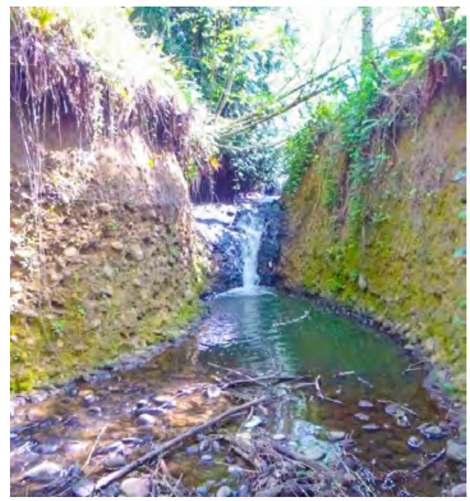
City of Gresham

City-wide Stormwater Master Plan

June 30, 2022



PREPARED BY Brown and Caldwell with support from AKS Engineering & Forestry LLC for surveying, and Environmental Science Associates for flow monitoring.

Gresham City-wide Stormwater Master Plan

Prepared for

City of Gresham, Oregon

June 30, 2022

Final

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List of Abbreviations

A/V	Area Velocity
ac	acre
AGR	agricultural
AM	asset management
BC	Brown and Caldwell
BMP	best management practice
cfs	cubic feet per second
CCI	Construction Cost Index
CCTV	closed-circuit television
CIP	Capital Improvement Program
CMP	corrugated metal pipe
COM	commercial
CWA	Clean Water Act
DEQ	Department of Environmental Quality
EC	employment center
ENG	Engineering News Record
ESRA	environmentally sensitive resource area
°F	degrees Fahrenheit
FC	flood control
ft	feet
ft^2	square feet
FY	fiscal year
GIS	Geographic Information System
H/H	hydrologic and hydraulic
HDM	Hierarchical Decision Model
HDPE	high-density polyethylene
HDR	high-density residential
HSG	hydrologic soil group
IMD	initial moisture deficit
IND	industrial
LDR	low-density residential
LID	low impact development
LF	linear feet
LiDAR	Light Detection and Ranging
MCDD	Multnomah County Drainage District
MDR	medium-density residential
MFR	multi-family residential
MS4	Municipal Separate Storm Sewer System
MSL	mean sea level
MU	mixed-use (employment)
MUR	mixed-use residential
NASSCO	National Association of Sewer Service Companies
NC	neighborhood center
NPDES	National Pollutant Discharge Elimination System
NR	natural resources
NRCS	National Resources Conservation Service
O&M	operations and maintenance
PACP	pipeline assessment and certification program
PGM	planning /programmatic recommendations (Project ID)
POS	parks/open space
PVPD	Pleasant Valley Planning District
PVC	polyvinyl chloride
PW	Public Works
R&R	rehabilitation and repair
ROW	right-of-way
RTI	research and technology industry
SCS	Soil Conservation Service
SDC	system development charge
SFR	single-family residential
SHC	saturated hydraulic conductivity
SME	Subject Matter Expert
SMM	Stormwater Management Manual
SMP	Stormwater Master Plan
SWMP	Stormwater Management Plan
SWPD	Springwater Planning District
TC	town center
THR	town house residential
TMDL	total maximum daily load
UGB	urban growth boundary
UIC	Underground Injection Control
VAC	vacant
VC	village center
VLDR	very low density residential
WQ	water quality
XPSWMM	XP-Storm Water Management Model

Executive Summary

The City of Gresham (City) developed this City-wide Stormwater Master Plan (SMP or Plan) to guide capital project and select stormwater program decisions over the next ten-year planning period. This SMP addresses water quantity, water quality and maintenance/system condition issues for stormwater infrastructure under the City's management. This document provides a comprehensive update to the individual basin master plans that were previously prepared for the City from 2002 to 2018. The study area for this SMP includes the City's storm drainage system in the major basins listed below:

- Kelly Creek/Burlingame Creek
- West Gresham
- Johnson Creek including the Springwater Planning District (SWPD)
- Kelley Creek including the Pleasant Valley Planning District (PVPD)
- Fairview Creek
- Beaver Creek

The City's storm system within these basins consists of piped and open-channel (e.g., ditches, creeks, etc.) conveyances, as well as treatment and detention facilities for stormwater management. These conveyance systems direct stormwater flow downstream to either one of three main receiving water bodies: the Willamette River to the west, the Columbia Slough to the north, or the Sandy River to the east. A portion of the City's stormwater runoff is also infiltrated into the ground through Underground Injection Control (UIC) systems. UIC systems are located almost exclusively within the West Gresham and Fairview Creek basins. The UIC areas are not covered by this SMP.

The City developed this SMP using a collaborative approach with engineering and maintenance staff to assess known storm drainage problem areas and identify areas where infrastructure addition, replacement, or retrofit may be needed to address identified capacity, water quality and system condition issues. A brief summary of the primary evaluations that were conducted is as follows:

Capacity/Flooding: Capacity deficiencies within the study area were identified based on a combination of City staff observations/knowledge, documented issues carried over from previous basin master plans, and hydrologic/hydraulic (H/H) modeling results. Individual XP-SWMM H/H models were developed for each basin. The development and refinement of these models allowed for the identification and validation of capacity deficiencies within the City's stormwater drainage infrastructure system. Capacity of the system was evaluated under both current and build-out development conditions to support capital project sizing to accommodate anticipated future growth. Capacity issues identified through modeling were reviewed by staff and compared to observations of flooding.

Water Quality: The water quality assessment for this SMP included a desktop assessment and review of unconstructed water quality projects per previous basin plans to help identify optimal water quality project locations. Through discussions with the City, the following criteria (in order of priority) were used to evaluate these potential locations for water quality projects throughout the study area:

- The location overlapped with the location of an identified capacity issue, and the water quality project could assist in mitigating flow to also help address the capacity deficient infrastructure.
- The location is in an area without any existing treatment.
- The location could support installation of a larger scale regional treatment facility (based on property ownership and/or available vacant lands).

Planning and Program Needs: In addition to capacity and water quality capital projects, this SMP includes planning projects and programs intended to support the City's long-term asset management efforts and supplement existing maintenance activities. To develop recommendations, the City's current stormwater asset inventory and available condition assessment records were evaluated. The condition assessment data were used to project future infrastructure repair and replacement needs. With this information, maintenance-related program needs were reviewed and evaluated for adequacy, modification, and inclusion in this plan. Planning projects are similar to capital projects, as they are considered a one-time cost expenditure; the programmatic needs reflect ongoing system improvements and the fulfillment of annual maintenance and replacement obligations. These programmatic activities require ongoing annual funding.

Results from both the capacity evaluation and water quality assessment were used to develop a comprehensive and integrated capital improvement project list for the City. A total of 15 capital projects were ultimately selected as high priority projects to address current and future capacity/flooding issues and provide water quality benefits. In addition, two regional, planning-related capital projects were developed for the Springwater Planning District (SWPD) and the Pleasant Valley Planning District (PVPD). The goal of these planning projects was to provide a framework and conceptual level cost estimate to accommodate drainage from anticipated future growth and urbanization in these areas. Finally, recommendations for three programs and one planning /basin study (to be conducted every three years) were included to ensure a functioning storm system and address existing gaps and needs identified.

For each high priority capital project, capital project fact sheets are provided in Appendix E of this SMP and include detailed project information and cost assumptions. Additional fact sheets were developed for the regional, planning related projects in the Springwater and Pleasant Valley Planning Districts.

Project prioritization is an important component of the stormwater master planning process and provides direction in terms of sequencing projects in accordance with City objectives. A capital improvement project (CIP) prioritization tool was developed for this project to assist with initial project prioritization, as well as updates on a continuous basis. As projects are constructed, they can be removed from the tool and new projects inserted as master plans are updated and new projects developed. The CIP prioritization tool includes prioritization criteria and weighting factors to assist in scoring projects.

Prioritization results for the developed, high priority CIPs are reflected in Table ES-1 below. In addition, Table ES-2 includes the planning district (Pleasant Valley and Springwater) capital project cost estimates to address future growth as well as the other planning and program recommendations (which were not amenable for inclusion in the prioritization tool) for inclusion in the City's capital improvement program. A map showing general CIP locations is provided in Figure ES-1.

Table ES-1. Capital Project Costs and Priorities			
Priority Project Ranking	Project Number	Project Name	Cost Estimates
1	FC-1-C and FC-1-WQ[a]	Fairview Creek Stark St. Culvert and Water Quality Swale	$520,000
2	KC-10-C and KC-10-WQ[a]	Hogan Drive Outfall Extension and Green Street Improvements on 17th and 18th	$2,992,000
3	KC-24-C and KC-24 WQ[a]	SE Salquist Rd. Pipe Improvements and Green Street Improvements on Wendy Ave. and 16th	$1,556,000
4	WG-2-C-WQ	Kirk Park/Hartley School Water Quality Facilities and Pipe Improvements	$2,210,000
5	KC-19-C	Powell and Hwy 26 Pipe Improvements	$7,149,000
6	KC-2-C	Channel Replacement Southeast of Division and Cleveland	$1,611,000
7	JC-1-C	NW 1st St./Ava Ave. Pipe Improvements	$760,000
8	FC-3b-C	NE Burnside Rd. Pipe Replacements	$3,521,000
9	KC-12-C	Division St. Pipe Improvements	$2,464,000
10	JC-11-C and JC-11-WQ[a]	Elliot Ave. Pipe Improvements and Green Street	$1,204,000
11	FC-3g-C	K-Mart Pipe Improvements	$4,823,000
12	FC-3c-C	NE 19th Ave. Parallel Pipe	$2,196,000
13	FC-3f-C	Civic Drive Pipe Improvements	$1,022,000
14	FC-3a-C	Wallula Ave. Pipe Open Channel	$671,000
15	FC-3e-WQ	Liberty Ave. Green Street	$505,000

a. *Two separate CIP fact sheets were prepared for this proposed capital project: one for capacity improvements and one for the water quality improvements. While the projects were developed to be integrated and complement each other, they may be constructed independently if needed.*

Table ES-2. Proposed Planning Projects and Programmatic Adjustments				
Project Number	Project Name	Estimated Cost	Project Assumptions	Project Timeframe
SW-1	Springwater Planning District Trunk Lines	$13,032,000	Trunkline sizes and locations were estimated based on projected development to estimate potential costs to support SDC estimates. Specific details will change as development occurs.	Development driven.
PV-1	Pleasant Valley Planning District Trunk Lines	$12,784,000	Trunkline sizes and locations were estimated based on projected development to estimate potential costs to support SDC estimates. Specific details will change as development occurs.	Development driven.
PGM-1	Modified Drywell Program	$250,000	Installation, on an annual basis, of two MaxWell Plus® deep UICs at approximately $125k per well. Project cost may be incorporated into the infrastructure capacity improvements program.	Annually
PGM-2	CCTV Expansion	$730,000	Expand CCTV inspections beyond local roads initiative timeframe. Increase current rate of linear feet inspected per year to 108,000 LF of pipe. Mainline video inspection assumed to cost $3.60 per LF.	Annually
CIPSW00004	Rehab & Repair of Pipe System	$1,300,000	Proposed annual obligation is in addition to the current program's $1M/year funding. Assumes approximately 430,900 LF of pipe will need to be repaired or replaced in remaining unassessed portion of system over a 50-year construction period.	Annually

Table ES-2. Proposed Planning Projects and Programmatic Adjustments				
Project Number	Project Name	Estimated Cost	Project Assumptions	Project Timeframe
PGM-3	Basin Master Plan Update	$120,000	A basin master plan update will occur every three years. The basin planning updates will rotate through the City's five major basins. Annualized estimate assumes each basin master plan to cost $360k.	Every three years

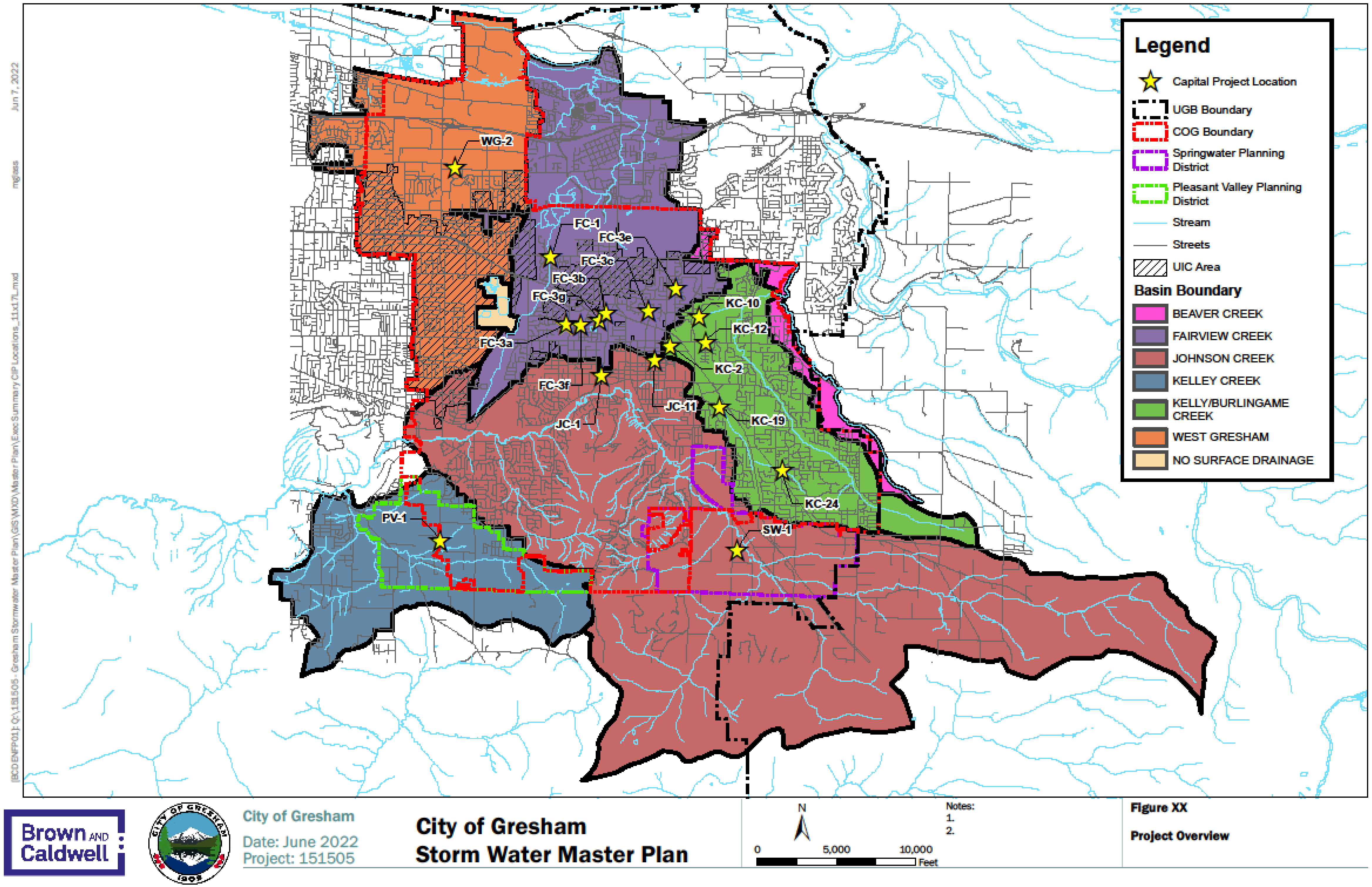

Figure ES-1 CIP Locations

Section 1

Introduction

The City of Gresham (City) developed this city-wide Stormwater Master Plan (SMP or Plan) to guide capital project and selected stormwater program decisions over the next ten-year planning period. This SMP addresses both water quantity and quality issues for stormwater infrastructure under the City's management. This document provides a comprehensive update to the individual basin master plans that were previously prepared for the City. The study area for this SMP includes the areas in the major basins listed below:

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- Beaver Creek

The City's storm drainage system within these basins consists of piped and open-channel (e.g., ditches, creeks, etc.) conveyances, in addition to treatment and detention facilities for stormwater management. These conveyance systems direct stormwater flow downstream to either of three main receiving water bodies: the Willamette River to the west, the Columbia Slough to the north, or the Sandy River to the east. A portion of the City's stormwater runoff is also infiltrated into the ground through Underground Injection Control (UIC) systems. UIC systems are located almost exclusively within the West Gresham and Fairview Creek basins.

This Plan documents the process and methods used to evaluate the City's drainage infrastructure and open-channel systems. Results of this evaluation provide the City with projects and programmatic stormwater actions for implementation to address conveyance capacity and/or water quality treatment needs. These projects and programs cover areas within the City limits, as well as two planning district areas (Pleasant Valley and Springwater).

1.1 Need for the Master Plan

Basin-scale master plans were previously developed for the City and were conducted for individual basins at different times (completion dates for individual basin plans ranged from 2002 to 2018). For this update, the City elected to develop a comprehensive, city-wide SMP. This allows for the application of consistent analytical methods to all basins to develop a comprehensive and prioritized city-wide Capital Improvement Program (CIP) list. This comprehensive CIP list will help inform the City when making decisions regarding future implementation of stormwater infrastructure projects and programs.

For the area inside the current city limits, there is limited potential for growth as most areas have already been developed. As such, the City needs a practical plan to address existing capacity deficiencies and failing infrastructure, in addition to providing water quality treatment.

Outside the city limits and within the Pleasant Valley and Springwater Planning Districts, new development is anticipated to occur as these areas begin to urbanize and develop. In order to accommodate this future growth, the City needs a proactive plan to provide stormwater collection and conveyance systems for its customers. Strategic planning for this new infrastructure will be critical to the long-term development of these areas.

1.2 Master Plan Objectives

The City's overarching goal for this SMP is to guide storm drainage infrastructure improvements over a ten-year implementation period. Improvements should address water quality, maintenance/system condition issues, and capacity issues into the future. To address this overarching goal, specific objectives of the City's SMP included the following:

- Incorporation of information from staff regarding project needs and improvements.
- Identification and validation of known areas of storm drainage problems and flooding.
  - Development of calibrated hydrologic and hydraulic (H/H) models to evaluate system capacity based on current system information as obtained from the City's Geographic Information System (GIS) and survey.
  - Assessment of the frequency and severity of flooding based on developed H/H models.
- Enhancement and expansion of water quality treatment throughout the City by improving existing treatment system functionality and implementing opportunistic retrofits to expand treatment area coverage within the City.
- Identification of programmatic opportunities to address maintenance activities, system condition deficiencies, and water quality on a city-wide scale.
- Development of a comprehensive, prioritized city-wide CIP list to address the identified stormwater needs related to capacity, water quality, and system condition.

While addressing climate change was not a primary objective of this plan, it should be noted that the effects of climate change are projected to increase in the Willamette Valley and surrounding areas in the coming years, and are anticipated to include increased rainfall intensities, storm surges and flooding (Dalton et al., 2017). Consequently, these changes may pose a threat to the City of Gresham's ability to meet desired levels of service in the storm system. However, current projections show wide ranging uncertainties and were not available for this planning process at the time scales needed to design storm systems (i.e, hourly vs. daily). Since the start of this planning project, the University of Washington Climate Impacts Group developed a Regional Climate Model to include hourly projections. While these results are now available and could be useful for planning and design, they are expected to include an even wider range of uncertainty than daily projections. Given the challenges of planning in the face of significant uncertainty, new planning approaches are continually being applied and tested. These new planning approaches include stress testing, vulnerability analyses and scenario planning to consider a range of potential futures. Evaluating a range of potential futures can support the development of robust design and sizing approaches. For the City of Gresham, it will be useful to stay abreast of current research regarding climate projections and to consider whether sizing adaptations should be integrated into the capital projects proposed in the SMP as the projects move from conceptual to final phase.

[1.] Dalton, M. M., Dello, K. D., Hawkins, L., Mote, P. W., & Rupp, D. E. (2017). *Third Oregon Climate Assessment Report*. Corvallis, OR: Oregon Climate Change Research Institute, College of Earth, Ocean and Atmospheric Sciences, Oregon State University. http://www.occri.net/media/1042/ocar3_final_125_web.pdf

1.3 Approach

The City developed this SMP using a collaborative approach with engineering and maintenance staff to assess known storm drainage problem areas and identify areas where infrastructure addition, replacement, or retrofit may be needed to address identified issues. Individual assessment efforts to evaluate capacity limitations, water quality opportunities, and develop project concepts were conducted following this initial information gathering process. Capital project and program needs were prioritized prior to development of project and program costs.

Figure 1-1 outlines the approach used to develop this Plan. Detail related to specific assessment efforts can be found in the following technical memorandums available separately from this Plan.

- Technical Memorandum #1 (TM1) – June 2019, Hydrologic and Hydraulic Modeling Methods and Results
- Technical Memorandum #2 (TM2) – September 2019, Water Quality Assessment and Project Identification

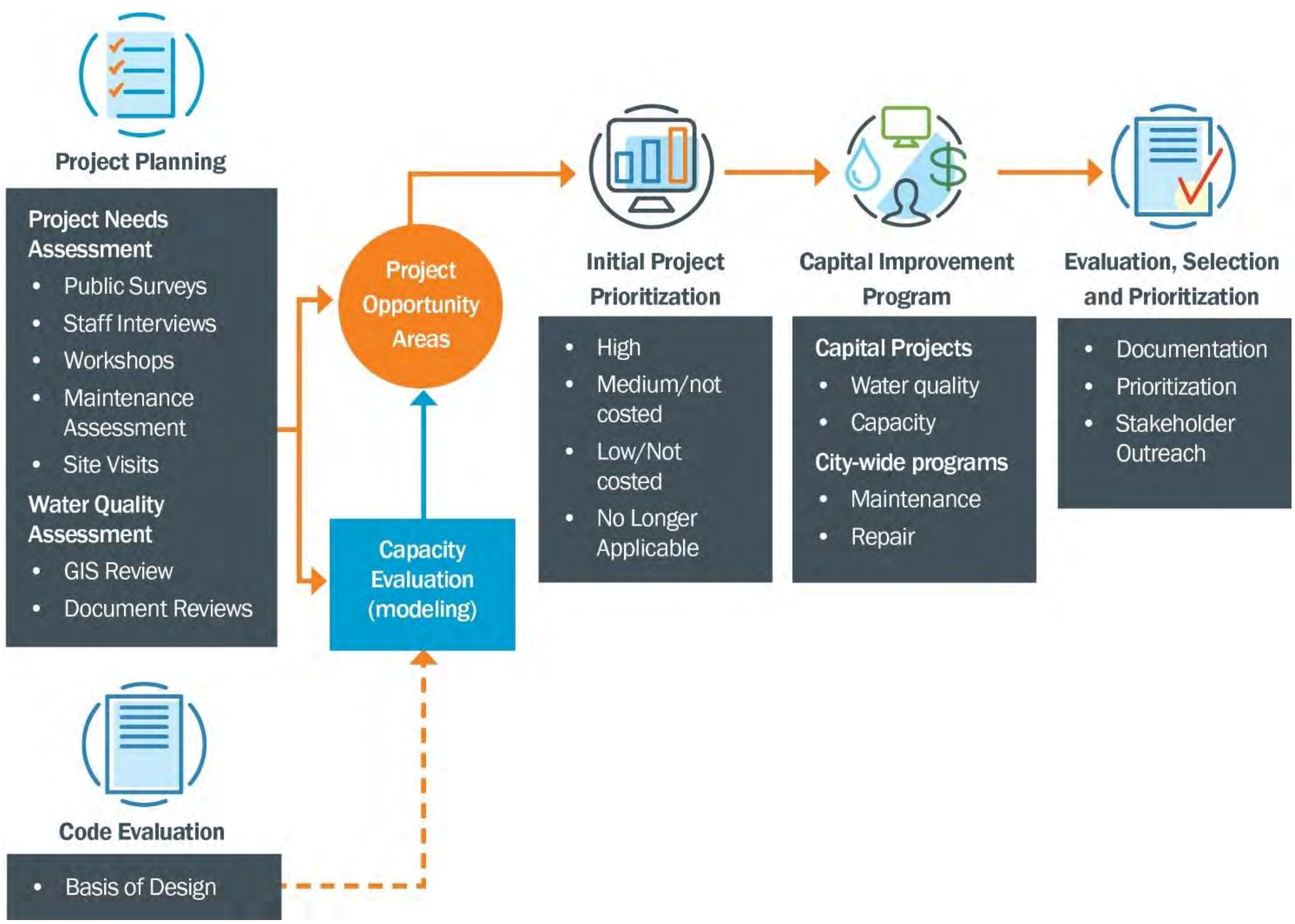

Figure 1-1. City-wide Stormwater Master Plan Approach

1.4 Master Plan Organization

Following this introductory Section 1, this SMP is organized as follows:

- Section 2 includes a description of the study area characteristics. This section also includes applicable regulatory drivers and summarizes the City's relevant stormwater code and design standards.
- Section 3 describes H/H modeling methods and results of the stormwater capacity evaluation, including identification of capacity-related capital project needs.
- Section 4 summarizes the water quality assessment and preliminary project areas that were identified, validated, and then carried forward for screening as to whether they should be prioritized as potential projects.
- Section 5 summarizes the City's current Maintenance Program and system condition evaluation.
- Section 6 summarizes the overall CIP recommendations including the development, prioritization, and cost estimation of capital projects and programs.

Section 2

Study Area Characteristics

The City of Gresham is located approximately 11 miles east of Portland, Oregon in Multnomah County. The City is approximately 23.4 square miles in area, bounded to the west by the City of Portland and to the north by the Columbia River and the cities of Fairview, Wood Village, and Troutdale (Figure 2-1). To the south and east are unincorporated areas of Clackamas and Multnomah County, respectively. Major transportation corridors of Interstate 84 (I-84) and U.S. Route 26 (US-26) run through the City.

The major waterways that define the major basin areas of the City include Fairview Creek, which discharges into the Columbia Slough; Burlingame, Kelly, and Beaver creeks, which combine and ultimately discharge to the Sandy River and Columbia River; and Johnson Creek and its tributary Kelley Creek, which flow west through the City towards the Willamette River.

