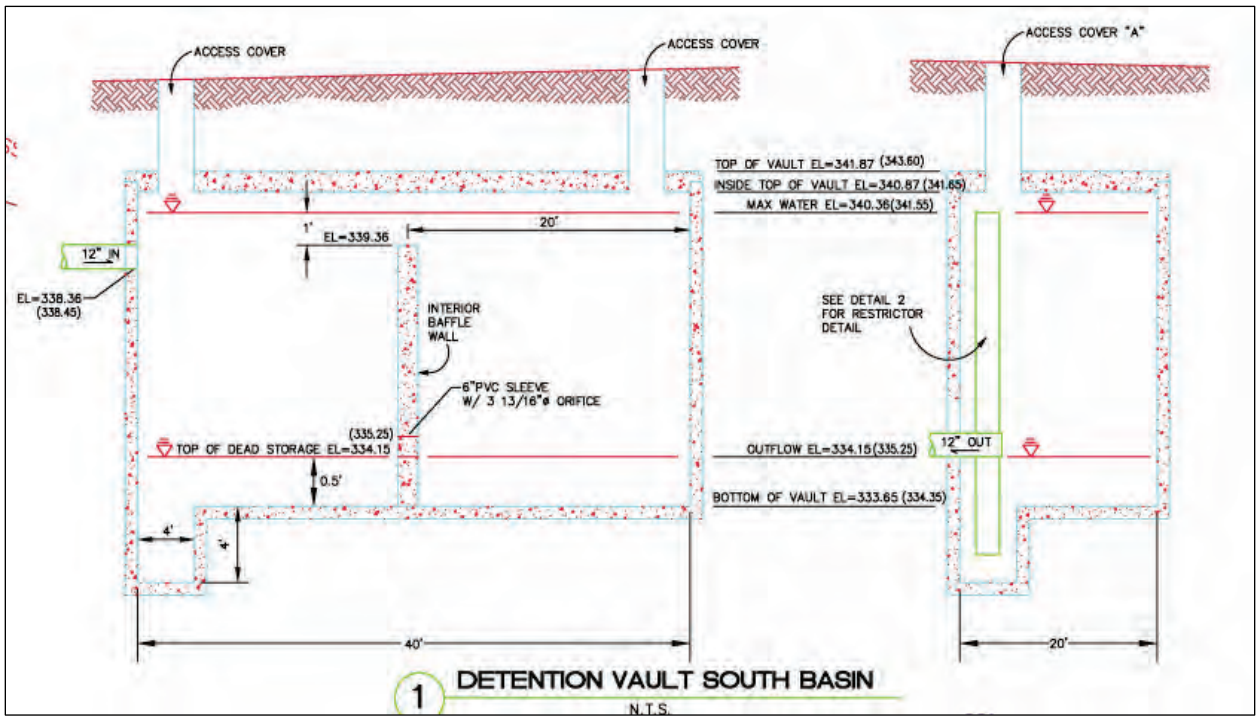

Figure 4. Hazelwood South Vault As-Built

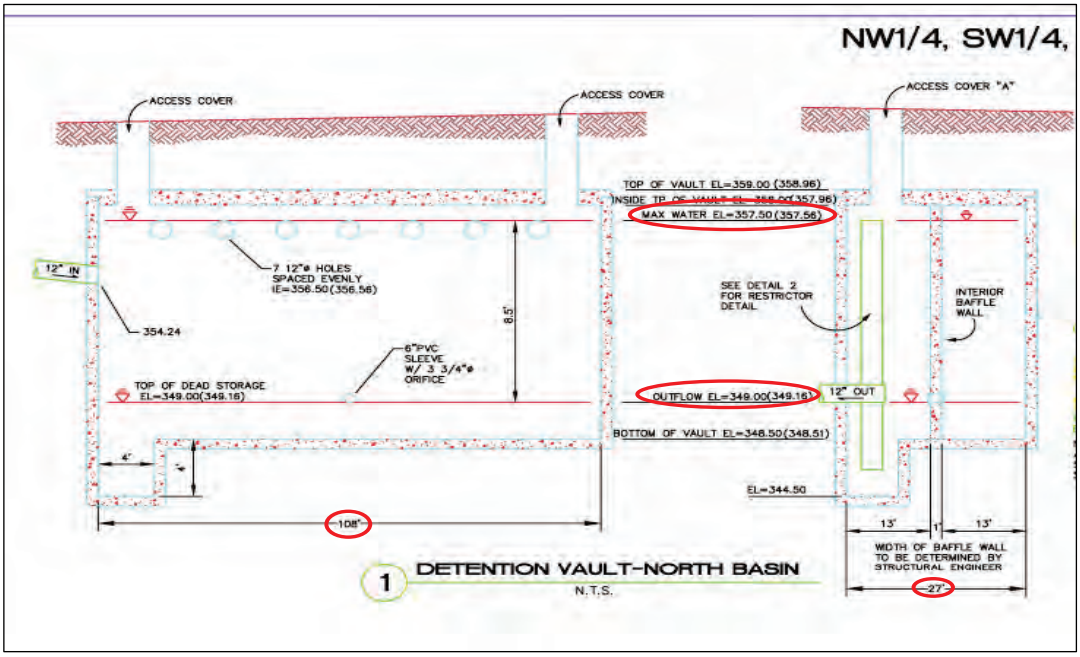

Figure 5. Hazelwood North Vault As-Built

Appendix C – Public Survey Results

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Q1 If you would like to bring any STORMWATER DRAINAGE or FLOODING problems in the City to our attention, please provide the following information in as much detail as possible. *Describe the location(s) using street address, intersection, water body, or landmark. *Describe the issue(s).Skip this question if you have no drainage/flooding issues to report.

Answered: 5 Skipped: 5

Answer Choices	Responses	
Issue 1	**100.00%**	5
Issue 2	**20.00%**	1
Issue 3	**0.00%**	0
Issue 4	**0.00%**	0
Issue 5	**0.00%**	0

#	Issue 1	Date
1	The areas subject to the problems noted below are not within Newcastle city limits. But are impacted by surface water drainage from the city's south east corner.	12/28/2016 7:59 AM
2	Storm water retention areas are fenced, all fences should be removed or at least given to disrepair. Would allow dogs and wildlife acces.	12/26/2016 7:47 PM
3	vastly wide roads in Lake Washington Crest (and other neighborhoods, too) lead to huge rivers running down SE 80th from 120th to 118th (for example) on rainy days; unsure if underground vaults can deal with these volumes and or if runoff is treated in any way	12/11/2016 8:05 PM
4	Water drains underground from my backyard and goes above ground when it hits my driveway keeping my driveway and sidewalk wet almost all of the time. This becomes a public safety issue in sub-freezing temps when my sidewalk is covered in a sheet of ice.	12/10/2016 8:04 AM
5	Leaves and other debris clogging storm drains.	12/6/2016 9:35 AM
#	**Issue 2**	**Date**
1	.Downstream of 148th Avenue SE properties along May Creek are subject to frequent flooding and erosion	12/28/2016 7:59 AM
#	**Issue 3**	**Date**
	There are no responses.	
#	**Issue 4**	**Date**
	There are no responses.	
#	**Issue 5**	**Date**
	There are no responses.	

Q2 If you would like to bring any EROSION and/or SEDIMENTATION issues in the City to our attention, provide the following information in as much detail as possible. *Describe the location(s) using street address, intersection, water body, or landmark. *Describe the issue(s).Skip this question and go to Q3 if you have no erosion/sedimentation issues to report.

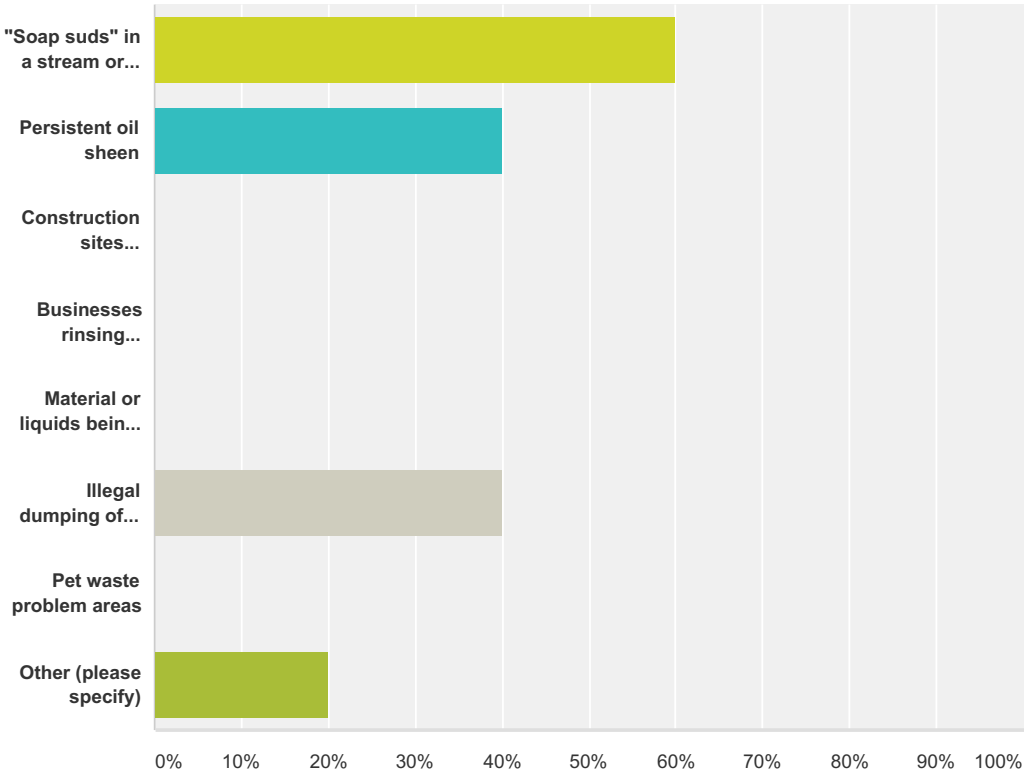
Answered: 3 Skipped: 7

Answer Choices	Responses	
Issue 1	**100.00%**	3
Issue 2	**33.33%**	1
Issue 3	**0.00%**	0
Issue 4	**0.00%**	0
Issue 5	**0.00%**	0

#	Issue 1	Date
1	may ceek triburtarys	12/29/2016 10:00 PM
2	Downstream of Ilwaco Ave. NE (143 Avenue SE) there is severe under cutting of the creek banks.	12/28/2016 7:59 AM
3	A number of years back several trees were removed and limbed up in Hazelwood Ridge Div 2 in the sensitave area tract. after that excess water runoff affects the downhill properties.	12/5/2016 5:41 AM
#	**Issue 2**	**Date**
1	Properties on the south side of May Creek between Lyons Ave. NE (146th Avenue SE) rely on private bridges that are in danger due to erosion. This could be life threatening.	12/28/2016 7:59 AM
#	**Issue 3**	**Date**
	There are no responses.	
#	**Issue 4**	**Date**
	There are no responses.	
#	**Issue 5**	**Date**
	There are no responses.	

Q3 Have you recently observed any of the following issues in the City (select all that apply)? Skip this question if not applicable.

Answered: 5 Skipped: 5



Answer Choices	Responses	
"Soap suds" in a stream or creek	**60.00%**	3
Persistent oil sheen	**40.00%**	2
Construction sites permitting muddy water to flow into storm drains	**0.00%**	0
Businesses rinsing equipment in the street	**0.00%**	0
Material or liquids being poured directly into (or within the flow path of) storm drains or water bodies	**0.00%**	0
Illegal dumping of trash or refuse in a natural area	**40.00%**	2
Pet waste problem areas	**0.00%**	0
Other (please specify)	**20.00%**	1
Total Respondents: 5		

#	Other (please specify)	Date
1	None of these problems exist	12/26/2016 7:47 PM

Q4 If you selected one or more items in Question 3 and have details to share (location, observations, etc.) briefly provide them here, being sure to note which type of issue(s) you're referencing.

Answered: 2 Skipped: 8

#	Responses	Date
1	Recent oil/gasoline sheen near the storm drain by my driveway. Last seen on 2016/12/12. Address is 7072 123rd Ave Se.	12/13/2016 1:57 PM
2	Suds in persistent whirlpool immediately downstream of May Creek Trail - creek crossing from Renton's NE 31st Street / Jones Road. Trash and yard waste dumping between East Crosstown Trail and Se 83rd (below backyards).	12/4/2016 7:18 PM

Q5 If you would like to bring any RIPARIAN, AQUATIC HABITAT, or CRITICAL AREA issues within the City to our attention, provide the following information in as much detail as possible. *Describe the location(s) using street address, intersection, water body, or landmark. *Describe the issue(s).

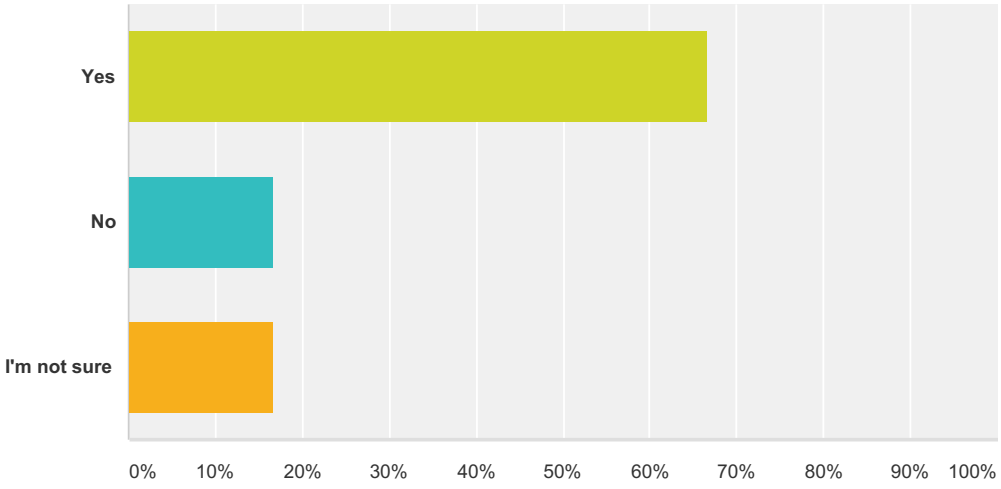
Answered: 2 Skipped: 8

Answer Choices	Responses	
Issue 1	**100.00%**	2
Issue 2	**50.00%**	1
Issue 3	**50.00%**	1
Issue 4	**0.00%**	0
Issue 5	**0.00%**	0

#	Issue 1	Date
1	The largest wetland in the City, with the exception of Lake Boren, is at the foot of DeLeo's wall (Cougar Mountain) SE corner of city.	12/28/2016 7:59 AM
2	critical area on south side of SE 80th between 117th and 118th Ave SE; sprinklers installed for new native plantings a few years ago needed adjustment/attention in summer; ivy should be removed from trees in protected area	12/11/2016 8:05 PM
#	**Issue 2**	**Date**
1	The "DeLeo" wetland is home to all of the local species of animals, and fowl. This habitat must be preserved at all costs.	12/28/2016 7:59 AM
#	**Issue 3**	**Date**
1	Also May Creek and its tributaries are important habitat and critical areas.	12/28/2016 7:59 AM
#	**Issue 4**	**Date**
	There are no responses.	
#	**Issue 5**	**Date**
	There are no responses.	

Q6 Are you interested in learning more about how RAIN GARDENS and other GREEN INFRASTRUCTURE can be part of the solution to managing stormwater in urban settings?

Answered: 6 Skipped: 4



Answer Choices	Responses	
Yes	**66.67%**	4
No	**16.67%**	1
I'm not sure	**16.67%**	1
Total		**6**

Q7 If you have ideas or feedback on surface water PUBLIC EDUCATION and OUTREACH EFFORTS for the City of Newcastle, provide them here.

Answered: 5 Skipped: 5

#	Responses	Date
1	field trip to view damaging issues within our city	12/29/2016 10:00 PM
2	Outreach can be done by volunteers, no budget needed	12/26/2016 7:47 PM
3	I would hope that people might respond with positive actions to an education effort that links their cars/gardens/etc. to ailing salmon and endangered orcas in Puget Sound. Since Earth Day attracts folks already interested in environmental concerns the trick is reaching everyone else -- perhaps educational booths at the shopping centers would be beneficial.	12/11/2016 8:05 PM
4	It'd be nice to see additional outreach regarding storm drains in Newcastle News, homeowners' association newsletters, or other messaging from the city. Residents with storm drains in front of their property should take 'ownership' of them just like we're required to keep our sidewalks clear.	12/6/2016 9:35 AM
5	Piggyback on neighborhood meetings. Use Newcastle News to tell public about problems the City is coping with.	12/4/2016 7:18 PM

Q8 If you have input for storm or surface water PROGRAM IMPROVEMENTS, provide them here.

