

GIG HARBOR STORMWATER COMPREHENSIVE PLAN 2018 UPDATE



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Prepared for:

City of Gig Harbor
3510 Grandview Street
Gig Harbor, WA 98335



Prepared By:

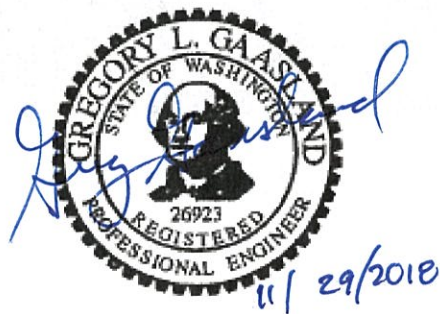
Tetra Tech, Inc.
1420 5th Avenue, Suite 650
Seattle, WA 98101

Certification

The technical material and data contained in this document was prepared by Tetra Tech, Inc., under the supervision of the below listed individuals. Those responsible staff members who are registered professional engineers are licensed in the State of Washington.



Richard L. Schaefer, P.E., LEED AP
Senior Program Manager



Gregory L. Gaasland, PE
Senior Project Manager

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FOREWORD

This document provides a periodic update to the Gig Harbor Stormwater Comprehensive Plan. As an update, this document references information provided in the 2009 Stormwater Comprehensive Plan. The 2009 plan document can be found at this link: <http://www.cityofgigharbor.net/272/2009-Stormwater-Comprehensive-Plan>.

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EXECUTIVE SUMMARY

This update to the City's Stormwater Comprehensive Plan (Plan Update) assesses conditions throughout the city affecting drainage, flooding, water quality, and riparian habitat. Based on engineering, operational and financial analyses, the Plan Update recommends capital improvements, operational measures, and a funding strategy to assure the City's management of its stormwater infrastructure protects residents and properties from flooding; provides for planned growth; preserves and protects water quality in area streams, wetlands and marine environments; promotes habitat access and utilization; and satisfies the City regulatory obligations under local, state and federal law.

This Plan update has been prepared in coordination with the City's Comprehensive Plan, and it reflects the goals and supports the objectives of the Comprehensive Plan.

The following discussion summarizes findings and recommendations for the various elements of the City's stormwater program.

Regulatory Compliance. The City has fulfilled its growing regulatory obligations under its most recent NPDES stormwater (MS4) permits. Most recently, the City adopted updated storm drainage standards and LID guidance in conformance with the current permit.

The City's MS4 permit will be renewed in August 2019, and the anticipated changes to the permit provisions are expected to increase the City's effort to comply in the areas of Education and Outreach, Illicit discharge tracking, system mapping, and in pollutant source control. Refer to Chapter 2 of the Plan Update for detailed discussion.

Watershed Conditions. The Plan Update completed a geologic analysis and infiltration assessment of the soils underlying Gig Harbor's drainage basins. Surface and subsurface soil conditions were examined to identify areas potentially suitable for shallow and/or deep infiltration of stormwater. The investigation identifies where infiltration may be a feasible technique to dispose of storm runoff as either a cost-effective alternative to increasing the capacity of an overloaded drainage system, or a preferred means of controlling runoff on-site as properties develop or redevelop.

The recommended management strategy for the Garr Creek tributary, parallel to and east of 38th Avenue NW, is to promote shallow infiltration of stormwater to better control peak flows and to support base flows in this fish-bearing stream. Refer to Chapter 3 for details of the watershed characterizations.

Storm System Analysis. Modeling of flows within the major storm drainage trunk systems was updated with projected land uses, rainfall data more representative of local conditions in Gig Harbor, and more rigorous hydraulic analysis. This Plan Update expanded the number of modeled trunk systems from seven to ten. The modeling results, along with corroborating observations of City staff, identified segments of the trunk systems with insufficient capacity to properly convey anticipated 25-year return period flows under future build-out land use conditions.