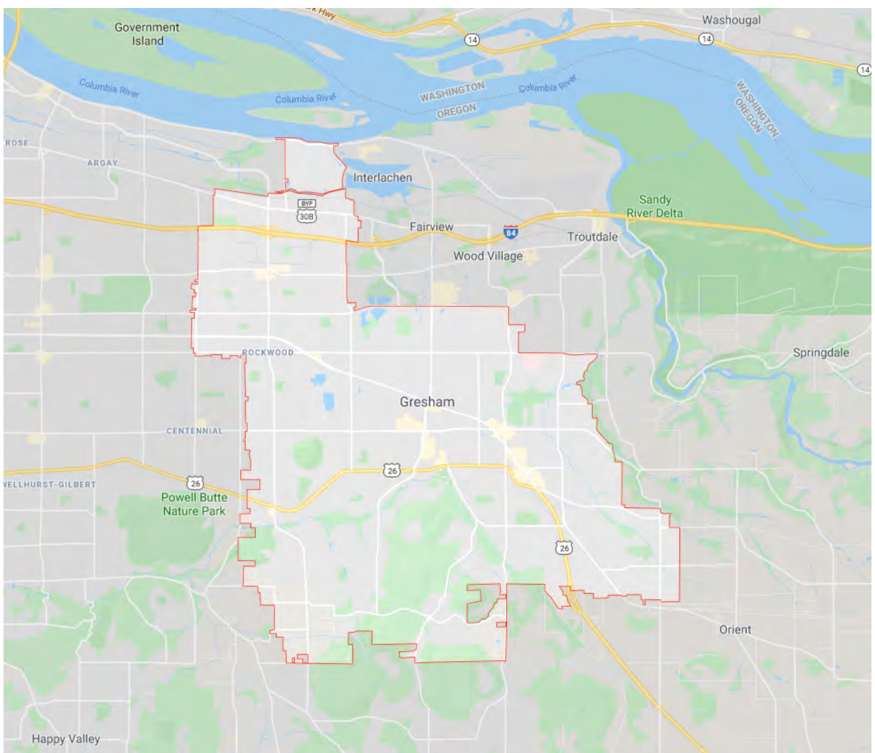

Figure 2-1. Location Overview

The study area for this SMP includes the City of Gresham, PVPD, SWPD, and area outside of city limits within each of the major basins that contributes flow to City infrastructure. Contributing drainage area by major basins are summarized in Table 2-1. Additional basin-specific information is contained in the following subsections.

Table 2-1. Study Area Overview				
Basin	Area (acre) within City Limits	Area (acre) outside of City Limits (within UGB)	Area (acre) outside of UGB	Total Area (acre)
Kelly Creek/Burlingame Creek	2,577	7	273	2,857
West Gresham	3,766	348	-	4,114
Johnson Creek including SWPD	4,777	3,297	5,110	13,184
Kelley Creek including PVPD	683	2,357	-	3,040
Fairview Creek	2,740	1,793	-	4,533
Beaver Creek	323	35	189	547
Total [a]	14,866	7,837	5,572	28,275

Abbreviations: UGB = urban growth boundary

[a] *Total does not include the 134-ac former mining site located between the West Gresham and Fairview Creek basins that produces no surface drainage into the City's stormwater system.*

2.1 Climate and Rainfall

The City of Gresham's climate is characterized by cool wet winters and warm dry summers. Most rainfall occurs between the months of October and May. On average, 34 inches of precipitation falls annually in the City. Summer low and high temperatures average between 55- and 82-degrees Fahrenheit (°F), respectively, while the winter low and high temperatures average from between 34°F and 46°F, respectively. Due to the influence of the Columbia River Gorge, weather and precipitation throughout the basins can vary. This is discussed in further detail in Section 3.4.3 where rainfall data from several City of Portland, HYDRA rainfall gauges were evaluated for use in calibrating models.

In December 2015, the Portland metro area experienced a large rainfall event that delivered more than five inches of rain over a three-day period, including 2.81 inches in one 24-hour period. This event was estimated to be between a 50- and 100-year frequency event because of the intensity and nature of the rainfall. As discussed in Section 1.2, "severe" events, such as this one, are expected to occur more frequently with projected climate change impacts.

2.2 Basin Overview

The study area is divided into six major basins as summarized in the following subsections. The major basin boundaries, including the Pleasant Valley and Springwater Planning Districts, are shown on Figure 2-2.

2.2.1 Kelly Creek/Burlingame Creek

The Kelly Creek/Burlingame Creek basin is located on the eastern edge of the City and drains approximately 2,857 acres. Kelly Creek originates southeast of the City limits and conveys flow northwest through the City for approximately four miles before combining with Burlingame Creek at the Gresham Golf Course (near NE Kane Drive and NE 23rd Street). Burlingame Creek similarly conveys flow northwest through the City; however, north of Powell Boulevard much of this waterway is piped underground. At the Gresham Golf Course (near NE Hogan Drive) Burlingame Creek daylights to an open channel as flow meanders east to combine with Kelly Creek.

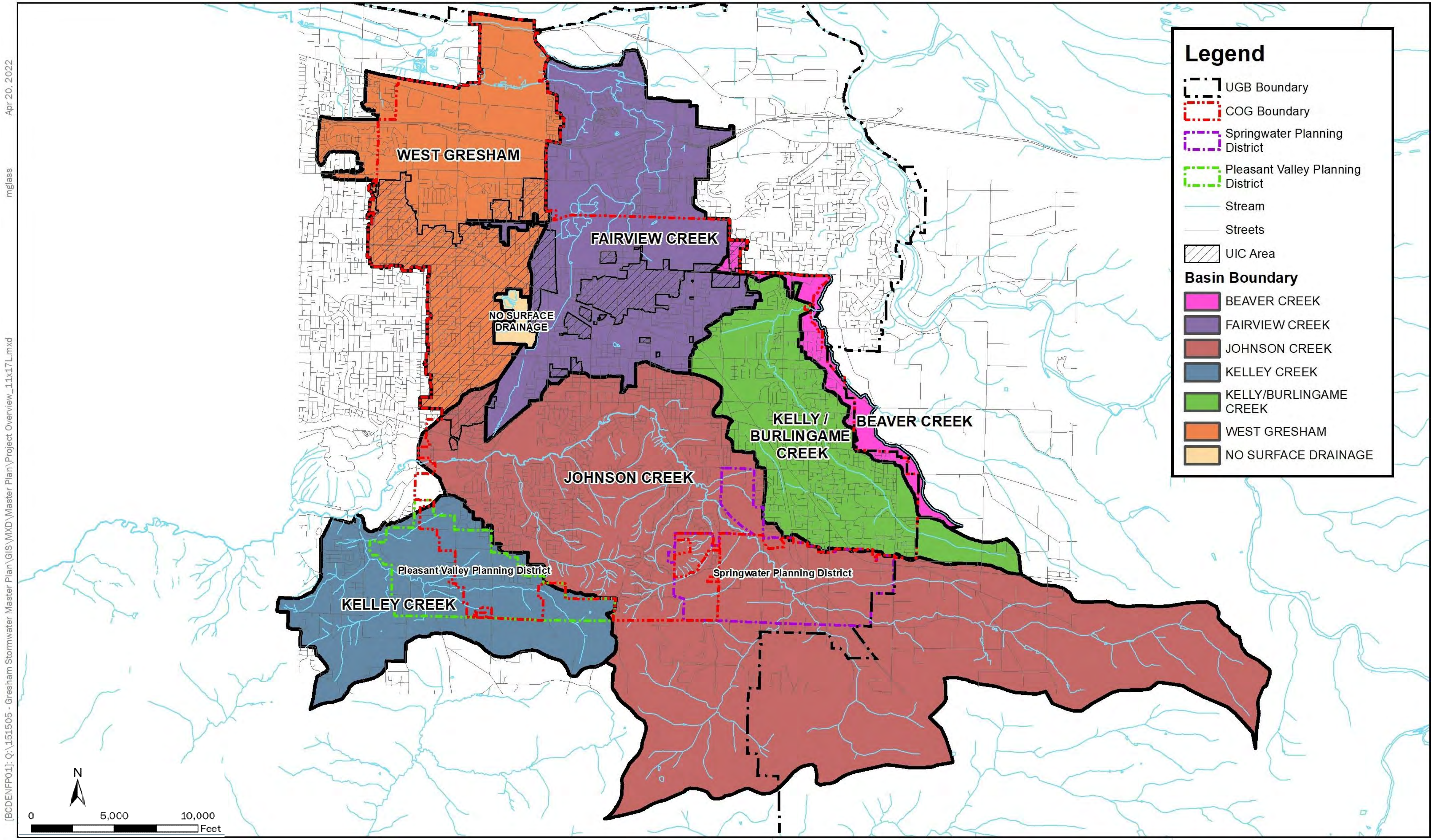

Figure 2-2. Project Overview

2.2.2 West Gresham

The West Gresham basin is located in the northwestern portion of the City and shares a border with the City of Portland. The basin is bisected by I-84 which runs East-West in the northern portion of the basin. Stormwater flow from the South Shore Development in the northernmost portion of the basin (239 acres) discharges to the south into the Columbia Slough at an outfall near NE 185th Drive. Runoff from the approximately 2,032-acre area south of the Columbia Slough and north of NE Glisan Street, enters the City's piped system and is conveyed north to either the Columbia Slough or into the City of Portland-owned drainage infrastructure. Runoff from the remaining southern half of the basin (1,843 acres) is managed entirely through a network of UICs (sometimes referred to as drywells).

2.2.3 Johnson Creek including the Springwater Planning District

The Johnson Creek basin is the largest of the major basins, consisting of approximately 13,184 acres that drain into the main stem of Johnson Creek. Johnson Creek flows through the study area from east to west. Large portions of this basin lie outside of the City limits to the south and east. These upland areas are conveyed by various tributaries to Johnson Creek before entering the mainstem. The SWPD is located southeast of the City limits and consists of 1,565 acres of primarily undeveloped land that is projected to develop in the near future.

2.2.4 Kelley Creek including the Pleasant Valley Planning District

The Kelley Creek basin drains approximately 3,040 acres and is primarily located outside of the southwest City limits. Runoff from this basin drains to Kelley Creek and its tributaries before combining with Johnson Creek near SE Foster Road and SE 162nd Avenue. The PVPD is contained within the Kelley Creek basin, extending beyond the City limits to the west. While most of this 1,015-acre area is currently undeveloped, residential development is anticipated as the City continues to annex property.

2.2.5 Fairview Creek

The Fairview Creek basin consists of 4,530 acres and is bordered by the West Gresham basin to the west, Johnson Creek to the south, and Kelly Creek/Burlingame Creek to the southeast. Stormwater in the northern half of the basin (north of NE Glisan Street) is managed by the City of Fairview. Drainage within this basin generally flows from east to west via the piped system before discharging into Fairview Creek. Fairview Creek originates in a wetland near Grant Butte in the southwestern corner of the basin and flows north into the Fujitsu Ponds, and then Salish Ponds. Discharge from these ponds enters Fairview Lake before discharging to the Columbia Slough.

2.2.6 Beaver Creek

The Beaver Creek basin is located in the eastern portion of the City. Beaver Creek itself runs parallel to Kelly Creek for roughly 3.5 miles just east of the City limits. The Beaver Creek basin is a narrow area that drains approximately 550 acres. The confluence of Beaver Creek and Kelly Creek is located just outside of the City limits, near Mt. Hood Community College.

2.3 Topography

Topography throughout the six major basins varies due to the large study area. As such, the topography of each of the major basins is discussed below. Overall topography for the study area is presented in Figure 2-3.

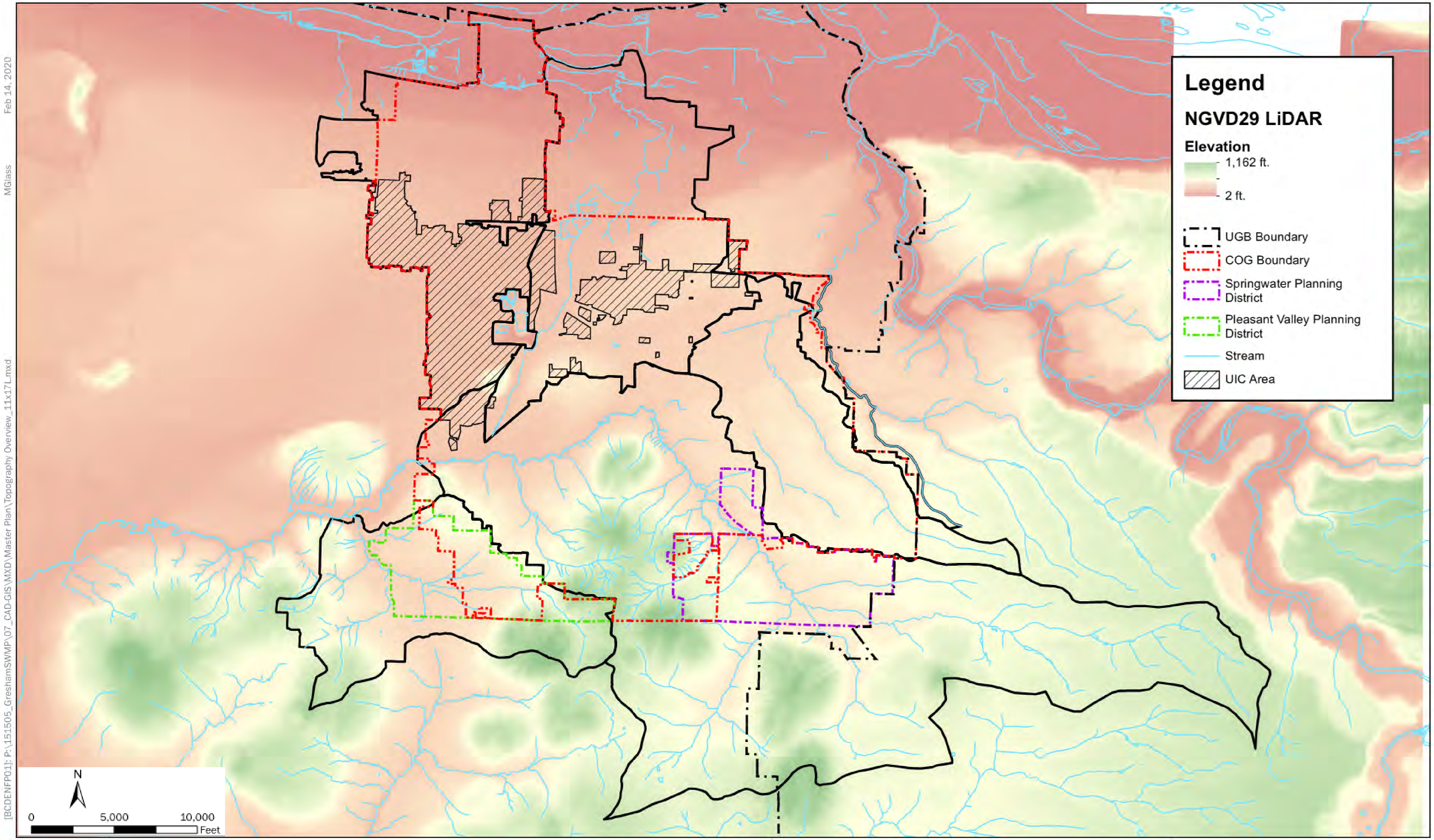

Figure 2-3. Topography Overview

2.3.1 Kelly Creek/Burlingame Creek

The Kelly Creek/Burlingame Creek basin generally slopes from the southeast to the northwest. Elevations throughout the basin range from approximately 590 feet (ft) above mean sea level (MSL) near the headwaters of Kelly Creek to 225 ft above MSL at the confluence of Kelly Creek and Beaver Creek near Mt. Hood Community College. Slopes throughout the basin are gradual and promote drainage to either Kelly or Burlingame Creek, which run southeast to northwest.

2.3.2 West Gresham

The West Gresham basin is relatively flat, with gentle slopes that convey drainage to the north. The high point of this basin is at approximately 600 ft above MSL along Grant Butte in the southeast corner of the basin. The low point of this basin is at approximately 10 ft above MSL and is in the northern portion of the basin at the system's discharge point into the Columbia Slough. Between the West Gresham and Fairview Creek basins, along 190th Avenue, is a mining pit. This 134-acre area consists of several abandoned pits that are graded so as not to discharge any runoff.

2.3.3 Johnson Creek including the Springwater Planning District

Topography within the Johnson Creek basin is characterized by relatively flat areas along Johnson Creek and areas to the north and relatively steep slopes to the south near Gresham Butte and other surrounding buttes. Elevations throughout the basin range from over 1,080 ft above MSL at the tops of these buttes to approximately 245 ft above MSL along Johnson Creek, as it exits the basin to the west.

2.3.4 Kelley Creek including the Pleasant Valley Planning District

The Kelley Creek basin is characterized by a gradual sloping central area with steep buttes in the southwest and southeast corners of the basin. This topography slopes to the northwest to the confluence of Kelley and Johnson Creeks at approximately 235 ft above MSL. The high point of this basin is approximately 1,130 ft MSL at the top of Bliss Butte in the southeastern corner of the basin.

2.3.5 Fairview Creek

Topography in the Fairview Creek basin consists of gentle slopes that direct runoff to the west towards Fairview Creek. The high point in this basin is approximately 600 ft above MSL in the southwestern corner of the basin at the top of Grant Butte. Gradual to moderate slopes in the basin direct drainage west to the low point of the basin, approximately 10 ft above MSL at Fairview Lake.

2.3.6 Beaver Creek

Topography within the Beaver Creek basin is characterized by steep slopes (>20 percent) that border the west side of Beaver Creek. City limits are located above these steep slopes to the west where there is mostly residential development. Elevations in this basin range from approximately 530 ft above MSL at the southern end of the basin to approximately 200 ft above MSL near Stark Street, as Beaver Creek exits the basin to the north.

2.4 Soils

The National Resources Conservation Service (NRCS) Soil Survey online tool was used to gather soils information for the study area. Soils are an important basin characteristic for evaluating potential runoff rates and volumes. Soils are generalized into categories or hydrologic soil groups (HSGs), which approximates soil runoff potential. These groups are A, B, B/D, C, C/D, and D, where A soils are characterized by high rates of infiltration and low runoff potential and D soils are characterized by low rates of infiltration and high potential for runoff. HSG conditions for the study area are reflected on Figure 2-4.

Most of the soils within the study area are either HSG Type C or D soils with pockets of Type B soils. Table 2-2 shows the NRCS HSGs by percent coverage within the study area, and Table 2-3 shows the percent coverage by basin.

Table 2-2. Soil Types within the Study Area

Hydrologic Soil Group	Acres	Percent of Total Area [a]
A	77	0%
B	6,358	23%
B/D	303	1%
C	10,833	38%
C/D	3,515	12%
D	6,885	24%
No Classification [b]	436	2%
Total	28,407	100%

a. *Rounded percentages.*

b. *Areas without an HSG classification include pits and water bodies and are identified in accordance with NRCS.*

Table 2-3. Soil Types within the Basins [a, b]

Basin	A	B	B/D	C	C/D	D
Kelly Creek/Burlingame Creek	0%	6%	0%	2%	29%	63%
West Gresham	0%	60%	5%	25%	7%	0%
Johnson Creek including SWPD	0%	6%	0%	57%	10%	26%
Kelley Creek including PVPD	1%	3%	0%	46%	2%	47%
Fairview Creek	0%	58%	2%	17%	20%	0%
Beaver Creek	0%	32%	0%	12%	14%	42%

b. *Areas within the basins without an HSG classification (i.e., pits or water) by NRCS do not contain a hydrologic soil group.*

c. *Sum of percent by basin may not add up to 100% due to footnote "a" and/or due to rounding.*

The West Gresham and Fairview Creek basins are the only basins within the study area that contain a large portion of B-type soils. Consequently, these basins are the only ones that utilize UICs as a significant component of their stormwater infrastructure. The remaining basins in the study area all contain a large portion of Type C, C/D, or D soils which provide little infiltration capacity.

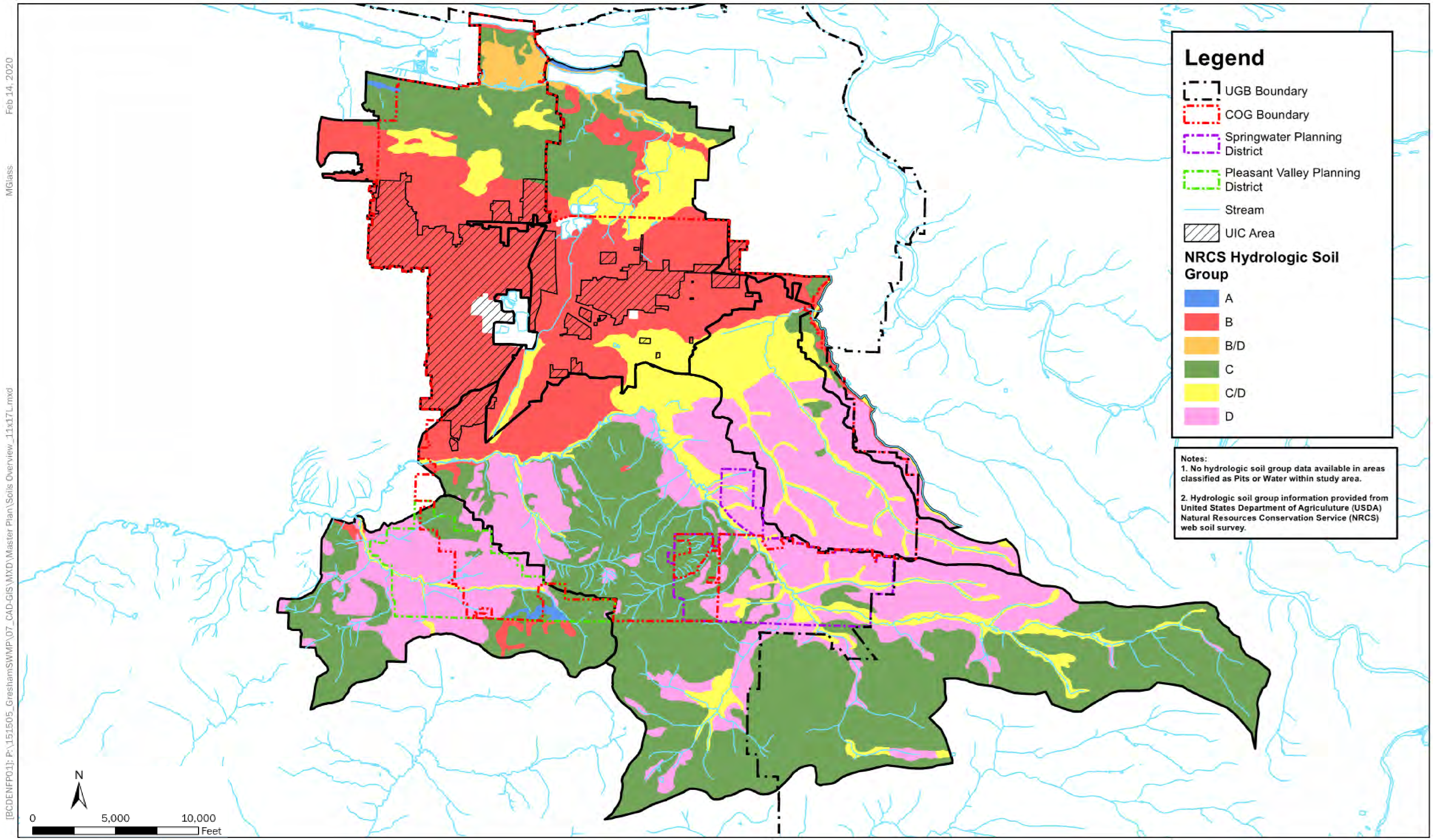

Figure 2-4. Soils Overview

2.5 Land Use (by Basin)

The City of Gresham is primarily developed within the current City limits. The primary areas of growth are located in the Pleasant Valley and Springwater Planning Districts. The urban growth boundary (UGB) was expanded in 1998 to include these areas and accommodate future growth. The City expects to provide urban services, including stormwater management to these planning districts in the near future.

Land use information for the study area was developed in GIS by the City as part of this SMP to evaluate stormwater drainage conditions in the City and planning districts using hydrologic models. Comprehensive existing and projected future land use information was developed based on the following sources:

- 2014 City tax lot data
- City staff knowledge regarding vacant areas and selected additional land use categories (e.g., Natural Areas and Institutional/Schools, etc.)
- Gresham's Natural Resource Overlay, which became effective January 2021 and replaced:
  - Environmentally Sensitive Restoration Area buffers in Pleasant Valley
  - Environmentally Sensitive Resource Area buffers in Springwater
  - Habitat Conservation Area and Water Quality Resource Area buffers (relevant to areas within Gresham city boundaries as of 2009)
- City and Planning District zoning information
- METRO zoning information

A detailed summary of the process to develop the City's land use information and associated impervious area estimates is provided in TM1), available separately from this SMP. The finalized land use categories and their assigned impervious percentages are summarized in Table 2-4 below.

Table 2-4. Land Use Categories and Impervious Percentages		
Modeled Land Use Category	Abbreviation	Assigned Impervious Percentage
Agricultural [a]	AGR	10
Commercial	COM	90
Environmentally Sensitive Resource Area	ESRA	10
High Density Residential (Planning Districts) [b]	HDR_PD	75
Industrial	IND	80
Institutional/Schools	INS	50
Low Density Residential (Planning Districts)	LDR_PD	55
Medium Density Residential (Planning Districts) [b]	MDR_PD	65
Multi-Family Residential	MRES	60
Natural Areas	NA	0
Open Space/Parks	OSP	10
Rural Residential	RUR	10
Low Density Residential	LDR	35
Vacant [a]	VAC	10

a. *Only present in the existing land use condition.*

b. *Only present in the future land use condition.*

Land use categories from Table 2-4 were applied spatially to each basin and subbasin within the study area for analysis. Summaries of the existing and future land use conditions by basin are presented in Table 2-5 and Table 2-6, respectively.

Table 2-5. Existing Land Use Categories within the Basins												
Basin	AGR	COM	ESRA	IND	INS	LDR_PD	MRES	NA	OSP	RUR	LDR	VAC
Kelly Creek/Burlingame Creek	0%	11%	0%	1%	4%	0%	13%	3%	6%	2%	49%	12%
West Gresham	0%	14%	0%	21%	3%	0%	14%	1%	4%	0%	36%	8%
Johnson Creek including SWPD	0%	3%	3%	1%	1%	0%	2%	7%	4%	13%	17%	49%
Kelley Creek including PVPD	0%	0%	8%	1%	0%	2%	0%	5%	2%	6%	22%	53%
Fairview Creek	4%	14%	0%	18%	3%	0%	9%	6%	4%	0%	41%	2%
Beaver Creek	1%	6%	0%	0%	13%	0%	2%	1%	5%	16%	32%	24%

Table 2-6. Future Land Use Categories within the Basins												
Basin	COM	ESRA	HDR_PD	IND	INS	LDR_PD	MDR_PD	MRES	NA	OSP	RUR	LDR
Kelly Creek/Burlingame Creek	11%	0%	0%	1%	4%	0%	0%	13%	3%	6%	9%	53%
West Gresham	15%	0%	0%	27%	3%	0%	0%	14%	1%	4%	0%	36%
Johnson Creek including SWPD	3%	3%	0%	6%	1%	2%	0%	2%	7%	4%	53%	19%
Kelley Creek including PVPD	5%	9%	1%	1%	0%	16%	5%	0%	5%	1%	21%	37%
Fairview Creek	15%	0%	0%	22%	3%	0%	0%	9%	6%	4%	0%	41%
Beaver Creek	6%	0%	0%	1%	13%	0%	0%	2%	1%	5%	35%	37%

Projected changes in land use from existing to future conditions are discussed below and illustrated in Figure 2-5 and Figure 2-6.