Answered: 5 Skipped: 5

#	Responses	Date
1	with increased rain comes increased stormwater. provide higher standards than Dept of ecology requires	12/29/2016 10:00 PM
2	Please implement development code and administrative regulations that ensure the highest preservation of our City's natural habitat and protects peoples homes and property. Especially in the few undeveloped areas of the City.	12/28/2016 7:59 AM
3	Do less. Buying a truck and managing things will do more harm than good.	12/26/2016 7:47 PM
4	I've heard Bellevue does a great job with their stormwater management -- perhaps Newcastle could follow their lead? I already attended the natural garden care workshop offered a couple of years ago and I assisted with installation of rain garden at Lake Boren Park last year. I've wondered about the feasibility of installing rain garden strips along edges of hillside roads to combat runoff in #1 above. Landscaped areas the size of two parked cars with a series of terraces, perhaps, to help some of the water infiltrate the earth on its way downhill. Plantings could be beneficial to native pollinators. And narrowing the roads a bit will help reduce speeding on neighborhood streets.	12/11/2016 8:05 PM
5	Enforcement is necessary--an unpalatable truth.	12/4/2016 7:18 PM

Q9 If you have other COMMENTS, CONCERNS, or QUESTIONS relevant to storm or surface water in the City of Newcastle, provide them here.

Answered: 4 Skipped: 6

#	Responses	Date
1	SEE ABOVE Thank you.	12/28/2016 7:59 AM
2	I'm concerned that this issue deems any effort.	12/26/2016 7:47 PM
3	The current explosion of development in Newcastle pretty much dooms the waterways in our area because of the loss of trees and vegetation and their replacement with impervious roofs, roads and driveways. Can any of the remaining patches of forests and fields be preserved? That would be a tremendous gift to future generations!	12/11/2016 8:05 PM
4	Please, no spraying of insecticides nor pesticides in water ponds - Frogs eat the mosquitoes. We have noticed a big increase in mosquitoes when ponds are disturbed, whether it be by construction or chemicals.	12/5/2016 5:41 AM

Page 10 was deleted because it included the names and addresses of respondents. The City of Newcastle has this information if needed for follow-up.

Appendix D – CIP Concept Summary Worksheets

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PROJECT SUMMARY SHEET

CIP Number and Name:	Problem ID #1 - Detention Pond 31, Detention Pond 40, Detention Pond 41, Detention Pond 131, Detention Pond 132
Subbasin:	City-wide
Problem Description:	Maintenance; Detention pond storage areas populated with shrubs, trees, and cattails; inlet and outlet clearing needed as well.
Project Solution:	Annual action: remove dead biomass, compost away from water. Near-term action: remove all woody vegetation from pond storage area. Long-term action: remove or dredge accumulated sediments once 10% of storage area is filled (assumed to be once every ten years). Cost estimate reflects Annual Action only.
Project Benefit:	Removing sediment and vegetation, and clearng inlets and outlets will restore detention pond storage capacity and water quality treatment function.
Estimated Project Cost:	$ 10,000 each facility
Associated Projects:	

Photo 1: Typical detention pond maintenance required

Project Cost Estimate

City of Newcastle **Date:** 5/2/2017

Stormwater Comprehensive Plan **Project No.:** 10042491

Problem ID #1 **Estimate By:** FPW

Order of Magnitude Cost Opinion

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
POND MAINTENANCE (PER POND)	1	LS	$ 4,000.00	$ 4,000.00

SUBTOTAL		$ 4,000
CONTINGENCIES	50%	$ 2,000
CONSTRUCTION TOTAL (ROUNDED)		$ 6,000
SALES TAX	10.0%	$ 600
CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)		$ 7,000
ENGINEERING, LEGAL/ADMIN, COORDINATION	20%	$ 1,200
CONSTRUCTION ENGINEERING	10%	$ 600
PERMITTING	10%	$ 600
INDIRECT COST TOTAL (ROUNDED)		$ 3,000
PROJECT TOTAL (ROUNDED)		**$ 10,000**

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PROJECT SUMMARY SHEET

CIP Number and Name: Problem ID #2

Subbasin: May Creek

Problem Description: Culvert plugging due to lack of access for maintenance.

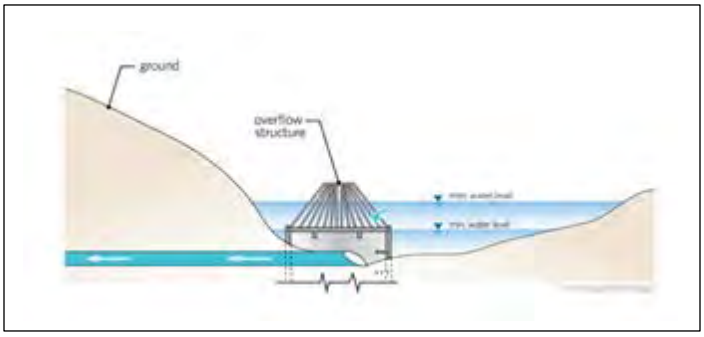
Project Solution: Install riser structure to prevent inlet blockage.

Project Benefit: Water will be allowed to pond and overflow into riser, letting suspended solids to settle out before they get into the culvert. Will also be a single maintenance point for City crews.

Estimated Project Cost: $ 51,000

Associated Projects:

Photo 1: Material clogging existing culvert inlet



Project Cost Estimate

City of Newcastle **Date:** 5/2/2107

Stormwater Comprehensive Plan **Project No.:** 10042491

Problem ID #2 **Estimate By:** FPW

Order of Magnitude Cost Opinion

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
MOBILIZATION (10%)	1	LS	$ 1,800.00	$ 1,800.00
SURVEY (6%)	1	LS	$ 1,100.00	$ 1,100.00
TESC (10%)	1	LS	$ 1,800.00	$ 1,800.00
STRUCTURE EXCAVATION CLASS B INCL. HAUL	12	CY	$ 15.00	$ 180.00
CATCH BASIN TYPE 2 48 IN. DIAM.	1	EA	$ 3,000.00	$ 3,000.00
DEBRIS CAGE	1	EA	$ 2,500.00	$ 2,500.00
CLEARING AND GRUBBING	1	LS	$ 1,000.00	$ 1,000.00
SEEDING AND MULCHING	1	LS	$ 1,000.00	$ 10,000.00
CONNECT TO EXISTING DRAINAGE STRUCTURE	1	EA	$ 500.00	$ 500.00

SUBTOTAL (ROUNDED)		$ 21,900
CONTINGENCIES	50%	$ 10,950
CONSTRUCTION TOTAL (ROUNDED)		$ 33,000
SALES TAX	10.0%	$ 3,300
CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)		$ 37,000
ENGINEERING, LEGAL/ADMIN, COORDINATION	20%	$ 6,600
CONSTRUCTION ENGINEERING	10%	$ 3,300
PERMITTING	10%	$ 3,300
INDIRECT COST TOTAL (ROUNDED)		$ 14,000
PROJECT TOTAL (ROUNDED)		**$ 51,000**

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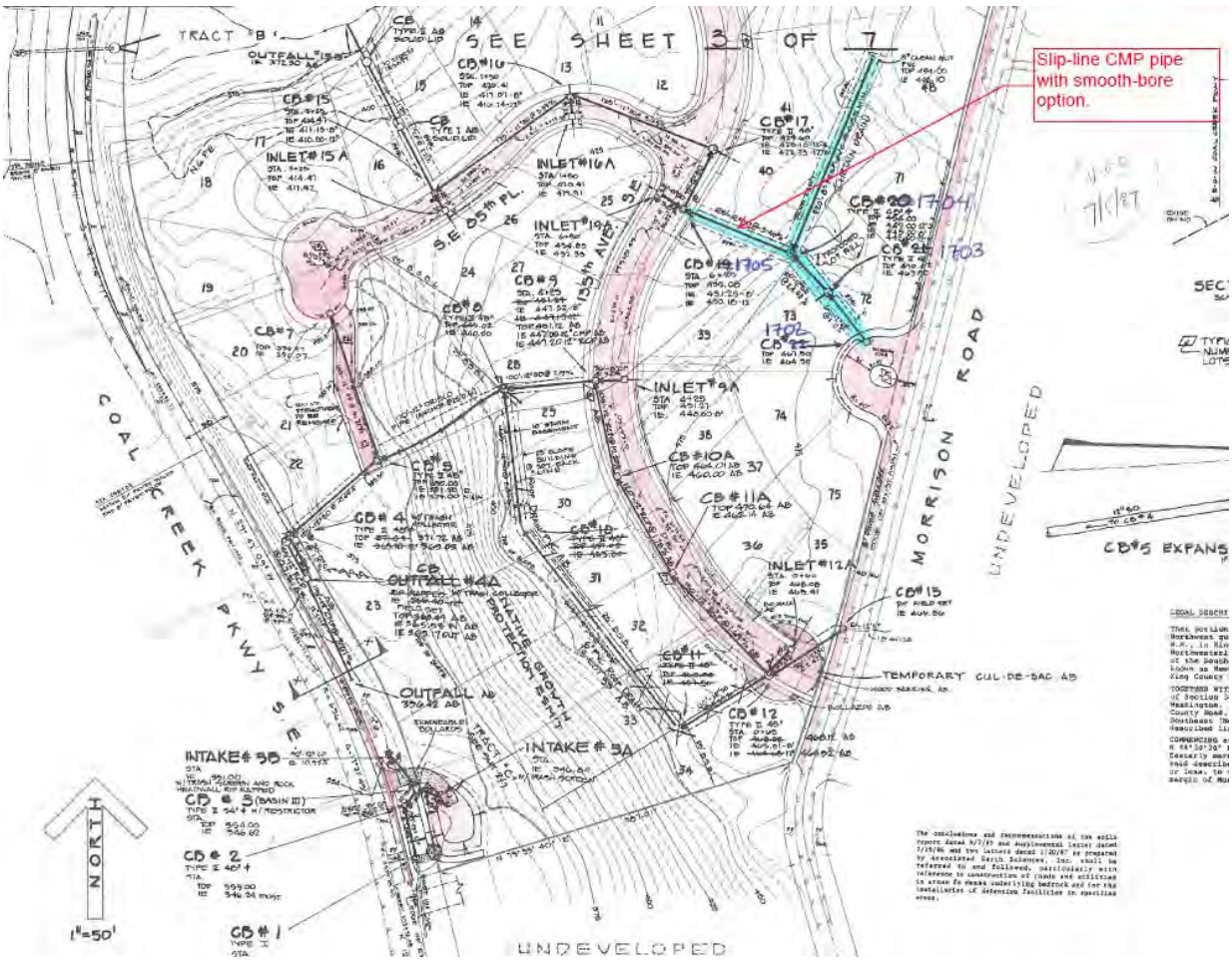
PROJECT SUMMARY SHEET

CIP Number and Name:	Problem ID #3
Subbasin:	May Creek
Problem Description:	Corrugated Metal Pipe (CMP) capacity is compromised and condition is damaged due to clogging from sedimentation and tree roots. Nearby residents are at risk of flooding due to reduced capacity.
Project Solution:	Slipline compromised CMP stormwater pipe and remove vegetation causing issues. Replant with grasses and shallow root shurbs.
Project Benefit:	Increase ease of access to culvert. Limit flooding in lot 40 by removing tree roots causing clogging.
Estimated Project Cost:	$ 85,000
Associated Projects:	

Photo 1:



Project Cost Estimate

City of Newcastle **Date:** 5/2/2017

Stormwater Comprehensive Plan **Project No.:** 10042491

Problem ID #3 **Estimate By:** FPW

Order of Magnitude Cost Opinion

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
MOBILIZATION (10%)	1	LS	$ 2,900.00	$ 2,900.00
SURVEY AND STAKING (6%)	1	LS	$ 1,800.00	$ 1,800.00
TESC (10%)	1	LS	$ 2,900.00	$ 2,900.00
LINE EXISTING 12" STORM WATER PIPE	125	LF	$ 35.00	$ 4,375.00
CLEARING AND GRUBBING	0.05	AC	$ 40,000.00	$ 2,000.00
REPLANTING (GRASS AND SHRUBS)	1350	SF	$ 12.00	$ 16,200.00
WOOD MULCH, 4-INCH DEPTH	20	CY	$ 35.00	$ 700.00
SOIL AMMENDMENT, COMPOST, 3-INCH DEPTH	15	CY	$ 38.00	$ 570.00
TREE REMOVAL	4	EA	$ 500.00	$ 2,000.00
TEMPORARY TRAFFIC CONTROL	1	LS	$ 3,000.00	$ 2,500.00

SUBTOTAL (ROUNDED)		$ 36,000
CONTINGENCIES	50%	$ 18,000
CONSTRUCTION TOTAL (ROUNDED)		$ 54,000
SALES TAX	10.0%	$ 5,400
CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)		$ 60,000
ENGINEERING, LEGAL/ADMIN, COORDINATION	20%	$ 10,800
CONSTRUCTION ENGINEERING	10%	$ 5,400
PERMITTING	10%	$ 5,400
EASEMENTS & ROW ACQUISITION	5%	$ 2,700
INDIRECT COST TOTAL (ROUNDED)		$ 25,000
PROJECT TOTAL (ROUNDED)		**$ 85,000**

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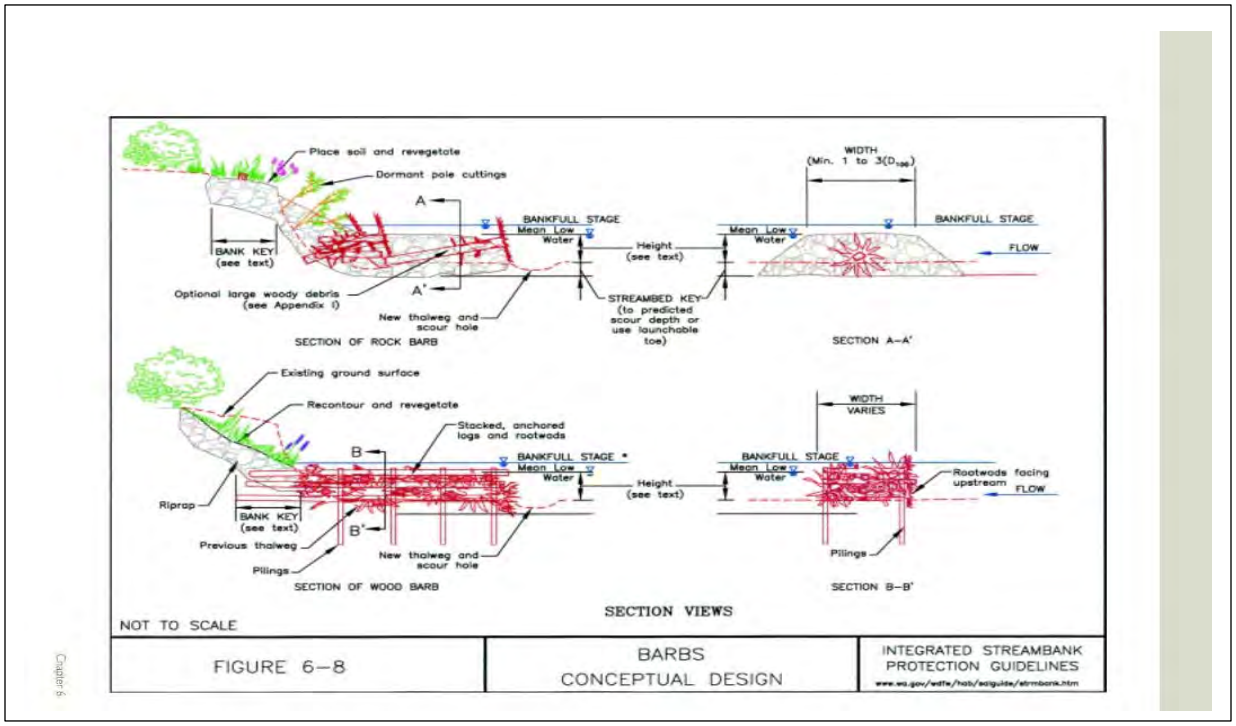
PROJECT SUMMARY SHEET

CIP Number and Name:	Problem ID #4
Subbasin:	May Creek
Problem Description:	Streambank sediment erosion due to peak stormwater flows delivers eroded sediment downstream, cloggin stormwater facilities. Clogged structures inhibit flow that causes flooding and increased maintenance frequency.
Project Solution:	Install large woody debris structures along streambank to provided a roughend channel to help reduce flows and erosion.
Project Benefit:	Reduce amount of maintenance needed at downstream facilities.
Estimated Project Cost:	$571,000
Associated Projects:	