In addition to the Trunkline systems, the hydraulic capacities of other outfalls along Harborview Drive were assessed for their abilities to convey future buildout 100-year return period peak discharges. These analyses were conducted to: (1) identify potential capacity issues that may suggest priority rehabilitation or replacement of these older facilities, and (2) inform policies surrounding the on-site flow control requirements for developing and redeveloping properties within the tributary drainages. All but one of the 21 additional outfalls have sufficient hydraulic capacity; however, several outfalls are experiencing scour of the soils supporting the outfall pipe structures, and their condition is expected to further deteriorate.

The Capital Improvement Plan identifies more focused analysis of outfall structures and follow-up repairs. The storm system analyses are described in Chapter 4 of this Plan Update.

Capital Improvement Plan. Chapter 5 of this Plan Update presents recommended storm system improvements for the Capital Improvement Plan (CIP) to meet the needs of the environment, future development and growth. The types of improvements identified and scheduled include condition (renewal), capacity, facility and habitat-driven projects. Also included are habitat studies and annual programs such as general storm system repairs and mapping. Storm system and habitat improvement projects identified in the CIP are based on the staff's knowledge of the service conditions in the storm drainage network, prior studies, and the storm system analysis. The resulting CIP is summarized in Table 5-1; the targeted implementation dates for the projects indicate their relative priority.

Operations and Maintenance. Operations and maintenance (O&M) is critical to both reliable performance and dependable function of the city's drainage infrastructure, and to meeting water quality objectives and regulatory compliance. Many of the City's regulatory compliance obligations are operational in nature: inspections, specific maintenance activities, mapping, monitoring, development standards, public outreach, and training. As noted above, the City has been meeting its operational responsibilities under its current and recent NPDES MS4 permits. With additional compliance activities anticipated in the 2019 permit, plus the implementation of the Cartegraph asset management system to realize maintenance and repair efficiencies, it is recommended that operations staffing be increased by 1.0 FTE.

The City is responsible for an extensive network of inlets, catch basins, pipes, culverts, ditches, outfalls, ponds, vaults, tanks, bioretention swales, rain gardens and other hydraulic and treatment facilities. This inventory has grown substantially over the past decade with continuing development and annexations to the City. The City inspects, maintains and repairs city-owned infrastructure; for privately owned facilities that discharge to the City's drainage system, the City performs regular inspections and, where indicated, provides technical guidance.

Growth in the storm drainage network reflects both annexations and robust development within the city. With system growth comes demands for development reviews, inspections, and system maintenance repairs and rehabilitation. Despite growth in construction activity and storm drainage system inventories, the stormwater programs staffing levels have remained flat for several years. It is recommended maintenance activities be expanded in the areas of catch basin cleaning, routine video inspection of older storm drains, ditch clearing and maintenance; this added maintenance is estimated to require the addition of 1.0 FTE.

Revisions to the City development standards are recommended in two areas:

Direct discharge. To minimize further degradation of outfall conditions from excessive scour, the Stormwater and Site Development Manual should restrict permitting of direct discharge of stormwater without flow control to only projects on parcels that directly abut saltwater bodies and do not discharge stormwater runoff through municipal stormwater systems.

Seasonal work limitations. While the City's standards require phasing of construction site work during the wet season, more specific limitations on the extent of open disturbed ground are recommended to mitigate the risk of large failures on construction sites.

Program Finance. The Plan Update presents in Chapter 7 a review of the stormwater utility's financial performance and a forecast of future operating and capital expenses projected over ten years. The analysis projects operating revenues, operating expenses, debt payments, capital revenues, and planned capital improvements through 2027. The resulting cash flow analysis indicates that the stormwater utility will need to issue debt to fund its share of the decant facility and Harborview Drive sediment vault in 2019 and the Crescent Creek culvert replacement in 2025. The City expects to issue revenue bonds in 2019 for

the stormwater utility as well as the water and wastewater utilities and therefore will minimize bond issuance costs.