2.5.1 Kelly Creek/Burlingame Creek

Existing land use in this basin contains the highest percentage of residential (low and medium) land use at 62 percent, which is primarily concentrated in the upper portions of the basin. The western portion of the basin, and areas along SE Burnside Road include a larger concentration of commercial parcels. In the lower portion of the basin there are two large parcels which fall into the categories of open space/parks and institutional/schools corresponding to the Gresham Golf Course and Mt. Hood Community College, respectively.

In the future condition for this basin, all of the existing 12 percent of undeveloped lands is projected for growth, however the overall percentage breakdown of area by land use category is anticipated to remain consistent.

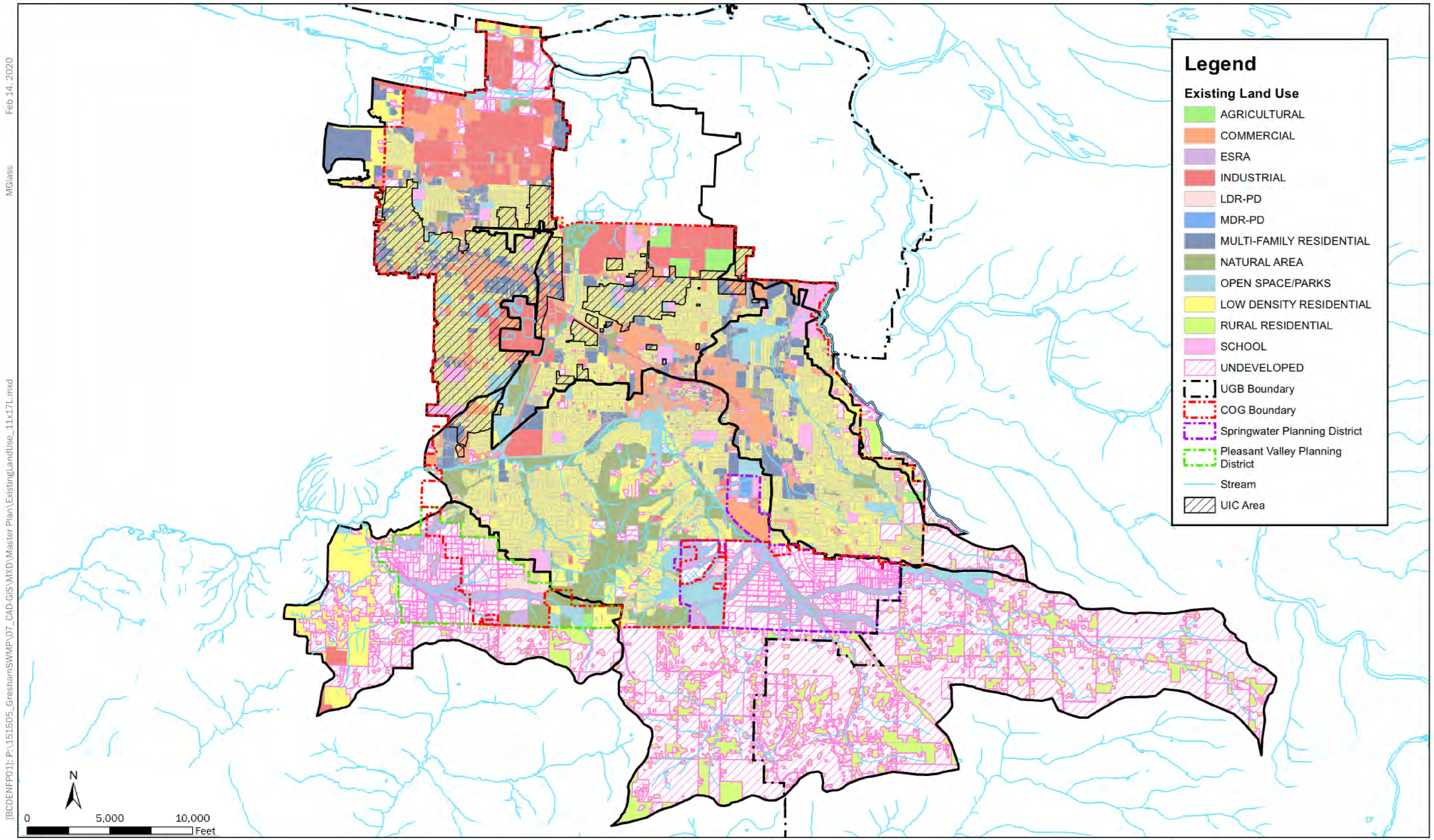

Figure 2-5. Existing Land Use

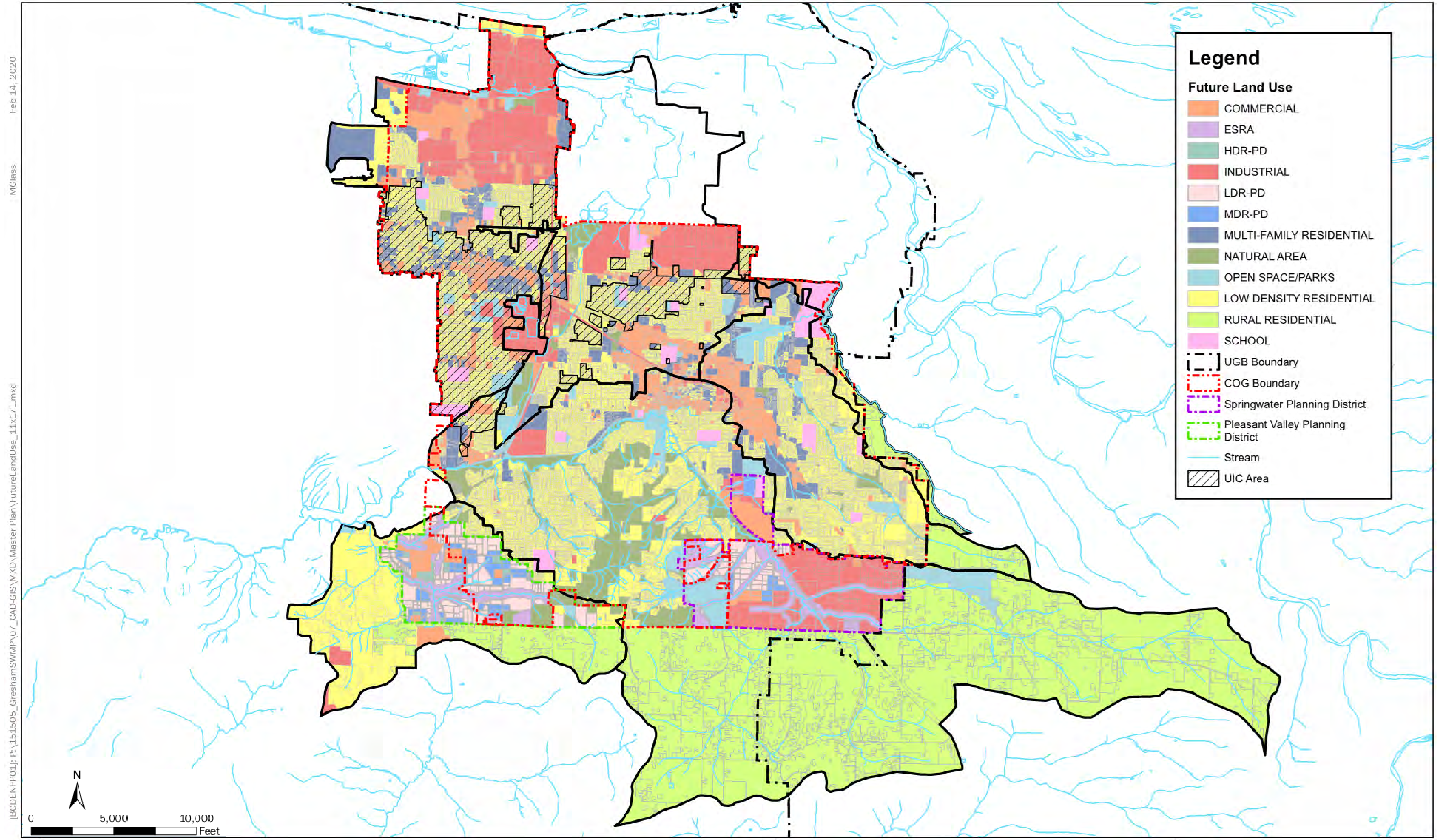

Figure 2-6. Future Land Use

2.5.2 West Gresham

West Gresham contains a significant portion of residential (low and medium density) land use at 50 percent which primarily exists in the southern half of the basin. A large portion of industrial (21 percent) and commercial (14 percent) land uses are also observed in in the northern portion of the basin around the I-84 corridor.

Undeveloped lands, mostly located in the South Shore development (north of the Columbia Slough) are anticipated to develop into Industrial lands in the future.

2.5.3 Johnson Creek including the Springwater Planning District

The Johnson Creek basin contains a high percentage (49 percent) of undeveloped lands due to the large extent of this basin, which extends beyond both the City limits and the SWPD boundaries to the south and southeast. Developed areas within Johnson Creek generally consist of residential lands within the City limits and some commercial areas near downtown Gresham. Areas that will not develop in this basin include the natural areas located around Gresham Butte and the ESRAs that buffer Johnson Creek and its tributaries within the SWPD.

Future conditions for Johnson Creek indicate that most of the vacant lands in the upper portion of the basin are expected to develop into rural residential parcels. The most significant development in the future is expected to occur in the SWPD which will change from undeveloped lands to mostly industrial parcels.

2.5.4 Kelley Creek including the Pleasant Valley Planning District

Similar to the Johnson Creek basin, much of the area within the Kelley Creek basin is undeveloped (53 percent). Areas that are currently developed in the basin are mostly residential where the Gresham City limits extend into the basin on the eastside or in the proximity of the PVPD or the City of Happy Valley on the west side of the basin.

Future development in this basin is primarily dictated by the PVPD which is mostly zoned as either low, medium, or high density (planning district). Consequently, for the future condition a much higher percentage of previously undeveloped lands were categorized as one of the several residential land use categories.

2.5.5 Fairview Creek

The Fairview Creek basin is the most developed basin in the study area with only two percent of lands classified as undeveloped. Majority of the developed parcels are residential, with 41 percent categorized as low density and nine percent as medium density. Industrial areas within Fairview Creek exist primarily along the SE Stark Street and NW Burnside Road corridors that run through the basin. Commercial areas within the basin are generally isolated between SE Stark Street and NE Glisan Street near the northern border of the City limits.

The future condition land use breakdown within Fairview Creek is similar to the existing condition, due to the minimal number of undeveloped lands. The only exception to this is a small increase in area covered by industrial land uses which increased from 18 to 22 percent of the basin, to account for the development of remaining agricultural lands.

2.5.6 Beaver Creek

The Beaver Creek basin is composed predominantly of low density and rural residential lands that comprise 48 percent of the basin. These areas are primarily located within the City limits in the lower portion of the basin. Other significant land use categories within the basin include undeveloped lands (24 percent) and institutional/schools (13 percent). The Institutional/Schools land use category corresponds to a portion of the Mt. Hood Community College campus located in the northern portion of the basin.

Future development conditions for Beaver Creek reflect an increase in residential lands as the area of low-density residential lands are anticipated to increase from 32 to 37 percent of the basin and rural residential lands are expected to increase from 16 to 35 percent of the basin. All other land use categories are expected to remain at the same percentage between existing and future conditions.

2.6 Stormwater Infrastructure Assets

The City manages approximately 168 miles (approximately 885,755 linear feet [LF]) of piped infrastructure (this includes stormwater mains and culverts) and approximately 12.75 miles (67,400 LF) of open-channel ditches. These systems convey stormwater runoff to the natural systems within each basin and ultimately to their respective major receiving water body as discussed in Section 2.3.

Tables 2-7 through 2-10 below provide a summary of pipe, culvert, open channel, storm structures, and water quality facility assets by basin, including a summary of pipe materials.

Table 2-7. System Asset Inventory – Public Pipe/Culvert and Open Channels (mapped in GIS), City-wide

	Length (feet) by Basin					
Diameter (inches)	Kelly Creek/ Burlingame Creek	West Gresham	Johnson Creek including SWPD	Kelley Creek including PVPD	Fairview Creek	Beaver Creek
0-6	1,923	1,022	3,423	708	1,492	76
8-12	120,468	34,406	185,285	2,914	79,512	11,777
14-18	47,091	23,909	70,009	4,712	35,926	4,166
20-24	23,056	24,226	22,374	2,328	20,864	2,133
26-30	7,214	15,558	9,828	766	9,199	0
32-36	12,434	13,903	10,360	0	7,060	1,324
38-42	925	7,868	2,836	0	4,045	4,045
44-48	5,868	9,066	4,485	54	7,131	52
50-58	394	3,627	1,954	0	2,657	0
60	3,386	383	2,789	0	209	234
62-70	1,203	0	0	0	4,440	0
72	5,645	0	1,289	0	227	407
>72	1,764	250	109	0	871	141
Total (Pipe and Culvert)	231,371	134,218	314,741	11,482	173,633	20,310
Total (Open Channel)	21,061	548	24,300	12,826	5,749	2,916
Total (Mapped Stream/ Creek)	54,647	5,991	443,440	29,796	66,358	4,019

Table 2-8. System Asset Inventory – Pipe/Culvert Material (mapped in GIS), City-wide

Basin	Pipe Material (Percent of Total [a])					
	Concrete	Plastic [b]	Reinforced Concrete	Ductile Iron	Corrugated Metal	Unknown [c]
Kelly Creek/Burlingame Creek	63	23	6	2	3	3
West Gresham	57	17	23	0	0	3
Johnson Creek including SWPD	70	18	4	2	3	3
Kelley Creek including PVPD	6	88	1	1	2	2
Fairview Creek	70	15	7	2	0	6
Beaver Creek	69	24	0	2	4	1

a. *Rounded percentages.*

b. *Includes high-density polyethylene (HDPE) and polyvinyl chloride (PVC) piping.*

c. *Gaps in GIS data.*

Table 2-9. System Asset Inventory – Public Water Quality Facilities

Facility	Number (#) or Facility Footprint Area (ft^2)					
	Kelly Creek/ Burlingame Creek	West Gresham	Johnson Creek including SWPD	Kelley Creek including PVPD	Fairview Creek	Beaver Creek
EcoRoofs	0	1,740 ft^2	1,307 ft^2	0	0	0
Infiltration Vaults	0	10	0	6	2	0
Pervious Surfaces (Pavement)	202,740 ft^2	122,510 ft^2	54,922 ft^2	0	58,829 ft^2	343 ft^2
Planter Boxes/Rain gardens	21	78	95	161	19	59
Ponds (public)	14	3	11	0	6	0
Regional Water Quality Facilities	2	1	0	1	1	0
Soakage Trenches	0	0	1	0	0	0
Swales	7	24	19	0	6	0
UICs	3	777	72	0	321	29
Proprietary Systems (i.e., StormFilter)	70	163	69	0	94	6

Abbreviation: ft^2 = square feet

Table 2-10. System Asset Inventory - Storm Structures (City Ownership) [a]						
Facility	Number					
	Kelly Creek/ Burlingame Creek	West Gresham	Johnson Creek including SWPD	Kelley Creek including PVPD	Fairview Creek	Beaver Creek
Clean out	41	7	118	4	19	3
Ditch inlet/Inlet structure	1,979	1,797	3,017	122	1,638	181
Manholes (all non-treatment categories including diversion, drop, flow control, etc.)	1,418	577	1,795	126	852	129
Outfalls	92	6	175	3	1	2

a. *Excludes identified county, Oregon Department of Transportation (ODOT), and private infrastructures.*

2.7 Regulatory Drivers

The Oregon Department of Environmental Quality (DEQ) is responsible for implementing provisions of the federal Clean Water Act (CWA) pertaining to stormwater discharges and surface water quality.

The DEQ conducts permitting for activities that discharge to surface waters, establishes water quality criteria for waterbodies based on designated uses, and conducts studies and evaluations to determine whether a water body is meeting water quality standards. More information regarding these regulations as they relate to municipal stormwater infrastructure is provided in the following subsections.

2.7.1 NPDES MS4 Permit

The National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit program regulates the discharge of stormwater to receiving waters from urban areas and requires permitted municipalities to develop and implement stormwater management measures to reduce pollutants in discharges to the maximum extent practicable.

The City is a co-permittee along with the City of Fairview on their NPDES MS4 permit for management of stormwater runoff. The DEQ recently issued a renewed five-year permit to the City of Gresham and City of Fairview with an effective date of October 1, 2021.

The City's Stormwater Management Plan (SWMP) describes the management practices that are implemented to comply with the NPDES MS4 permit. These management practices were developed to address the requirements of the permit which include prohibiting non-stormwater discharges, public education, public involvement, illicit discharge detection/elimination, construction site management, post-construction stormwater management, industrial/commercial facility inspections, good housekeeping practices for municipal operations, operations and maintenance (O&M) activities for stormwater management facilities, and stormwater monitoring.

In addition to the permit elements listed above, the NPDES MS4 permit requires the co-permittees to prepare an assessment of outcomes related to a previously prepared hydromodification assessment and retrofit strategy. For permit renewal, development of updated total maximum daily load (TMDL) pollutant load reduction benchmarks will be required. The NPDES MS4 permit requirements are programmatic and have not included capital projects to date. However, these additional requirements (most specifically the water quality retrofit strategy) were considered in the development of capital projects for this master plan (see Section 6).

2.7.2 TMDL and 303(d) Requirements

Section 303(d) of the CWA requires states to develop a list of water bodies that are not meeting water quality standards. The DEQ develops this list for Oregon, which is used to identify and prioritize water bodies for development of TMDLs. A TMDL identifies the assimilation capacity of a water body for specific pollutants and establishes pollutant load allocations for sources of discharge to the water body.

The Willamette River, Columbia Slough, and Sandy Rivers are the major receiving waters for the City. These rivers and corresponding tributaries are on the 303(d) list for various parameters of concern and hold TMDLs for specific parameters and sources of pollutant loading. Table 2-11 summarizes the TMDL parameters relevant to the City. With respect to municipal stormwater, DEQ is responsible for implementing these TMDLs through NPDES MS4 permits. To date, this has included a requirement to evaluate the potential for stormwater to be a source of 303(d) listed pollutants, and a requirement to develop TMDL pollutant load reduction benchmarks.

The information in the table below was considered in the development and prioritization of water quality capital projects for this master plan.

Table 2-11. TMDL Summary for Gresham

Watershed/ Major Basin	Subbasin(s)	TMDL Year	Applicable TMDL parameters	TMDL surrogate parameters
Willamette	Lower Willamette	2006	• Mercury (updated in 2020) • Bacteria (*E. coli*) • Temperature	• Effective shade (surrogate for temperature)
	Johnson Creek	2006	• DDT • Dieldrin • Bacteria (*E. coli*) • Temperature	• Effective shade (surrogate for temperature)
	Columbia Slough [a]	2006	• Temperature	• Effective shade (surrogate for temperature)
Sandy	Sandy River	2005	• Bacteria (*E. coli*) • Temperature	• Effective shade (surrogate for temperature)
Columbia Slough	Columbia Slough	1998	• DDT/DDE • Dieldrin • Dioxin • PCBs • Lead, dissolved • Phosphorus • Dissolved Oxygen • pH • Chlorophyll a • Bacteria (*E. coli*) • Temperature (updated in 2006)	• BOD (surrogate for Dissolved Oxygen) • Phosphorus (surrogate for pH and Chlorophyll a) • Effective shade (surrogate for temperature)

Abbreviation: DDT = dichloro-diphenyl-trichloroethane, DDE = dichloro-diphenyl-dichloroethylene; PCB = polychlorinated biphenyl; BOD = biochemical oxygen demand

a. *The Willamette Basin TMDL includes the Columbia Slough subbasin for temperature only. Per the 2006 Willamette TMDL document, pg. 5-13, "The 1998 TMDL established for the Slough remains in effect."*

2.8 Basis of Planning (Code and Standards Review)

The City's Public Works (PW) Standards and Stormwater Management Manual (SMM) (October 2018) were used to establish design criteria relevant to the analysis of the City's stormwater system. Design criteria were used to identify where the system has capacity limitations and as the basis for conceptual design of stormwater capital projects to address water quality, condition improvements, and capacity deficiencies. Applicable design criteria are listed in Table 2-12.

Table 2-12. Drainage Standards and Design Criteria

Criteria	Source	Standards/ Criteria
Water Quality Facility Design	Stormwater Management Manual	Treat 80 percent of average annual runoff (1.2 inch, 24-hour storm)
Flow Control Design	Table 1-1 Stormwater Management Manual	Infiltrate the 10-year storm. If infiltration of the 10-year storm is infeasible, control post-development peak flow rates for the 5-, 10- and 25-year storms to the pre-development peak flow rates, and control the 2-year storm post-development peak flow rate to 50 percent of the 2-year pre-development peak flow rate.
Pipe Design Storm	Table 4.07 Public Works Standards	10-year for pipes draining less than 250 acres. 50-year for pipes draining greater than 250 acres.
Creek or Stream Channel Design Storm	Table 4.07 Public Works Standards	50-year for system without a designated flood plain. 100-year for system with a designated flood plain.
Minimum Pipe Sizes	Section 4.04 Public Works Standards	Minimum of 12 inches in diameter except for lines connected to catch basins and inlets that convey water directly from private property.
Pipe Materials	Section 4.04 Public Works Standards	Reinforced concrete, D3034 PVC, HDPE solid wall, or polypropylene smooth interior corrugated exterior pipe as specified in Subsection 401.02 of the Standard Specifications. Where required, for added strength, ductile iron, PVC C900 or C905 will be used. (Note that as of the finalization of this master plan, the 2018 standards were updated and C905 is now obsolete and has been consolidated into C900.) PVC pipe may not be used for culverts where there is not a connected structure on both the upstream (US) end and the downstream (DS) end of the pipe. When HDPE is used for culverts, solid wall SDR-17 or SDR-26 must be used.
Pipe Cover	Section 4.03.02 Public Works Standards	Minimum 30 inches from the top of pipe to finished grade in paved areas and 36 inches at all other locations.
Structure Spacing	Section 4.05 Public Works Standards	Manholes: no greater than 500 feet. Inlets: no greater than 400 feet.
Manhole Size	Public Works Standard Details-Stormwater	48-inch diameter

Abbreviation: PVC – polyvinyl chloride; HDPE – high-density polyethylene; SDR – standard dimension ratio

Water quality capital projects that feature green infrastructure such as rain gardens, planter boxes, and swales, were sized in accordance with the Simple Sizing Method (Section 2.3.1 of the SMM). The Simple Sizing Method was developed by the City assuming retention of the 10-year, 24-hour storm event using a generalized native soil infiltration rate based on the HSG. This method results in pre-defined sizing factors that are applied based on the amount of impervious area to be managed by each stormwater facility. For the capital projects in this master plan, the amount of impervious area draining to a facility was estimated using an area-weighted average based on the estimated impervious area by land use category as established and provided in Table 2-4.

The following design criteria listed in Table 2-13 were incorporated into the conceptual design and costing of the water quality capital projects. This information is summarized from Section 3 of the SMM.

Table 2-13. Design Criteria for Water Quality Facilities		
Facility	**Source**	**Design Criteria**
Rain gardens/Swales	Section 3.2.2 Stormwater Management Manual	• Minimum width = ten feet • Maximum side slope = 3:1 (H:V) • Underdrain = to be included (6-inch diameter with a maximum perforated length of 36 inches) • Media Layers = 12-inch minimum of planting media; 18-inch minimum aggregate subgrade where required • Vegetation = Entire footprint area
Planter boxes	Section 3.2.1 Stormwater Management Manual	• Minimum width = 24 inches • Underdrain = to be included (6-inch diameter with a maximum perforated length of 36 inches) • Media Layers = 12-inch minimum of planting media; 18-inch minimum aggregate subgrade where required • Vegetation = Entire footprint area
Ponds	Section 3.2.5 Stormwater Management Manual	• Sized to fully store the volume of the 25-year, 24-hour post-development runoff volume from the contributing drainage area with 1 foot of freeboard • Access road to be included • A weir and orifice overflow structure are required • Maximum side slope = 3:1 (H:V) • Media Layers = 12-inch planting media • Vegetation = Entire footprint area

Section 3

Capacity Evaluation

Capacity deficiencies within the study area were identified based on a combination of City staff observations/knowledge, documented issues from previous basin master plans, and H/H model results. The H/H models for this SMP effort were developed using the XP-Storm Water Management Model (XPSWMM) modeling software platform. The XPSWMM software is highly suited to urban modeling exercises and has been used successfully for the City's previous master plans.

Individual models were developed for each basin. Each XPSWMM model for the SMP was either developed entirely from the City's latest GIS stormwater infrastructure data or updated from an existing XPSWMM model developed as part of a previous basin study. The development and refinement of these models provides the primary tool for identifying, validating, and evaluating capacity deficiencies within the City's stormwater drainage infrastructure system. The following subsections provide a summary of the modeling approach and process used to develop this SMP. A detailed description of modeling methods is included in a separate technical memorandum (TM1) as referenced on page 1-2.

3.1 Modeling Extents and Approach

Available GIS stormwater infrastructure data and existing H/H models were reviewed at the beginning of the project to develop a modeling approach. Modeling extents for each major basin were established during the Modeling Approach Workshop, in consideration of both the City's desire to target specific locations and the availability of information. In general, modeled system extents include all piped infrastructure greater than or equal to 24 inches in diameter. Deviation from this assumption occurred within the Johnson Creek basin where modeling extents were selected based on observed flooding areas requiring further evaluation. Specific modeling extents for each basin are discussed in detail in Section 4.1 of TM1, available separately from this SMP.

To evaluate capacity issues across the several major basins in the study area, a consistent H/H modeling approach was applied. This comprehensive approach replaces the individual master plan efforts which utilized various H/H methodologies to develop input parameters and produce results. Methodologies adopted for the XPSWMM models developed as part of this SMP are discussed in Section 3.2 (Hydrologic Model Development) and Section 3.3 (Hydraulic Model Development).

3.2 Hydrologic Model Development

The SWMM Runoff method was used to generate runoff hydrographs for each modeled basin. The Runoff method was applied to estimate runoff based on land use, subbasin area, and estimated flow path (slope, subbasin width, etc.) for various design storm events. This method has been widely used for generating surface runoff since the early 1970s and is often used for larger planning studies due to its simplicity. This method accounts for soil conditions and associated infiltration rates and initial losses. Using the SWMM Runoff method, each subbasin is simplified into a rectangular surface with a uniform slope and width. Each subbasin is modeled as a reservoir and only when rainfall has exceeded the initial abstraction and infiltration capacity will runoff be generated.

As part of the Runoff method, the following hydrologic input parameters were required, as described in more detail in the following subsections:

- Subbasin area
- Subbasin impervious percentage
  - Existing land use
  - Projected future land use
- Infiltration related information for soils/pervious areas
- Subbasin width
- Subbasin slope
- Rainfall

It should be noted that there is a stormwater drainage system referred to as the South Shore Area in the West Gresham Basin, located north of I-84 that is within the Multnomah Country Drainage District (MCDD) boundary. This area was modeled for a stormwater master plan for MCDD in 2019. Given the connection of this system to the larger MCDD system, and rather than creating a new model for this area, the City obtained permission to copy and use MCDD's model to evaluate this area. A consistent modeling platform (XPSWMM) and hydrologic modeling method (Runoff method) were used by MCDD; however, hydrologic input parameters varied for infiltration parameters (i.e., Green Ampt parameters as described in Section 3.2.5). For MCDD modeling methods, see the Draft Drainage Master Plan, Multnomah Country Drainage District No.1, May 10, 2019.