Photo 1:



Project Cost Estimate

City of Newcastle **Date:** 5/2/2017

Stormwater Comprehensive Plan **Project No.:** 10042491

Problem ID #4 **Estimate By:** FPW

Order of Magnitude Cost Opinion

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
MOBILIZATION (10%)	1	LS	$ 18,800.00	$ 18,800.00
CONTRUCTION SURVEY AND STAKING (6%)	1	LS	$ 11,300.00	$ 11,300.00
TESC (10%)	1	LS	$ 18,800.00	$ 18,800.00
CLEARING AND GRUBBING	0.1	AC	$ 40,000.00	$ 4,000.00
STREAMBED COBBLE, 8"	250	TON	$ 55.00	$ 13,750.00
STREAMBED BOULDER, ONE MAN	600	TON	$ 78.00	$ 46,800.00
STREAMBED SEDIMENT FILL MATERIAL	150	CY	$ 54.00	$ 8,100.00
LARGE WOODY DEBRIS	20	EA	$ 2,500.00	$ 50,000.00
ROOT WADS	7	EA	$ 1,800.00	$ 12,600.00
LANDSCAPE RESTORATION	1	LS	$ 50,000.00	$ 50,000.00
TEMPORARY TRAFFIC CONTROL	1	LS	$ 2,000.00	$ 2,000.00

SUBTOTAL (ROUNDED)		$ 236,200
CONTINGENCIES	50%	$ 118,100
CONSTRUCTION TOTAL (ROUNDED)		$ 355,000
SALES TAX	10.0%	$ 35,500
CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)		$ 391,000
ENGINEERING, LEGAL/ADMIN, COORDINATION	20%	$ 71,000
CONSTRUCTION ENGINEERING	10%	$ 35,500
GEOTECHNICAL ENGINEERING		$ 20,000
PERMITTING	15%	$ 53,250
INDIRECT COST TOTAL (ROUNDED)		$ 180,000

PROJECT TOTAL (ROUNDED)	**$**	**571,000**

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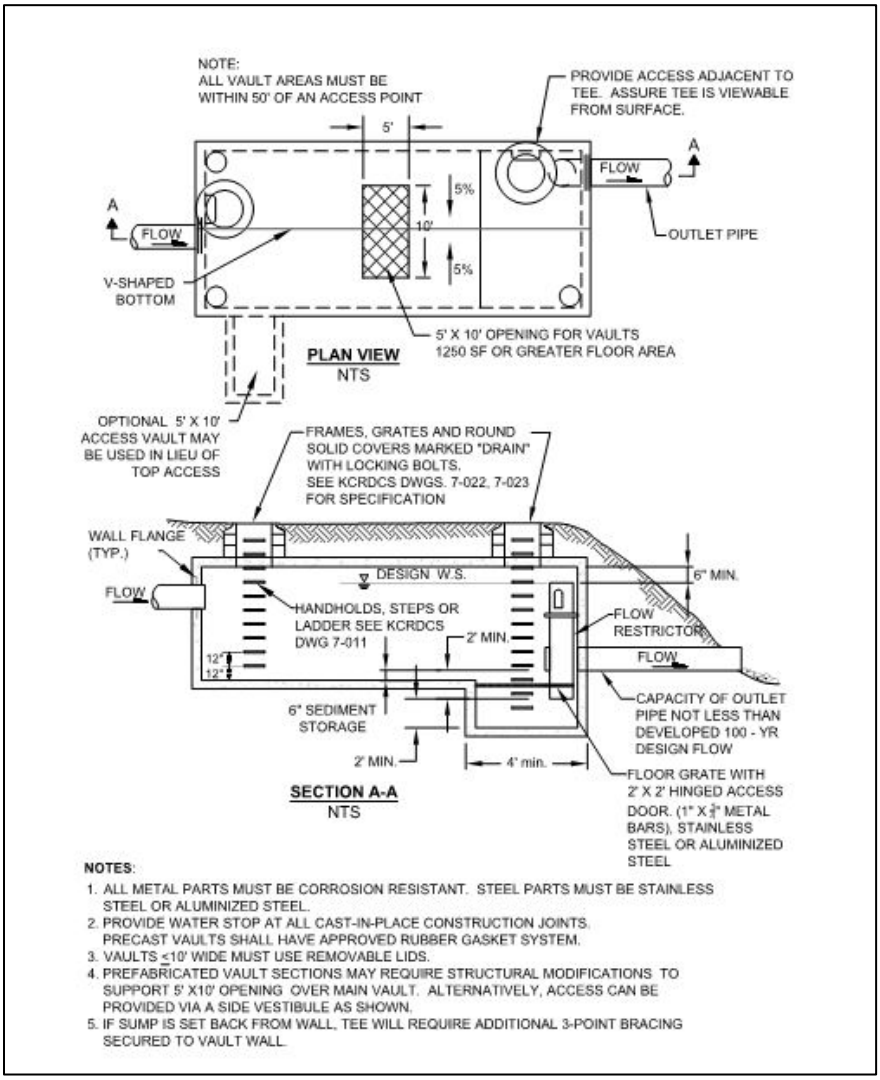
PROJECT SUMMARY SHEET

CIP Number and Name:	Problem ID #5 116th Ave SE & SE 72nd St.
Subbasin:	East Lake Washington
Problem Description:	Peak stormwater flows contribute to erosion of streambanks in Landcastle Creek.
Project Solution:	Installation of a 36x12x8 vault within the right-of-way to reduce flows discharging to Landcastle Creek.
Project Benefit:	Reduce erosion and therefore sedimentation at downstream facilities.
Estimated Project Cost:	$ 493,000
Associated Projects:	



Project Cost Estimate

City of Newcastle **Date:** 5/2/2017

Stormwater Comprehensive Plan **Project No.:** 10042491

Include CIP Name **Estimate By:** FPW

Order of Magnitude Cost Opinion

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
MOBILIZATION (10%)	1	LS	$ 14,800.00	$ 14,800.00
SURVEY (6%)	1	LS	$ 8,900.00	$ 8,900.00
TESC (10%)	1	LS	$ 14,800.00	$ 14,800.00
VAULT	1	LS	$ 55,000.00	$ 55,000.00
CRUSHED SURFACING BASE COURSE	135	TON	$ 150.00	$ 20,250.00
HMA CL 1/2 IN. PG 64-22	250	TON	$ 180.00	$ 45,000.00
STRUCTURE EXCAVATION CLASS B INCL. HAUL	30	CY	$ 15.00	$ 450.00
ROADWAY EXCAVATION INCL. HAUL	30	CY	$ 25.00	$ 750.00
REMOVING ASPHALT CONCRETE PAVEMENT	20	SY	$ 20.00	$ 400.00
SCHEDULE A STORM SEWER PIPE 18 IN. DIA	80	LF	$ 72.00	$ 5,760.00
REMOVE EXISTING STORM PIPE	80	LF	$ 15.00	$ 1,200.00
OUTLET CONTROL STRUCTURE	1	EA	$ 7,500.00	$ 7,500.00
CONNECT TO EXISTING DRAINAGE SYSTEM	2	EA	$ 500.00	$ 1,000.00
TEMPORARY TRAFFIC CONTROL	1	LS	$ 10,000.00	$ 10,000.00

SUBTOTAL (ROUNDED)		$ 185,900
CONTINGENCIES	50%	$ 92,950
CONSTRUCTION TOTAL (ROUNDED)		$ 279,000
SALES TAX	10.0%	$ 27,900
CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)		$ 307,000
ENGINEERING, LEGAL/ADMIN, COORDINATION	20%	$ 55,800
GEOTECHNICAL ENGINEERING		$ 60,000

CONSTRUCTION ENGINEERING	10%	$	27,900
PERMITTING	15%	$	41,850
INDIRECT COST TOTAL (ROUNDED)		$	186,000
PROJECT TOTAL (ROUNDED)		**$**	**493,000**

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PROJECT SUMMARY SHEET

CIP Number and Name: Problem ID #6; SW Vault 116th Ave. SE & SE 76th St.

Subbasin: East Lake Washington

Problem Description: Peak stormwater flows contribute to erosion of streambanks in Landcastle Creek.

Project Solution: Installation of a 34x12x8 vault within the right-of-way to reduce flows.

Project Benefit: Reduce erosion and therefore sedimentation at downstream facilities.

Estimated Project Cost: $ 389,000

Associated Projects:

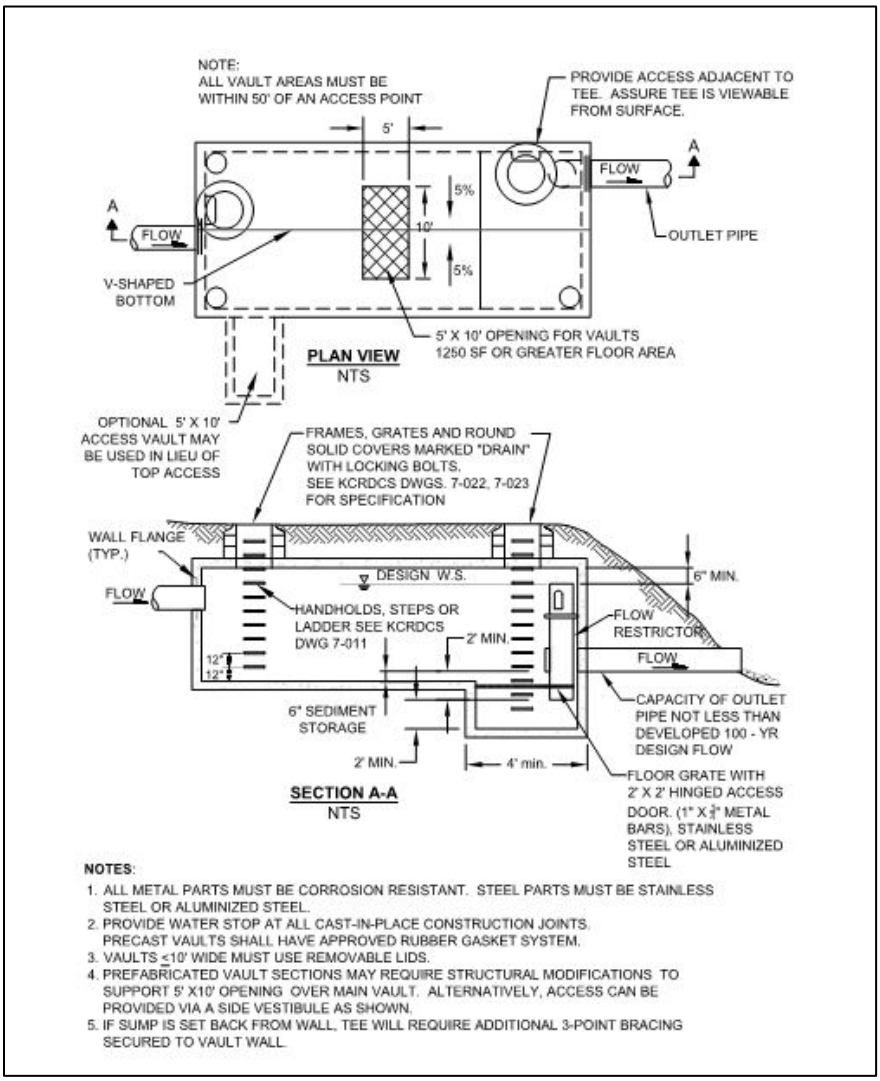

Photo 1:

Project Cost Estimate

City of Newcastle **Date:** 5/2/2017

Stormwater Comprehensive Plan **Project No.:** 10042491

Problem ID #6 **Estimate By:** FPW

Order of Magnitude Cost Opinion

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
MOBILIZATION (10%)	1	LS	$ 11,500.00	$ 11,500.00
SURVEY (6%)	1	LS	$ 6,900.00	$ 6,900.00
TESC (10%)	1	LS	$ 11,500.00	$ 11,500.00
VAULT	1	LS	$ 50,000.00	$ 50,000.00
CRUSHED SURFACING BASE COURSE	85	TON	$ 150.00	$ 12,750.00
HMA CL 1/2 IN. PG 64-22	155	TON	$ 180.00	$ 27,900.00
STRUCTURE EXCAVATION INCL. HAUL	25	CY	$ 15.00	$ 375.00
ROADWAY EXCAVATION INCL. HAUL	25	CY	$ 25.00	$ 625.00
REMOVING ASPHALT CONCRETE PAVEMENT	10	SY	$ 20.00	$ 200.00
SCHEDULE A STORM SEWER PIPE 15 IN. DIA	60	LF	$ 62.00	$ 3,720.00
REMOVE EXISTING STORM PIPE	60	LF	$ 15.00	$ 900.00
OUTLET CONTROL STRUCTURE	1	EA	$ 7,500.00	$ 7,500.00
CONNECT TO EXISTING DRAINAGE SYSTEM	2	EA	$ 500.00	$ 1,000.00
TEMPORARY TRAFFIC CONTROL	1	LS	$ 10,000.00	$ 10,000.00

SUBTOTAL (ROUNDED)		$ 144,900
CONTINGENCIES	50%	$ 72,450
CONSTRUCTION TOTAL (ROUNDED)		$ 218,000
SALES TAX	10.0%	$ 21,800
CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)		$ 240,000
ENGINEERING, LEGAL/ADMIN, COORDINATION	20%	$ 43,600
CONSTRUCTION ENGINEERING	10%	$ 21,800
GEOTECHNICAL ENGINEERING		$ 50,000

PERMITTING	15%	$	32,700
INDIRECT COST TOTAL (ROUNDED)		$	149,000
PROJECT TOTAL (ROUNDED)		**$**	**389,000**

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PROJECT SUMMARY SHEET

CIP Number and Name: Problem ID #7

Subbasin: Land Castle

Problem Description: Seepage onto roadway results in driving hazards and icy roads in winter.

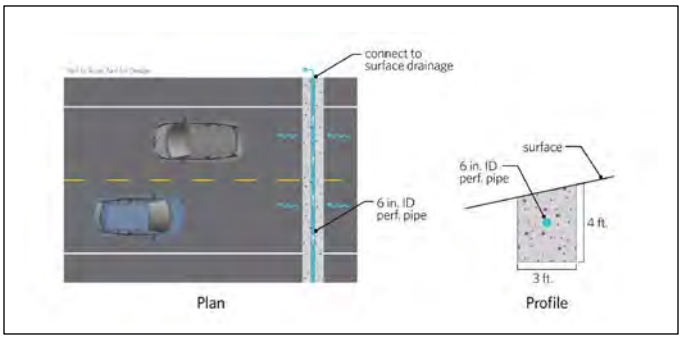
Project Solution: Install underdrain below the roadway to direct groundwater into an existing ditch/storm drain.

Project Benefit: Reduce potential for groundwater seepage through the roadway/sidewalk.

Estimated Project Cost: $ 58,000

Associated Projects:

Photo 1: Roadway seepage on SE 76th St.