Implementing 3% annual rate adjustments and issuing the specified debt will enable the utility to fund ongoing operations, staff increases, new debt service, and fund scheduled capital improvements. It is important that the City monitor growth because revenues from general facility charges are a significant source of funds needed to pay for the planned capital improvements.

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1. INTRODUCTION

This update to the City's Stormwater Comprehensive Plan assesses current conditions throughout the city affecting drainage, flooding, water quality, and riparian habitat. Based on engineering, operational and financial analyses, the Plan recommends capital improvements, operational measures, and a funding strategy to assure the City's management of its stormwater infrastructure protects residents and properties from flooding; provides for planned growth; preserves and protects water quality in area streams, wetlands and marine environments; promotes habitat access and utilization; and satisfies the City regulatory obligations under local, state and federal law.

This Plan update has been prepared in coordination with the City's Comprehensive Plan, and it reflects the goals and supports the objectives of the Comprehensive Plan.

The Stormwater Comprehensive Plan has a ten-year planning horizon, from 2018 through 2027. A number of the Plan's recommendations respond to the City's obligations under its current NPDES MS4 permit, and also anticipates provisions of the next re-issue of the permit to take effect August 2019.

In May 2017, Tetra Tech was authorized to proceed with preparation of an update to the City's 2009 Stormwater Comprehensive Plan. The work is summarized in the following chapters in this document:

- Stormwater Regulations

- Service Area

- Storm System Analysis

- Capital Improvement Plan

- Operations and Maintenance

- Finance

This plan is a collaborative effort between City staff, Tetra Tech, and partner firms: Peninsula Financial Consulting, and Associated Earth Sciences, Inc. This plan intentionally avoids reiterating the contents of the 2009 Plan, but instead focuses on changes and conditions that have arisen over the past nine years, and on preparing the City for anticipated changes.

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2. STORMWATER REGULATIONS

The City of Gig Harbor manages stormwater to meet multiple objectives: protecting lives and property from damage by storm runoff; protecting water quality in receiving water bodies; and protecting riparian habitat, associated natural environments, and critical areas from the effects of storm runoff and pollution it conveys. City policy guiding stormwater management is embodied in the City's Comprehensive Plan and in city ordinances and regulations.

The City's stormwater management practices are also shaped by federal and state regulations, the most significant being regulations promulgated through the Federal Clean Water Act. Federal authority to enforce Clean Water Act provisions in Washington State is delegated to the Washington State Department of Ecology. Other regulations significantly influencing the City's management of stormwater and related land use actions include the Federal Endangered Species Act, and the state's Puget Sound Water Quality Management Plan.

The 2009 Stormwater Comprehensive Plan describes the origin, scope and authorities of these regulations. This section of the update describes changes to regulations since the 2009 plan was published that substantially affect the City's operation of its stormwater system.

CITY OF GIG HARBOR COMPREHENSIVE PLAN

This Stormwater Comprehensive Plan update has provided input to the concurrent updating of the City of Gig Harbor Comprehensive Plan, most specifically to the plan's Utilities Element and the Capital Facilities Element of the Plan.

This Stormwater Comprehensive Plan update was prepared consistent with the land uses established in the Comprehensive Plan, most substantially with respect to impervious area densities applied in the hydrologic modeling that correspond to the land uses and zoning defined in the Comprehensive Plan.

The operation of the City's stormwater program historically have been guided by the policies in the City's Comprehensive Plan, and they conform to the policies contained in the current draft of the Comprehensive Plan update.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

Through the Clean Water Act and other legislation at the federal level, the Washington State Department of Ecology (Ecology) has been delegated the authority to implement rules and regulations that meet the goals of the Clean Water Act. As part of these rules and regulations, Ecology first issued the Western Washington Phase II Municipal Stormwater Permit (Permit) to the City of Gig Harbor in January 2007. This permit was reissued effective August 1, 2013 for a five-year term, was amended in 2014, and its term extended for a sixth year to expire July 31, 2019. The Permit authorizes the discharge of stormwater to surface waters and to ground waters of the State from Municipal Separate Storm Sewer System (MS4) owned or operated by the City of Gig Harbor.