3.2.1 Subbasin Refinement and Areas

Existing subbasin delineations from the previous master planning efforts were available in GIS and refined for this SMP effort. The existing delineations were reviewed in conjunction with current stormwater pipe layout and aerial imagery reflecting current development conditions. Updates were made to maintain consistency with any infrastructure changes that had occurred since the previous master planning efforts. Boundaries for the existing subbasins were refined as needed to match the major basin boundaries. Existing subbasins were also subdivided for application with the refined H/H model extents to ensure the best set up for the input of drainage/runoff into the modeled system.

Reference data to aid in the delineation of new subbasin boundaries included topography (contours developed from Light Detection and Ranging [LiDAR]), aerial photos, tax lot boundaries, storm pipe infrastructure, and hydraulic model extents.

Subbasin naming conventions were provided within the City's existing GIS database. Original subbasin names were maintained when subbasins were refined. If a subbasin was subdivided into smaller subbasins, the original name was retained with a -1, -2, etc., applied to the end of the name.

Once subbasin delineations within each basin were finalized, areas were calculated for each subbasin in GIS. Subbasins throughout the major basins varied in size depending on the density of the stormwater infrastructure, density of development, and heterogeneity of land use. The number, mean area, and median area of subbasins within each major basin are included below in Table 3-1.

Table 3-1. Summary of Subbasin Areas

Basin	Number of Subbasins	Area of Subbasin (acre)	
		Mean	Median
Kelly Creek/Burlingame Creek	210	13.6	11.0
West Gresham [a]	60	31.7	26.3
Johnson Creek including the SWPD [b]	284	46.0	15.7

Table 3-1. Summary of Subbasin Areas

Basin	Number of Subbasins	Area of Subbasin (acre)	
		Mean	Median
Kelley Creek including the PVPD [b]	44	69.0	32.1
Fairview Creek [c]	144	14.3	8.5
Beaver Creek [b]	16	32.2	34.4

a. *This table does not include the South Shore Areas modeled using MCDD's stormwater master planning model.*

b. *While hydrologic modeling was conducted for all subbasins, hydraulic modeling was not conducted for all subbasins in these major basins (see Section 4.0 of TM1 for Hydraulic Model Extents).*

c. *Does not include areas within Fairview city limits.*

3.2.2 Existing Land Use

Existing land use information within the City limits was based primarily on 2014 tax lot data provided by the City and other sources as summarized in Section 2.6. Tax lot data was provided as a GIS shapefile and initially categorized to include the following land use designations:

- Agricultural
- Commercial
- Industrial
- Multi-family residential
- Mixed-use residential
- Open space/parks
- Single-family residential
- Vacant

Brown and Caldwell (BC) met with City staff to review and establish land use categories and impervious assumptions by land use for the study area. As a result of this meeting, the following refinements and decisions were made regarding the existing land use information.

- Multi-family residential and mixed-use residential were combined into one land use category based on their similar densities. This combined category is referred to as multi-family/medium density residential.
- Select parcels originally identified as vacant were developed since the 2014 shapefile was created. As a result, the City identified vacant areas that were developed as of January 2018 and updated the land use designation for those parcels.
- A natural areas overlay was applied to the study area, and a separate natural areas land use category was developed. These areas are currently vacant with 0 percent impervious surface and will not develop under future development conditions, even if the underlying zoning information may imply otherwise.
- Schools were assigned their own land use category. In the 2014 shapefile, schools were designated as commercial land use. However, the typical impervious information for schools is lower than for typical commercial areas in the City. This difference was deemed significant enough by City staff to create an institutional/schools land use category.
- Land within the Planning Districts (Springwater and Pleasant Valley) but outside City limits was categorized as vacant for existing conditions.

- For areas outside both the City limits and the Planning Districts, zoning and vacant lands information was obtained from METRO to designate existing land use conditions in these areas. Table 3-2 shows how the METRO zoning classifications were categorized into the City-wide land use categories. A rural residential land use category was also added to account for residential areas outside both the City limits and Planning Districts.

Table 3-2. Modeled Land Use Category to METRO Zoning		
Modeled Land Use Category	**METRO Zoning Abbreviation**	**METRO Zoning Definition**
Agricultural [a]	AGR	Agricultural
Commercial	COM	Commercial
	MUR	Mixed-Use Residential
Environmentally Sensitive Resource Area [c]	-	-
High Density Residential (Planning Districts) [b]	-	-
Industrial [c]	IND	Industrial
Institutional/Schools [c]	-	-
Low Density Residential (Planning Districts)	-	-
Medium Density Residential (Planning Districts) [b]	-	-
Multi-Family Residential	MFR	Multi-Family Residential
Natural Areas [c]	-	-
Open Space/Parks	POS	Parks/Open Space
Rural Residential (added as a new category)	RUR	Rural Residential
Low Density Residential	SFR	Single-Family Residential
Vacant [a]	VAC	Vacant

a. *Only present in the existing land use condition.*

b. *Only present in the future land use condition.*

c. *Equivalent METRO Zoning category not available.*

After these land use category assumptions were finalized, an updated GIS shapefile for existing land use was created by the City. This revised shapefile was applied across the study area along with the impervious percentage assumptions listed previously in Table 2-4.

3.2.3 Projected Future Land Use

Future land use within the study area remained consistent with the existing land use designations discussed in Section 3.2.2, except for vacant/undeveloped parcels. In the future condition, these parcels were modified (i.e., assumed to be built out) based on their underlying zoning which came from one of three sources. Underlying zoning for parcels within City limits corresponded to their City zoning designation; for areas outside the City limits but within the Planning Districts, underlying zoning is based on the Planning District zoning designation. For areas outside of both the City and Planning Districts, the METRO zoning designation is applied.

To apply consistent future land use designations across the study area, the City zoning designations were consolidated. METRO zoning designations were also consolidated as previously shown in Table 3-2, while Planning District zoning designations were consolidated in accordance with Table 3-3.

Table 3-3. Modeled Land Use Categories for Planning District Zoning		
Modeled Land Use Category	Planning District Zoning Abbreviation	Planning District Zoning Definition
Agricultural [a, c]	-	-
Commercial	EC	Employment Center
	MU	Mixed Use Employment
	NC	Neighborhood Center
	TC	Town Center
	VC	Village Center
Environmentally Sensitive Resource Area	ESRA	Environmentally Sensitive Resource Area
High Density Residential (Planning Districts) [b]	HDR	High-Density Residential
Industrial	RTI	Research and Technology Industry
Institutional/Schools [c]	-	-
Low Density Residential (Planning Districts)	VLDR	Very Low Density Residential
	LDR	Low-Density Residential
Medium Density Residential (Planning Districts) [a]	THR	Town House Residential
	MDR	Medium-Density Residential
Multi-Family Residential [c]	-	-
Natural Areas [c]	-	-
Open Space/Parks [c]	-	-
Rural Residential [c]	-	-
Low Density Residential [c]	-	-
Vacant [a, c]	-	-

a. *Only present in the existing land use condition.*

b. *Only present in the future land use condition.*

c. *Equivalent Planning District Zoning category not available.*

3.2.4 Impervious Areas

The Runoff method requires an impervious percentage for each subbasin in order to calculate runoff volume and peak discharge. Percent impervious values were estimated for each land use category based on previous planning efforts and staff understanding of development density. These values are listed in Table 2-4. These land use-based impervious percentages were used to develop area-weighted impervious percentages for each subbasin to calculate a composite impervious percentage for each subbasin.

3.2.5 Soils

The Runoff method includes four different options for calculating infiltration. For this project, the Green Ampt method was selected. The Green Ampt method requires the following input data for each soil type, as described (see Table 3-5):

- **Average Capillary Suction (inches).** Related to the conductivity of water through soils. The values used in the models for average capillary suction were obtained from typical values provided in the documentation for the XPSWMM software by soil texture classification (see Table 3-4).
- **Initial Moisture Deficit (unitless).** The fractional difference between soil porosity and actual moisture content. Initial moisture deficit values were selected for each NRCS soil group based on values referenced in the XPSWMM Manual.
- **Saturated Hydraulic Conductivity (inches/hour).** A physical parameter reflective of the rate at which water moves through the soil. Input parameters for saturated hydraulic conductivity vary by soil type and were based on soil data gathered from the NRCS website.

Table 3-4. Typical Values for Average Capillary Suction

Soil Texture	Typical Values for Capillary Suction (inches)
Sand	4
Sandy Loam	8
Silt Loam	12
Loam	8
Clay Loam	10
Clay	7

For each subbasin, the Green Ampt parameters were applied based on the most predominant soil type (or soil texture classification in the case of average capillary suction) in the subbasin. If there were two soil types that were nearly equally represented for a subbasin, the most impervious of the two soil types was applied to be conservative.

Table 3-5. Initial Green Ampt Parameters

NRCS Hydrologic Soil Group	Saturated Hydraulic Conductivity (inch/hour)	Initial Moisture Deficit	Average Capillary Suction (inches)
B	0.5	0.33	12
C	0.3	0.30	10
C/D	0.2	0.26	4
D	0.1	0.23	4

During the calibration phase these parameters were further refined (See Section 3.4).

3.2.6 Subbasin Width and Slope

The Runoff method requires the calculation of average subbasin width. Average subbasin width was calculated by dividing the flow path length by the subbasin area. The flow path length was estimated as the longest flow path a drop of water might take from the top of the subbasin to the bottom. The calculated flow path length reflects overland flow, channel flow, and pipe flow components to estimate the longest flow path.

Slope was calculated for all subbasins by calculating the elevation difference along the established flow path length and dividing by the flow path length. Elevations at the top and bottom of each subbasin were established from City-provided LiDAR data.

3.2.7 Design Storms

Design storms are precipitation patterns typically used to evaluate the capacity of storm drainage systems and design capital improvements for the desired level of service. Design storms used for this project to identify capacity deficiencies included the two-, ten-, and 50-year recurrence interval for 24-hour storm events. The rainfall depths were taken from the 2018 City of Gresham *Stormwater Management Manual*. The rainfall distribution for these design storms was based on a Soil Conservation Service (SCS) Type IA, 24-hour distribution, which is applicable to rainfall in western Oregon, Washington, and northwestern California.

Table 3-6 lists the design storm rainfall depths used for hydrologic modeling. The water quality, 25- and 100-year events were not used for identifying capacity deficiencies but are provided for reference. Actual rainfall records were also used for purposes of model calibration as described in Section 3.4.

Table 3-6. Design Storm Depths

Design Storm Event	Rainfall Depth (inches)
Water Quality	1.2
2-year, 24-hour	2.8
10-year, 24-hour	3.6
25-year, 24-hour	4.0
50-year, 24-hour	4.4
100-year, 24-hour	4.9

3.3 Hydraulic Model Development

To evaluate capacity limitations of stormwater infrastructure, the models were developed with the latest hydraulic information to simulate the performance of select pipe and open-channel systems for the selected design storms. This section includes a summary of the hydraulic data assessment, required hydraulic model input parameters, and modeled systems.

3.3.1 Data Assessment

The City's GIS stormwater infrastructure data as of December 2017 was the primary source of data for the development or update of hydraulic models. Once relevant GIS data were integrated into the models, data gaps were identified. Data gaps included missing inverts or conduit sizes within the selected model extents or where the infrastructure data from a previous model contradicted the City's current GIS information. The following methods were used to initially address data gaps:

- When information was missing for a location, that location was reviewed in the previous master plan to see if information was provided/available there.
- Select data gaps in the GIS database for the development of the new/updated models were reviewed with the City to obtain additional understanding of the system. These reviews occasionally resulted in the provision of as-builts that could be used for model updates.
- Modeled pipe invert elevations were interpolated for pipes located between other pipes with known inverts.
- LiDAR information was reviewed for missing rim/ground elevations.

Data gaps not resolved using methods defined above were addressed through field survey. The number of data gaps requiring survey by basin are summarized in Table 3-7.

Table 3-7. Survey Needs Summary

Basin	Structures	Cross-sections
Kelly Creek/Burlingame Creek	24	4
West Gresham	4	0
Johnson Creek	58	1
Total	86	5

The following categories of data gaps were identified:

- Missing rim elevations
- Missing conduit diameters
- Missing invert elevations
- Pipe junction discontinuity (defined as the flow entrance to a node/manhole being lower in elevation than flow exiting a node/manhole by a foot or more)

A total of 86 structures required field survey. AKS Engineering & Forestry (a subcontractor on this project) performed the field survey in the fall of 2018. Survey results were delivered in the form of an ArcGIS geodatabase file and an Excel spreadsheet. Survey results were imported into XPSWMM to revise or resolve data gaps in hydraulic modeling.

3.3.2 Node Data

Model nodes include manholes, outfalls, and other junction points as defined in the City's GIS data or developed based on changes in conduit direction, slope, or cross-section configurations for open channels.

The upstream and downstream node names for each conduit were assigned based on the naming convention provided in the City's GIS data. The rim elevation at each node location was assigned based on the City's GIS data.

Upstream and downstream invert elevations were extracted from node and conduit data in the GIS database. If invert information was missing or conflicting between the node and conduit attribute data, the invert data was collected via one of the methods described in Section 3.3.1.

3.3.3 Conduit Data

Modeled conduits included pipes, culverts, and open channels. The length of each modeled conduit was originally provided in the City's GIS database. Conduits were sometimes extended or combined with other segments in the model for efficiencies. In these cases, revised conduit lengths were directly calculated using GIS. Conduit slopes were calculated in XPSWMM using the upstream and downstream node invert elevations and refined segment lengths.

Pipe diameters were obtained from the City's GIS or collected during field survey. For pipes where pipe diameters were not provided in GIS or could not be field verified during the survey work, the diameter was assumed to be the same size as the pipe segment immediately upstream. This assumption provides a conservative estimate of hydraulic system capacity. Pipes were assumed to be circular in shape.

Most open-channel cross-sections were obtained by field survey. Open-channel segments not surveyed or used for flow routing purposes were assumed to be trapezoidal in shape with dimensions approximated based on measurements obtained during field visits or via aerial imagery.

Manning's roughness coefficient "n" is dependent on the surface material of pipes and open channels. If models were obtained from previous master plans, roughness coefficients in the models were maintained. For newly developed models a roughness coefficient of 0.014 was assigned to all pipes. A roughness coefficient range of 0.027 to 0.045 was assigned to open-channel conduits based on field observations from aerial imagery. Open channels lined with shorter vegetation and dirt had lower roughness while open channels lined with large rocks and thick vegetation had values of Manning's "n" up to 0.045.

3.3.4 Modeled Hydraulic Systems

This subsection provides some brief background information on the history of each hydraulic model. Major updates or revisions made to the models for this SMP are also discussed.

3.3.4.1 Kelly Creek/Burlingame Creek

For the Kelly/Burlingame Creek basin, a hydraulic model was available from the recent Burlingame Creek flood study, completed in March 2018. Only minor changes were made to the existing hydraulic model extents to include additional areas where the City reported capacity problems. In addition, changes were made to ground surface elevations at the culvert crossing at Salquist Road based on erroneous elevations observed in the GIS data. A summary of the locations where the existing model extents were expanded is as follows:

- Upstream end of Kelly Creek to approximately SE 302nd Avenue
- Piped system along SE Quail Lane
- Open-channel section along SE Orient Drive
- Piped system along SE Salquist Road
- Piped system along SE Condor Avenue
- Piped system along SE 23rd Street
- Piped system within residential area, west of SE Hogan Drive
- Piped system along NE 8th Street

3.3.4.2 West Gresham

For West Gresham, the system selected for modeling was generally based on the modeling extents from the 2005 basin planning effort. In addition, in the West Gresham basin, the City was interested in evaluating the South Shore area, north of I-84.

Since the previous model was not available for the West Gresham basin, a new hydraulic model was created. City GIS data for piped infrastructure 24 inches in diameter and larger was used as the basis for creation of the hydraulic model. In addition to the City's GIS piped infrastructure, the hydraulic model was developed using the following additional data sources:

- As-built information provided by the City for the flow-splitter installed at NE 181st and Halsey Streets.
- MCDD's storm system model which was obtained at the request of the City and used to analyze system capacity in the South Shore development area north of the Columbia Slough.

3.3.4.3 Johnson Creek Including the SWPD

For the Johnson Creek basin, the model from the previous master plan was not available. Therefore, a new hydraulic model was developed based on GIS data. The previous Johnson Creek model extended beyond the City limits and focused on Johnson Creek itself as opposed to the contributing piped and open-channel collection systems. Portions of the City's collection system to Johnson Creek were selected for modeling based on the potential for upstream development and the identification of existing flooding problems requiring further examination. These systems are located north of Johnson Creek and reflect the more urbanized areas of the basin. In addition to the City's GIS data, the hydraulic model development included information from City-provided as-builts for pipes along Powell Boulevard.

For the SWPD, a separate hydraulic model was created with the goal of sizing trunk lines based on preliminary projections and calculating system development charges (SDCs). Future hydrology results from contributing Johnson Creek subbasins were used to estimate conceptual trunk line sizing. Locations of the future trunk lines were estimated based on conceptual roadway plans from the City's 2035 Transportation System Plan and discussions with the City's Development Engineering Department.

3.3.4.4 Kelley Creek including the PVPD

Within the Kelley Creek Basin and PVPD, limited pipe infrastructure exists, and an existing conditions hydraulic model was not created.

For the PVPD, a separate hydraulic model was created with the goal of sizing trunk lines based on preliminary projections and calculating SDCs (similar to SWPD). Future hydrology results from contributing Kelley Creek subbasins were used to estimate conceptual trunk line sizing. Locations of the future trunk lines were estimated based on conceptual roadway plans from the City's 2035 Transportation System Plan and discussions with the City's Development Engineering Department.

3.3.4.5 Fairview Creek

The hydraulic model files were provided by the City as a starting point for this basin. Updates to the hydraulic model for this basin incorporated infrastructure projects completed since the 2005 model update and major creek crossings based on received City GIS data and site visits. The model extents were terminated at the north side of Glisan Street, although drainage continues north from these outfalls through the City of Fairview. Details related to the updates are as follows:

- Incorporation of the Red Sunset Park Detention Project (CIP No. 910000 & 914100) as-built drawings (dated 2011). The drainage system conveying flow to the park was revised per the City's GIS data.
- Incorporation of the Sedimentation Manhole Project (2952-F-004.1), east of Fairview Creek crossing on Glisan Street. This manhole connected the storm pipe on Glisan Street to the existing culvert crossing at this location.
- Update of the Division Street Crossing to a 48-inch-diameter pipe per City GIS and site visit. Noted that most of the flow south of Division Street flows to Johnson Creek.
- Update of the Lora Culvert (Link 3151F1970), which crosses under a trail south of the railroad tracks to a four-feet high by five-feet width box culvert per City GIS.
- Update of the Stark Street Crossing to add a second culvert which drains the storm drain system on Stark Street per City GIS and City field verification. Noted that this culvert was installed lower than the Fairview Creek crossing and discharges to Fairview Creek on the northeast side of the Stark Street crossing.

3.3.4.6 Beaver Creek

A decision was made to evaluate only hydrology and not hydraulics for this basin. This was due to the small size of this basin and limited infrastructure or observed flooding problems.

3.4 Model Calibration

Significant assumptions and generalizations regarding the landscape (e.g., impervious areas, soils, slopes, flow paths, etc.) went into the development of H/H models established for master planning level purposes. As with all models, the accuracy of predictions may be significantly improved if field measurements can be used to calibrate the models. In addition, capital project sizing estimates can vary widely, based on model results which can lead to the under-sizing or oversizing of CIPs. To improve model outcomes and more accurately sized CIPs, the City elected to collect flow data for model calibration purposes. This section provides a summary of the selected flow monitoring sites, flow monitoring equipment, calibration adjustments, and calibration results.

3.4.1 Flow Monitoring Sites and Equipment

Five locations, reflecting different modeled basins in the City, were selected for flow monitoring to obtain calibration data for use in refining the models. Monitoring sites were selected to represent modeled basins and land use categories. Sites were also selected based on ease of access for equipment installation. An overall map of flow monitoring locations is provided in Figure 3-1. More detailed maps of each flow monitoring location, as well as aerial photos of each site are included in TM1, available separately from this SMP.

Continuous flow monitoring was conducted with sensors and data loggers to record flows at each site. Table 3-8 summarizes the sensor/logger configurations for each of the five monitoring stations.

Table 3-8. City Flow Monitoring Locations

Monitoring Station ID	Basin	Station Location/Description	Sensor	Logger
15th at K-mart	Fairview	Manhole station located on City property (1S3E04DD 1900), east of the terminus of NW 15th Street and southwest of K-Mart. A 54-inch diameter concrete pipe conveys flows westerly towards NW 15th Street at this location.	One Sub A/V sensor mounted with scissor band on the bottom of 54-inch-diameter pipe, just downstream of manhole.	Sensor cable connected to FL904 logger attached to ladder within manhole.
West Gresham Elementary	Johnson Creek (#1)	Manhole station located in the landscaping of the West Gresham Elementary School parking lot, adjacent to Powell Boulevard. A 42-inch-diameter pipe conveys flows in a southwesterly direction at this location.	One Sub A/V sensor mounted with scissor band on the bottom of 42-inch diameter pipe, just downstream of manhole inside fence.	Sensor cable connected to FL904 logger attached to ladder within manhole.
700 SW Eastman Parkway	Johnson Creek (#2)	Manhole station located in the parking lot of the Hollycrest South Apartments at 700 SW Eastman Parkway. A 36-inch-diameter pipe conveys flows southerly towards the Springwater Corridor Trail and Johnson Creek at this location.	One Sub A/V sensor mounted with scissor band on the bottom of 36-inch-diameter pipe, just downstream of manhole.	Sensor cable connected to FL904 logger attached to ladder within manhole.
805 NE Kane Drive	Kelly Creek	Manhole station located adjacent to the southwest corner of the Gresham Park Apartments at 805 NE Kane Drive. A 36-inch-diameter pipe conveys flows northwesterly towards Kelly Creek at this location.	One Sub A/V sensor mounted with scissor band on the bottom of 36-inch diameter pipe, just upstream of manhole.	Sensor cable connected to FL904 logger attached to ladder within manhole.
Sandy Boulevard	West Gresham	Manhole station located on the north side of NE Sandy Boulevard, near the east driveway entrance to the City's regional water quality facility. A 42-inch-diameter pipe conveys flows northward at this location.	One Sub A/V sensor mounted with scissor band on the bottom of 42-inch-diameter pipe, just downstream of manhole.	Sensor cable connected to FL904 logger attached to ladder within manhole.

Abbreviation: A/V = Area Velocity

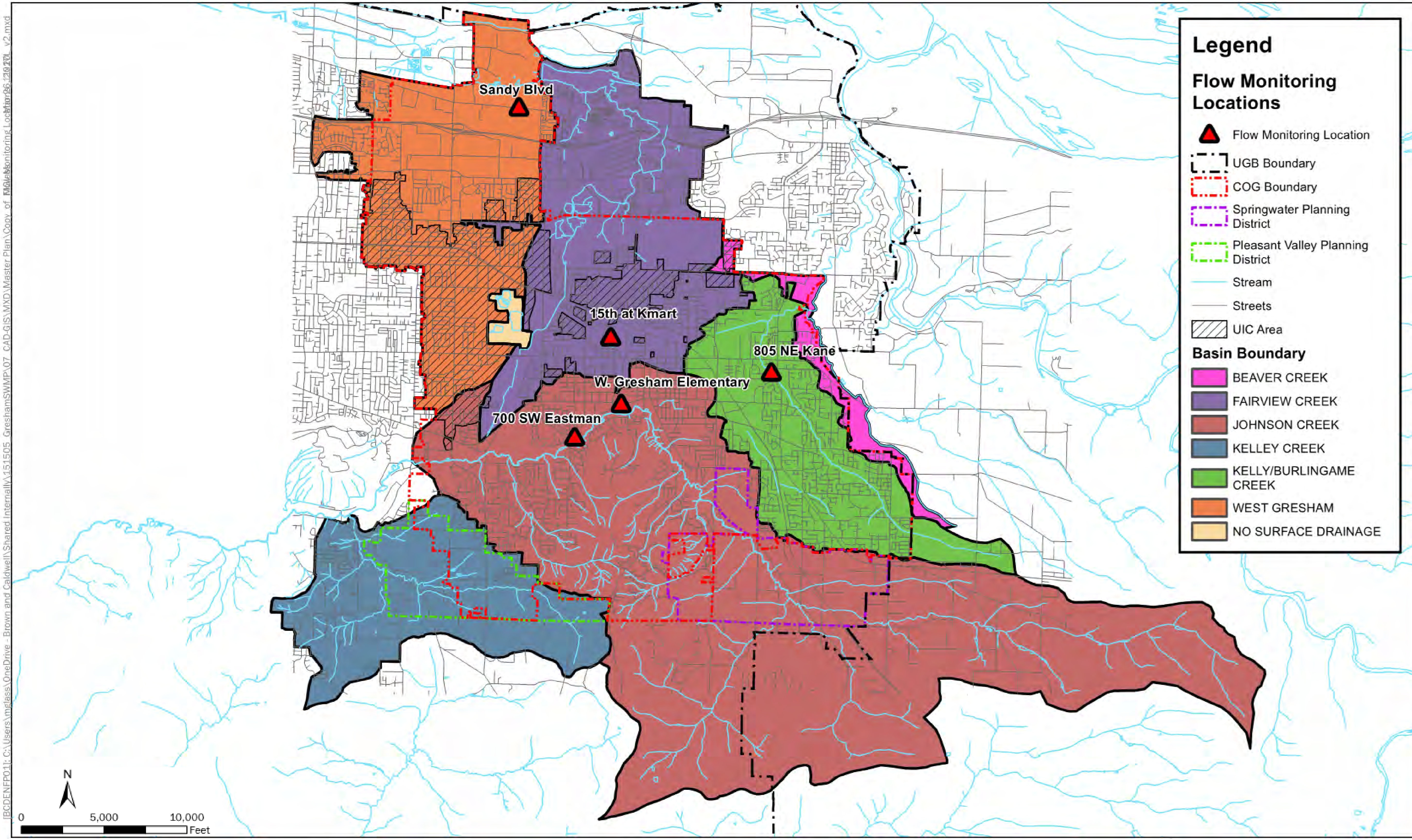

Figure 3-1. Flow Monitoring Location

3.4.2 Flow Monitoring Results Compared to Model Results

Flow data was recorded at the five locations from March 23, 2018, to July 2, 2018. Significant rainfall events occurred in the City during this period, with two events selected for use in calibration efforts due to the presence of peak flows throughout the storm hydrograph. These storm events are summarized in Table 3-9 below.