Project Cost Estimate

City of Newcastle **Date:** 5/2/2017

Stormwater Comprehensive Plan **Project No.:** 10042491

Problem ID #7 **Estimate By:** FPW

Order of Magnitude Cost Opinion

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
MOBILIZATION	1	LS	$ 5,000.00	$ 5,000.00
SURVEY	1	LS	$ 2,000.00	$ 2,000.00
TESC	1	LS	$ 5,000.00	$ 5,000.00
REMOVING ASPHALT CONCRETE PAVEMENT	15	SY	$ 20.00	$ 300.00
ROADWAY EXCAVATION INCL. HAUL.	20	CY	$ 25.00	$ 500.00
UNDERDRAIN PIPE 6 IN. DIAM.	30	LF	$ 40.00	$ 1,200.00
GRAVEL BACKFILL FOR DRAIN	5	CY	$ 65.00	$ 325.00
GRAVEL BACKFILL FOR PIPE ZONE BEDDING	12	CY	$ 40.00	$ 480.00
HMA CL 1/2 IN. PG 64-22	7	TON	$ 55.00	$ 385.00
CRUSHED SURFACING BASE COURSE	5	TON	$ 35.00	$ 175.00
CLEANOUT	1	EA	$ 700.00	$ 700.00
CONSTRUCTION GEOTEXTILE FABRIC	10	SY	$ 10.00	$ 100.00
TEMPORARY TRAFFIC CONTROL	1	LS	$ 3,000.00	$ 3,000.00

SUBTOTAL (ROUNDED)		$ 19,200
CONTINGENCIES	50%	$ 9,600
CONSTRUCTION TOTAL (ROUNDED)		$ 29,000
SALES TAX	10.0%	$ 2,900
CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)		$ 32,000
ENGINEERING, LEGAL/ADMIN, COORDINATION	20%	$ 5,800
CONSTRUCTION ENGINEERING	15%	$ 4,350
GEOTECHNICAL ENGINEERING		$ 12,000
PERMITTING	10%	$ 2,900

INDIRECT COST TOTAL (ROUNDED)	$	26,000
PROJECT TOTAL (ROUNDED)	**$**	**58,000**

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PROJECT SUMMARY SHEET

CIP Number and Name:	Problem ID #8
Subbasin:	May Creek
Problem Description:	Flooding in roadway on 144th Place SE.
Project Solution:	Excavate out roadside conveyance ditch and upsize existing culvert at 144th Pl SE and 136th Ave SE.
Project Benefit:	Upsized conveyance systems will allow runoff to to be conveyed off of 144th Place SE, eliminating flooding issues.
Estimated Project Cost:	$ 240,000
Associated Projects:	

Photo 1: Existing culvert and conveyance ditch at 114th Pl SE and 136th Ave SE

Project Cost Estimate

City of Newcastle **Date:** 5/2/2017

Stormwater Comprehensive Plan **Project No.:** 10042491

Problem ID #8 **Estimate By:** FPW

Order of Magnitude Cost Opinion

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
MOBILIZATION (10%)	1	LS	$ 6,800.00	$ 6,800.00
SURVEY (6%)	1	LS	$ 4,100.00	$ 4,100.00
TESC (10%)	1	LS	$ 6,800.00	$ 6,800.00
DITCH EXCAVATION INCL. HAUL	140	CY	$ 35.00	$ 4,900.00
CLEARING AND GRUBBING	0.10	AC	$ 40,000.00	$ 4,000.00
DUCTILE IRON PIPE FOR STORM SEWER 18 IN. DIAM.	50	LF	$ 150.00	$ 7,500.00
REMOVING ASPHALT CONCRETE PAVEMENT	20	SY	$ 20.00	$ 400.00
ROADWAY EXCAVATION INCL. HAUL	20	CY	$ 25.00	$ 500.00
GRAVEL BACKFILL FOR PIPE ZONE BEDDING	18	CY	$ 40.00	$ 720.00
HMA CL 1/2 IN. PG 64-22	12	TON	$ 55.00	$ 660.00
CRUSHED SURFACING BASE COURSE	1	TON	$ 35.00	$ 35.00
WOOD MULCH, 4-INCH DEPTH	45	CY	$ 35.00	$ 1,575.00
SOIL AMMENDMENT, COMPOST, 3-INCH DEPTH	35	CY	$ 38.00	$ 1,330.00
REPLANTING	3500	SF	$ 12.00	$ 42,000.00
TEMPORARY TRAFFIC CONTROL	1	LS	$ 4,000.00	$ 4,000.00

SUBTOTAL (ROUNDED)		$ 85,400
CONTINGENCIES	50%	$ 42,700
CONSTRUCTION TOTAL (ROUNDED)		$ 129,000
SALES TAX	10.0%	$ 12,900
CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)		$ 142,000
ENGINEERING, LEGAL/ADMIN, COORDINATION		$ 50,000
CONSTRUCTION ENGINEERING	10%	$ 12,900
		$ 15,000

GEOTECHNICAL ENGINEERING			
PERMITTING	15%	$	19,350
INDIRECT COST TOTAL (ROUNDED)		$	98,000
PROJECT TOTAL (ROUNDED)		**$**	**240,000**

This opinion of cost is considered a "Class IV" estimate (see attached descriptions). The American Association of Cost Engineers (AACE) and the American National Standards Institute (ANSI) both define the expected accuracy of a "Class IV" estimate to be plus 30 percent or minus 30 percent. It must be clearly understood that this is a very preliminary estimate and has been prepared only for guidance in project evaluation purposes from information presented to the estimator at the time of the estimate.

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The estimate assumes that the site will have access and approvals for the scope of work described. No cost has been included for environmental mitigation or restorations. Costs shown are current April 2017 anticipated construction costs and **no** escalation, cost of capital, construction management or Operation & Maintenance costs have been included. Because of these factors, project feasibility, benefit/cost ratios, risks, and funding needs must be carefully reviewed prior to making specific financial decisions or establishing project budgets to help ensure proper project evaluation and adequate funding.

PROJECT SUMMARY SHEET

CIP Number and Name:	Problem ID #9
Subbasin:	May Creek
Problem Description:	Runoff from road is flowing onto private property, and is being directed into pipes which discharge onto private property.
Project Solution:	Abandon existing storm drain system and obtain easement to install new system. Install asphalt berm along roadway to redirect drainage.
Project Benefit:	New system will eliminate bends prone to clogging and provide sumps to collect sediment/debris that enters the storm system. Current discharge onto private property will be eliminated.
Estimated Project Cost:	$ 166,000
Associated Projects:	

Photo 1:

Project Cost Estimate

City of Newcastle **Date:** 5/2/2017

Stormwater Comprehensive Plan **Project No.:** 10042491

Problem ID #9 **Estimate By:** FPW

Order of Magnitude Cost Opinion

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
MOBILIZATION	1	LS	$ 5,000.00	$ 5,000.00
SURVEY (6%)	1	LS	$ 2,400.00	$ 2,400.00
TESC	1	LS	$ 5,000.00	$ 5,000.00
ABANDON EXISTING PIPE	60	CY	$ 115.00	$ 6,900.00
EXCAVATION CLASS B INCL. HAUL	40	CY	$ 15.00	$ 600.00
SCHEDULE A STORM SEWER 12 IN. DI	250	LF	$ 50.00	$ 12,500.00
GRAVEL BACKFILL FOR PIPE ZONE BEDDING	30	CY	$ 40.00	$ 1,200.00
SOIL AMENDMENT, COMPOST, 3-INCH DEPTH	3	CY	$ 38.00	$ 114.00
TOPSOIL, 6-INCH DEPTH	5	CY	$ 48.00	$ 240.00
REPLANTING	275	SF	$ 12.00	$ 3,300.00
STRUCTURE EXCAVATION CLASS B INCL. HAUL	36	CY	$ 15.00	$ 540.00
CATCH BASIN TYPE 2 48 IN. DIAM.	2	EA	$ 3,000.00	$ 6,000.00
CATCH BASIN TYPE 1	2	EA	$ 1,300.00	$ 2,600.00
ASPHALT THICKENED EDGE	300	LF	$ 10.00	$ 3,000.00
CLEARING AND GRUBBING	1	LS	$ 2,000.00	$ 2,000.00

SUBTOTAL (ROUNDED)		$	51,400
CONTINGENCIES	50%	$	25,700
CONSTRUCTION TOTAL (ROUNDED)		$	78,000
SALES TAX	10.0%	$	7,800
CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)		$	86,000
ENGINEERING, LEGAL/ADMIN, COORDINATION		$	40,000
GEOTECHNICAL ENGINEERING		$	10,000
	10%	$	7,800

CONSTRUCTION ENGINEERING			
PERMITTING	15%	$	11,700
EASEMENTS & ROW ACQUISITION		$	10,000
INDIRECT COST TOTAL (ROUNDED)		$	80,000
PROJECT TOTAL (ROUNDED)		**$**	**166,000**

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Project Summary Sheet

CIP Number and Name:	Problem ID #10
Subbasin:	Varies
Problem Description:	Groundwater seepage onto sidewalks results in slipping hazards and icy conditions in winter.
Project Solution:	Install underdrain below the roadway to direct groundwater into an existing ditch/storm drain.
Project Benefit:	Reduce potential for groundwater seepage through the roadway/sidewalk.
Estimated Project Cost:	$ 38,000
Associated Projects:	

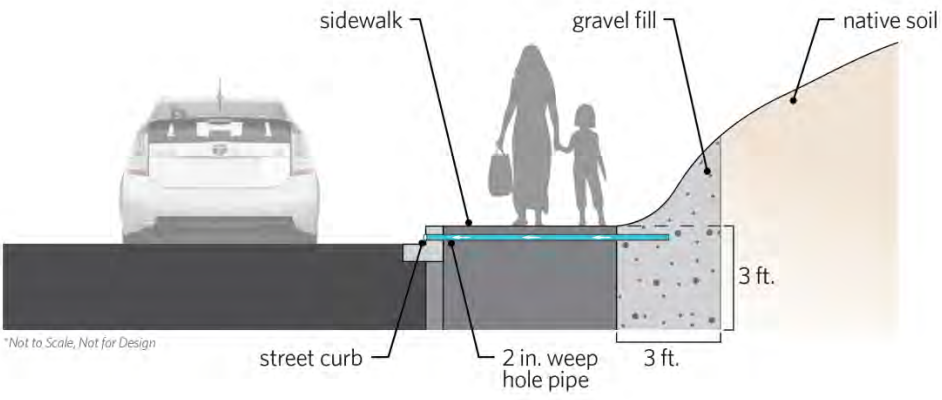

Photo 1: Typical seepage onto sidewalk

Project Cost Estimate

City of Newcastle **Date:** 5/2/2017

Stormwater Comprehensive Plan **Project No.:** 10042491

Include CIP Name **Estimate By:** FPW

Order of Magnitude Cost Opinion

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
MOBILIZATION	1	LS	$ 3,000.00	$ 3,000.00
SURVEY	1	LS	$ 2,000.00	$ 2,000.00
TESC	1	LS	$ 3,000.00	$ 3,000.00
REMOVING CEMENT CONC. SIDEWALK	8	SY	$ 120.00	$ 960.00
REMOVING CEMENT CONC. CURB AND GUTTER	10	LF	$ 100.00	$ 1,000.00
CHANNEL EXCAVATION INCL. HAUL	5	CY	$ 55.00	$ 275.00
CRUSHED SURFACING BASE COURSE	2	TON	$ 200.00	$ 400.00
CEMENT CONCRETE SIDEWALK	8	SY	$ 170.00	$ 1,360.00
CEMENT CONCRETE TRAFFIC CURB AND GUTTER	10	LF	$ 100.00	$ 1,000.00
GRAVEL BACKFILL FOR DRAIN	5	CY	$ 100.00	$ 500.00
2 IN. WEEP HOLE PIPE	8	LF	$ 75.00	$ 600.00
TEMPORARY TRAFFIC CONTROL	1	LS	$ 2,000.00	$ 2,000.00

SUBTOTAL		$	8,095
CONTINGENCIES	50%	$	4,048
CONSTRUCTION TOTAL (ROUNDED)		$	13,000
SALES TAX	10.0%	$	1,300
CONSTRUCTION TOTAL WITH SALES TAX (ROUNDED)		$	15,000
ENGINEERING, LEGAL/ADMIN, COORDINATION		$	10,000
GEOTECHNICAL ENGINEERING		$	2,000
CONSTRUCTION ENGINEERING		$	1,500
PERMITTING		$	1,500
		$	8,000

EASEMENTS & ROW ACQUISITION		
INDIRECT COST TOTAL (ROUNDED)	$	23,000
PROJECT TOTAL (ROUNDED)	**$**	**38,000**

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Appendix E – Summary Notes of Previous Railroad Embankment Reconnaissance

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Railroad Embankment on Newport Hills Creek
S-017
Summary

Excerpts from Jerald LaVassar's Letters/Report
On: June 12, 2012

Key Personnel

1. Jerald LaVassar, Dam Engineer, Dam Safety Office, Washington State Department of Ecology
2. Kathy Nygard, King County Parks Dept.
3. Mark Rigos, City of Newcastle Public Works Director
4. David and Lidia Edgmon, Property Owners at 12529 SE 89TH PL 98056

Ecology's Dam Safety Office Involvement

- Wants/Plans to remove this structure from our inventory of dams.
- Will remain involved and assist until the City has implemented a suitable monitoring and maintenance program.
- Make sure the City understands the threat this embankment could become if the existing outlet works were overwhelmed and the pool behind the embankment were allowed to rise to an unprecedented level.
- Plan to work with the City to develop a basic plan to exercise responsible stewardship of the embankment and its outlet works.

Suggested/ Required Action Items

1) Routine monitoring of pond levels,

2) Routine updating of the existing Emergency Action Plan (EAP) to keep contact information for residences within the likely inundation zone current, and

3) In the EAP establish threshold levels of the pond that trigger: a) alerting downstream residences of an unusual increase in pond levels, b) evacuating downstream residences, and c) the City's mobilizing an excavator (to lower the crest), setting up pumps on the lowered section of the embankment, and then drawing down the pool. Prudence dictates that one always have a plan to deal with the implausible but not impossible scenario.

Characterization of the Structure (LaVassar)

Structure does not meet the definition of, or function as, a dam. A more accurate description is an **"abandoned railroad embankment with an unrestricted, low level culvert near its base."** "Unrestricted" here signifies the fact that the culvert inlet does not have a valve on it for the purpose of restricting outflows and impounding a reservoir. That lack of a valve on the low level outlet pipe distinguishes it from a dam. The existing outlet pipe, together with minor seepage, has maintained the pool depth within a few feet of the mud line in the pond. Further, it appears that the existing outlet has limited water surface rises during the runoff season to nominal amounts.

Positives:

- embankment crest is some 65 feet wide, approximately equal to the maximum height of the structure (downstream side)- Stable
- Freeboard is a minimum of about 50 feet so the majority of the embankment cross-section is unsaturated.
- Drainage area tributary to the pond per the 1994 study is small, about 140 acres.

Negatives:

- slopes of the embankment are steep
- only one outlet to the pond (24" concrete pipe)
- Interior of the embankment is unknown.

Potential Problems to Watch/Address

- Seepage driven by an elevated pool could induce internal erosion of the lower portion of the embankment. In an extreme case that seepage could lead to a washout of the embankment. Again, it is in everyone's interest that the embankment never impound water to any significant depth. The key to holding the pool down is maintaining the full outflow capacity of the low level outlet pipe.
- There is always the possibility that the entrance to the low level outlet might be restricted.
- That restriction could result from debris accumulating at the pipe inlet, from an embankment slope failure burying the pipe inlet (low probability given distance of the inlet from the embankment toe), or from the dock abutting the pipe inlet (visible in our 1994 photo) if it is still present. That dock could shift and wrench the outflow pipe entrance in that process.

Site Visit March 2012 (LaVassar)

- Examined the downstream slope for seepage issues and the low level outlet pipe outfall area for erosion
- Both concerns that were identified in our 1994 inspection letter.

The following observations were made:

1) Did not observe seepage emerging along the dam toe or on the lower reaches of the dam face in quantities sufficient to produce a visible flow or to have induced creep of the embankment face.

2) The discharge from the low level pipe has eroded soils within the embankment footprint some 10 feet back from the original slope face. The last section of pipe with its concrete head wall lays on the slope below the pipe outfall. The pipe discharge impinges on a competent glacial till stratum. That discharge has eroded a near vertical face some 20 feet high at the base of the left side of the valley (facing downstream). This erosion zone does not appear to pose a material threat at this time of inducing a deep seated failure of the valley sidewall. None-the-less it would be prudent to armor the area accepting the pipe outflow to still some of the erosive power of the flow. It is possible some of the armoring could be obtained by breaking up the concrete head wall assembly presently lying on the slope.

3) In 1995 the DSO ran their remote controlled video camera up the outlet pipe to evaluate the condition of the segmented concrete pipe. That evaluation showed many pipe joints in various degrees of distress. To aid the City in their deliberations as to a suitable course of action regarding that pipe, the DSO would be willing to again run our remote camera up the pipe. This would need to be schedule at a time when the pond level drops below the level of the outlet pipe entrance. A comparison of the present condition of the pipe with that of 17 years ago ideally will allow estimating what remains of the useful life of the pipe.

Property Ownership

- Dam embankment is on City of Newcastle property part of the May Creek open space
- However upstream section of the pipe and its inlet are on private property, which complicates matters. (Need to inspect structure but requires permission to access property)
- Could be responsibility of property owners to perform monitoring or would require City to obtain some sort of dedication, maintenance agreement or easement.
- DSO is available to meet with the involved parties if the City sees that as a step that would likely advance resolving the matter.
- The following information is of the parcels where the pond touches their property. The first parcel listed, 334510-0370, has the control structure.