As a permittee, the City is required to satisfy specific obligations in establishing local stormwater development standards, performing facility inspections and maintenance, participate in water quality monitoring, provide related public involvement and education opportunities, and report annually on stormwater programs and activities. The City has successfully implemented their obligations under the 2013 permit. The City's obligations have increased with successive permits; by example, in 2016 the City adopted updated its stormwater regulations incorporating low impact development (LID) techniques as the preferred approach to site development.

The current MS4 permit was scheduled to expire on July 31, 2018; however, the expiration date has been extended to July 31, 2019 to coincide with the release of the next edition of the Department of Ecology's Surface Water Management Manual for Western Washington. It is anticipated the City's obligations will again increase under the next permit renewal, scheduled for 2019.

The provisions of the next MS4 permit have not been finalized, and a draft permit is anticipated to be released for public comment over the summer of 2018. Based on the preliminary draft permit language released in October 2017 and subsequent meetings, the following discussion presents the anticipated changes in requirements and their expected impacts on City resources.

MS4 PERMIT CHANGES

S5.C.1 Education and Outreach

Updates are intended to increase effectiveness of behavior change through education and outreach. These include clarification on the approach and strategies that go beyond individual permittees to include regional outreach approaches. The city will need to conduct a new evaluation of effectiveness of the current behavior change program, documenting lessons learned and strategy to improve effectiveness moving forward. The update removes the requirement for reporting of one specific target audience as is required under the current permit.

Impacts to Gig Harbor: Overall, the level of effort required to comply with the proposed education and outreach provisions is elevated from current compliance requirements. This can be mitigated through collaborating with other MS4s, particularly Pierce County and the West Sound Stormwater Outreach Group, in conducting joint assessments, sharing strategies, and joint implementation.

S5.C.3 IDDE tracking and reporting

Data for all potential illicit discharges found during the year must be submitted in the annual report. Summary to be formatted in WQWebIDDE or the City's own system, but the final submittal must follow the WQWebIDDE schema. Intent is for permittees with <50 incidents to use the Ecology tracking and form through Ecology's web portal. These now include not only illicit discharges, but the updated requirements expand reporting to identified potential (not necessarily confirmed) illicit discharges and the actions taken to investigate the incidents.

Impacts to Gig Harbor: The City's reporting efforts are expected to expand to report all identified potential discharges (not just confirmed discharges) along with documentation of investigative efforts. Recommended the City develop templates and training for reporting that can be efficiently uploaded to Ecology's web portal.

S5.C.X Mapping

This is a proposed new permit section, with mapping requirements removed from the IDDE section of the permit. Updates to the previous mapping requirements additionally require mapping of geographic areas served by the City's MS4 that do not discharge stormwater to surface waters (i.e. areas that drain to on-site infiltration BMPs or permeable pavement); connections between the City's MS4 and abutting County MS4; mapped outfalls with size, material, and locations wherever known; and permanent stormwater facilities owned and operated by the City. The new electronic mapping standards are to be incorporated by August 1, 2021.

Impacts to Gig Harbor: The City's GIS database of public facilities is well-developed, and limited data gaps were identified during the watershed characterization and modeling completed with this plan update.

There are data gaps for older on-site facilities which should be addressed over time. It is recommended that new development projects be directed to provide the City with mapping data for storm drainage improvements, infiltration systems, and tributary drainage basins consistent with the expanded requirements under the new permit. When conducting planned outfall inspections, the necessary data should be recorded and incorporated to the City's GIS database.