Table 3-9. Summary of Calibration Events Identified from Flow Monitoring Data

Storm Event Month	Rainfall (inches)	Event Start Time	Event End Time
April	3.27	4/4/2018 12:00	4/8/2018 23:00
June	1.15	6/8/2018 0:00	6/10/2018 12:00

Flow data at each monitoring location from these two events were graphed to compare with model results for the same events.

To run the models for these two events, local precipitation data were needed. Rainfall data were obtained from the City of Portland HYDRA Rainfall network. Specifically, rainfall data were obtained from the Gresham Fire Department Rain Gauge HYDRA site located at 1333 NW Eastman Parkway.

The XPSWMM model files were run to simulate flows using the collected rainfall from the HYDRA rain gauge for the two events listed in Table 3-9. The runoff hydrographs from the models were plotted against flow data from the respective flow meters at the calibration locations.

Initial XPSWMM modeled flow results for the two calibration storms fit the flow monitoring results at the different sites with varying degrees of accuracy. In some cases, the model results for an individual site varied between the two calibration storm events. Generally, the model results underpredicted flows for the Kelly Creek and Johnson Creek #1 (West Gresham Elementary) calibration sites. The model results more closely predicted flows for the Johnson Creek #2 (700 SW Eastman Parkway) site, and overpredicted flows for the Fairview site. The model results significantly overpredicted flows for the West Gresham site. Hydrographs of the initial model runs compared to monitored flows for each calibration site are provided in Attachment B of TM1, which is available separately from this SMP.

3.4.3 Model Calibration Adjustments and Results

Model calibration began with a closer examination of each flow meter's drainage area characteristics to help identify differences that could be contributing to the variation (i.e., overestimation vs. underestimation) in predicted model flow results in comparison with recorded flow monitoring data. As listed below in Table 3-10, key differences between the basins included soil types and impervious percentages based on land use. The West Gresham calibration site and associated flow meter drainage area varied significantly from characteristics of the other calibration sites. The West Gresham site represents the flow meter drainage basin area with the highest impervious percentage, most industrial type land uses, and greatest subbasin widths; the only calibration site with predominantly C-type soils.

Table 3-10. Flow Meter Locations					
	Kelly	Johnson #1	Johnson #2	Fairview	West Gresham
Flow Monitoring Drainage Area (acre)	55.98	172.49	45.64	584	231.02
Average Subbasin Width (feet)	413	492	330	367	684
Most Predominant Soil Type (percent)	C/D - 79%	B - 57%	B - 99%	B - 73%	C - 72%
Second Most Predominant Soil Type (percent)	D - 21%	C/D - 43%	C/D - 1%	C/D - 27%	C/D - 16%
Impervious Percentage	41.74	50.72	44.7	53.17	72.97
Most Predominant Land Use (percent)	LDR - 83%	LDR - 68%	LDR - 63%	LDR - 49%	IND - 63%
Second Most Predominant Land Use (percent)	COM - 11%	COM - 28%	MRES - 26%	COM - 28%	LDR - 13%

Prior to model calibration, a sensitivity analysis was conducted to identify which model calibration parameters would be most appropriate to modify for desired results. Calibration parameters that had the greatest impact to flows were selected for use in calibration and included the following:

- Impervious percentage
- Saturated hydraulic conductivity
- Initial moisture deficit
- Subbasin width

Model calibration was complicated due to the varying initial model results at the different calibration sites and/or opposing results between different events. The initial goal was to apply the same calibration adjustments City-wide. However, applying consistent adjustments City-wide would exacerbate over prediction and under prediction in flows from another site. Therefore, selection of calibration parameters focused on unique basin area characteristics to apply changes that would benefit one site without negatively impacting another. The resulting calibration adjustments and the rationale for the adjustment are as follows:

- The low-density residential (LDR) land use impervious percentage was increased from 35 to 50 percent.
  - For the Kelly Creek basin, where flows were underestimated by the model, aerial photos were reviewed for parcels (in the calibration site drainage area) classified as LDR to qualify the initial estimate of 35-percent impervious.
  - Aerial photos confirmed that the 35-percent impervious estimate was likely underestimating actual impervious coverage. A final impervious percentage of 50 percent was selected based on calibration attempts to best match measured flows.
  - This change resulted in increased flow for basins where the models were underpredicting flows (i.e., the Kelly Creek and Johnson Creek #1 calibration sites). This change had less impact on the Fairview and West Gresham calibration sites, which contained the least amount of LDR land use area. This was important as these two calibration sites were already overpredicting flows so calibration efforts were focused on avoiding further flow increases for these sites.
- The industrial (IND) land use impervious percentage was decreased from 80 to 65 percent.
  - Given the land use composition of the West Gresham calibration site, this change resulted in reduced modeled flows at the West Gresham calibration site without negatively affecting other calibration sites where industrial land use was non-existent or minor.

- The Green Ampt parameters were revised for the various soil types (See Table 3-11):
  - Saturated hydraulic conductivity (SHC) was reduced for all soil types to increase modeled flow and better reflect poor draining soils as observed throughout the study area.
  - Initial Moisture Deficit (IMD) was increased to reduce flows associated with Type B and C soils in comparison to C/D and D-type soils. This change resulted in a decrease in modeled flow for the Fairview Creek and West Gresham calibration sites, which primarily consist of B- and C-type soils without negatively impacting the other calibration sites. While this change also slightly increased flow at the Johnson Creek #2 calibration site, which was negatively impacted, the change was considered beneficial overall with respect to the goal of balancing the calibration for all five sites.

Table 3-11. Initial versus Calibrated Green Ampt Parameters

NRCS Hydrologic Soil Group	Initial SHC (inch/hour)	Calibration SHC (inch/hour)	Initial IMD	Calibration IMD
B	0.5	0.08	0.33	0.40
C	0.3	0.06	0.30	0.40
C/D	0.2	0.04	0.26	0.01
D	0.1	0.04	0.23	0.01

Even with the calibration adjustments, modeled flows at the West Gresham calibration site continued to be significantly higher than measured flows. Based on further sensitivity analyses, a decision was made that reasonable calibration adjustments could not be made to resolve this discrepancy. This significant overprediction in modeled flow was also documented in the previous West Gresham Master Plan (2005), which used the same flow meter location for calibration. As a result, rainfall data, specifically the presence of localized rainfall patterns, were identified as a potential source of the flow discrepancy.

Data from nearby HYDRA rain gauges was reviewed, and significant variability in precipitation was observed, especially for the June event. An investigation was conducted to inform whether precipitation data from an alternative HYDRA Rain Gauge (PDX Post Office HYDRA Rain Gauge at 7660 NE Airport Way) would result in better calibration than use of the selected HYDRA Rain Gauge (Gresham Fire Department HYDRA Rain Gauge at 1333 NW Eastman Parkway). Using rainfall from the alternative gauge. The model predicted flows that matched more closely with measured flows for this site. An assumption was made that micro-climates/varying rainfall patterns throughout the City were potentially causing the initially large overprediction in flows for this site. As a result, the NE Airport Way rainfall data was used as the basis for an additional calibration adjustment specific to the West Gresham basin:

- Subbasin widths were reduced for the West Gresham basin by 25 percent. As noted in Table 3-10, the average subbasin width from the West Gresham basin was the highest in comparison to the other modeled basins. This reduction reduced modeled flows from the West Gresham calibration site while maintaining better alignment with the average subbasin widths in other basins.

Model calibration adjustments and findings were reviewed with the City. After discussions with the City, the model calibration results were finalized, as summarized in Table 3-12.

Table 3-12. Model Calibration Adjustments						
Model Adjustments	Kelly Creek/ Burlingame Creek	West Gresham [a]	Johnson Creek including SWPD	Kelley Creek including PVPD	Fairview Creek	Beaver Creek
Increased LDR impervious percent from 35 to 50 percent	◆	◆	◆	◆	◆	◆
Decreased IND impervious percent from 80 to 65 percent	◆	◆	◆	◆	◆	◆
Lowered SHC for each Soil Type	◆	◆	◆	◆	◆	◆
Increased IMD for B and C soils	◆	◆	◆	◆	◆	◆
Decreased IMD for C/D and D soils	◆	◆	◆	◆	◆	◆
Reduced subbasin widths by 25 percent		◆				

[a.] *Calibration adjustments were made using the PDX Post Office HYDRA Rain Gauge at 7660 NE Airport Way for the West Gresham basin which differed from the other basins where calibrations were based on the Gresham Fire Department HYDRA Rain Gauge at 1333 NW Eastman Parkway.*

3.5 Model Results

Following model development and calibration as described in previous sections, hydrology and hydraulics were simulated for the two-, ten-, and 50-year, 24-hour design storms. Capacity deficiencies were identified for existing and future conditions when model simulated flows were estimated to be at or above the ground surface elevation. Surcharging was not considered to be a capacity deficiency in the context of this plan. Maps indicating capacity deficiencies and severity (by design storm) by location throughout the modeled basins are included in Appendix A.

Hydrologic model input data and results are provided in tables and organized by basin in Appendix B. Hydraulic model results are provided in tables and organized by basin (except for Beaver Creek) in Appendix C. Design storms where the models indicated capacity deficiencies within a conduit are identified in the hydraulic results tables. Capacity deficiencies were reviewed in detail and compared to field observation notes from City staff, the City's current capital improvement program, and previous master planning documentation.

To evaluate the identified capacity deficiencies, each problem area was initially classified as low-, medium-, or high-priority based on the following information:

- **Design Storm** - Problems were considered higher priority for more frequently occurring design events. In other words, problems identified for two-year storms were considered relatively higher in priority when compared to the ten- or 50-year events.
- **Field Observations** - If City staff confirmed that problems have been observed in the field at the identified location, it was considered higher priority than a problem not observed in the field.
- **Impact** - Problems were considered higher priority where the flooding extents included more than one pipe segment and the surrounding area was highly urbanized (i.e., impact would be high).
- **Previous Master Plans** - Problems were considered higher in priority if they were also identified as problems in previous master plans.
- **Level of flooding** - Problems were considered higher priority based on the relative level of flooding which was evaluated based on the height of the hydraulic grade-line compared to the ground surface.

Capacity deficiencies identified throughout the basin and their initial priority levels were reviewed by the City. An initial list of the highest priority sites is provided in Table 3-13 below. CIP projects were developed for select problem areas to address these capacity deficiencies as discussed in Section 6. A full list of all low- and medium-priority capacity deficiencies identified as part of this SMP has been included for reference in Appendix D.

Table 3-13. Initial Identification of High-Priority Sites Recommended for CIP Development

Modeled Basin	Opportunity Area ID	General Location	Node or Link ID	Flooding Scenario	Source of Capacity Deficiency Identification		
					Model	Field Observation	Previous Master Plan
Kelly/ Burlingame Creek	KC-2	Open channel between NE Cleveland Avenue and NE Burnside Road	Link - BGTND	2-year	◆	◆	◆
	KC-3	NE 2nd Street System	Link - 3357K003	10-year	◆	◆	
	KC-10	Country Club Estates and Gresham Golf Course	Nodes - • US: 3254-K076 • DS: Bridge 6.1	2-year	◆	◆	◆
	KC-12	Pipe segments on Division at Francis Avenues	Link - 3255K005	2-year	◆		◆
	KC-19	Powell Valley and Highway 26 intersection	Node - 3455-K-615	10-year	◆		◆
	KC-24	Near Salquist Road and Paloma Avenue; Pipes along Salquist Road, west of Condor Avenue	Node - M9901, M4165, M5080, M3494	2-year	◆		◆
West Gresham	WG-2	NE 183rd Avenue, west on Halsey Street and north on 192nd Avenue	Nodes – • M2849-W-90-21, 14, 24, 22, 25, 02, 26, 27, 28	2-year	◆	◆	
	WG-8	Portal Way	Links – • 6305 • 6370	10-year	◆	◆	
Johnson Creek	JC-1	1st and Ava Streets	Link – L3352-J-9759	2-year	◆	◆	◆
	JC-11	Outfall at 6th Street and Linden Avenue; and 5th and Elliot Avenue	Not included in the model.	Frequent response needed by Field Operations.		◆	◆
	JC-12	Catch basin at 9th Street and Hogan Road	Not included in the model.	System configuration unknown. The City has constant problems at this location.		◆	◆

Table 3-13. Initial Identification of High-Priority Sites Recommended for CIP Development							
Modeled Basin	Opportunity Area ID	General Location	Node or Link ID	Flooding Scenario	Source of Capacity Deficiency Identification		
					Model	Field Observation	Previous Master Plan
Fairview Creek	FC-1	Stark Street and Fairview Creek and surrounding piped system	Nodes – • US: 3151-F-607 • DS: 3051-F-602	N/A		◆	
	FC-2	Glisan Street in the vicinity of Fairview Creek	Nodes – • US: 2951-F-253 • DS: 2951-F-254	2-year	◆	◆	◆
	FC-3	• Red Sunset Park to NE Elliot • Liberty Avenue • NE Elliot Avenue to N Main Avenue • Burnside Road and NW Fairview Drive	Red Sunset Park to NE Elliot Avenue • 3154-F-057 to 3154-F-041 Liberty Avenue • 3154-F-002 to 3154-F-004 NE Elliot Avenue to N Main Avenue • 3154-F-041 to 3253-F-030 Burnside Road and NW Fairview Drive • 3253-F-033 to 3252-F-024	• 50-year (Red Sunset Park to NE Elliot Avenue) • 10-year (for all other locations)	◆	◆	◆

Section 4

Water Quality Assessment and Retrofit Identification

The water quality assessment for this SMP was conducted to identify opportunistic water quality projects for the City. Through discussions with the City the following criteria (in order of priority) were used to identify potential locations throughout the study area for water quality projects:

- The opportunity overlapped with the location of an identified capacity issue (noted in Section 3) and could assist in mitigating flow to help address the capacity deficient infrastructure.
- The opportunity located in an area without any existing treatment.
- The opportunity area could support installation of a larger scale regional treatment facility (based on property ownership and/or available vacant lands).

The following sections summarize the methods for identifying these potential and resulting water quality project opportunities. A detailed description of methods and results is included in a separate technical memorandum (TM2) as referenced on page 1-2.

4.1 Methodology

As part of the assessment, the following documents relating to water quality were reviewed:

- Water quality capital improvement projects proposed in previous master plans
- Stormwater Retrofit Strategy and Plan (2014)
- Gresham TMDL Benchmarks (2015)
- Stormwater Retrofit Master Plan (2017)
- Capital Improvement Plan (FY 2019-2023)

These documents provide a foundational knowledge base related to historic and ongoing water quality efforts undertaken by the City. The intention of this water quality assessment is to integrate previously identified regional concepts into the CIP list as well as identify new locations for larger-scale water quality capital improvement projects throughout the major basins. Smaller-scale projects including those on private property such as parking lots, are identified in the City's retrofit strategy.

4.1.1 Assessment Methods

The following assessment activities were conducted to identify water quality project opportunities for this SMP. Activities were conducted in two phases. Phase 1 (Steps 1–5, to follow) comprehensively identified preliminary water quality project opportunities and project concepts by basin. Phase 2 (Steps 6–8) included efforts to validate and refine the project concepts for the high-priority project opportunity areas anticipated for inclusion in SMP as capital improvement projects. High-priority project opportunity areas are those that are associated with capacity-related deficiencies as summarized in Table 3-13.

Referenced steps for the water quality assessment effort are as follows:

1. Review the FY 2019-2023 Capital Improvement Program for previously identified water quality-related project needs and opportunities.
2. Review locations of modeled capacity deficiencies and capacity-related project opportunity areas based on H/H modeling conducted for this SMP (see Section 3).
3. Overlay the previously identified water quality-related project opportunities per the FY 2019-2023 Capital Improvement Program (Step 1) with locations of modeled capacity deficiencies (Step 2) to identify water quality project concepts for capacity-related project opportunity areas. Resulting project concepts were intended to: 1) mitigate flow to help address the capacity deficiency (e.g., water quality treatment that incorporates infiltration, etc.), and/or 2) address treatment only in the vicinity of the capacity deficiency to achieve efficiencies in construction.
4. Identify additional water quality project concepts for the capacity-related project opportunity areas.
5. Identify additional, standalone water quality project opportunities, not affiliated with modeled capacity deficiencies. These additional, standalone project concepts were identified using GIS mapping for available properties (i.e., public property or currently undeveloped private property) or identified in the FY 2019-2023 Capital Improvement Program (for projects not affiliated with an existing capacity deficiency).
6. Confirm water quality project needs and project concepts with the City in a workshop setting.
7. Validate/refine water quality project concepts for those high-priority project opportunity areas, based on a desktop GIS analysis and City feedback following the workshop (Step 6).
8. Establish the need for additional modeling to support water quality project development for both standalone (water quality only) or integrated (capacity and water quality) capital projects.

4.1.2 Preliminary Project Identification (Phase I)

Specific to Phase I efforts (Steps 1–5), GIS maps of each basin were created to show modeled capacity deficiencies per H/H modeling (see Attachment C of TM1, available separately) and locations of water quality-related project needs per the City's FY 2019-2023 Capital Improvement Program. The GIS maps also included subbasins, parks and natural areas, undeveloped/vacant property, public property, and existing stormwater infrastructure to help inform development of project concepts.

Water quality project concepts were developed by basin. Water quality project concepts that directly overlapped with a modeled capacity deficiency were numbered in accordance with the associated (capacity-based) project opportunity area ID, such that the water quality project concept could be incorporated into the overall capital project development for the area. For some project opportunity areas, multiple water quality project concepts were developed and identified as "Option 1," "Option 2," etc. Water quality project concepts that did not overlap with a capacity-based project opportunity area were identified with a unique opportunity area ID and numbered accordingly.

A summary table reflecting results of the preliminary project identification effort is provided in Table 4-1. Maps reflecting Phase I efforts are contained in Attachment B by basin within TM2 (provided separately).

Table 4-1. Preliminary Water Quality Project Concepts

Project Opportunity Area ID	Location Description	Flow Reduction Driver [a] (Y/N)	Vacant/ Public Property (Y/N)	Preliminary Project Concept		
				Description	Flow Mitigation (Y/N)	Treatment (Y/N)
West Gresham						
WG-1	Glisan Street and 181st Avenue	Y	Y	Expansion of UIC Drainage Area. Expand existing UIC drainage area south of Glisan to minimize flow downstream to WG-1.	Y	Y
WG-2	Parcel north of Hartley Elementary School	Y	Y	Regional Water Quality Facility. Utilize existing public property west of 188th Avenue for a regional facility to mitigate flow to WG-2.	Y	Y
WG-3	North of Halsey Street and west of 195th Avenue	Y	Y	Option 1: Regional Water Quality Facility. Utilize existing vacant area north of Barr Avenue to construct a regional facility (diverting flow from 195th Avenue).	Y	Y
	Neighborhoods south of Barr Avenue			Option 2: Expansion of UIC Drainage Area. Expand existing UIC drainage area south of Barr Avenue to mitigate flow downstream.	Y	Y
WG-4	North of Sandy Boulevard and 170th Avenue Intersection	Y	Y	Option 1: Regional Water Quality Facility. Utilize available vacant property to install a regional facility and outfall improvement. See FY 2019-2023 CIP #911900 (Ex. Project WGWQ-1A).	Y	Y
	North of Sandy Boulevard and 172nd Avenue Intersection			Option 2: Regional Water Quality Facility. Use available public property and vacant property along Sandy Boulevard for an offline regional facility.	Y	Y
WG-10	178th Avenue and Halsey Street	N	Y	Option 1: Regional Water Quality Facility. Install regional facility at 178th Avenue and Halsey Street (Ex Project WGWQ-2A).	Y	Y
	South of Halsey Steet and east of 162nd Avenue			Option 2: Regional Water Quality Facility. Install regional facility in existing vacant property south of Halsey Street and east of 162nd Avenue to mitigate flow downstream.	Y	Y
WG-11	North of I-84 and east of 162nd Avenue	N	Y	Regional Water Quality Facility. Utilize available vacant property to install a regional facility and outfall improvement. See FY 2019-2023 CIP #911800 (Ex Project WGWQ-1B).	Y	Y
Fairview Creek						
FC-1	Fairview Creek at Stark Street crossing and connected pipe system in this area.	N	N	Stand-alone Treatment Facility Installation. Divert flow downstream of the Stark Street culvert via meandering swale. See existing project description per FY 2019-2023 CIP #911000 and #911100 (Ex. Project WQ-04 and WQ-05).	N	Y

Table 4-1. Preliminary Water Quality Project Concepts						
Project Opportunity Area ID	Location Description	Flow Reduction Driver [a] (Y/N)	Vacant/ Public Property (Y/N)	Preliminary Project Concept		
				Description	Flow Mitigation (Y/N)	Treatment (Y/N)
FC-2	Glisan Street near Fairview Creek	Y	Y	Option 1: Stand-alone Treatment Facility Installation. Divert flow along Glisan Street via meandering swale. Project not in current FY 2019-2023 CIP (see Ex. Project WQ-03 - Glisan Street Swale per Fairview Creek MP).	N	Y
				Option 2: Expansion of UIC Drainage Area. UIC expansion with pretreatment to mitigate flow on Glisan Street (202nd Avenue to Hartley Elementary School).	Y	Y
				Option 3: Regional Water Quality Facility. Utilize existing open area just east of Fairview Parkway, if possible, for regional water quality facility (retention or infiltration). Divert flow from Glisan Street and/or 223rd Avenue.	Y	Y
FC-3	Red Sunset Park to NE Elliot Avenue	Y	Y [b]	Option 1: Expansion of UIC Drainage Area. Expand UIC drainage area in residential area east of Cleveland Avenue (near Sunset Park) to minimize flow to the system at Red Sunset Park.	Y	Y
	Liberty Avenue			Option 2: Stand-alone Treatment Facility Installation. Convert grass strips in right-of-way (ROW) and median to stormwater planter strips to treat runoff and provide overflow from Liberty Avenue. Green Street applications can be expanded per Watershed CIP: NE Cleveland 18th to 22nd.	Possible	Y
	NE Elliot Avenue to N Main Avenue			Option 3: Expansion of UIC Drainage Area. Expand UIC drainage area on public property (Aspen Highland Park) or at adjacent school to minimize flow to the system at Red Sunset Park.	Y	Y
	Burnside Road and NW Fairview Drive			Option 4: Porous Pavement Installation. Integrate porous pavement on city hall property in conjunction with repaving needs.	Possible	Y
				Option 5: Regional Water Quality Facility. Daylight existing pipe with redevelopment and retain flow in vacant property at Civic Drive and 16th Street.	Y	Y
FC-4	NW Division Street and NW Wallula Avenue to open space just north of NW 13th Street	Y	Y	Expansion of UIC Drainage Area. Expand UIC drainage area, using existing vacant lands to minimize flow to the system at Towle Avenue.	Y	Y
FC-8	Glisan Street east of 223rd Avenue	Y	Y	Refer to FC-2 (Option 3) as a potential project to address this location.	Y	Y

Table 4-1. Preliminary Water Quality Project Concepts						
Project Opportunity Area ID	Location Description	Flow Reduction Driver [a] (Y/N)	Vacant/ Public Property (Y/N)	Preliminary Project Concept		
				Description	Flow Mitigation (Y/N)	Treatment (Y/N)
Johnson Creek						
JC-2	Powell Boulevard between Orchard Place and Birdsdale Avenue	Y	Y	Option1: Regional Water Quality Facility. Utilize available vacant property north of deficient pipe to install regional facility to detain/treat flow.	Y	Y
				Option 2: Neighborhood-Scale Green Street Installations. Install green infrastructure in ROW, in conjunction with pipe upsizing to help mitigate localized flooding.	Possible	Y
JC-6	Powell Boulevard between Hood Avenue and Roberts Avenue	Y	Y	Porous Pavement Installation. Use City-owned parking lot on the north side of Powell Boulevard to install a facility to mitigate flow instead of increasing the pipe size.	Y	Y
JC-9	Culvert at Hogan Road (Cedar Creek Place)	N	Y	Regional Water Quality Facility. Use available vacant property north of the stream channel to install a regional facility to detain/treat flow from public property in the north and developing property to the east.	Y	Y
JC-10	Culvert at Hogan Road (Brick Creek)	N	Y	Regional Water Quality Facility. Use available vacant property south of stream channel to install regional facility to detain/treat flow from potential developing property to east. (Note: this project could require mitigation depending on whether it is located in a high value resource area as defined by the City's Natural Resource Overlay.)	Y	Y
JC-11	Outfall at 6th Street and Linden (585 NE Linden Avenue) 5th Street and Elliot Avenue (615 NE 5th Street)	N	Y	**Neighborhood-Scale Green Street Installations.** Incorporate Green Street (rain garden or street swales) with installation of diversion pipe per FY 2019-2023 CIP #900300. Vacant property adjacent to roadway is available.	Possible	Y
JC-12	Catch Basin at 9th Street and Hogan Road (800 SE Hogan Road)	N	N	Ditch-to-Swale Conversion. Incorporate ditch to swale conversion to incorporate water quality and address a maintenance issue. See existing project description in FY 2019-2023 CIP #913500.	N	Y
JC-13	Catch basin at end of SE 22nd Court (cul-de-sac) (1201 SE 22nd Court)	N	N	Porous Pavement Installation. Incorporate porous pavement into the residential neighborhood and relocate catch basins, as needed.	Possible	Y
JC-14	East Gresham Grade School	N	N	Porous Pavement Installation. Incorporate parking lot swales and pervious pavement in conjunction with pavement restoration activities. See existing project description in FY 2019-2023 CIP #913300.	Possible	Y
JC-15	5th Drive and Duniway Avenue	N	Y	Expansion of UIC Drainage Area. Expand UICs in the public ROW within residential	Y	Y

Table 4-1. Preliminary Water Quality Project Concepts						
Project Opportunity Area ID	Location Description	Flow Reduction Driver [a] (Y/N)	Vacant/ Public Property (Y/N)	Preliminary Project Concept		
				Description	Flow Mitigation (Y/N)	Treatment (Y/N)
				neighborhood (north of SW 5th Drive between 182nd Avenue and Hartley Avenue).		
Kelly Creek						
KC-2	Open channel between NE Cleveland Avenue and NE Burnside Road	Y	Y	Stand-alone Treatment Facility Installation. Use adjacent vacant property to create an offline treatment swale in conjunction with capacity improvements.	N	Y
KC-3	NE 2nd Street System	Y	Y	Neighborhood-Scale Green Street Installation. Incorporate neighborhood scale green infrastructure in the ROW to treat contributing area and potentially mitigate flow to address capacity deficiency.	Possible	Y
KC-4	SE Quail Drive near SE 29th Way and SE 30th Way	Y	Y	Stand-alone Treatment Facility Installation. Utilize vacant property north of 30th Way, between SE Osprey Loop and SE Pheasant Avenue, for an offline water quality facility to treat and potentially mitigate flow to address capacity deficiency.	Y	Y
KC-10	Country Club Estates and Gresham Golf Course	Y	Varies based on option	Option 1: Stand-alone Treatment Facility Installation. Construct pollution reduction facility at Vista Way and Hogan Drive. See unfunded CIP 918200.	N	Y
				Option 2: Neighborhood-Scale Green Street Installation. Coordinate with Kelly Creek Natural Resources Plan related projects within the golf course. (Ex. Project KC-3)	N	Y
				Option 3: Stand-alone Treatment Facility Installation. Construct offline pollution reduction facility. See FY 2019-2023 CIP #917300. (Ex. Project KC-2)	N	Y
KC-13	Piping along SE 29th Street	Y	N	Ditch-to-Swale Conversion. Incorporate ditch to swale conversions along SE Hillyard Road. Also assists KC-21.	N	Y
KC-20	SE Powell Valley Road and SE Kane Drive	Y	N	Neighborhood-Scale Green Street Installation. Incorporate pervious pavement, green infrastructure, and low impact development into Gordon Russell Middle School property to provide water quality treatment and mitigate flow.	Y	Y
KC-24	Near SE Salquist Road and SE Paloma Drive	Y	Y	Neighborhood-Scale Green Street Installation. Incorporate neighborhood scale green infrastructure into surrounding area.	Possible	Y
KC-26	Pipes along SE Kane Avenue	Y	Y	Regional Water Quality Facility. Divert flow from 27th Street to new retention facility in existing vacant property between 27th Street and 26th Street.	Y	Y
KC-28	Ecology Embankment along Highway 26	N	N	Stand-alone Treatment Facility Installation. Install ecology embankment in accordance	N	Y

Table 4-1. Preliminary Water Quality Project Concepts						
Project Opportunity Area ID	Location Description	Flow Reduction Driver [a] (Y/N)	Vacant/ Public Property (Y/N)	Preliminary Project Concept		
				Description	Flow Mitigation (Y/N)	Treatment (Y/N)
				with FY 2019-2023 CIP #918100 (Ex. Project KC-1).		
KC-29	SE 23rd Street and SE Hale Drive	N	N	Option 1: Stand-alone Treatment Facility Installation. Construct offline pollution reduction facility. See FY 2019-2023 CIP #918300.	N	Y
			Y	Option 2: Neighborhood-Scale Green Street Installation. Construct neighborhood scale green infrastructure (Ex. Project KC-4).	Possible	Y
KC-30	SE 23rd Street and SE Hale Drive	N	Y	Regional Water Quality Facility. Utilize vacant property for a regional retention facility to manage upstream contributing area to Kelly Creek.	Y	Y

a. *A flow reduction driver exists if the Project Opportunity Area was identified due to a modeled capacity deficiency, such that a water quality facility may mitigate flow and address/aid in addressing the capacity deficiency. Project Opportunity Areas stemming from maintenance or water quality-only needs are not considered to have a flow reduction driver.*

b. *Vacant/undeveloped or public property is located across the Project Opportunity Area but may not be specific to where each project concept is proposed.*

4.1.3 Desktop Analysis and Project Refinement (Phase II)

Results of the preliminary water quality project identification effort (Phase I) were presented to the City during a Model Results and CIP Development Workshop (held on June 17, 2019). Following the workshop, City staff validated the high-priority project opportunity areas. These projects were carried forward for further refinement. High-priority project opportunity areas were associated with modeled and observed capacity deficiencies. As such, any standalone water quality project opportunity area and project concept was not considered high-priority and was not carried forward for further refinement under Phase II.