Parcel Number	334510-0370
Name	EDGMON DAVID L+LYDIA D
Site Address	12529 SE 89TH PL 98056
Legal	HILLMANS LK WN GARDEN OF EDEN # 6 POR N OF R/W & E OF CO RD NO 1722 LESS POR BEG ON NLY MGN OF PC R/W OPPSITE STA 22 + 298 TH ELY ALG SD NLY MGN 100 FT TH NLY AT R/A TO SD R/W 25 FT TH WLY PLT SD SLY MGN 100 FT TH SLY AT R/A TO SD NLY MGN 25 FT TO BEG SUBJ TO TRAN LN ESMT TGW VAC SE 88TH ADJ ORD #6326

Appendix F – Condition Assessment Program Concept Level Cost Estimate

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Targeted Condition Assessment Program Cost Estimate

City of Newcastle **Date:** 4/17/2017

Stormwater Management Comprehensive Plan Update **Estimate By:** EL

Targeted Condition Assessment Program

Order of Magnitude Cost Opinion

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST[1]
INF AREA 1				**$58,500**
Structures – manholes, catch basins, inlets, separators	142	Per asset	$260	$37,000
Structures – vaults, tanks	1	Per asset	$500	$500
Pipes	12,725	LF	*	$21,000
INF AREA 2				**$16,500**
Structures – manholes, catch basins, inlets, separators	44	Per asset	$260	$11,000
Structures – vaults, tanks	3	Per asset	$500	$1,500
Pipes	2,678	LF	*	$4,000
INF AREA 3				**$5,000**
Structures – manholes, catch basins, inlets, separators	7	Per asset	$260	$2,000
Structures – vaults, tanks	0	Per asset	$500	$-
Pipes	1,691	LF	*	$3,000
RISK EXPOSURE AND DECISION LOGIC DEVELOPMENT	**1**	**LS**	**$50,000**	**$50,000**

[1]Unit costs and total costs have been rounded to the nearest $10 and nearest $500 respectively.
*cost per linear foot (LF) varies by diameter, shown under **Cost Assumptions**. Cost estimates are therefore based on the specific pipe diameters found in each area.

Developing a reserve for assets found to be in a state of imminent failure is recommended; the size will depend upon selected mitigation measures (maintenance, repair, rehabilitation, and replacement). For instance, if a failure rate of 2% of all inspected assets is assumed, and it is assumed that all failed assets are replaced outright, an estimated reserve of approximately $250,000 may be required. This excludes manholes, tanks, and vaults for which, due to the small sample size, an estimated failure rate could not be applied.

Cost Assumptions:

The following assumptions and values are made for the inspection costs of each area:

Asset Type	Assumptions	Values
Structures – manholes, catch basins, inlets, separators	Assumes 1 2-person contractor crew and 2 hours per inspection to access, evaluate, and document; 1 contractor crew chief at 17% of full-time; 1 in-house analyst requiring 0.25 hours per asset to QC and review findings.	$56 per hour average loaded rate for all labor
Structures – vaults, tanks	Assumes 1 2-person contractor crew and 4 hours per inspection to access, evaluate, and document; 1 contractor crew chief at 17% of full-time; 1 in-house analyst requiring 0.25 hours per asset to QC and review findings.	$56 per hour average loaded rate for all labor
Pipes	Price per linear feet (LF) based on pipe diameter; 1 in-house analyst requiring 0.25 hours per asset to QC and review findings.	8”: $1.00 per LF 12”: $1.25 per LF 18”: $1.50 per LF ≥24”: $2.00 per LF Analyst loaded rate: $56 per hour

The lump sum cost for developing risk exposure factors and decision logic for risk mitigation measures is based on HDR’s knowledge of similar programs.

The reserve estimate provided is based on possible failure rates and subsequent mitigation measures. The following estimated replacement costs are based on average replacement costs found for the King County Road Services Division for its stormwater assets in the right-of-way.

Asset Type	Replacement Cost
Catch Basin	$9,740 per asset
Pipe	$560 per LF (open cut only – it is assumed that based on the location of the assets, pipe bursting is not required)

The opinions of cost (estimates) shown, and any resulting conclusions on program financial or economic feasibility or funding requirements, have been prepared for guidance in program evaluation and implementation from the information available at the time the opinion was prepared. The final costs of the program and resulting feasibility will depend on actual labor and material costs, competitive market conditions, actual site conditions, final program scope, implementation schedule, continuity of personnel and engineering, and other variable factors. As a result, the final program costs will vary from the opinions of cost presented herein.

Costs shown are 2017 dollars, and **no** escalation or mitigation costs for defects/failures found have been included. Because of these factors, project feasibility, benefit/cost ratios, risks, and funding needs must be carefully reviewed prior to making specific financial decisions or establishing project budgets to help ensure proper project evaluation and adequate funding.

Appendix G – NPDES General Conditions

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4.1 General Conditions

The General Conditions of the permit have the following requirements:

4.1.1 G1. DISCHARGE VIOLATIONS

All discharges and activities authorized by this Permit shall be consistent with the terms and conditions of this Permit.

4.1.2 G2. PROPER OPERATION AND MAINTENANCE

The Permittee shall at all times properly operate and maintain all facilities and systems of collection, treatment, and control (and related appurtenances) which are installed or used by the Permittee for pollution control to achieve compliance with the terms and conditions of this Permit.

4.1.3 G3. NOTIFICATION OF DISCHARGE, INCLUDING SPILLS

If a Permittee has knowledge of a discharge, including spills, into or from a MS4 which could constitute a threat to human health, welfare, or the environment, section G3 lists reporting procedures.

4.1.4 G4. BYPASS PROHIBITED

The intentional bypass of stormwater from all or any portion of a stormwater treatment BMP whenever the design capacity of the treatment BMP is not exceeded is prohibited unless certain conditions apply (see permit for specific details).

4.1.5 G5. RIGHT OF ENTRY

The Permittee shall allow an authorized representative of Ecology, upon the presentation of credentials and such other documents as may be required by law at reasonable times.

4.1.6 G6. DUTY TO MITIGATE

The Permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this Permit which has a reasonable likelihood of adversely affecting human health or the environment.

4.1.7 G7. PROPERTY RIGHTS

This permit does not convey any property rights of any sort, or any exclusive privilege.

4.1.8 G8. COMPLIANCE WITH OTHER LAWS AND STATUTES

Nothing in the Permit shall be construed as excusing the Permittee from compliance with any other applicable federal, state, or local statutes, ordinances, or regulations.

4.1.9 G9. MONITORING

Standards for conducting stormwater monitoring are included in section G9 and are summarized below.

A. Representative Sampling: Samples and measurements shall be representative of the volume and nature of the monitored discharge.

B. Records Retention: The Permittee shall retain records of all monitoring information, including all calibration and maintenance records for a period of at least five years.

C. Recording of Results: the date, exact place and time of sampling; the individual who performed the sampling or measurement; the dates the analyses were performed; who performed the analyses; the analytical techniques or methods used; and the results of all analyses.

D. Test Procedures: Guidelines Establishing Test Procedures for the Analysis of Pollutants contained in 40 CFR Part 136, unless otherwise specified in this permit or approved in writing by Ecology

E. Flow Measurement: Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges.

F. Lab Accreditation: All monitoring data, except for flow, temperature, conductivity, pH, total residual chlorine, and other exceptions approved by Ecology, shall be prepared by a laboratory registered or accredited under the provisions of, Accreditation of Environmental Laboratories, chapter 173-50 WAC.

G. Additional Monitoring: Ecology may establish specific monitoring requirements in addition to those contained in this permit by administrative order or permit modification.

4.1.10 G10.REMOVED SUBSTANCES

With the exception of decant from street waste vehicles, the Permittee shall not allow collected screenings, grit, solids, sludge, filter backwash, or other pollutants removed in the course of treatment or control of stormwater to be re-suspended or reintroduced to the storm sewer system or to waters of the state. Decant from street waste vehicles resulting from cleaning stormwater facilities may be reintroduced only when other practical means are not available and only in accordance with the Street Waste Disposal Guidelines in Appendix 6 of the NPDES General Conditions. Solids generated from maintenance of the MS4 may be reclaimed, recycled, or reused when allowed by local codes and ordinances. Soils that are identified as contaminated pursuant to chapter 173-350 WAC shall be disposed at a qualified solid waste disposal facility (see Appendix 6 of the NPDES General Conditions).

4.1.11 G11.SEVERABILITY

The provisions of this Permit are severable, and if any provision of this Permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this Permit shall not be affected thereby.

4.1.12 G12.REVOCATION OF COVERAGE

The director may terminate coverage under this General Permit in accordance with chapter 43.21B RCW and chapter 173-226 WAC. Details of cases where coverage may be terminated include are listed in the permit.

4.1.13 G13.TRANSFER OF COVERAGE

The director may require any discharger authorized by this General Permit to apply for and obtain an individual permit in accordance with chapter 43.21B RCW and chapter 173-226 WAC.

4.1.14 G14.GENERAL PERMIT MODIFICATION AND REVOCATION

This General Permit may be modified, revoked and reissued, or terminated in accordance with the provisions of WAC 173-226-230. Additional details are found in the permit.

4.1.15 G15.REPORTING A CAUSE FOR MODIFICATION OR REVOCATION

A Permittee who knows or has reason to believe that any activity has occurred or will occur which would constitute cause for modification or revocation and reissuance under Condition G12, G14, or 40 CFR 122.62 must report such plans, or such information, to Ecology so that a decision can be made on whether action to modify, or revoke and reissue this Permit will be required. Ecology may then require submission of a new or amended application. Submission of such application does not relieve the Permittee of the duty to comply with this Permit until it is modified or reissued.

4.1.16 G16.APPEALS

A. The terms and conditions of this General Permit, as they apply to the appropriate class of dischargers, are subject to appeal within thirty days of issuance of this General Permit, in accordance with chapter 43.21B RCW, and chapter 173-226 WAC.

B. The terms and conditions of this General Permit, as they apply to an individual discharger, are appealable in accordance with chapter 43.21B RCW within thirty days of the effective date of coverage of that discharger. Consideration of an appeal of General Permit coverage of an individual discharger is limited to the General Permit's applicability or nonapplicability to that individual discharger.

C. The appeal of General Permit coverage of an individual discharger does not affect any other dischargers covered under this General Permit. If the terms and conditions of this General Permit are found to be inapplicable to any individual discharger(s), the matter shall be remanded to Ecology for consideration of issuance of an individual permit or permits.

D. Modifications of this Permit are appealable in accordance with chapter 43.21B RCW and chapter 173-226 WAC.

4.1.17 G17.PENALTIES

Penalties for permit violations are promulgated by federal rules.

4.1.18 G18.DUTY TO REAPPLY

The Permittee shall apply for permit renewal at least 180 days prior to the specified expiration date of this permit.

4.1.19 G19.CERTIFICATION AND SIGNATURE

All formal submittals to Ecology shall be signed and certified.

4.1.20 G20.NON-COMPLIANCE NOTIFICATION

In the event a Permittee is unable to comply with any of the terms and conditions of this Permit, the Permittee must:

A. Notify Ecology of the failure to comply with the permit terms and conditions in writing within 30 days of becoming aware that the non-compliance has occurred. The written notification must include all of the following:

   1. A description of the non-compliance, including dates.
   2. Beginning and end dates of the non-compliance, and if the compliance has not been corrected, the anticipated date of correction.
   3. Steps taken or planned to reduce, eliminate, or prevent reoccurrence of the noncompliance.

B. Take appropriate action to stop or correct the condition of non-compliance.

4.1.21 G21.UPSETS

Permittees must meet the conditions of 40 CFR 122.41(n) regarding “Upsets.” The conditions are as follows:

A. Definition. “Upset” means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

B. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of paragraph (C) of this condition are met. Any determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, will not constitute final administrative action subject to judicial review.

C. Conditions necessary for demonstration of upset. A Permittee who wishes to establish the affirmative defense of upset must demonstrate, through properly signed contemporaneous operating logs, or other relevant evidence that:

   1. An upset occurred and that the Permittee can identify the cause(s) of the upset;
   2. The permitted facility was at the time being properly operated; and
   3. The Permittee submitted notice of the upset as required in 40 CFR 122.41(l)(6)(ii)(B) (24-hour notice of noncompliance).
   4. The Permittee complied with any remedial measures required under 40 CFR 122.41(d) (Duty to Mitigate).

Burden of proof. In any enforcement proceeding, the Permittee seeking to establish the occurrence of an upset has the burden of proof.

Appendix H – NPDES Gap Analysis

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Permit Section	Compliance Date	Requirement Type	Description of Permit Condition
Special Conditions S5—Stormwater Management Program			
S5.A.1	Immediate	Documentation	✓ The City of Newcastle's SWMP applies to the geographical city limits.
S5.A.2	Immediate	Documentation	✓ Newcastle prepares and updates its SWMP annually. **Citation**: http://www.ci.newcastle.wa.us/public_works/stormwater_management.htm.
S5.A.3	August 1, 2015	Record Keeping	✓ The City gathers, tracks, and uses information to evaluate its SWMP development, implementation, and compliance. **Citation**: YourGov (Cartegraph), or emails and phone calls to the Surface Water Program Manager. City tracks non-IDDE drainage complaints in an excel spreadsheet, and assigns each complaint a number (2017-01) within the spreadsheet. IDDE/spill response is tracked in another spreadsheet, with electronic folders with spill information.
S5.A.3.a	August 1, 2015	Record Keeping	☐ The City tracks the estimated cost of development of each component of the SWMP. **Gap**: Surface Water Management budget items are not sub-divided into SWMP sections. **Recommend** developing labor tracking process for SWMP implementation.
S5.A.3.b	Immediate	Record Keeping	✓ The City tracks the number of inspections, official enforcement actions, and public education activities it implements. **Citation**: • Publicly maintained stormwater systems are inspected per NPDES requirements and inspections are tracked in Work Orders (with subsequent tasks) in Cartegraph. • Privately maintained systems are inspected (FCS after 2007) yearly, other PDI systems are inspected every other year. Currently, records are kept in an excel spreadsheet and separate property folders. The City is interested in purchasing/using NPDES Pro. • Construction stormwater/TESC inspections tracked in TrakIT. • Enforcement actions/WQ violations are tracked in electronic folders and in TrakIT. • Public education activities are tracked in an excel spreadsheet. We utilize grant money also from KCD to provide watershed education to the schools, they track their outreach and submit a report to us at the end of the year.
S5.A.4	Immediate	Record Keeping	✓ The City continues to implement the SWMP until the updated version is implemented. **Citation**: NMC does not allow a lapse in code requirement.
S5.A.5	Immediate	Documentation	✓ The City coordinates with other jurisdictions for shared bodies of water. **Citation**: The SW Program Manager attends regional stormwater forums/meetings: STORM, ROADMAP, WRIA 8, SAM, NPDES Permit Coordinators. Also, beginning this quarter, the SW Program Manager and other SWM staff are meeting quarterly with each surrounding jurisdiction to discuss O&M concerns, WQ, spill response plans and coordination, and outreach activities.
S5.B	Immediate	Documentation	✓ The SWMP shall be designed to reduce the discharge of pollutants from regulated small MS4s to the MEP, meet state AKART requirements, and protect water quality.