To supplement the GIS mapping developed under Phase I, a desktop GIS analysis was conducted during Phase II to take a more detailed look at site conditions that could inform refinement and prioritization of the water quality project concepts for the high-priority project opportunity areas. The desktop evaluation specifically assessed the following site conditions:

- **Existing Land Use**. Higher pollutant load generation is typically associated with land use categories that have high impervious percentages and support higher vehicle traffic volumes (i.e., commercial, mixed-use residential, industrial land uses versus single-family residential or open space/parks land uses).
- **Existing Water Quality Facilities**. Existing water quality facility locations and drainage areas were used to identify whether treatment was already being provided for portions of the drainage area.
- **Hydrologic Soil Group (HSG)**. Highly infiltrating soils support use of infiltration-based water quality facilities (e.g., UICs, infiltration rain gardens, etc.). Infiltration-based facilities may be used to help mitigate stormwater runoff volumes and address capacity deficiencies downstream, in addition to addressing water quality.

A summary table reflecting results of the desktop analysis effort is provided in Table 4-2.

Table 4-2. Proposed Water Quality Project Concepts										
Project Opportunity Area ID	Location Description	Initial Priority [a]	GIS Desktop Evaluation			Water Quality Project Development				
			Dominant Land Use	Existing Treatment? (Y/N)	Primary Hydraulic Soil Group	Project Concept [e]	Flow Reduction Capability? (Y/N)	Modeling? (Y/N)	Standalone or Integrated Design? [b]	Proposed Project ID
JC-11	• Outfall at NE 6th Street and NE Linden Avenue (585 NE Linden Avenue) • NE 5th Street and NE Elliot Avenue (615 NE 5th Street)	H	IND	N	C/D	Neighborhood-Scale Green Street Installation. Install green infrastructure in the public ROW along Linden Ave. in conjunction with new piping.	N	N	Standalone	JC-11-WQ
FC-1	Fairview Creek at Stark Street crossing and connected pipe system in this area	H	LDR	Y	B	Stand-alone Treatment Facility Installation. Install a water quality swale along north side of Stark Street. Coordination with Microchip Technology Inc. (property owner) will be required to obtain easement.	N	N	Standalone	FC-1-WQ
FC-2	NE Glisan Street near Gresham Fairview Trail	H	IND	N	B	Expansion of UIC Drainage Area. UIC expansion along NE Glisan Street from NE 202nd Avenue to Hartley Elementary School, combined with pretreatment via swales.	Y	Y	Integrated	FC-2-WQ-C
FC-3	Red Sunset Park to NE Elliot Avenue	H	LDR	Y	B	Expansion of UIC Drainage Area. UIC expansion in the residential neighborhood east of NE Cleveland Avenue (near Red Sunset Park).	Y	Y	Integrated	FC-3a-WQ-C
	NE Liberty Avenue		LDR	Y	B	Neighborhood-Scale Green Street Installation. Install green infrastructure in the public ROW and median of Liberty Avenue. Green Street applications maybe expanded per Watershed CIP: NE Cleveland 18th to 22nd.	Y	N [c]	Standalone	FC-3e- WQ
	NE Elliot Avenue to N Main Avenue		OS/SCHOOL	Y	C/D	Expansion of UIC Drainage Area. UIC expansion on public property (Aspen Highlands Park).	Y	Y	Integrated	FC-3c-WQ-C

Table 4-2. Proposed Water Quality Project Concepts

Project Opportunity Area ID	Location Description	Initial Priority [a]	GIS Desktop Evaluation			Water Quality Project Development				
			Dominant Land Use	Existing Treatment? (Y/N)	Primary Hydraulic Soil Group	Project Concept [e]	Flow Reduction Capability? (Y/N)	Modeling? (Y/N)	Standalone or Integrated Design? [b]	Proposed Project ID
KC-2	Open channel between NE Cleveland Avenue and NE Burnside Road	H	COM	N	C/D	Piping of the existing open channel section of Burlingame Creek to address the capacity deficiency is likely to address water quality impacts from illegal dumping and debris accumulation.	N	N [d]	Integrated	KC-2-C
KC-10	Country Club Estates and Gresham Golf Course (NE Vista Way and NE Hogan Drive)	H	LDR	N	B	Neighborhood-Scale Green Street Installation. Install neighborhood scale green infrastructure in the public ROW, west of NE Hogan Drive and north of NE 16th Way.	Y	N [c]	Standalone	KC-10-WQ
KC-24	• Near SE Salquist Road and SE Paloma Drive • Pipes along SE Salquist Road, West of SE Condor Avenue	H	LDR	N	D	Neighborhood-Scale Green Street Installation. Install green infrastructure in the public ROW, in conjunction with pipe replacement along SE Salquist Road.	N	N	Standalone	KC-24-WQ
WG-2	Parcel north of Hartley Elementary School	H	SCHOOL	Y	B	Regional Water Quality Facility. Construct a regional treatment/detention facility on the public property (Kirk Park), north of Hartley Elementary School.	Y	Y	Integrated	WG-2-C-WQ
JC-2	W Powell Boulevard between NW Orchard Place and NW Birdsdale Avenue	M	OS/IND	N	B	Option1: Regional Water Quality Facility. Utilize available vacant property north of deficient pipe to install regional facility to detain/treat flow. Option 2: Neighborhood-Scale Green Street Installations. Install Green Street in ROW, in conjunction with pipe upsizing to help mitigate localized flooding.	----	----	----	----

Table 4-2. Proposed Water Quality Project Concepts											
Project Opportunity Area ID	Location Description	Initial Priority [a]	GIS Desktop Evaluation			Water Quality Project Development					
			Dominant Land Use	Existing Treatment? (Y/N)	Primary Hydraulic Soil Group	Project Concept [e]	Flow Reduction Capability? (Y/N)	Modeling? (Y/N)	Standalone or Integrated Design? [b]	Proposed Project ID
JC-6	Powell Boulevard between SE Hood Avenue and SE Roberts Avenue	M	COM	N	C/D	Porous Pavement Installation. Use City-owned parking lot on the north side of Powell Boulevard to install a facility to mitigate flow instead of increasing the pipe size.	----	----	----	----
JC-9	Culvert at SE Hogan Road (Cedar Creek)	L	LDR	N	D	Regional Water Quality Facility. Use available vacant property north of the stream channel to install a regional facility to detain/treat flow from public property in the north and developing property to the east.	----	----	----	----
JC-10	Culvert at SE Hogan (Brick Creek)	L	Mixed (LDR, MFR, IND, SCHOOL)	N	D	Regional Water Quality Facility. Use available vacant property south of stream channel to install regional facility to detain/treat flow from potential developing property to east.	----	----	----	----
JC-12	Catch basin at SE 9th Street and SE Hogan Road (800 SE Hogan Road)	M	COM	N	D	Ditch-to-Swale Conversion. Incorporate ditch-to-swale conversion to incorporate water quality and address a maintenance issue. See existing project description in FY 2019-2023 CIP #913500 (Ex. Project JC-NR04).	----	----	----	----
JC-13	Catch basin at end of SE 22nd Court (cul-de-sac) (1201 SE 22nd Court)	M	LDR	N	D	Porous Pavement Installation. Incorporate porous pavement into the residential neighborhood and relocate catch basins, as needed.	----	----	----	----

Table 4-2. Proposed Water Quality Project Concepts											
Project Opportunity Area ID	Location Description	Initial Priority [a]	GIS Desktop Evaluation			Water Quality Project Development					
			Dominant Land Use	Existing Treatment? (Y/N)	Primary Hydraulic Soil Group	Project Concept [e]	Flow Reduction Capability? (Y/N)	Modeling? (Y/N)	Standalone or Integrated Design? [b]	Proposed Project ID
JC-14	East Gresham Grade School	M	SCHOOL	N	D	Porous Pavement Installation. Incorporate parking lot swales and pervious pavement in conjunction with pavement restoration activities. See existing project description in FY 2019-2023 CIP #913300 (Ex Project JC-NR02).	----	----	----	----
JC-15	SW 5th Drive and SW Duniway Avenue	M	LDR	N	B	Expansion of UIC Drainage Area. Expand UICs in the public ROW within residential neighborhood (north of SW 5th Drive between SE 182nd Avenue and SW Hartley Avenue).	----	----	----	----
FC-4	NW Division Street and NW Wallula Avenue to open space just north of NW 13th Street	L	LDR	Y	B	Expansion of UIC Drainage Area. Expand UIC drainage area, using existing vacant lands to minimize flow to the system at NW Towle Avenue.	----	----	----	----
FC-8	NE Glisan Street east of NE 223rd Avenue	L	IND	N	C/D	Refer to FC-2 (Option 3) as a potential project to address this location.	----	----	----	----
KC-3	NE 2nd System	M	LDR	N	C/D	Neighborhood-Scale Green Street Installation. Incorporate neighborhood scale green infrastructure in the ROW to treat contributing area and potentially mitigate flow to address capacity deficiency.	----	----	----	----
KC-4	SE Quail Drive near SE 29th Way and SE 30th Way	L	LDR	Y	D	Stand-alone Treatment Facility Installation. Utilize vacant property north of 30th Way, between SE Osprey Avenue and SE Pheasant Avenue, for an offline water quality facility to treat and potentially mitigate flow to address capacity deficiency.	----	----	----	----

Table 4-2. Proposed Water Quality Project Concepts											
Project Opportunity Area ID	Location Description	Initial Priority[a]	GIS Desktop Evaluation			Water Quality Project Development					
			Dominant Land Use	Existing Treatment? (Y/N)	Primary Hydraulic Soil Group	Project Concept[e]	Flow Reduction Capability? (Y/N)	Modeling? (Y/N)	Standalone or Integrated Design?[b]	Proposed Project ID
KC-13	Piping along SE 29th Street	L	LDR	N	D	Ditch-to-Swale Conversion. Incorporate ditch-to-swale conversions along SE Hillyard Street. Also assists KC-21.	----	----	----	----
KC-20	SE Powell Valley Road and SE Kane Drive	M	SCHOOL	N	D	Neighborhood-Scale Green Street Installation. Incorporate pervious pavement, green infrastructure, and low-impact development into Gordon Russell Middle School property to provide water quality treatment and mitigate flow.	----	----	----	----
KC-26	Pipes along SE Kane Avenue	M	LDR	N	D	Regional Water Quality Facility. Divert flow from SE 27th Street to new retention facility in existing vacant property between SE 27th Street and SE 26th Street.	----	----	----	----
KC-28	Ecology Embankment along Highway 26	M	LDR	N	D	Stand-alone Treatment Facility Installation. Install ecology embankment in accordance with FY 2019-2023 CIP #918100 (Ex. Project KC-1).	----	----	----	----
KC-29	SE 23rd Street and SE Hale Drive	M	LDR	N	B	Option 1: Stand-alone Treatment Facility Installation. Construct offline pollution reduction facility. See FY 2019-2023 CIP #918300. Option 2: Neighborhood-Scale Green Street Installation. Construct neighborhood-scale green infrastructure (Ex. Project KC-4).	----	----	----	----
KC-30	Parcel NE of NE Kane Drive and NE Division Street Intersection	M	LDR	N	C/D	Regional Water Quality Facility. Utilize vacant property for a regional retention facility to manage upstream contributing area to Kelly Creek.	----	----	----	----

Table 4-2. Proposed Water Quality Project Concepts											
Project Opportunity Area ID	Location Description	Initial Priority [a]	GIS Desktop Evaluation			Water Quality Project Development					
			Dominant Land Use	Existing Treatment? (Y/N)	Primary Hydraulic Soil Group	Project Concept [e]	Flow Reduction Capability? (Y/N)	Modeling? (Y/N)	Standalone or Integrated Design? [b]	Proposed Project ID
WG-1	NE Glisan Street and NE 181st Avenue	L	COM	N	B	Expansion of UIC Drainage Area. Expand existing UIC drainage area south of NE Glisan Street to minimize flow downstream to WG-1.	----	----	----	----
WG-3	North of NE Halsey Street and west of NE 195th Avenue	M	LDR	Y	C	Option 1: Regional Water Quality Facility. Utilize existing vacant area north of NE Barr Road to construct a regional facility (diverting flow from NE 195th Avenue).	----	----	----	----
	Neighborhoods south of NE Barr Road	M	LDR	Y	B	Option 2: Expansion of UIC Drainage Area. Expand existing UIC drainage area south of NE Barr Road to mitigate flow downstream.	----	----	----	----
WG-4	North of NE Sandy Boulevard and NE 170th Place Intersection	M	IND/COM	N	C	Option 1: Regional Water Quality Facility. Utilize available vacant property to install a regional facility and outfall improvement. See FY 2019-2023 CIP #911900 (Ex. Project WGWQ-1A).	----	----	----	----
	North of Sandy Boulevard and NE 172nd Place Intersection	M	IND/COM	N	C	Option 2: Regional Water Quality Facility. Use available public and vacant properties along Sandy Boulevard for an offline regional facility.	----	----	----	----
WG-10	NE 178th Avenue and NE Halsey Street	M	IND/COM	N	B	Option 1: Regional Water Quality Facility. Install regional facility between NE 178th Avenue and NE Halsey Street (Ex Project WGWQ-2A).	----	----	----	----
	South of NE Halsey Street and east of NE 162nd Avenue	M	LDR	N	B	Option 2: Regional Water Quality Facility. Install regional facility in existing vacant property south of NE Halsey Street and east of NE 162nd Avenue to mitigate flow downstream.	----	----	----	----

Table 4-2. Proposed Water Quality Project Concepts										
Project Opportunity Area ID	Location Description	Initial Priority [a]	GIS Desktop Evaluation			Water Quality Project Development				
			Dominant Land Use	Existing Treatment? (Y/N)	Primary Hydraulic Soil Group	Project Concept [e]	Flow Reduction Capability? (Y/N)	Modeling? (Y/N)	Standalone or Integrated Design? [b]	Proposed Project ID
WG-11	North of I-84 and east of NE 162nd Avenue	M	LDR	N	C	Regional Water Quality Facility. Utilize available vacant property to install a regional facility and outfall improvement. See FY 2019-2023 CIP #911800 (Ex Project WGWQ-1B).	----	----	----	----

a. *Initial high-, medium-, and low-priority project needs were based on input from City staff. High-priority project opportunity areas were associated with modeled and observed capacity deficiencies and did not include standalone water quality project concepts as identified through this water quality assessment effort.*

b. *An integrated water quality project would require construction in conjunction with the capacity deficiency CIP, to mitigate flows.*

c. *Although the proposed water quality project is capable of flow reduction, it is assumed that this flow reduction will provide an insignificant percentage of total drainage. Hence, flow reduction was not accounted for in modeling of the CIP.*

d. *Modeling at this location was conducted to address a capacity deficiency but was not conducted to evaluate CIP sizing for water quality.*

e. *Refined project concepts are only described for high-priority project opportunity areas. Preliminary project descriptions per Appendix D are reflected for low- and medium-priority sites (shaded gray) and have not been refined based on results of the GIS desktop evaluation at this time.*

4.2 Results/Potential Projects

Preferred water quality project concepts were identified for select high-priority project opportunity areas as shown in Table 4-2. Results of the GIS desktop evaluation and the need to mitigate flow to help address an identified capacity deficiency were considered when selecting preferred water quality project concepts for a project opportunity area.

Space constraints and the elevation (grade) of existing stormwater infrastructure prevented water quality project concepts from being developed/refined for two high-priority project opportunity areas. These project opportunity areas (FC-3 and KC-2) were originally identified as part of the preliminary water quality project identification effort (Phase 1). For the other high-priority areas, the developed water quality project concepts included:

- Four neighborhood-scale Green Street low impact development (LID) installations (i.e., rain gardens, planters installed in the public right-of-way [ROW]).
- One stand-alone treatment facility installation (i.e., water quality swale).
- Three expanded UIC drainage areas (the addition of UICs adjacent to existing UIC drainage areas).
- One regional water quality facility (dry detention pond with swale bottom or wet pond) to address treatment and flow control.

Table 4-2 indicates whether the select project concept is anticipated to have flow reduction capabilities. Water quality projects located in areas of Type A or B soils and that incorporated use of LID, UICs, or regional detention were considered to have flow reduction capabilities impacting the ultimate CIP sizing. It should be noted that site-specific investigations during preliminary and final design will need to fully vet the preferred water quality project concept and flow reduction capabilities.

Finally, Table 4-2 indicates whether sizing and conceptual design of the water quality project, for incorporation into this SMP, required additional modeling or design integration with a capacity project serving the same project opportunity area. An integrated design approach was proposed when the size of the water quality project or the capacity project were reliant on each other. Although a water quality project concept may have flow reduction capabilities hence reducing the size of the CIP for capacity, for this water quality assessment effort, modeling and project integration was assumed only for: 1) upstream expansion of UIC drainage areas, or 2) installation of an upstream regional facility. This conservative assumption considered that removal of contributing drainage area (due to UIC installation) or stormwater detention of a large contributing drainage area would alter stormwater flow downstream and could reduce/alleviate the need for additional pipe upsizing and replacement to address the identified capacity deficiency. Alternatively, the flow reduction capabilities of green infrastructure/rain gardens were assumed to be more uncertain, as they are directly related to site-specific infiltration characteristics of soils. Additionally, these facilities generally serve relatively small drainage areas when considering the total contributing stormwater flow to an identified capacity deficiency. However, this is a conservative assumption as these facilities are known to provide flow reduction benefits.

Project concepts developed and documented in Table 4-2 were further refined with the City to produce a finalized list for CIP development and prioritization. This finalized list consisted of seven separate water quality projects, all associated with a capacity CIP. These projects are discussed in detail in Section 6 and are listed in Table 6-1.

Section 5

System Maintenance and Programmatic Assessment

This SMP includes both projects and programs intended to support the City's long-term asset management efforts and supplement existing maintenance activities.

This section outlines planning projects and maintenance-related program needs stemming from review of the City's current maintenance activities and costs, and staff feedback from a programmatic activities' meeting held in February 2020. Project needs are considered as one-time planning and cost expenditures, whereas programmatic needs are related to ongoing system improvements and the fulfillment of annual maintenance obligations. Programmatic activities typically require ongoing annual funding.

To develop recommendations, the City's current stormwater asset inventory (Section 2.7) and available condition assessment records were evaluated. The City provided GIS datasets containing condition assessment ratings for stormwater infrastructure as a follow up to the programmatic activities' meeting held in February 2020. This condition assessment data and coverage information was used to anticipate and project future infrastructure repair and replacement needs for the proposed programs covered in this section.

5.1 Maintenance Activities Overview

System maintenance is necessary for the long-term health and stability of the City's stormwater system. This includes the ongoing cleaning, repair, and replacement of piped conveyance systems, open-channel conveyance systems, stormwater structures (e.g., manholes, catch basins, etc.), water quality facilities, outfalls and natural systems, and any other structural elements that comprise the stormwater system. Neglected systems perform at a lower level of service than maintained systems. Typically, it is significantly more expensive to fix a neglected system when it fails than to conduct routine preventive maintenance.

Understanding the City's maintenance program is essential to identify, refine, and estimate costs for annual program needs as part of a comprehensive CIP. The City both subcontracts and conducts scheduled (routine) and unscheduled maintenance activities for stormwater infrastructure and facilities throughout the City. Required maintenance activities and frequencies are specified in the City's NPDES MS4 permit and the associated SWMP. As a co-permittee of the NPDES permit (along with the City of Fairview), the City annually conducts and reports on maintenance activities for permit compliance.

Table 5-1 provides an overview of the City's current maintenance activities and obligations. Based on current NPDES MS4 permit annual reporting, the City has been meeting their maintenance targets. These maintenance activities are funded in part through programmatic activities outlined in Section 5.2.

Table 5-1. City Maintenance Activities (per the City's 2011 NPDES MS4 SWMP)						
Activity	Frequency required	Annual target [a]	2018 Annual effort [a]	Meeting target? (Y/N)	Staff Time	Division
Pipeline inspection and cleaning	Annual	15-20 miles/ year	11.5 miles inspected; 6.1 miles cleaned	Y [c]	• 20 feet/hour (cleaning) • 200 feet/ hour (inspection)	Watershed Division/ Operations and Maintenance
CB inspection and cleaning (public)	Annual	All	7,596 cleaned	Y	1 hour/facility	Watershed Division/ Operations and Maintenance
MH/ detention line cleaning	Annual	75 percent of all structures (inspection)	Inspected 100 percent of structures	Y	1 hour/facility	Watershed Division/ Operations and Maintenance
Street sweeping	Annual	8-10 times/year (City-wide)	12x/year	Y	Varies	Transportation Division
System repair and maintenance	As needed	----	17,700 hours	Y	Varies	Watershed Division/ Operations and Maintenance
Public water quality facility maintenance [b]	Annual	20-25 facilities	Inspected 473 facilities; routine maintenance conducted at all	Y	1-16+ hours/facility	Watershed Division/ Operations and Maintenance
UIC maintenance and cleaning	As needed	----	13 UICs	Y	Varies	Watershed Division/ Operations and Maintenance
Private water quality facility inspections	Annual	Inspect 20–30/ year	31 inspections	Y	4 hours/facility	Watershed Division/Water Quality

a. *Based on the 2018 NPDES MS4 annual report.*

b. *Public facilities include regional facilities (five), ponds (35), swales/rain gardens (489), and proprietary facilities (404).*

c. *Inspection efforts include use of closed-circuit television (CCTV) to determine cleaning needs. The City applied for permit modification in 2012 to reduce cleaning obligations in favor of increasing other maintenance activities. Per City (on February 3, 2020), inspection efforts can account for part of the pipeline cleaning estimates.*

5.2 Programmatic Activities Overview

An updated Stormwater (Watershed) Capital Program budget summary was provided by the City in February 2020. This updated budget identified programmatic activities to address maintenance needs, water quality, nuisance flooding, and system condition deficiencies. A summary of these programmatic activities through fiscal year (FY) 2024-2025 are listed in Table 5-2.

Current programmatic activities and funding levels were reviewed with staff during the February 2020 programmatic activities' meeting to inform any recommendations related to refinements to existing activities and additional needs.

Table 5-2. Stormwater Programs (2019-2025)			
Project	Project Name	Annual Budget (Dollars)	Funding Breakdown
CIPSW00001	Localized Drainage Improvements	96,000-108,000/year	50-percent Operating and 50-percent Repair and Replacement Reserves
CIPSW00002	Low Impact Development (LID) Practices Retrofit Program	200,000/year	100-percent Operating
CIPSW00003	Stream and Slope Stabilization	83,000-94,000/year	100-percent Repair and Replacement Reserves
CIPSW00004	Rehabilitation and Repair (R&R) of Pipe System	1,000,000/year	100-percent Repair and Replacement Reserves
CIPSW00005	Stormwater Facility Improvements	50,000/year	50-percent Operating and 50-percent Repair and Replacement Reserves
CIPSW00006	Riparian and Wetland Improvement Projects	77,000-87,000/year	50-percent Operating and 50-percent Repair and Replacement Reserves
CIPSW00009	Infrastructure Capacity Improvements [a]	333,333	60-percent Operating and 40-percent Repair and Replacement Reserves

[a.] *Annual budget reflects FY 2020-2021 only. Program scheduled to end in 2021. Funding for this program has not been extended.*

Per discussions with City staff, ongoing stream and slope stabilization (CIPSW00003) and riparian and wetland improvement projects (CIPSW00006) will be identified in conjunction with the current Natural Resources Master Plan and do not require a review or update as part of this City-wide stormwater master planning effort.

The primary program requiring refinement and cost update needs is the rehabilitation and repair of pipe systems (CIPSW000004). Results from CCTV inspection efforts and associated pipeline cleaning have informed the need for more significant repair and replacement efforts. As part of the CCTV inspection, structures are given a National Association of Sewer Service Companies (NASSCO) rating, which in turn helps inform and prioritize pipes in need of repair or replacement. Retrofit funding allocated for R&R of pipe systems will be continually evaluated to make sure funding is adequate to meet MS4 NPDES permit requirements if needed.