S5.C.1 Public Education and Outreach			
S5.C.1.a	Immediate	Documentation	The City is required to provide information for businesses and the general public about impacts to surface waters, from impervious surfaces, illicit discharges, LID principals, and opportunities for stewardship. ✓ (i) Outreach directed towards general public, engineers, contractors, and land use planners. ✓ (ii) Outreach affects behaviors from the general public, engineers, contractors, and land use planners. **Citation**: City's web page discussing rain gardens, oil leaks, car wash kits, water quality hotline meets the condition of the permit section. http://www.ci.newcastle.wa.us/public_works/StormwaterEducation.htm.
S5.C.1.b	Immediate	Documentation	✓ The City creates stewardship opportunities and/or partners with existing organizations to encourage residents to participate in activities such as stream teams, storm drain marking, volunteer monitoring, riparian plantings and education activities. **Citation:** City's web site listing opportunities to volunteer. http://newcastlewa.gov/your_community/volunteering
S5.C.1.c	February 2, 2016	Documentation	✓ Each Permittee shall measure the understanding and adoption of the targeted behaviors for at least one target audience in at least one subject area. **Citation:** In partnership with neighboring jurisdictions, the City relies on regional stormwater forums/meetings, to measure overall audience behavior, feedback from residents at events. The curriculum that KCD offers/includes behavior-change surveys for students that is offered to both elementary schools. The City may implement an annual survey to measure behavior changes that could help us with its SWMP.
S5.C.2 Public Involvement and Participation			
S5.C.2.a	Immediate	Policy Development and Implementation	✓ Opportunities for public involvement in decision-making process. **Citation**: The City has regular Planning Commission and City Council meetings allowing the public opportunities to provide comments.
S5.C.2.b	Immediate	Documentation	✓ Post on web site the SWMP and annual report. The City is required to post the Annual Report and the SWMP Plan by May 31st each year. **Citation**: http://www.ci.newcastle.wa.us/public_works/stormwater_management.htm.
S5.C.3 Illicit Discharge Detection and Elimination			
S5.C.3.a	February 2, 2016	Data Management	Maps to include the following: **Citation** Ecology audit, April 2016, pp.3. ✓ (i) Locations of MS 4 outfalls. ✓ (ii) Receiving waters. ✓ (iii) Publically owned treatment BMPs & flow control. ✓ (iv) Tributary conveyance with 24" or larger diameters to outfalls. ✓ (v) Connections to MS4 built after 2/16/2007. ✓ (vi) Connections to MS 4 by other municipalities. ✓ (vii) Areas by MS 4 that don't discharge to receiving waters. ✓ (viii) Make maps available to Ecology. ✓ (ix) Make maps available to tribes, and other permittees.
S5.C.3.b	Immediate	Regulatory	The City is required to have ordinances that prohibit non-stormwater, illicit discharges into the MS4. ✓ (i) Ordinance lists allowable discharges (diverted streams, rising ground waters, springs, footing drains, etc.). **Citation**: NMC 13.05.025C ✓ (ii) Conditional allowances are listed. **Citation**: NMC 13.05.025B ✓ (iii) The City addresses any category of discharges in (i) or (ii) above if the discharges are identified as significant sources of pollutants to waters of the State. **Citation:** For illicit discharges from a commercial business or construction site (SFR typically excluded unless paint spill or obvious discharge), water quality violations are also issued (notice and order). For SFR and SFR construction sites, outreach is favored, and sometimes they might be given a letter with opportunity to correct. ✓ (iv) Ordinance includes provisions for escalating enforcement. **Citation**: NMC 13.05.055, Title 4 ✓ (v) Permittee has a compliance strategy that includes informal actions (e.g. public education, technical assistance) and enforcement. **Citation**: Compliance strategy includes informal outreach both scheduled (part of the privately maintained system inspections) and not scheduled (IDDE or complaint response). ✓ (vi) Ordinance in effect as of date of current permit and updated no later than 2/2/2018.

S5.C.3.c	Immediate	Documentation	The City is required to have procedures for locating priority areas likely to have illicit discharges, including at a minimum: evaluating land uses and associated business/industrial activities present; areas where complaints have been registered in the past; and areas with storage of large quantities of materials that could result in illicit discharges, including spills. ✓ (i) Investigation procedures. **Citation** Newcastle uses Ecology approved IDDE guidelines prepared by Herrera. ✓ (ii) Hotline # for reporting. **Citation**: http://www.ci.newcastle.wa.us/public_works/StormwaterEducation.htm. ✓ (iii) Training program for staff. **Citation** Training program includes IDDE/spill response training led by SW Program Manager. Includes RainCheck and other videos. Training includes inventory of our materials, updates to our procedures and on-call book, coordinating with other jurisdictions, and lessons learned after spill response activities. Instructor has 40-hour HAZWOPPER training. ✓ (iv) Informing public of hazards with illicit discharges**. Citation:** http://www.ci.newcastle.wa.us/public_works/StormwaterEducation.htm.
S5.C.3.d	Dec. 31, 2018	Record Keeping	The City is required to field assess for illicit discharges in 40% of the system by Dec. 31, 2018 and on average 12% of the system each year after 2018. ✓ (i) Procedures for characterizing illicit discharge. **Citation**: Ecology audit, April 2016, pp.3. ✓ (ii) Tracing procedures. **Citation**: Ecology audit, April 2016, pp.3. ✓ (iii) Procedures for eliminating illicit discharges. **Citation**: Ecology audit, April 2016, pp.3. ✓ (iv) Compliance provisions. **Citation**: Ecology audit, April 2016, pp.3.
S5.C.3.e	February 2, 2016	Record Keeping	✓ The City is required to train staff for the identification, investigation, termination, cleanup, and reporting of illicit discharges. **Citation**: Ecology audit, April 2016, pp.3.
S5.C.3.f	Immediate	Record Keeping	✓ The City is required to track and maintain records of the activities conducted to meet the requirements of this section including inspection reports, warning letters, notices of violations, and other enforcement records. **Citation**: Outfalls are inspected annually in the dry months and are tracked in Cartegraph as a separate Work Order. Each inspection form/task in Cartegraph (for publicly maintained) has a question that asks if there is presence of an illicit discharge or connection. Illicit connections and discharges are fined (notice and order) per NMC.
S5.C.4 Controlling Runoff from New Development, Redevelopment, and Construction Sites			
S5.C.4.a	Dec. 31, 2016	Policy Development and Implementation	✓ The City is required to implement and enforce a program to reduce pollutants in stormwater runoff from new development, redevelopment, and construction site activities. Minimum performance standards are included in the Ecology and King County surface water design manuals. **Citation**: The City has adopted the King County Stormwater Design Manual, an equivalent manual to the Stormwater Management Manual for Western Washington which meets the permit standards in this section.
S5.C.4.b	Immediate	Record Keeping	The City is required to have a permitting process with Site Plan Review. ✓ (i) Review site plans. **Citation**: NMC 13.10.060 ✓ (ii) Inspect prior to clearing and construction. **Citation:** Duties performed by City Engineer. ✓ (iii) Inspect during construction. **Citation:** Duties performed by City Engineer. ✓ (iv) Inspect upon completion. **Citation:** Duties performed by City Engineer, data recorded in TrakIT database. ✓ (v) Verify compliance with inspection. **Citation:** Duties performed by City Engineer, data recorded in TrakIT database. ✓ (vi) Implement enforcement strategy. **Citation:** Duties performed by City Engineer, violations and enforcement tacked in TrakIT database.
S5.C.4.c	Dec. 31, 2016	Record Keeping	Operations and Maintenance, Inspections: ☐ (i) Ordinance requiring responsible party be identified. **Gap**: City ordinances need to be reviewed for consistency with this condition. ✓ (ii) Adopted O&M standards. **Citation:** O&M standards are 2016 KCSWDM Appendix A. ✓ (iii) Annual inspections of all SW facilities. **Citation:** The City inspects privately maintained facilities that meet criteria in S5.C.4.c.iii once per year, each privately maintained facility every other year. ✓ (iv) New plats, CB inspections every 6 months. **Citation:** Inspected by City engineer/inspector and noted in TrakIT. Need to create standard forms and scan into TrakIT (then into NPDES Pro for privately maintained facilities or Cartegraph for publicly maintained facilities after maintenance bonds). ✓ (v) Compliance measured by having records of 80% of total inspections. **Citation:** Tracked in Cartegraph. ✓ (vi) Compliance maintenance completed by deadlines. **Citation:** Construction inspections (both TESC and stormwater infrastructure), violations are tracked in TrakIT. ✓ (vii) Records of inspections and enforcement actions. **Citation:** violations and enforcement tacked in TrakIT database

S5.C.4.d	Immediate	Record Keeping	✓ The program shall make available copies of the "Notice of Intent for Construction Activity" and copies of the "Notice of Intent for Industrial Activity" to representatives of proposed new development and redevelopment. **Citation:** NOIs available on our website and at City Hall. ✓ Permittees shall continue to enforce local ordinances controlling runoff from sites that are also covered by stormwater permits issued by Ecology. **Citation:** We have a new inspector that inspects construction sites weekly and after rain events. WQ violations are enforced by ordinances, whether the site has a CSGP or not.
S5.C.4.e	Immediate	Record Keeping	✓ Each Permittee shall document and maintain records of the training provided to staff whose primary job duties are implementing the program to control stormwater runoff from new development, redevelopment, and construction sites, including permitting, plan review, construction site inspections, and enforcement. Follow-up training shall be provided as needed to address changes in procedures, techniques or staffing. **Citation:** Field staff and inspectors are CESCL trained. The City is in the process of upgrading their permit and development review handouts/packages for new development and redevelopment. Handouts/packages will include stormwater runoff control requirements according to the KCSWDM, and include Ecology CSGP information, and will be presented/required at each pre-app. Materials will be provided on our City website also. Development review staff and inspectors will be trained by the Surface Water Program Manager on new forms/requirements. Sites are required to provide TESC plans, and sites with CSGPs are required to provided original and updated SWPPP, map, and monitoring plan to City throughout project.
S5.C.4.f	Dec. 31, 2016	Regulatory	Low impact development (LID) code-related requirements. **Citation**: NMC 13.10.085 ✓ (i) 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. ✓ (ii) This summary shall include, at a minimum, a list of the participants (job title, brief job description, and department represented), the codes, rules, standards, and other enforceable documents reviewed, and the revisions made to those documents which incorporate and require LID principles and LID BMPs. The summary shall include existing requirements for LID principles and LID BMPs in development-related codes. The summary shall be organized as follows: (a) Measures to minimize impervious surfaces; (b) Measures to minimize loss of native vegetation; and (c) Other measures to minimize stormwater runoff.
S5.C.4.g	April 4, 2018	NA	Watershed-scale Stormwater Planning with King County. This permit condition is not applicable to Newcastle. King County selected the Bear-Evans Creek watersheds to conduct their studies These watersheds are not within the jurisdictional limits of Newcastle.
S5.C.5 Municipal Operations and Maintenance			
S5.C.5.a	Dec. 31, 2016	O&M	Each Permittee shall implement maintenance standards that are as protective, or more protective, of facility function than those specified in Chapter 4 of Volume V of the *Stormwater Management Manual for Western Washington, 2012, as amended in December 2014.* ✓ (i)) Standard must determine if maintenance is required. **Citation**: Ecology audit, April 2016, pp.4 verified standards matched KCSWDM, 2009. ✓ (ii) Maintenance shall be performed within 1-year for facilities other than catch basins. Catch basins within 6-months. **Citation** Maintenance to be performed according to the permit and KCSWDM standards. SWM inspector assigns due dates according to requirements in Cartegraph.
S5.C.5.b	Dec. 31, 2017	O&M	Select appropriate alternative: ✓ (i) Maintenance. Annual inspection of all municipally owned or operated permanent stormwater treatment and flow control BMPs/facilities, and appropriate maintenance actions in accordance with the adopted maintenance standards. **Citation**: Ecology audit letter, April 2016, pp.5 ✓ (ii) (check and provide details if applicable) Maintenance Permittees may reduce the inspection frequency based on maintenance records of double the length of time of the proposed inspection frequency. In the absence of maintenance records, the Permittee may substitute written statements to document a specific less frequent inspection schedule. **Citation:** Inspected annually, not enough data to provide longer maintenance schedules.
S5.C.5.c	Dec. 31, 2017	O&M	✓ Maintenance standards list flow control BMP facilities requiring spot checks after major storm events (24 hour storm event with a 10 year or greater recurrence interval). **Citation:** City staff performing spot checks, Surface Water Program Manager recently updated spreadsheet used for rain events.

S5.C.5.d	August 1, 2017	O&M	Select appropriate alternative Clean catch basins if the inspection indicates cleaning is needed to comply with maintenance standards established in the *Stormwater Management Manual for Western Washington*. Decant water shall be disposed of in accordance with Appendix 6 *Street Waste Disposal*. ✓ All catch basins and inlets owned or operated by the Permittee are required to be inspected at least once no later than August 1, 2017 and every two years thereafter; or alternatively (see next check box). **Citation**: Ecology audit, April 2016, pp.5. ☐ (check box if applicable) maintenance records and written statement in SWMP documents an inspection schedule of every two years is appropriate (see. (i), (ii), and (iii) below): (i): The catch basin inspection schedule of every two years may be changed as appropriate to meet the maintenance standards based on maintenance records of double the length of time of the proposed inspection frequency. In the absence of maintenance records for catch basins, the Permittee may substitute written statements to document a specific, less frequent inspection schedule. Written statements shall be based on actual inspection and maintenance experiences and shall be certified in accordance with G19 Certification and Signature. (ii): Inspections at least once by August 1, 2017 and every two years thereafter may be conducted on a "circuit basis" whereby 25% of catch basins and inlets within each circuit are inspected to identify maintenance needs. Include an inspection of the catch basin immediately upstream of any system outfall or discharge point, if applicable. Clean all catch basins within a given circuit for which the inspection indicates cleaning is needed to comply with maintenance standards established under S5.C.5.a, above. (iii): The Permittee may clean all pipes, ditches, catch basins, and inlets within a circuit once during the permit term. Circuits selected for this alternative must drain to a single point.
S5.C.5.e	Immediate	O&M	✓ The City has a documented inspection program meeting the inspection requirements in b, c, and d above and is designed to inspect all sites and achieve at least 95% of inspections. **Citation**: Ecology audit, April 2016, pp.5.
S5.C.5.f	Immediate	O&M	☐ The City implements practices, policies and procedures to reduce stormwater impacts. **Gap**: Ecology audit says this is a deficiency, pp. 6. ☐ The following activities are addressed in the procedures: pipe cleaning, cleaning of culverts that convey stormwater in ditch systems, ditch maintenance, street cleaning, road repair and resurfacing, including pavement grinding, snow and ice control, utility installation, pavement striping maintenance, maintaining roadside areas, including vegetation management, dust control, application of fertilizers, pesticides, and herbicides according to the instructions for their use, including reducing nutrients and pesticides using alternatives that minimize environmental impacts sediment and erosion control, landscape maintenance and vegetation disposal, trash and pet waste management, building exterior cleaning and maintenance. **Gap**: Ecology audit says this is a deficiency, pp. 6.
S5.C.5.g	Immediate	O&M	✓ The City is implementing an ongoing training program for employees whose primary construction, operations or maintenance job functions may impact stormwater quality. **Citation**: Ecology audit letter, pp. 6. ✓ The City documents and maintains records of training provided and the staff trained. **Citation:** The Surface Water Program Manager tracks training in a spreadsheet, including CESCL certification, IDDE and spill response training, and other related training.
S5.C.5.h	Immediate	O&M	✓ The City has a Stormwater Pollution Prevention Plan (SWPPP) for all heavy equipment maintenance or storage yards, and material storage facilities owned or operated by the Permittee. **Citation**: Ecology audit letter, pp. 6. ✓ The City's SWPPP has a schedule for implementation of structural BMPs (generic SWPPPs that can be applied at multiple sites may be used to comply with this requirement). **Citation**: SWPPP is reviewed at least once per year by Surface Water Program Manager. Maintenance staff review SWPPP BMPs and spill kit materials once per week. ☐ The City documents periodic visual observation of discharges from the facility to evaluate the effectiveness of the BMPs. **Gap**: City makes periodic observations, but lacks a forma documentation process.
S5.C.5.i	Immediate	O&M	✓ The City maintains records of inspections and maintenance or repair activities conducted by the Permittee. **Citation** The City implemented Cartegraph to track inspections and maintenance.
S6 Stormwater Management for Secondary Permittees—NA			
S7 Compliance with Total Maximum Daily Load Requirements—NA			

S8 Monitoring and Assessment			
S8.A	August 15, 2014	Regulatory	✓ The City of Newcastle includes in each annual report a description of any stormwater monitoring or stormwater-related studies conducted by the Permittee during the reporting period. **Citation**: Ecology audit letter, pp.6.
S8.B	August 15, 2014	Regulatory	✓ The City of Newcastle has notified Ecology in writing and has selected to participate in the Regional Stormwater Monitoring Group status and trends monitoring option. Newcastle pays into a collective fund to implement RSMP small streams and marine nearshore status and trends monitoring in Puget Sound. **Citation**: The City of Newcastle is listed on Ecology's web site as a participating permittee.
S8.C	Dec. 1, 2013	Regulatory	✓ The City of Newcastle pays into a collective fund to implement RSMP effectiveness studies. **Citation**: The City of Newcastle is listed on Ecology's web site as a participating permittee.
S8.D	August 15, 2014	Regulatory	✓ The City of Newcastle pays into the Regional Stormwater Group fund. **Citation**: The City of Newcastle is listed on Ecology's web site as a participating permittee.
S9 Reporting Requirements			
S9.A	Immediate	Documentation	✓ The City submits its Annual Report no later than March 31 of each year. **Citation:** http://www.ecy.wa.gov/programs/wq/stormwater/municipal/annualreports.html
S9.B	Immediate	Documentation	✓ The City keep all records related to this permit and the SWMP for at least five years. **Citation:** The City post Annual Plans on its web site or have paper copies available in archives. http://www.ci.newcastle.wa.us/public_works/stormwater_management.htm. :
S9.C	Immediate	Documentation	✓ The City makes all records related to this permit and the City's SWMP available to the public at reasonable times during business hours. The City provides a copy of the most recent annual report to any individual or entity, upon request. **Citation**: The City's SWMP is available on our website, and in paper copy at City Hall.
S9.D	Immediate	Documentation	The City's annual report includes the following: **Citation**: http://www.ci.newcastle.wa.us/public_works/stormwater_management.htm ✓ A copy of the City's current SWMP Plan as required by S5.A.2. ✓ Submittal of the Annual Report form as provided by Ecology pursuant to S9.A, describing the status of implementation of the requirements of this permit during the reporting period. ✓ Attachments to the annual report form including summaries, descriptions, reports, and other information as required, or as applicable, to meet the requirements of this permit during the reporting period. Refer to Appendix 3 for annual report questions. ✓ If applicable, notice that the MS4 is relying on another governmental entity to satisfy any of the obligations under this permit. ✓ Certification and signature pursuant to G19.D, and notification of any changes to authorization pursuant to G19.C.