5.3 Planning Projects and Programmatic Recommendations

From the previously discussed review and ongoing discussions with City staff, the following program objectives were identified to address implementation gaps:

- Establishment of a modified drywell program to install wells in targeted areas throughout the City to provide flow reduction benefits. The City is currently evaluating a modified drywell pilot program to look at the performance and feasibility of using deep UICs (>30 ft. depth) to infiltrate stormwater runoff. Once the pilot program concludes, the City anticipates expanded use of deep UICs, located along the periphery of current UIC installation locations. In lieu of establishing a separate modified drywell program, annual funding could be incorporated into the City's LID practices and retrofit program (CIPSW00002) as these UICs address water quality issues through retention and hence pollutant load reduction.
- Performance of basin-specific master planning efforts, assuming initiation of a new basin every three years. Cost estimates assume each of the five basins will be evaluated on a rotating basis. Basins were assumed to include: 1) Kelly/Burlingame/Beaver Creek, 2) West Gresham, 3) Johnson Creek including the SWPD, 4) Kelley Creek including the PVPD, and 5) Fairview Creek.
- Expansion of current CCTV inspection program to complete inspection efforts for all 12-inch diameter and greater pipes within the system over a ten-year period.

- Refinement of current pipe system rehabilitation and repair (R&R) program (CIPSW0004) to establish updated funding levels based on required replacement needs to address completed pipe assessment efforts.

Additional detail related to the basis for cost estimation of the CCTV inspection program and R&R system updates are provided below.

5.3.1 CCTV Program Cost Assumptions

The City's current CCTV inspection program is conducted in conjunction with the City's local roads initiative. This initiative is currently funded until 2022 and involves the reconstruction of the City's most deteriorated residential streets. Prior to reconstruction, CCTV efforts are conducted to identify pipe replacement needs that could be completed at the same time as road reconstruction activities.

Based on the City's latest available CCTV inspection pipe records, approximately 125,000 LF of stormwater mains and laterals were inspected during the March 2017–February 2018 timeframe. This represents approximately 11 percent of the entire piped stormwater system managed by the City. To complete CCTV inspection of the entire piped collection system, current CCTV efforts would need to be expanded beyond systems associated with the local roads initiative and extend beyond the current 2022 end date.

If the City wishes to expand their CCTV program to inspect all remaining pipes (approximately 1,077,200 LF) with pipe inspections occurring on a ten-year frequency (on average), the City would need to inspect approximately 108,000 LF of pipe annually. A CCTV program could be developed independently from the City's current pipe cleaning program to inform the City's R&R program. To provide adequate funding to complete all pipe inspections on a ten-year frequency, an estimated $730,000 should be allocated to this program annually. This cost estimate assumes a unit cost for mainline video inspection of $3.60/LF plus a 30-percent contingency, 30-percent design administrative fee, and a 14-percent general administrative fee.

5.3.2 Rehabilitation and Repair (R&R) Program Cost Assumptions

As part of the CCTV program, inspected pipes are scored using the NASSCO pipeline assessment and certification program (PACP) rating system. This system provides the City with a standardized approach to assess which pipes are in most need of replacement.

Of the inspected pipes with completed assessments in the City, approximately 40 percent received a rating of 4 or 5 indicating that replacement or repair is recommended soon. If City-wide CCTV efforts continue over the remainder of the City's piped system, and a similar percentage of deficiencies are identified, it is projected that 430,900 LF of pipe in the remaining system will likely be identified as in need of repair or replacement.

Assuming the City would address the required R&R activities over a 50-year construction period, approximately 8,600 LF of pipe replacement would be needed annually. Annual funding needed to repair or replace this length of pipe is estimated to cost $2,300,000. This cost estimate includes a 30-percent contingency, 30-percent design administrative fee, 5-percent permitting fee, and a 14 percent general administrative fee. This planning level cost estimate assumes the following:

- All pipes identified as deficient are replaced in-kind. Actual costs to repair or line a pipe may be significantly less than the replacement cost.
- Unit costs for 12-inch high-density polyethylene (HDPE) pipe installation with asphalt resurfacing was applied for all deficient pipes. This approximation is supported by the stormwater infrastructure asset evaluation in Section 2.7, which identified that approximately 50 percent of all City-managed pipe is 12 inches or smaller.

- Pipe replacement cost does not include a disposal cost for the existing deficient pipe.

Table 5-3 summarizes the resulting planning projects and proposed programmatic activity adjustments.

Table 5-3. Proposed Planning Projects and Programmatic Adjustments

Project Number	Project Name	Proposed Annual Obligation	Project Assumptions	Project Timeframe
PGM [a] #1	Modified Drywell Program	$250k	Installation of two MaxWell Plus® deep UICs annually at approximately $125k per well. Project cost may be incorporated into the infrastructure capacity improvements program.	Annually
PGM #2	CCTV Expansion	$730k	Expand CCTV inspections beyond local roads initiative time frame. Increase current rate of LF inspected per year to 108,000 LF of pipe. Mainline video inspection assumed to cost $3.60 per LF.	Annually
CIPSW00004	Rehabilitation and Repair (R&R) of Pipe System	$1.3M	Proposed annual obligation is in addition to the current program's $1M/year funding. Assumes approximately 430,900 LF of pipe will need to be repaired or replaced in remaining unassessed portion of system over a 50-year construction period.	Annually
PGM #3	Basin Master Plan Update	$120k	A basin master plan update will occur every three years. The basin planning updates will rotate through the City's five major basins. Annualized estimates assume each basin master plan to cost $360k.	Every three years

a. *PGM was used as an ID to represent planning /programmatic recommendations.*

Section 6

Capital Improvement Plan

This section summarizes the capital projects and programs identified throughout the master planning process. These projects were developed based on the capacity evaluation (Section 3), water quality assessment (Section 4), and system maintenance and program assessment (Section 5).

A total of 23 capital projects were identified to address current and future needs related to capacity/flooding issues and provide water quality benefits. To supplement these projects, program recommendations were also included (Section 5.2) to address ongoing system infrastructure repair and replacement, maintenance activities, and general stormwater program planning needs.

Section 6.1 provides a summary of the CIP selection. Section 6.2 provides a summary of CIP development and cost estimation methods for the Pleasant Valley and Springwater Planning Districts, respectively. Section 6.3 provides an overview of the cost estimation methodology, and Section 6.4 provides a summary of the CIP prioritization process and results.

6.1 Integrated CIP Development/CIP Project Recommendations

Results from both the Capacity Evaluation (Section 3) and Water Quality Assessment (Section 4) were considered to develop a comprehensive and integrated capital improvement project list/plan for the City. The finalized capital improvement project list was designed to address the following primary objectives:

- Increase system capacity to address existing and potential future deficiencies (i.e., flood control)
- Improve system configuration
- Provide water quality benefits
- Address maintenance needs or reported problems

In addition to the projects developed to address the previously listed objectives, two regional, planning-related capital improvement projects were developed for the SWPD and PVPD areas. The goal of these projects was to provide a conceptual plan and cost estimates for accommodating drainage from anticipated future growth and urbanization in these areas. Finally, four planning/programmatic recommendations were made as necessary components of a functioning storm system and to address existing gaps. These recommendations will require budgeting in addition to implementation of capital projects.

Development of the finalized capital improvement project list began with preliminary project concepts (see high-priority projects from Table 3-13 and Table 4-2) that were reviewed and validated by the City in an October 2019 workshop. These project concepts were advanced to capital improvement projects, with the subsequent development of fact sheets to summarize project descriptions, design considerations, and estimated costs. A total of 19 capital improvement projects, as organized by major basin, are listed below in Table 6-1 along with key project information. The four planning/programmatic recommendations are also included in the table. Corresponding capital project fact sheets with more detailed project information and cost estimates for each project are provided in Appendix E. Fact sheets are not provided for planning/programmatic recommendations.

In summary, of the 19 CIPs, a total of 15 flood-control CIP locations were identified. As described in Section 4.0, seven of these 15 CIP locations include stormwater quality treatment. All CIPs that address water quality would qualify as stormwater retrofits to help address NPDES MS4 permit requirements. Additionally, CIP fact sheets were developed for the Springwater and Pleasant Valley Planning Districts as described in Section 6.2.

Table 6-1. Project and Program Summary Table

Project ID [a]	Project Name	Location	Project Objectives	Initial Prioritization [b]	Project Information				
					Project Description	Total Estimated Cost (Preliminary) One time cost unless otherwise noted.	SDC Eligible Cost	Water Quality Retrofit	Identified in the Transportation Plan
WG-2-C-WQ	Kirk Park/Hartley Elementary School Water Quality Facilities and Pipe Improvements	NE Halsey Street between NE 183rd Avenue and NE 192nd Avenue (and Kirk Park/Hartley Elementary School)	Flooding and Water Quality	H	Replace capacity deficient piping along NE Halsey Street and NE 192nd Avenue along with construction of a water quality facility that includes infiltration to reduce flows to the Halsey system.	$2,210,000	$24,000	Y	20-YR Project #9 for NE Halsey Street
JC-1-C	NW 1st Street/Ava Avenue Pipe Improvements	NW 1st Street and NW Ava Avenue	Flooding	H	Replace capacity deficient piping along NW 1st Street and NW Ava Avenue with 1,040 LF of 24-inch HDPE pipe.	$760,000	$7,000		
JC-11-C	Elliot Avenue Pipe Improvements	NE Elliot Avenue; (NE 4th Street and NE Linden Avenue)	Flooding, Debris Accumulation	H	Install/replace capacity deficient piping along NE Linden Avenue, NE 4th Street, and NE Elliot Avenue with 1,250 LF of 24-inch HDPE pipe.	$863,000	$120,000		20-YR Project #24 for NE 5th Street
JC-11-WQ	Elliot Avenue Green Street	NE Elliot Avenue (from NE 3rd Street to NE 5th Street)	Water Quality	Associated with JC-11-C	Install 2,800 SF of stormwater quality facilities along NE Elliot Avenue (from NE 3rd Street and NE 5th Street).	$341,000	$0	Y	
KC-2-C	Channel Replacement Southeast of Division and Cleveland	NE Cleveland Avenue and NE Division Street	Flooding, Water Quality, Debris Accumulation	H	Pipe the existing open channel between NE Division Street and NE 8th Street with 760 LF of 60-inch corrugated metal pipe (CMP) piping. While not a water quality retrofit, piping of the existing open channel is expected to result in reducing the amount of trash and debris that is currently often discharged into the waterway at this location.	$1,611,000	$61,000		
KC-10-C	Hogan Drive Outfall Extension	NE 16th Way and NE Hogan Drive	Flooding	H	Pipe the existing open channel on the east side of NE Hogan Dr with 450 LF of 72-inch pipe. Install vault structure at intersection of NE Hogan Drive and Burlingame Creek (at Country Club Estate Condominiums). Install 390 LF of 75-inch x 115-inch arch pipe to outfall east into Gresham Golf Course.	$2,348,000	$79,000		50-YR Project #32a for Hogan Drive
KC-10-WQ	17th and 18th St. Green Streets Improvements	NE 17th Street and NE 18th Street	Water Quality	Associated with KC-10-C	Install 6,800 SF of stormwater quality facilities in residential neighborhood upstream (northwest) of KC-10.	$644,000	$0	Y	
KC-12-C	Division St. Pipe Improvements	NE Division Street	Flooding	H	Replace capacity deficient piping along NE Divisions Street and NE Hogan Drive with 1,630 LF of 36-inch and 910 LF of HDPE piping.	$2,464,000	$32,000		50-YR Project #32a for Hogan Drive
KC-19-C	Powell and Hwy 26 Pipe Improvements	Powell Boulevard and Highway 26	Flooding	H	Replace capacity deficient piping downstream of intersection of Powell Boulevard and Highway 26 with 84-inch HDPE pipe. Install 2,390 LF of pipe from Powell Boulevard to north of NE 1st Street.	$7,149,000	$297,000		20-YR Project #34
KC-24-C	SE Salquist Rd. Pipe Improvements	SE Salquist Road and SE Paloma Drive	Flooding	H	Reconfigure piped system of Burlingame Creek that crosses underneath SE Salquist Road. Abandon 390 LF of capacity-deficient 21-inch pipe. Provide new alignment consisting of 280 LF of 48-inch and 175 LF of 18-inch new HDPE piping. Also replace sections of existing piping with 290 LF of 48-inch and 120 LF of 24-inch of HDPE piping as part of pipe improvements.	$1,000,000	$29,000		50-YR Project #47 for SE Salquist Road
KC-24-WQ	Wendy Ave. and 16th St. Green Street Improvements	SE Wendy Avenue and SE 16th Street	Water Quality	Associated with KC-24-C	Install 5,800 SF of stormwater quality facilities in residential neighborhood upstream (northeast) of KC-24.	$556,000	$0	Y	
FC-1-C	Fairview Creek Stark St. Culvert	SE Stark Street (between SE 205th Avenue and SE 208th Avenue)	Flooding	H	Replace and raise the elevation of the existing 20-foot long, 60-inch diameter culvert with a 25-foot long, 60-inch diameter culvert.	$401,000	$15,000		
FC-1-WQ	Stark St. Water Quality Swale	SE Stark Street (between Fairview Creek and SE 212th Avenue)	Water Quality	Associated with FC-1-C	Install a shallow water quality swale on the north side of SE Stark Street along the frontage of tax lot 1N3E33-01300.	$119,000	$0	Y	
FC-3a-C	Wallula Ave. Open Channel	Piped system (between NW Wallula Avenue and SE 202nd Avenue)	Flood Control, Water Quality	H	Install a new parallel 48-inch culvert under NW Wallula Avenue and construct an engineered overflow channel to convey and treat flow through the natural area from the new manhole to a new inlet at the west end of the natural area before hitting NW 14th Street.	$671,000	$16,000		50-YR Project #19 for Wallula Avenue
FC-3b-C	NE Burnside Rd Pipe Replacements	NE Burnside Road (from NW Fairview Drive to NW Eastman Parkway)	Flood Control	H	Replace 1,090 LF of existing 48-inch diameter pipe with 72-inch diameter pipe on NE Burnside Road from the intersection with NW Fairview Drive to NW Eastman Parkway (Node M3252-F-9026).	$3,521,000	$19,000		20-YR Project #31 for NE Burnside Road
FC-3c-C	NE 19th Ave. Parallel Pipe	NE 19th Street (from N Main Avenue to just east of NE 20th Street)	Flood Control	H	Install a 48-inch parallel pipe from Manhole 3254-F-009 on NE 19th Street for 1,900 LF to the intersection of N Main Avenue and NE 19th Street. Replace 220 LF of existing 18-inch pipe with 48-inch from NE 19th Street and N Main Avenue to Manhole M3253-F-9031 at the intersection of N Main Avenue and NE 18th Street.	$2,196,000	$12,000		

Table 6-1. Project and Program Summary Table

Project ID a	Project Name	Location	Project Objectives	Initial Prioritization b	Project Information				
					Project Description	Total Estimated Cost (Preliminary) One time cost unless otherwise noted.	SDC Eligible Cost	Water Quality Retrofit	Identified in the Transportation Plan
FC-3e-WQ	Liberty Ave. Green Street	NE Liberty Avenue (between NE 19th Street and 23rd Street)	Water Quality, Capacity Relief	Associated with FC-3-C projects	Construct stormwater water quality facilities along NE Liberty Avenue from NE 19th Street to NE 23rd Street within existing grassed planter strips between the sidewalk and curb.	$505,000	$0	Y	
FC-3f-C	Civic Drive Pipe Improvements	To the west of NW Civic Drive just south of NW Burnside Road	Flood Control	H	Abandon 300 feet of 66-inch pipe and relocate and replace with 322 LF of 84-inch diameter pipe.	$1,022,000	$24,000		
FC-3g-C	K-Mart Pipe Improvements	Property at the intersection of NW Eastman Parkway and NW Burnside Road	Flood Control	H	Replace 1,630 LF of existing 54-inch pipe with 84-inch diameter pipe.	$4,823,000	$79,000		
SW-1	Springwater Planning District Trunk Line Sizing	Springwater Planning District	Future Trunk Line Sizing, Calculating System Development Charges	H	Sized-pipe infrastructure based on the assumed drainage patterns of subbasins located within the planning district. Trunk alignment is based on the transportation system plan. Project includes 1,010 LF of 12-inch, 8,846 LF of 18-inch, 11,345 LF of 24-inch, and 7,095 LF of 30-inch HDPE pipe.	$13,032,000	$9,673,000		Includes several SW planned road projects (#61, 62, 64, 66, 67, 68, 79, 80, 82, 84, 86)
PV-1	Pleasant Valley Planning District Trunk Line Sizing	Pleasant Valley Planning District	Future Trunk Line Sizing, Calculating System Development Charges	H	Sized-pipe infrastructure based on the assumed drainage patterns of subbasins located within the planning district. Trunk alignment is based on the transportation system plan. Project includes 800 LF of 12-inch, 4,220 LF of 18-inch, 4,905 LF of 24-inch, 6,160 LF of 30-inch, 3,555 LF of 36-inch, 1,140 LF of 42-inch, and 535 LF of 48-inch HDPE pipe.	$12,784,000	$9,049,000		Includes several PV planned road projects (#52, 89, 94, 95, 96, 98, 100, 101, 102)
PGM-1	Modified drywell Program	TBD	Provide flow/volume reduction and water quality benefits.	H	Installation of two MaxWell Plus® deep UICs annually at approximately $125k per well. Project cost may be incorporated into the infrastructure capacity improvements program.	$250,000 per year	TBD	Y	
PGM-2	CCTV Expansion	TBD	Identify system condition issues.	H	Expand CCTV inspections beyond local roads initiative time frame. Increase current rate of LF inspected per year to 108,000 LF of pipe. Mainline video inspection assumed to cost $3.60 per LF.	$730,000 per year	NA		
CIPSW00004	Rehabilitation/Repair (R&R) of Piped System	TBD	Address asset failures	H	Proposed annual obligation is in addition to the current program's $1M/year funding. Assumes approximately 430,900 LF of pipe will need to be repaired or replaced in remaining unassessed portion of system over a 50-year construction period.	$1,300,000 per year	NA		
PGM-4	Basin Master Plan Updates	TBD	Update plans to reflect current conditions	H	A basin master plan update will occur every three years. The basin planning updates will rotate through the City's five major basins. Annualized estimates assume each basin master plan to cost $360k.	$120,000 every three years	NA		

a. Project IDs are developed by basin and overarching objectives: JC = Johnson Creek; KC = Kelly Creek; WG = West Gresham; FC = Fairview Creek; SW = Springwater Planning District (Johnson Creek); PV = Pleasant Valley Planning District (Kelley Creek); C = Capacity; WQ = Water Quality.

b. Initial priority is the identification of high-, medium-, and low-priority project needs based on input from City staff. High-priority project opportunity areas are associated with modeled and observed capacity deficiencies.

6.2 CIP Sizing and Design Assumptions for the Planning Districts

A separate analysis was conducted to estimate trunk line pipe sizes and locations for the Pleasant Valley and Springwater Planning Districts in conjunction with anticipated new development. This analysis was conducted as these areas are mostly undeveloped and will require new infrastructure to support anticipated growth.

BC and City staff initially identified the anticipated pipe alignments in the planning districts according to proposed roadway layouts that were provided in the transportation system plans for these areas. Relatively large subbasins (averaging approximately 67 acres) were delineated and pipe sizes were calculated based on XPSWMM future condition modeled flows for these areas. Using this method, pipes were sized based on the anticipated flow at the most downstream end of the subbasin and that pipe size was assumed for the entire pipe length extending to the most upstream portion of the subbasin. This conservative approach was taken due to the unknown schedule for development and post-construction drainage patterns.

This conservative approach was later revisited and reconsidered because of the significant cost implications of consistently assuming a large pipe diameter when smaller pipe sizes would likely be sufficient at the upstream ends of the subbasins, and pipe sizes would gradually increase as flow moves downstream to the lowermost end of the subbasin. Refinement of pipe size is needed to show breaks in pipe lengths where pipe sizes would be expected to increase in size moving in a downstream direction. As a result, the following steps were taken to refine the initial pipe size estimates for the Pleasant Valley and Springwater Planning Districts:

- **Step 1.** Contributing subbasins were further refined based on a more detailed review and general forecasting of how runoff throughout each of the subbasins would be anticipated to reach the storm system after development occurs. The pipe alignments were still assumed to follow the anticipated rights-of-way as reflected in the most recent transportation system plans for the districts. In refining the subbasin boundaries, it was assumed that runoff originating within 100 ft of the right-of-way would drain into the roadway system and the associated storm drain system, regardless of the underlying topography. This assumption was made to reflect typical development practices where properties directly adjacent to roadways are graded to drain to the roadways.
- **Step 2.** The XPSWMM hydrology models were rerun to reflect the refined subbasin delineations as described and developed under Step 1, and to obtain updated subbasin peak flow rates for the relevant design storms (i.e., ten-year design event for subbasins less than 250 acres, and 50-year design event for subbasins greater than 250 acres).
- **Step 3.** Model results of peak flow rates, for each of the subbasins, were divided by the subbasin areas, to estimate an average peak flow rate on a per acre basis for each subbasin (i.e., cubic feet per second [cfs]/ac).
- **Step 4.** The estimated peak flow rate per acre for each subbasin (from Step 3) was used to estimate a maximum subbasin drainage area that could be accommodated by a 12-inch diameter pipe before needing to move to an 18-inch diameter pipe size, and so forth, for each incremental increase in pipe size. These drainage area estimates were based on Manning's equation results assuming full pipe flow as documented in Table 6-2. For example, if the average slope of a subbasin was three percent, then from Table 6-2, approximately 5.7 cfs could be accommodated in a 1-foot diameter pipe. If the average peak flow rate per acre for this example subbasin was 0.5 cfs (from Step 3), then it was assumed that approximately 11 acres could be accommodated by a 1-foot diameter pipe (i.e., 5.7 cfs/0.5 cfs per acre) before needing to move to a larger pipe size. For this example, an 11-acre subbasin would then be delineated in the upstream-most portion of the original subbasin. This process was repeated for each incremental

pipe size and refined subbasin boundaries were delineated within the original subbasin area to reflect these refined drainage areas corresponding with each change in pipe size. Pipe lengths were also estimated as the pipe sizes were generally estimated to extend the length of the associated subbasin.

Table 6-2. Planning Districts Pipe Full Flow Capacity Table

Pipe Diameter (ft)	Pipe Cross Sectional Area (ft^2)	Pipe Wetted Perimeter (ft)	Slope (Percent)	Max Flow (based on Manning's equation) (cfs)
1	0.79	3.14	0.5%	2.3
1	0.79	3.14	1.0%	3.3
1	0.79	3.14	1.5%	4.1
1	0.79	3.14	2.0%	4.7
1	0.79	3.14	2.5%	5.2
1	0.79	3.14	3.0%	5.7
1	0.79	3.14	3.5%	6.2
1	0.79	3.14	4.0%	6.6
1	0.79	3.14	4.5%	7.0
1	0.79	3.14	5.0%	7.4
1.5	1.77	4.71	0.5%	6.9
1.5	1.77	4.71	1.0%	9.8
1.5	1.77	4.71	1.5%	12.0
1.5	1.77	4.71	2.0%	13.8
1.5	1.77	4.71	2.5%	15.5
1.5	1.77	4.71	3.0%	16.9
1.5	1.77	4.71	3.5%	18.3
1.5	1.77	4.71	4.0%	19.6
1.5	1.77	4.71	4.5%	20.7
1.5	1.77	4.71	5.0%	21.9
2	3.14	6.28	0.5%	14.9
2	3.14	6.28	1.0%	21.1
2	3.14	6.28	1.5%	25.8
2	3.14	6.28	2.0%	29.8
2	3.14	6.28	2.5%	33.3
2	3.14	6.28	3.0%	36.5
2	3.14	6.28	3.5%	39.4

Table 6-2. Planning Districts Pipe Full Flow Capacity Table				
Pipe Diameter (ft)	Pipe Cross Sectional Area (ft^2)	Pipe Wetted Perimeter (ft)	Slope (Percent)	Max Flow (based on Manning's equation) (cfs)
2	3.14	6.28	4.0%	42.1
2	3.14	6.28	4.5%	44.7
2	3.14	6.28	5.0%	47.1
2.5	4.91	7.85	0.5%	27.0
2.5	4.91	7.85	1.0%	38.2
2.5	4.91	7.85	1.5%	46.8
2.5	4.91	7.85	2.0%	54.0
2.5	4.91	7.85	2.5%	60.4
2.5	4.91	7.85	3.0%	66.1
2.5	4.91	7.85	3.5%	71.4
2.5	4.91	7.85	4.0%	76.4
2.5	4.91	7.85	4.5%	81.0
2.5	4.91	7.85	5.0%	85.4
3	7.07	9.42	0.5%	43.9
3	7.07	9.42	1.0%	62.1
3	7.07	9.42	1.5%	76.1
3	7.07	9.42	2.0%	87.8
3	7.07	9.42	2.5%	98.2
3	7.07	9.42	3.0%	107.6
3	7.07	9.42	3.5%	116.2
3	7.07	9.42	4.0%	124.2
3	7.07	9.42	4.5%	131.7
3	7.07	9.42	5.0%	138.9
3.5	9.62	11.00	0.5%	66.2
3.5	9.62	11.00	1.0%	93.7
3.5	9.62	11.00	1.5%	114.7
3.5	9.62	11.00	2.0%	132.5
3.5	9.62	11.00	2.5%	148.1
3.5	9.62	11.00	3.0%	162.2
3.5	9.62	11.00	3.5%	175.2
3.5	9.62	11.00	4.0%	187.3

Table 6-2. Planning Districts Pipe Full Flow Capacity Table				
Pipe Diameter (ft)	Pipe Cross Sectional Area (ft^2)	Pipe Wetted Perimeter (ft)	Slope (Percent)	Max Flow (based on Manning's equation) (cfs)
3.5	9.62	11.00	4.5%	198.7
3.5	9.62	11.00	5.0%	209.5
4	12.57	12.57	0.5%	94.6
4	12.57	12.57	1.0%	133.7
4	12.57	12.57	1.5%	163.8
4	12.57	12.57	2.0%	189.1
4	12.57	12.57	2.5%	211.5
4	12.57	12.57	3.0%	231.6
4	12.57	12.57	3.5%	250.2
4	12.57	12.57	4.0%	267.5
4	12.57	12.57	4.5%	283.7
4	12.57	12.57	5.0%	299.1

- **Step 5.** Revised hydrologic model input parameters were developed for each of the re-delineated subbasins from Step 4. These revised hydrologic model input parameters included subbasin area, soil types, impervious percentages, flow path lengths, and subbasin widths.
- **Step 6.** The revised XPSWMM hydrologic models from Step 5 were run to develop updated model output for peak flows for each of the re-delineated and updated subbasins developed under Steps 4 and 5.
- **Step 7.** Pipe sizes and pipe lengths estimated under Step 4 were included in the revised XPSWMM hydraulic model and the model was run to confirm pipe-size estimates from Step 4. Minor adjustments were made to optimize pipe sizes, lengths, and/or drainage areas where needed.
- **Step 8.** Revised GIS figures were produced to illustrate the updated subbasins boundaries, pipe diameters, and pipe lengths (see figures associated with the capital project fact sheets for the Pleasant Valley and Springwater Planning Districts provided in Appendix E as CIPs PV-1 and SW-1).