Appendix I – Utility Rate Study Details

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City of Newcastle
Comprehensive Surface Water Management Plan Update
Appendix - I
Exhibit 1
Escalation Factors

	Budget					Forecast				
	2017	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Revenue										
Rate Revenue Growth	Budget	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Connection Charges	Budget	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Miscellaneous Revenue	Budget	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Flat	Budget	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Interest Revenue	Budget	0.5%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Expenditures										
Salary	Budget	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
Benefits	Budget	6.0%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
Supplies and Equipment	Budget	2.2%	2.5%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Chemicals	Budget	2.0%	2.5%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Electricity	Budget	3.0%	2.5%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Other Utilities	Budget	3.0%	2.5%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Professional Services	Budget	2.5%	2.5%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Miscellaneous	Budget	2.2%	2.5%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Fuel	Budget	3.0%	2.5%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
CPI-U West Urban (Avg 2006-2016)	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
10 Year Average Seattle CCI (ENR)	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Composite O&M Growth		**7.6%**	**7.8%**	**3.5%**	**13.0%**	**3.5%**	**3.5%**	**3.5%**	**3.6%**	**3.6%**
Bond Terms										
Term	20	20	20	20	20	20	20	20	20	20
Interest Rate	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
Loan Terms										
Term	10	10	10	10	10	10	10	10	10	10
Interest Rate	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%

City of Newcastle
Comprehensive Surface Water Management Plan Update
Appendix - I
Exhibit 2
Revenue Requirement

	Budget	Forecast									
	2017	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
Revenue											
Rate Revenue											
Surface Water Rate Revenue	$901,762	$910,780	$919,887	$929,086	$938,377	$947,761	$957,239	$966,811	$976,479	$986,244	As Rate Revenue Growth
Miscellaneous Revenue											
ROW T-Mobile	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	As Miscellaneous Revenue
Operating Grant	0	42,000	42,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	As Flat
Storm Water Review Fees	25,000	28,000	28,500	22,000	23,000	23,500	24,000	24,480	24,970	25,469	As Miscellaneous Revenue
Contributions	0	0	0	0	0	0	0	0	0	0	As Miscellaneous Revenue
Fines and Penalties	0	0	0	0	0	0	0	0	0	0	As Miscellaneous Revenue
Bank Earnings	7,000	0	0	0	0	0	0	0	0	0	As Miscellaneous Revenue
Total Revenue	$933,762	$980,780	$990,387	$958,086	$968,377	$978,261	$988,239	$998,291	$1,008,449	$1,018,713	
Operations & Maintenance Expenditures											
Salary & Benefits											
Salaries	$311,710	$293,885	$277,120	$286,819	$296,858	$307,248	$318,001	$329,131	$340,651	$352,574	As Salary
Benefits	152,455	179,525	199,645	208,629	218,017	227,828	238,080	248,794	259,990	271,689	As Benefits
New FTE	0	58,000	120,060	124,262	234,347	242,549	251,038	259,824	268,918	278,330	+ FTE in 2018 & 2021
Seasonal Salaries	47,960	55,625	58,128	60,744	63,477	66,334	69,319	72,438	75,698	79,104	As Benefits
Total Salary & Benefits	$512,125	$587,035	$654,953	$680,454	$812,699	$843,958	$876,439	$910,188	$945,257	$981,698	

City of Newcastle
Comprehensive Surface Water Management Plan Update
Appendix - I
Exhibit 2
Revenue Requirement

	Budget	Forecast									
	2017	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
Supplies											
Office & Operating Supplies	$1,000	$1,000	$1,025	$1,056	$1,087	$1,120	$1,154	$1,188	$1,224	$1,261	As Supplies and Equipment
Meeting Meals	200	400	410	422	435	448	461	475	490	504	As Supplies and Equipment
Soil & Ground Materials	10,000	5,000	5,125	5,279	5,437	5,600	5,768	5,941	6,120	6,303	As Supplies and Equipment
Maintenance & Repair Supplies	20,000	48,000	49,200	50,676	52,196	53,762	55,375	57,036	58,747	60,510	As Supplies and Equipment
Clothing & Accessories	900	1,900	1,948	2,006	2,066	2,128	2,192	2,258	2,325	2,395	As Supplies and Equipment
Books/Maps	500	1,500	1,538	1,584	1,631	1,680	1,730	1,782	1,836	1,891	As Supplies and Equipment
Small Tools/Minor Equipment	50,000	25,000	25,625	26,394	27,186	28,001	28,841	29,706	30,598	31,516	As Supplies and Equipment
Computer Software/Hardware	700	700	718	739	761	784	808	832	857	882	As Supplies and Equipment
Total Supplies	$83,300	$83,500	$85,588	$88,155	$90,800	$93,524	$96,329	$99,219	$102,196	$105,262	
Services											
Professional Services	$100,000	$90,000	$92,250	$95,018	$97,868	$100,804	$103,828	$106,943	$110,151	$113,456	As Professional Services
Communications	1,000	0	0	0	0	0	0	0	0	0	As Other Utilities
Postage	0	0	0	0	0	0	0	0	0	0	As Miscellaneous
Cell Phone	4,000	5,000	5,125	5,279	5,437	5,600	5,768	5,941	6,120	6,303	As Miscellaneous
Mileage	500	500	513	528	544	560	577	594	612	630	As Fuel
Rental & Leases	10,000	6,000	6,150	6,335	6,525	6,720	6,922	7,130	7,343	7,564	As Supplies and Equipment
Waste Disposal	8,000	10,000	10,250	10,558	10,874	11,200	11,536	11,883	12,239	12,606	As Other Utilities
Repairs & Maintenance	85,000	93,000	95,325	98,185	101,130	104,164	107,289	110,508	113,823	117,238	As Supplies and Equipment
Street Sweeping	35,000	30,000	30,750	31,673	32,623	33,601	34,609	35,648	36,717	37,819	As Fuel
Miscellaneous	0	0	0	0	0	0	0	0	0	0	As Miscellaneous
Dues & Memberships	250	250	256	264	272	280	288	297	306	315	As Miscellaneous
Printing	500	1,000	1,025	1,056	1,087	1,120	1,154	1,188	1,224	1,261	As Miscellaneous
Total Services	$244,250	$235,750	$241,644	$248,893	$256,360	$264,051	$271,972	$280,131	$288,535	$297,191	
Travel & Training											
Training & Professional Development	$2,700	$7,000	$7,175	$7,390	$7,612	$7,840	$8,076	$8,318	$8,567	$8,824	As Miscellaneous
Total Travel & Training	$2,700	$7,000	$7,175	$7,390	$7,612	$7,840	$8,076	$8,318	$8,567	$8,824	
Intergovernmental											
Intergovernmental Other	$20,645	$20,000	$20,500	$21,115	$21,748	$22,401	$23,073	$23,765	$24,478	$25,212	As Miscellaneous
Intergovernmental: KC	70,000	70,400	72,160	74,325	76,555	78,851	81,217	83,653	86,163	88,748	As Miscellaneous
Total Intergovernmental	$90,645	$90,400	$92,660	$95,440	$98,303	$101,252	$104,290	$107,418	$110,641	$113,960	
Total Expenditures	**$933,020**	**$1,003,685**	**$1,082,019**	**$1,120,332**	**$1,265,774**	**$1,310,625**	**$1,357,105**	**$1,405,275**	**$1,455,196**	**$1,506,935**	
CIP Through Rates	**$0**	**$20,000**	**$130,000**	**$400,000**	**$500,000**	**$550,000**	**$575,000**	**$550,000**	**$575,000**	**$600,000**	

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Exhibit 2
Revenue Requirement

	Budget	Forecast									
	2017	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
Taxes and Transfers											
Taxes											
401-70-531-15-5110	$13,500	$14,712	$14,856	$14,371	$14,526	$14,674	$14,824	$14,974	$15,127	$15,281	1.5% State Tax
Total Taxes	$13,500	$14,712	$14,856	$14,371	$14,526	$14,674	$14,824	$14,974	$15,127	$15,281	
Transfers											
Transfer Connection Charges to CIP Fund	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Transfer to (from) Operating Reserves	(102,883)	(42,310)	6,822	(104,266)	(113,429)	1,125	10,392	46,475	32,591	$18,727	
General Fund City Overhead	0	0	0	0	0	0	0	0	0	0	As Miscellaneous
Parks CIP	0	0	0	0	0	0	0	0	0	0	As Miscellaneous
ERF Transfer Out	50,000	105,860	68,000	70,040	72,141	74,305	76,535	78,831	81,196	83,631	As Miscellaneous
Facilities Transfer Out	40,125	40,125	43,825	45,800	47,865	50,020	51,521	53,066	54,658	56,298	As Miscellaneous
Total Transfers	($12,758)	$103,675	$118,647	$11,574	$6,577	$125,450	$138,447	$178,372	$168,444	$158,657	
Total Taxes and Transfers	**$742**	**$118,387**	**$133,503**	**$25,945**	**$21,103**	**$140,124**	**$153,271**	**$193,346**	**$183,571**	**$173,938**	
Debt Service											
New Loan	$0	$0	$0	$0	$18,434	$18,434	$33,940	$33,940	$33,940	$33,940	10 Years @ 1.5%
New Bond Issue	0	0	0	0	0	0	0	0	0	0	20 Years @ 4.5%
Total Debt Service	$0	$0	$0	$0	$18,434	$18,434	$33,940	$33,940	$33,940	$33,940	
Total Revenue Requirement	**$933,762**	**$1,142,072**	**$1,345,522**	**$1,546,277**	**$1,805,310**	**$2,019,183**	**$2,119,316**	**$2,182,561**	**$2,247,707**	**$2,314,813**	
Cumulative Balance (Deficiency) of Funds	$0	($161,292)	($355,134)	($588,191)	($836,933)	($1,040,922)	($1,131,078)	($1,184,270)	($1,239,259)	($1,296,100)	
Cumulative Bal.(Defic.) as a % of Rates	0.0%	18.0%	39.2%	64.3%	90.6%	111.6%	120.0%	124.4%	128.9%	133.5%	
Proposed Rate Adjustment	**0.0%**	**18.0%**	**18.0%**	**18.0%**	**16.0%**	**11.0%**	**4.0%**	**2.0%**	**2.0%**	**2.0%**	
Additional Revenue from Rate Adj.	$0	$163,940	$360,964	$597,432	$850,092	$1,057,292	$1,148,869	$1,202,901	$1,258,758	$1,316,498	
Less Additional Taxes From Rate Increase	0	2,648	5,829	9,241	13,159	16,370	17,791	18,631	19,500	20,398	
Net Adjustment After Rate Increase	$0	$161,292	$355,134	$588,191	$836,933	$1,040,922	$1,131,078	$1,184,270	$1,239,259	$1,296,100	
Bal.(Defic.) after Rate Adjustment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Bal.(Defic.) as a % after Rate Adjustment	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	

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Revenue Requirement

	Budget	Forecast									
	2017	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	
Debt Service Coverage Ratio Before Adjustment	0.00	0.00	0.00	0.00	(16.92)	(18.83)	(11.30)	(12.43)	(13.61)	(14.84)	
Debt Service Coverage Ratio After Adjustment	0.00	0.00	0.00	0.00	28.12	30.84	17.94	17.21	17.94	18.68	Target Min. 1.25
Operating Fund											
Beginning Fund Balance	$582,865	$570,120	$530,449	$542,644	$442,761	$332,626	$337,088	$350,955	$401,404	$438,335	
Additions											
Bal. of Rev after Operating Costs	0	0	6,822	0	0	1,125	10,392	46,475	32,591	18,727	
Interest Earnings	0	2,639	5,373	4,384	3,293	3,338	3,475	3,974	4,340	4,571	
Uses											
Dfcncy of Rev After Operating Costs	(12,745)	(42,310)	0	(104,266)	(113,429)	0	0	0	0	0	
Transfer to Capital Reserve Fund	0	0	0	0	0	0	0	0	0	0	
Ending Fund Balance	$570,120	$530,449	$542,644	$442,761	$332,626	$337,088	$350,955	$401,404	$438,335	$461,633	
Days of O&M (Target =90)	223	193	183	144	96	94	94	104	110	112	
Capital Reserve Fund											
Beginning Fund Balance	$550,000	$478,000	$217,382	$24,882	$220,880	$14,678	$243,484	$183,208	$546,575	$742,927	
Additions											
Capital Funded Through Rates	0	20,000	130,000	400,000	500,000	550,000	575,000	550,000	575,000	600,000	
Capital Grant	289,000	0	0	0	0	0	0	0	0	0	
Opportunity Grant	120,000	0	0	0	0	0	0	0	0	0	
Transfer from Operating Fund	0	0	0	0	0	0	0	0	0	0	
Debt Issues	0	0	0	170,000	0	143,000	0	0	0	0	
Interest Earnings	0	1,082	246	504	145	995	1,814	5,412	7,356	2,526	
Uses											
Capital Expenditures	(481,000)	(281,700)	(322,746)	(374,505)	(706,348)	(465,188)	(637,090)	(192,045)	(386,003)	(1,090,334)	
Ending Fund Balance	$478,000	$217,382	$24,882	$220,880	$14,678	$243,484	$183,208	$546,575	$742,927	$255,119	
CIP Target Balance	$100,000	$102,500	$105,063	$107,689	$110,381	$113,141	$115,969	$118,869	$121,840	$124,886	
Single Family Residential Bill per Year	$175.30	$202.79	$239.29	$282.36	$327.54	$363.56	$378.11	$385.67	$393.38	$401.25	
Annual Change		27.49	36.50	43.07	45.18	36.03	14.54	7.56	7.71	7.87	
Cumulative Change		27.49	63.99	107.06	152.24	188.26	202.81	210.37	218.08	225.95	

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Exhibit 3
Capital Funding

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
Capital Improvement Plan											
Railroad Embankment Newport Hills Creek	$6,000	$34,850	$0	$0	$0	$0	$0	$0	$0	$0	$34,850
Lake Boren Flooding Mitigation/Conservation	179,500	0	0	0	0	0	0	0	0	0	0
2017 Stormwater Repairs	220,500	0	0	0	0	0	0	0	0	0	0
Detention Pond Restoration	0	24,600	25,215	25,845	26,492	27,154	27,833	28,528	29,242	29,973	244,881
135th Place SE Culvert Inlet Retrofit	0	0	0	0	0	0	0	0	62,139	0	62,139
Storm Conveyance Rehabilitation Program	0	100,000	102,500	105,063	107,689	110,381	113,141	115,969	118,869	121,840	995,452
Landcastle Creek Streambank Restoration Project	0	0	0	0	0	0	0	0	175,755	532,640	708,395
116th Ave SE and SE 72nd Street Flow Control Vault	0	0	0	169,772	369,667	0	0	0	0	0	539,439
116th Ave SE and SE 76th Street Flow Control Vault	0	0	0	0	0	142,897	303,608	0	0	0	446,505
Roadway/Sidewalk Seepage Program	0	61,500	52,531	43,076	0	45,256	0	47,547	0	49,955	299,865
144th Place SE Culvert Replacement and Ditch Rehabilitation Project	0	0	0	0	0	0	0	0	0	355,926	355,926
SE 90th Street Drainage Improvement Project	0	0	0	0	0	0	192,509	0	0	0	192,509
Sidewalk Seepage Project	0	0	0	0	0	0	0	0	0	0	0
Condition Assessment of 3 neighborhoods	0	0	0	0	0	0	0	0	0	0	0
Surface water Participation in Transportation Capital Fund projects	75,000	60,750	142,500	30,750	202,500	139,500	0	0	0	0	576,000
Total Capital Improvement Plan	**$481,000**	**$281,700**	**$322,746**	**$374,505**	**$706,348**	**$465,188**	**$637,090**	**$192,045**	**$386,003**	**$1,090,334**	**$4,455,960**
Transfer to Capital Reserve Fund	**$0**	**$0**	**$0**	**$195,495**	**$0**	**$227,812**	**$0**	**$357,955**	**$188,997**	**$0**	$970,258
Less Other Funding											
Capital Grant	$289,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$289,000
Opportunity Grant	120,000	0	0	0	0	0	0	0	0	0	120,000
Developer Contributions	0	0	0	0	0	0	0	0	0	0	0
Use of Operating Reserve Funds	0	0	0	0	0	0	0	0	0	0	0
Use of Capital Reserve Funds	72,000	261,700	192,746	0	206,348	0	62,090	0	0	490,334	1,285,218
New Loan	0	0	0	170,000	0	143,000	0	0	0	0	313,000
New Bond Issue, Planned	0	0	0	0	0	0	0	0	0	0	0
Default Bond Issue	0	0	0	0	0	0	0	0	0	0	0
Total Other Funding Sources	**$481,000**	**$261,700**	**$192,746**	**$170,000**	**$206,348**	**$143,000**	**$62,090**	**$0**	**$0**	**$490,334**	$2,007,218
Capital Funded Through Rates	**$0**	**$20,000**	**$130,000**	**$400,000**	**$500,000**	**$550,000**	**$575,000**	**$550,000**	**$575,000**	**$600,000**	

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Exhibit 4
Customer Allocation Factor

Customer Class	Customer Counts [1]	% of Total
Residential (Single Family)	3,114	97.8%
Very Light	12	0.4%
Light	4	0.1%
Moderate	11	0.3%
Moderately Heavy	21	0.7%
Heavy	13	0.4%
Very Heavy	10	0.3%
Minimum Rate	0	0.0%
Discounted Light Rate	0	0.0%
Discounted Residential & Very Light Rate	0	0.0%
	3,185	100.0%

(CR)

Exhibit 5
Surface Area Allocation Factor

Customer Class	Surface Area (Acres)	% of Total	% Impervious [2], [3]	Impervious Area (Acres)	% of Total
Residential (Single Family)	1,049	64%	15%	157	56%
Very Light	364	22%	4%	14	5%
Light	15	1%	13%	2	1%
Moderate	91	6%	34%	31	11%
Moderately Heavy	54	3%	59%	32	11%
Heavy	41	3%	72%	30	11%
Very Heavy	15	1%	91%	14	5%
Minimum Rate	0	0%	0	0	0%
Discounted Light Rate	0	0%	0	0	0%
Discounted Residential & Very Light Rate	0	0%	0	0	0%
	1,629	100%		279	100%

(SA) (AREA)

Exhibit 6
Revenue Related Allocation Factor

Customer Class	Revenue	% of Total
Residential (Single Family)	$551,343	61%
Very Light	2,533	0%
Light	7,506	1%
Moderate	92,390	10%
Moderately Heavy	105,506	12%
Heavy	101,791	11%
Very Heavy	49,710	5%
Minimum Rate	0	0%
Discounted Light Rate	0	0%
Discounted Residential & Very Light Rate	0	0%
	$910,780	100%

(RR)

[1] Customer Counts were provided from City Billing Data.

[2] All customer classes other than Residential (Single Family) were from billing data provided by the City.
[3] Residential (Single Family) Impervious was estimated by taking a straight average of High, Low, Medium density and rural percent impervious found in the page 162 of the land use to land cover conversion table of the 2010 Comprehensive Surface Water Management Plan.

City of Newcastle
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Appendix - I
Exhibit 7
Expense Allocation

	2018	Impervious Area (AREA)	Customer Related (CR)	Revenue Related (RR)	Direct Assignment (DA)	Notes:
Operations & Maintenance Expenditures						
Salary & Benefits						
Salaries	$293,885	$264,497	$29,389	$0	$0	AREA 90% / CR 10%
Benefits	179,525	161,573	17,953	0	0	AREA 90% / CR 10%
New FTE	58,000	52,200	5,800	0	0	AREA 90% / CR 10%
Seasonal Salaries	55,625	50,063	5,563	0	0	AREA 90% / CR 10%
Intern Salaries	0	0	0	0	0	AREA 90% / CR 10%
Intern Benefits	0	0	0	0	0	AREA 90% / CR 10%
Time charges to CIP	0	0	0	0	0	AREA 90% / CR 10%
Maintenance Allocated Costs	0	0	0	0	0	AREA 90% / CR 10%
Total Salary & Benefits	$587,035	$528,332	$58,704	$0	$0	
Supplies						
Office & Operating Supplies	$1,000	$900	$50	$50	$0	AREA 90% / CR 5% / RR 5%
Meeting Meals	400	400	0	0	0	AREA 100%
Soil & Ground Materials	5,000	5,000	0	0	0	AREA 100%
Maintenance & Repair Supplies	48,000	48,000	0	0	0	AREA 100%
Clothing & Accessories	1,900	1,710	95	95	0	AREA 90% / CR 5% / RR 5%
Books/Maps	1,500	1,350	75	75	0	AREA 90% / CR 5% / RR 5%
Small Tools/Minor Equipment	25,000	25,000	0	0	0	AREA 100%
Computer Software/Hardware	700	350	315	35	0	AREA 50% / CR 45% / RR 5%
Total Supplies	$83,500	$82,710	$535	$255	$0	

City of Newcastle
Comprehensive Surface Water Management Plan Update
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Exhibit 7

Expense Allocation	2018	Impervious Area (AREA)	Customer Related (CR)	Revenue Related (RR)	Direct Assignment (DA)	Notes:
Services						
Professional Services	$90,000	$81,000	$4,500	$4,500	$0	AREA 90% / CR 5% / RR 5%
Communications	0	0	0	0	0	CR 100%
Postage	0	0	0	0	0	CR 100%
Cell Phone	5,000	4,500	250	250	0	AREA 90% / CR 5% / RR 5%
Mileage	500	450	25	25	0	AREA 90% / CR 5% / RR 5%
Rental & Leases	6,000	5,400	300	300	0	AREA 90% / CR 5% / RR 5%
Waste Disposal	10,000	9,000	500	500	0	AREA 90% / CR 5% / RR 5%
Repairs & Maintenance	93,000	93,000	0	0	0	AREA 100%
Street Sweeping	30,000	30,000	0	0	0	AREA 100%
Miscellaneous	0	0	0	0	0	AREA 90% / CR 5% / RR 5%
Dues & Memberships	250	225	13	13	0	AREA 90% / CR 5% / RR 5%
Printing	1,000	0	1,000	0	0	CR 100%
Total Services	$235,750	$223,575	$6,588	$5,588	$0	
Travel & Training						
Training & Professional Development	$7,000	$6,300	$700	$0	$0	As Salaries & Benefits
Total Travel & Training	$7,000	$6,300	$700	$0	$0	
Intergovernmental						
Intergovernmental Other	$20,000	$18,000	$1,000	$1,000	$0	AREA 90% / CR 5% / RR 5%
Intergovernmental: KC	70,400	63,360	3,520	3,520	0	AREA 90% / CR 5% / RR 5%
Total Intergovernmental	$90,400	$81,360	$4,520	$4,520	$0	
Total Expenditures	$1,003,685	$922,277	$71,046	$10,363	$0	
CIP Through Rates	$20,000	$18,000	$2,000	$0	$0	AREA 90% / CR 10%
Taxes and Transfers						
Taxes						
External Tax	$14,712	$0	$0	$14,712	$0	RR 100%
Total Taxes	$14,712	$0	$0	$14,712	$0	

City of Newcastle
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Exhibit 7
Expense Allocation

	2018	Impervious Area (AREA)	Customer Related (CR)	Revenue Related (RR)	Direct Assignment (DA)	Notes:
Transfers						
Transfer Connection Charges to CIP Fund	$0	$0	$0	$0	$0	AREA 90% / CR 5% / RR 5%
Transfer to (from) Operating Reserves	(42,310)	(38,079)	(2,115)	(2,115)	0	AREA 90% / CR 5% / RR 5%
General Fund City Overhead	0	0	0	0	0	DA 100%
Parks CIP	0	0	0	0	0	AREA 90% / CR 5% / RR 5%
ERF Transfer Out	105,860	95,274	5,293	5,293	0	AREA 90% / CR 5% / RR 5%
Facilities Transfer Out	40,125	36,113	2,006	2,006	0	AREA 90% / CR 5% / RR 5%
Total Transfers	$103,675	$93,308	$5,184	$5,184	$0	
Total Taxes and Transfers	118,387	93,308	5,184	19,895	0	
Debt Service						
New Loan	$0	$0	$0	$0	$0	AREA 100%
New Bond Issue	0	0	0	0	0	AREA 100%
Total Debt Service	$0	$0	$0	$0	$0	
Total Revenue Requirement	$1,142,072	$1,033,584	$78,230	$30,258	$0	
Miscellaneous Revenue						
ROW T-Mobile	$0	$0	$0	$0	$0	As Total Revenue Requirement
Operating Grant	42,000	38,010	2,877	1,113	0	As Total Revenue Requirement
Storm Water Review Fees	28,000	25,340	1,918	742	0	As Total Revenue Requirement
Contributions	0	0	0	0	0	As Total Revenue Requirement
Fines and Penalties	0	0	0	0	0	As Total Revenue Requirement
Bank Earnings	0	0	0	0	0	As Total Revenue Requirement
Total Revenue	$70,000	$63,351	$4,795	$1,855	$0	
	$1,072,072	$970,234	$73,435	$28,403	$0	

City of Newcastle
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Exhibit 8
Allocation Summary

Classification Component	Total	Residential	Very Light	Light	Moderate	Moderately Heavy	Heavy	Very Heavy
Impervious Area	$970,234	$547,225	$47,333	$7,002	$108,195	$109,622	$102,763	$48,094
Customer Related	$73,435	$71,798	$277	$92	$254	$484	$300	$231
Revenue Related	$28,403	$17,194	$79	$234	$2,881	$3,290	$3,174	$1,550
Direct Assignment	$0	$0	$0	$0	$0	$0	$0	$0
Allocation of Net Revenue Requirements	$1,072,072	$636,217	$47,689	$7,329	$111,330	$113,396	$106,237	$49,875

Exhibit 9
Cost of Service Summary

	Total	Residential	Very Light	Light	Moderate	Moderately Heavy	Heavy	Very Heavy
Revenues at Present Rates	$910,780	$551,343	$2,533	$7,506	$92,390	$105,506	$101,791	$49,710
Allocated Revenue Requirement	$1,072,072	$636,217	$47,689	$7,329	$111,330	$113,396	$106,237	$49,875
Additional Taxes with Adjustment	$2,648	$1,572	$118	$18	$275	$280	$262	$123
Balance/(Deficiency) of Funds	($163,940)	($86,445)	($45,273)	$159	($19,214)	($8,170)	($4,709)	($288)
% Change Over Present Rates	18.0%	15.7%	1787.3%	-2.1%	20.8%	7.7%	4.6%	0.6%

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Exhibit 10
Unit Cost Summary

	Total	Residential	Very Light	Light	Moderate	Moderately Heavy	Heavy	Very Heavy
Current Revenue per Unit								
Current Revenue/Acre	$559.21	$525.55	$6.95	$491.87	$1,020.10	$1,969.50	$2,496.72	$3,270.38
Current Revenue/Customer	$285.96	$177.05	$211.09	$1,876.48	$8,399.13	$5,024.10	$7,830.10	$4,970.98
Cost of Service Results per Unit								
Impervious Area Cost/ Acre of Impervious	$3,477.52	$3,477.52	$3,477.52	$3,477.52	$3,477.52	$3,477.52	$3,477.52	$3,477.52
Cust. & Rev. Related Cost/Customers	$31.97	$28.58	$29.64	$81.58	$284.99	$179.74	$267.24	$178.08
Total Cost/Acre	$658.24	$606.46	$130.92	$480.25	$1,229.21	$2,116.78	$2,605.77	$3,281.25
Total Cost/Customer	$336.60	$204.31	$3,974.05	$1,832.16	$10,120.88	$5,399.81	$8,172.11	$4,987.49
Base Data:								
Acres of Impervious Area	279	157	14	2	31	32	30	14
Total Area in Acres	1,629	1,049	364	15	91	54	41	15
Total Customers	3,185	3,114	12	4	11	21	13	10

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Exhibit 11
Rate Class Revenue Projection

	2018 Rev Before Adjustment	COSA Adjustments	2018	2019	2020	2021	2022	2023	2024	2025	2026
Overall Adjustments											
Increases				18.0%	18.0%	16.0%	11.0%	4.0%	2.0%	2.0%	2.0%
Cumulative Increase				39.2%	64.3%	90.6%	111.6%	120.0%	124.4%	128.9%	133.5%
Total Class Revenue Adjustments											
Residential	$551,343	15.7%	$637,768	$760,092	$905,878	$1,061,327	$1,189,853	$1,249,822	$1,287,567	$1,326,451	$1,366,510
Very Light (≤ 10%)	2,533	1787.3%	47,806	56,976	67,903	79,556	89,190	93,685	96,514	99,429	102,432
Light (> 10% and ≤ 20%)	7,506	0.0%	7,379	8,794	10,481	12,280	13,767	14,461	14,897	15,347	15,811
Moderate (> 20% and ≤ 45%)	92,390	20.8%	111,601	133,006	158,517	185,719	208,209	218,703	225,308	232,112	239,122
Moderately Heavy (> 45% and ≤ 65%)	105,506	7.7%	113,672	135,475	161,459	189,165	212,073	222,762	229,489	236,419	243,559
Heavy (> 65% and ≤ 85%)	101,791	4.6%	106,496	126,922	151,266	177,223	198,685	208,698	215,001	221,494	228,183
Very Heavy (> 85%)	49,710	0.6%	49,996	59,586	71,014	83,200	93,276	97,977	100,936	103,984	107,124
Total	$910,780	18.0%	$1,074,720	$1,280,851	$1,526,519	$1,788,469	$2,005,053	$2,106,107	$2,169,712	$2,235,237	$2,302,741
Less Additional Taxes			($2,648)	($5,829)	($9,241)	($13,159)	($16,370)	($17,791)	($18,631)	($19,500)	($20,398)
Plus Misc. Revenue			$70,000	$70,500	$29,000	$30,000	$30,500	$31,000	$31,480	$31,970	$32,469
Total Revenue Requirement			$1,142,072	$1,345,522	$1,546,277	$1,805,310	$2,019,183	$2,119,316	$2,182,561	$2,247,707	$2,314,813

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Exhibit 12
Proposed Rates

Proposed Rate Adjustments						18.0%	18.0%	16.0%	11.0%	4.0%	2.0%	2.0%	2.0%	
Rate Category	Rate Description	Percent Impervious Surface	2017	Cost of Service Adjustments	2018	2019	2020	2021	2022	2023	2024	2025	2026	
1	Residential (Single Family)		$175.30	15.7%	$202.79	$239.29	$282.36	$327.54	$363.56	$378.11	$385.67	$393.38	$401.25	per parcel
2	Very Light[1]	≤ 10%	209.00	1787.3%	131.25	154.87	182.75	211.99	235.30	244.72	249.61	254.60	259.70	per acre
3	Light	> 10% and ≤ 20%	487.00	0.0%	487.00	574.66	678.10	786.59	873.12	908.04	926.21	944.73	963.62	per acre
4	Moderate	> 20% and ≤ 45%	1,010.00	20.8%	1,220.05	1,439.66	1,698.79	1,970.60	2,187.37	2,274.86	2,320.36	2,366.77	2,414.10	per acre
5	Moderately Heavy	> 45% and ≤ 65%	1,950.00	7.7%	2,101.00	2,479.18	2,925.43	3,393.50	3,766.79	3,917.46	3,995.81	4,075.73	4,157.24	per acre
6	Heavy	> 65% and ≤ 85%	2,472.00	4.6%	2,586.35	3,051.89	3,601.23	4,177.43	4,636.94	4,822.42	4,918.87	5,017.25	5,117.59	per acre
7	Very Heavy	> 85%	3,238.00	0.6%	3,256.78	3,843.00	4,534.74	5,260.30	5,838.94	6,072.49	6,193.94	6,317.82	6,444.18	per acre
8	Minimum Rate		174.00	18.0%	202.79	239.29	282.36	327.54	363.56	378.11	385.67	393.38	401.25	per parcel
9	Discounted Light Rate		174.00	18.0%	205.32	242.28	285.89	331.63	368.11	382.83	390.49	398.30	406.27	per parcel
10	Discounted Residential & Very Light Rate		87.00	18.0%	102.66	121.14	142.94	165.81	184.05	191.42	195.24	199.15	203.13	per parcel

[1] Very Light customer class proposed to move from per parcel charge to per acre charge.