6.3 Cost Estimate Assumptions

Project cost estimates were based on the total capital investment necessary to complete a project (i.e., engineering through construction). Costs are based on the proposed layout and general design assumptions as documented in the CIP fact sheets (in Appendix E).

Unit prices that were used to estimate construction costs were based on recent (and previous) bid tabulations and local stormwater master planning efforts; adjusted for 2019 dollars based on the Engineering News Record (ENR) Construction Cost Index (CCI). The ENR CCI contains a 20-city average of historical labor and material costs that were used to escalate costs.

In addition to engineering and construction costs, preliminary cost estimates included a 30-percent construction contingency and additional multipliers to account for design/construction administration, permitting, and general administration. The design/construction administrative costs (30 percent), permitting costs (5-15 percent) and general administrative costs (14 percent) were applied as general percentages to the capital expense total, including contingency. The range in permitting costs were based on the anticipated permitting level of effort including whether in-water work was anticipated, warranting environmental permitting efforts in conjunction with Section 404 of the CWA. For planning purposes, total capital project implementation costs were rounded to the nearest $1,000.

Site acquisition and easement costs were not included in the estimates, as most projects are located on City-owned property or within the City right-of-way.

Appendix F includes the unit cost table developed for this SMP, and the planning-level cost estimates for each project.

6.4 Capital Project Prioritization

Project prioritization is an important component of the stormwater master planning process and provides direction in terms of sequencing projects in accordance with City objectives. This section includes a summary of work conducted to prioritize high priority projects for implementation. For this project, a CIP prioritization tool was developed to assist with project prioritization. The tool was developed to be used on a continual basis; as projects are constructed, they can be removed from the ranking tool and new projects can be inserted as master plans are updated.

The CIP prioritization tool was developed using Microsoft Excel software and includes prioritization criteria, weighting factors and results which are described in the subsections that follow.

It should be noted that the Stormwater CIP list includes several ongoing programs established to facilitate improvements without dedicated, individual CIP consideration. Failed infrastructure is primarily addressed through the existing R&R program; water quality retrofits are often performed under the LID Retrofit program; identified capacity deficiencies can often be addressed by the Infrastructure Capacity Improvement program. Whether a project can be performed within one of these programs or requires a dedicated CIP is not clearly defined but is generally a matter of scale and at the discretion of the City's Senior Engineer.

6.4.1 Development of Prioritization Criteria

The City of Gresham's Stormwater Capital Improvement Program is the primary instrument to perform varied improvements related to watershed health and management. As an open and dynamic system, the spectrum of potential improvements is quite broad. As discussed throughout this plan, generally, potential improvements were developed to address one or more of the following objectives which were considered as the basis for developing project prioritization criteria.

- **Flood Control (FC)**: Cases of modeled or observed flooding typically fall into this category. While most often related to capacity deficiencies or naturally occurring floodplain inundations, flooding may also result from sub-optimal drainage patterns, hydraulic anomalies, natural obstructions, structural failures, inadequate maintenance, etc.
- **Water Quality (WQ):** Projects that introduce or enhance treatment in the form of pollutant load, temperature, or volume reduction using established or experimental best management practices (BMPs) are categorized here. Water quality projects are strategic and/or opportunistic in nature and are a valuable mechanism in the pursuit of achieving permit-driven benchmarks.

- **Asset Management (AM):** Recognizing the finite effective useful life of the broad spectrum of discrete assets in the City's stormwater portfolio and the natural degradation over time, asset management projects are driven by a combination of age, condition, and criticality. Healthy asset management is critical to maintaining a safe, effective, and efficient system.

Whereas some projects may fall under a single category, others may present improvements to two or more of the above.

The evaluation criteria were determined through an analysis of the historical CIPs and the current overarching program objectives described above. The criteria were then arranged into families as shown in Figure 6.1.

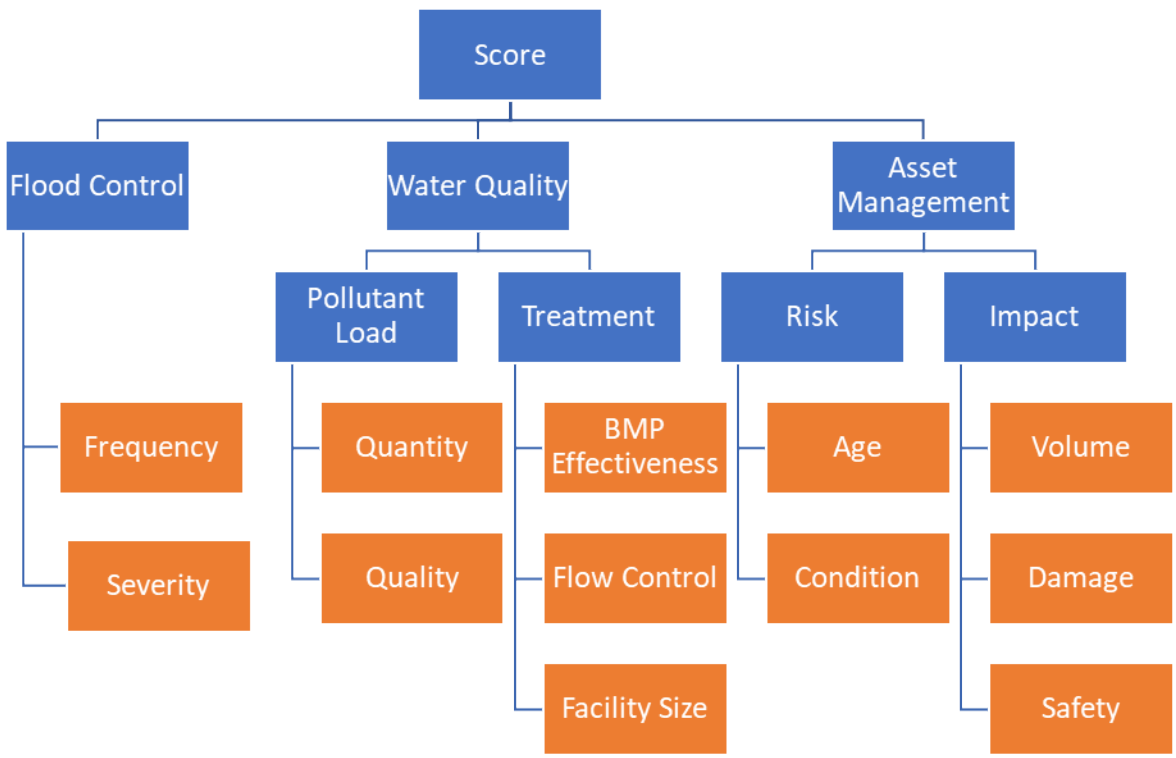

Figure 6-1. CIP Hierarchical Decision Model

The nodes are aligned in tiers starting with the Tier 1 family of nodes on the top, the Tier 2 sub-nodes in the middle, and the evaluation criteria sub-nodes in orange. Each family of sub-nodes represents a discrete element of its respective parent node and is arranged to form a Hierarchical Decision Model (HDM). The definitions of each node and criterion are as follows:

- Tier 1:
  - **Flood Control:** Capacity-related improvements in which current deficiencies (either observed or modeled) cause flooding.

    - **Water Quality:** Projects that treat and improve the quality of stormwater runoff.
    - **Asset Management:** Improvements that address structural or operational infrastructure deficiencies impacting the performance or expected remaining useful life of the asset.
- Tier 2:
    - **Pollutant Load:** The load (quality and quantity) of the untreated runoff from a contributing area.
    - **Treatment:** The effectiveness of the facility to reduce pollutant loads.
    - **Risk:** The relative likelihood that an asset will fail or reach the effective end of its useful life.
    - **Impact:** The severity of the impact presented by failure.
- Tier 3 (Prioritization Criteria):
    - **Frequency:** The expected frequency of a capacity-related flood event.
    - **Severity:** The extent of the flooding event or its impact.
    - **Quality:** The quality of the untreated runoff from a contributing area.
    - **Quantity:** The size of the contributing area.
    - **BMP Effectiveness:** The ability of a BMP to reduce pollutant loads.
    - **Flow Control:** The capacity of the facility to infiltrate and/or detain runoff to reduce the peak flow rate to a downstream system (i.e., to prevent instream erosion).
    - **Facility Size:** The size of the treatment area relative to the contributing catchment.
    - **Age:** The age of the asset and how it pertains to remaining useful life.
    - **Condition:** Either the PACP score or other data point (if available) identifying existing deficiency.
    - **Volume:** The size of the asset, or its conveyance criticality.
    - **Damage:** The likely monetary damage related to a catastrophic failure event.
    - **Usage:** The immediate risk to public safety in a failure event.

The first spreadsheet in the Excel spreadsheet tool includes the project evaluation criteria and associated scoring guide used for evaluating and scoring CIPs. For each of the evaluation criteria, a scoring guide is provided to assist in scoring projects consistently. A summary of the evaluation criteria that were selected based on the City's main objectives is provided in Table 6-3, to follow. As the City implements this tool over time, and as priorities change and evolve, these criteria and the scoring guide can easily be revised at the City's discretion.

The third spreadsheet in the Excel spreadsheet tool includes a table for entry of information regarding each of the CIPs. Information for each of the projects is included in this spreadsheet for project ID, project name, project location, objectives, description, cost, SDC cost, SDC percentage, whether the project addresses water quality, acres treated, whether the project location is in a roadway that has been identified as a project in the Transportation System Plan, and any additional field notes from City staff. The purpose of this sheet is to provide the information necessary for the user to have sufficient information to score each project. The fourth spreadsheet in the Excel spreadsheet tool includes a table for the user to score the alternatives for each evaluation criterion.

Table 6-3. Evaluation Criteria and Scoring Guide								
Criteria		Range For Scoring		Scoring Guide				
		Min Score	Max Score	0	1	2	3	4
1	FC - Frequency	0	4	Flooding has not been observed and is not expected to occur based on model results.	Flooding is predicted through modeling based on future land use conditions for an infrequent event (50-year storm) but does not occur under existing conditions.	Flooding is predicted through modeling based on future land use conditions for a 2- or 10-year storm but does not occur under existing conditions.	Flooding has been predicted to occur for a 2, 10, or 50-year return interval design storm based on existing land use conditions.	Flooding has been predicted by modeling and is frequently observed in the field.
2	FC - Severity	0	4	No impact to traffic or property.	Nuisance flooding anticipated without impact to traffic.	Flooding is anticipated to impact traffic on residential or collector streets.	Flooding is anticipated to impact residential or collector streets and property.	Flooding is anticipated to impact arterials and property, potentially as well.
3	WQ – Pollutant Load - Quantity	0	4	CIP does not remove pollutants.	CIP provides pollutant removal for drainage area of less than one acre.	CIP provides pollutant removal for a drainage area of 1 to 9 acres.	CIP provides pollutant removal for a drainage area of ten to 30 acres.	CIP provides pollutant removal for a drainage area of greater than 30 acres.
4	WQ – Pollutant Load - Quality	0	4	CIP treats runoff from a drainage area that has no anthropogenic sources of stormwater pollutants (e.g., natural areas, etc.).	CIP treats runoff from a drainage area that is predominantly single-family residential.	CIP treats runoff from a drainage area that is mixed density residential.	CIP treats runoff from a drainage area that is mixed-land use and includes commercial and/or industrial land use.	CIP treats runoff from a drainage area that is predominantly commercial/industrial.

Table 6-3. Evaluation Criteria and Scoring Guide								
Criteria		Range For Scoring		Scoring Guide				
		Min Score	Max Score	0	1	2	3	4
5	WQ – Treatment – Effectiveness	0	4	CIP does not provide water quality treatment.	CIP is a sedimentation manhole or vault with mechanism for treatment that is based on settling or vortex but not filtration.	CIP is a vault or "grey" structure that includes media for filtration of runoff.	CIP is a vegetated facility that provides filtration (e.g., rain garden, swale, planter, etc.).	CIP is a vegetated facility that incorporates both filtration and infiltration.
6	WQ – Treatment – Flow Control	0	4	NA	CIP provides non-flow control through either retention/infiltration or peak attenuation. Or peak attenuation is solely provided for infrequent, large storms (i.e., greater than ten-year recurrence interval).	CIP provides detention to attenuate peak flows for 50 percent of the two-year return frequency peak flow or less (i.e., frequently occurring storms).	CIP provides a minimum infiltration/retention of the water quality storm.	CIP provides a minimum infiltration/retention of the ten-year storm.
7	WQ – Treatment – Facility Size	0	4	CIP does not provide treatment.	Footprint of the facility is less than one percent of the contributing drainage area.	Footprint of the facility is greater than one percent but less than five percent of the contributing drainage area.	Footprint of the facility is greater than five percent but less than ten percent of the contributing drainage area.	Footprint is greater than or equal to ten percent of the contributing drainage area.
8	AM – Risk – Age (of asset being modified/replaced)	0	4	The CIP does not include modification or replacement of an existing asset.	The CIP does not modify or replace an existing asset but provides redundancy for that asset.	The CIP includes modification or replacement of an asset that is up to 25 years old.	The CIP includes modification or replacement of an asset that is greater than 25 but less than 50 years old.	The CIP includes replacement of an asset that is greater than 50 years old or beyond its identified remaining useful life.

Table 6-3. Evaluation Criteria and Scoring Guide								
		Range For Scoring		Scoring Guide				
	Criteria	Min Score	Max Score	0	1	2	3	4
9	AM – Risk - Condition	0	4	The CIP does not include modification or replacement of an existing asset, or it replaces an asset with a PACP score of 1.	The CIP includes modification or replacement of an asset with a PACP score of 2.	The CIP includes modification or replacement of an asset with a PACP score of 3.	The CIP includes modification or replacement of an asset with a PACP score of 4.	The CIP includes replacement of an asset with a PACP score of 5.
10	AM – Impact - Volume	0	4	The CIP does not provide conveyance functions.	The CIP includes pipe sizes no greater than 18 inches in diameter.	The CIP includes pipe sizes no greater than 24-inches in diameter.	The CIP includes pipe sizes no greater than 36 inches in diameter.	The CIP includes pipe sizes of greater than 36 inches in diameter.
11	AM – Impact – Damage (related to a catastrophic failure event)	0	4	The identified problem is not anticipated to cause any additional collateral damage.	The identified problem is anticipated to cause minor collateral damage to non-essential property/structures.	The identified problem is anticipated to cause minor collateral damage to utilities, property, and/or local roadways.	The identified problem is anticipated to cause collateral damage to utilities, property, and/or collector streets.	The identified problem is anticipated to cause collateral damage to backbone utilities (e.g., Bull Run conduit, etc.), essential facilities (e.g., hospital, police, etc.), and/or arterial roadways.
12	AM – Impact – Safety (immediate risk to public safety in a failure event)	0	4	The identified problem is not anticipated to cause any safety risk.	The identified problem has the potential to cause minor safety risks (e.g., flooded sidewalk causing pedestrians to access the residential street, etc.).	The identified problem is anticipated to cause safety risks related to traffic accidents on residential or collector streets.	The identified problem is anticipated to cause safety risks related to traffic accidents on residential or collector streets, and due to minor property or utility damage.	The identified problem is anticipated to cause significant safety risks related to traffic accidents on major arterials, injury related to property damage, and/or health impacts related to utility damage.

6.4.2 Weighting Factors

The second spreadsheet in the Excel spreadsheet tool includes the weighting factors that were applied to each of the quantitative and qualitative evaluation criteria based on the importance of that criterion to the City. The weights were assigned based on a pairwise comparison exercise by select Subject Matter Experts (SMEs) at the City in which each criterion was individually scored against the other criteria within its respective family (Tier 1 designation) for relative criticality. The resulting scores from the SMEs were then averaged and normalized and the final scores represent the weight of each criterion.

Every project was scored by assigning a "1" through "4" score to each criterion which was then multiplied by its weight and summed for a final project score thus creating a project ranking. In selecting weighting factors, the goal was that the sum of the weighting factors would add up to a total of 100. Resulting weighting factors are provided in Table 6-4 below.

Table 6-4. Weighting Factors

	Criteria	Weight
1	FC – Frequency	17
2	FC – Severity	19
3	WQ - Pollutant Load - Quantity	6
4	WQ - Pollutant Load Quality	8
5	WQ - Treatment - BMP Effectiveness	3
6	WQ - Treatment - Flow Control	4
7	WQ - Treatment - Facility Size	3
8	AM - Risk - Age (of asset being modified/replaced)	4
9	AM - Risk – Condition	14
10	AM - Impact – Volume	4
11	AM - Impact - Damage (related to a catastrophic failure event)	6
12	AM - Impact - Safety (immediate risk to public safety in a failure event)	11

6.4.3 Prioritization Results

The sixth spreadsheet in the Excel spreadsheet tool provides a bar graph that illustrates scoring results. The bar represents the total score, and each colored segment of the bar represents a specific evaluation criterion so the user can see which criterion played the most prominent role in the scoring results for each project. When you click on the graph with your mouse, three icons appear in the upper right corner of the graph. If you select the icon that looks like a funnel, you will see the list of evaluation criteria used to score each CIP. If you hover over one of the evaluation criteria in that list, only the portion of the bar graph representing that evaluation criterion will be highlighted. In this way, the user can look at one evaluation criterion, such as flood control severity, to see how it played a role in the ultimate prioritization of projects.

Prioritization results for the City of Gresham CIPs are provided in Table 6-5, to follow. CIP locations are shown on Figure 6-2.

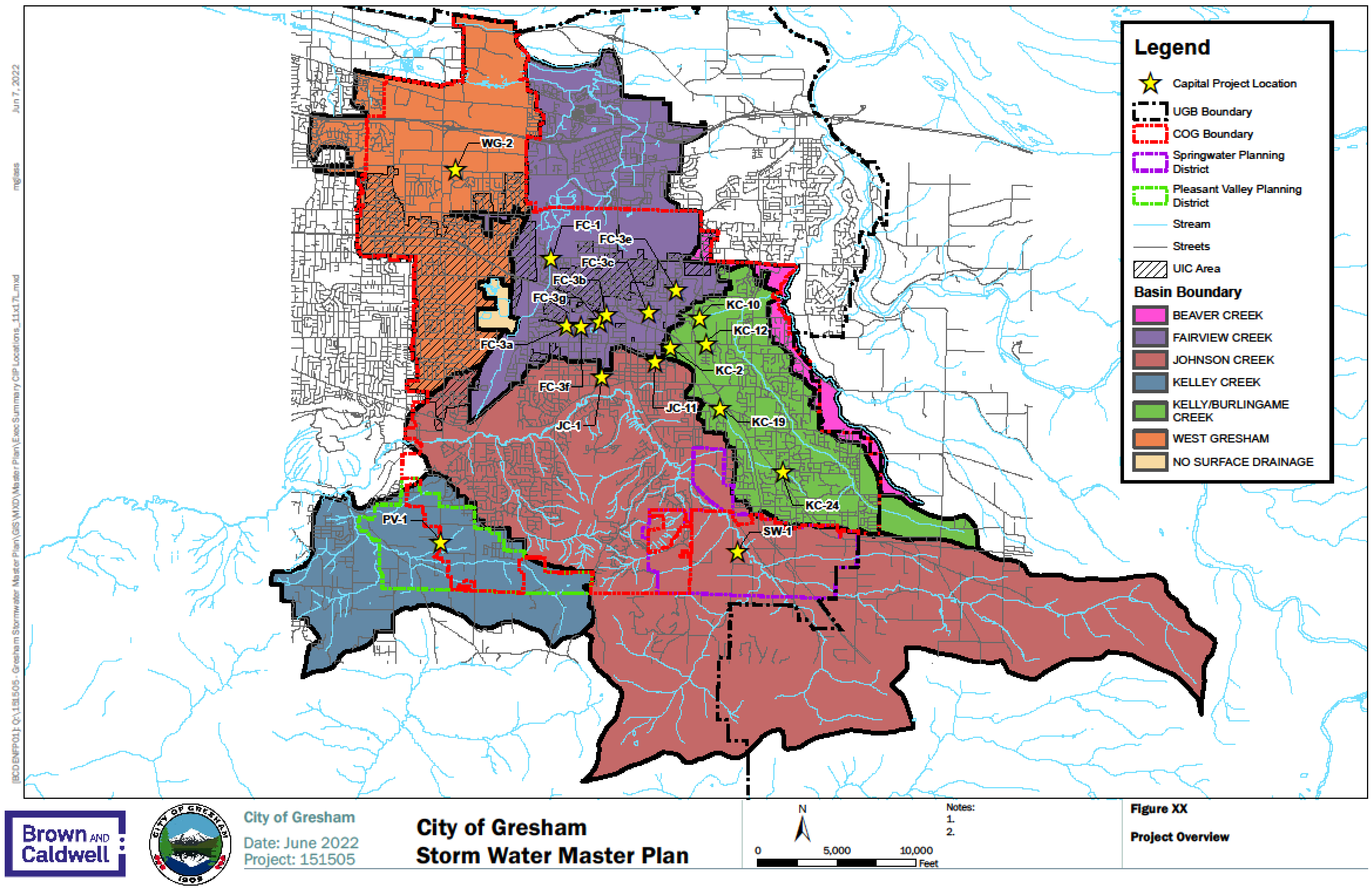

Figure 6-2 CIP Locations

Table 6-5. Capital Project Costs and Priorities			
Priority Project	CIP Number	CIP Name	Cost Estimates
1	FC-1-C and FC-1-WQ[a]	Fairview Creek Stark St. Culvert and Water Quality Swale	$520,000
2	KC-10-C and KC-10-WQ[a]	Hogan Drive Outfall Extension and Green Street Improvements on 17th and 18th	$2,992,000
3	KC-24-C and KC-24 WQ[a]	SE Salquist Rd. Pipe Improvements and Green Street Improvements on Wendy Ave. and 16th	$1,556,000
4	WG-2-C-WQ	Kirk Park/Hartley School Water Quality Facilities and Pipe Improvements	$2,210,000
5	KC-19-C	Powell and Hwy 26 Pipe Improvements	$7,149,000
6	KC-2-C	Channel Replacement Southeast of Division and Cleveland	$1,611,000
7	JC-1-C	NW 1st St./Ava Ave. Pipe Improvements	$760,000
8	FC-3b-C	NE Burnside Rd. Pipe Replacements	$3,521,000
9	KC-12-C	Division St. Pipe Improvements	$2,464,000
10	JC-11-C and JC-11-WQ[a]	Elliot Ave. Pipe Improvements and Green Street	$1,204,000
11	FC-3g-C	K-Mart Pipe Improvements	$4,823,000
12	FC-3c-C	NE 19th Ave. Parallel Pipe	$2,196,000
13	FC-3f-C	Civic Drive Pipe Improvements	$1,022,000
14	FC-3a-C	Wallula Ave. Pipe Open Channel	$671,000
15	FC-3e-WQ	Liberty Ave. Green Street	$505,000

a. *Two separate CIP fact sheets were prepared for this proposed capital project: one for capacity improvements and one for the water quality improvements. While the projects were developed to be integrated and complement each other, they may be constructed independently if needed.*

The above Table 6-5 represents the recommended final prioritized list of Stormwater CIPs for this master plan. In addition to the CIPs in the table above, the following planning and program recommendations (which were not amenable for inclusion in the prioritization exercise) are also recommended for inclusion in the CIP as detailed in Table 6-6 below.

Table 6-6. Proposed Planning Projects and Programmatic Adjustments				
Project Number	Project Name	Estimated Cost	Project Assumptions	Project Timeframe
SW-1	Springwater Planning District Trunk Lines	$13,032,000	Trunkline sizes and locations were estimated based on projected development to estimate potential costs to support SDC estimates. Specific details will change as development occurs.	Development driven.
PV-1	Pleasant Valley Planning District Trunk Lines	$12,784,000	Trunkline sizes and locations were estimated based on projected development to estimate potential costs to support SDC estimates. Specific details will change as development occurs.	Development driven.
PGM-1	Modified Drywell Program	$250,000	Installation, on an annual basis, of two MaxWell Plus® deep UICs at approximately $125k per well. Project cost may be incorporated into the infrastructure capacity improvements program.	Annually
PGM-2	CCTV Expansion	$730,000	Expand CCTV inspections beyond local roads initiative timeframe. Increase current rate of linear feet inspected per year to 108,000 LF of pipe. Mainline video inspection assumed to cost $3.60 per LF.	Annually

Table 6-6. Proposed Planning Projects and Programmatic Adjustments				
Project Number	Project Name	Estimated Cost	Project Assumptions	Project Timeframe
PGM-2	CCTV Expansion	$730,000	Expand CCTV inspections beyond local roads initiative timeframe. Increase current rate of linear feet inspected per year to 108,000 LF of pipe. Mainline video inspection assumed to cost $3.60 per LF.	Annually
CIPSW00004	Rehab & Repair of Pipe System	$1,300,000	Proposed annual obligation is in addition to the current program's $1M/year funding. Assumes approximately 430,900 LF of pipe will need to be repaired or replaced in remaining unassessed portion of system over a 50-year construction period.	Annually
PGM-3	Basin Master Plan Update	$120,000	A basin master plan update will occur every three years. The basin planning updates will rotate through the City's five major basins. Annualized estimate assumes each basin master plan to cost $360k.	Every three years

As a final note, the project prioritization method outlined in this section does not fully represent the criteria that may be used to rank projects by priority. Given the limitations of a strictly quantitative tool, the approach recognizes managerial discretion, nuance, and that some criteria cannot or should not be quantified. Examples of qualitative considerations not included in the tool are as follows:

- **Council Priorities.** Mayor and council maintain the prerogative to establish priorities based on non-engineering criteria.
- **Timing/Sequencing.** The sequencing of development or other initiatives may cause improvements to take unnatural priority due to opening/closing windows of opportunity.
- **Diversity/Equity/Inclusion.** Equitable improvements are not easily quantifiable as the City shifts its priority to improving service delivery to traditionally marginalized communities within Gresham. Relationships with historically underserved communities are better nurtured through inclusion and dialogue rather than just quantitative-based investments. This program also recognizes the disproportionate impact of system deficiencies to different communities.
- **Climate Resiliency.** Infrastructure decisions will need to account for the effects of climate change into the future, but there is not yet a clear, industry-wide approach to quantifying these needs.
- **Permit Drivers.** Instances in which project rankings must be shuffled to satisfy or anticipate various permit conditions.
- **Costs.** Whereas estimated costs are quantitative, improvements must be strategically distributed to fit within a healthy revenue forecast.
- **Emergencies.** Sudden changes in conditions may require immediate reprioritization.

The examples here also serve to demonstrate that this prioritization tool is limited. There are innumerable variables that may lead to a discretionary divergence from the findings of this tool. The intent is to use this as a preliminary ranking method for decisions and to document when and why priorities need to shift.