S5.C.5 Controlling Runoff – site and subdivision scale

These requirements relate to the adoption of the 2019 Surface Water Management Manual for Western Washington (SWMMWW). The new SWMMWW is not expected to introduce substantive changes in requirements for development; rather, the manual will be reformatted to improve usability and will correct errors. The permit will require the City standards to reference the new manual (or a compliant manual, such as Pierce County's).

Impacts to Gig Harbor: This update is not projected to significantly impact the City outside of procedural efforts to revise references in City standards and codes.

S8. Monitoring

Revisions to the payment amounts due to annual payment during 5-year period rather than 4 payments during the 5-year period.

Impacts to Gig Harbor: The update proposes to increase the City's annual payments by \$100 to a revised total of \$4,995 per year.

S5.C.X Source Control

Ecology is proposing to add to the Phase II MS4 permit requirements to develop and implement a source control program for existing development. This requirement is modeled on an existing provision in Phase I permits. The intent of the program is to develop proactive and preventative measures to address pollution that could be released to the City's storm drainage system and receiving waters. The program relies on local authority to inspect businesses and properties and, if necessary, require operational or structural controls to prevent pollution from being discharged. Components of the program include:

- Adopting authority to require the use of BMPs to address pollution from existing land uses and activities
- Developing an inventory of businesses/properties
- Inspections of properties
- Progressing compliance strategy, including authority to inspect and enforce
- Staff training

The schedule proposed by Ecology provides two years to adopt necessary ordinances and develop an inventory of businesses, with inspections commencing 6 months later. Twenty percent of the businesses would be inspected each year.

Impacts to Gig Harbor: The new permit section poses substantial additional compliance efforts on the City, including the adoption of new authorities, staff training, development of a business inventory, and inspections/enforcement. There is a collaborative opportunity that can reduce the burden on the City to maintain training levels among staff for such a program: There exists within Ecology's Hazardous Waste Program a Local Source Control (LSC) Partnership

(<https://fortress.wa.gov/ecy/publications/documents/1604006.pdf>) comprised of local governments to provide on-site technical assistance to help small businesses identify and address pollution sources. Nearby jurisdictions with trained staff participating in the LSC Partnership include City of Puyallup, City of

Sumner, Tacoma-Pierce County Health Department, Kitsap County Public Works, and Kitsap Public Health District.

3. SERVICE AREA

STUDY AREA

The study area for the Stormwater Comprehensive Plan Update generally encompasses the city limits of Gig Harbor, as well as the adjacent urban growth area (UGA). This chapter summarizes the service area conditions as they relate to stormwater and surface water conditions, focusing on changes that have occurred since the 2009 plan was prepared.

Figure 3-1 depicts the study area which is situated on the Gig Harbor Peninsula. The urbanizing footprint of Gig Harbor has continued to grow, particularly with residential development to the north, and additional development along the SR16 corridor. Redevelopment and infill development is active in the city center. There have been no significant annexations to the City since 2009; however, growth is projected to continue, expanding the City's resident population and employment as indicated in Table 3-1. With projected annual growth rates of 2 percent and 0.5 percent for population and employment, respectively, the intensity and overall footprint of urbanization within the UGA will increase and place pressure upon the built and natural drainage systems.

Table 3-1: Population Projections

Year	Population	Employment
2010	7,126	9,155
2030	10,500	10,189
Maximum capacity	14,500	14,760

PHYSICAL CHARACTERISTICS

The physical properties of the landscape that determine hydrology include topography, geology, surficial soils, vegetation, and impervious surfaces. Considerable background information is provided in the 2009 Plan; discussion in this section provides updates and expansion upon the prior document.

TOPOGRAPHY

The topography of the study area defines drainage basins, and the slope of the land affects the retention of precipitation and the rate at which water runs off. Hydrologic modeling performed in analyzing the City's storm drainage system performance represents the slope of the land, as shown in Figure 3-2. The slope is delineated in incremental gradations of low (up to 5 percent), moderate (5 to 15 percent) and steep (greater than 15 percent) corresponding to data input to the hydrologic modeling.

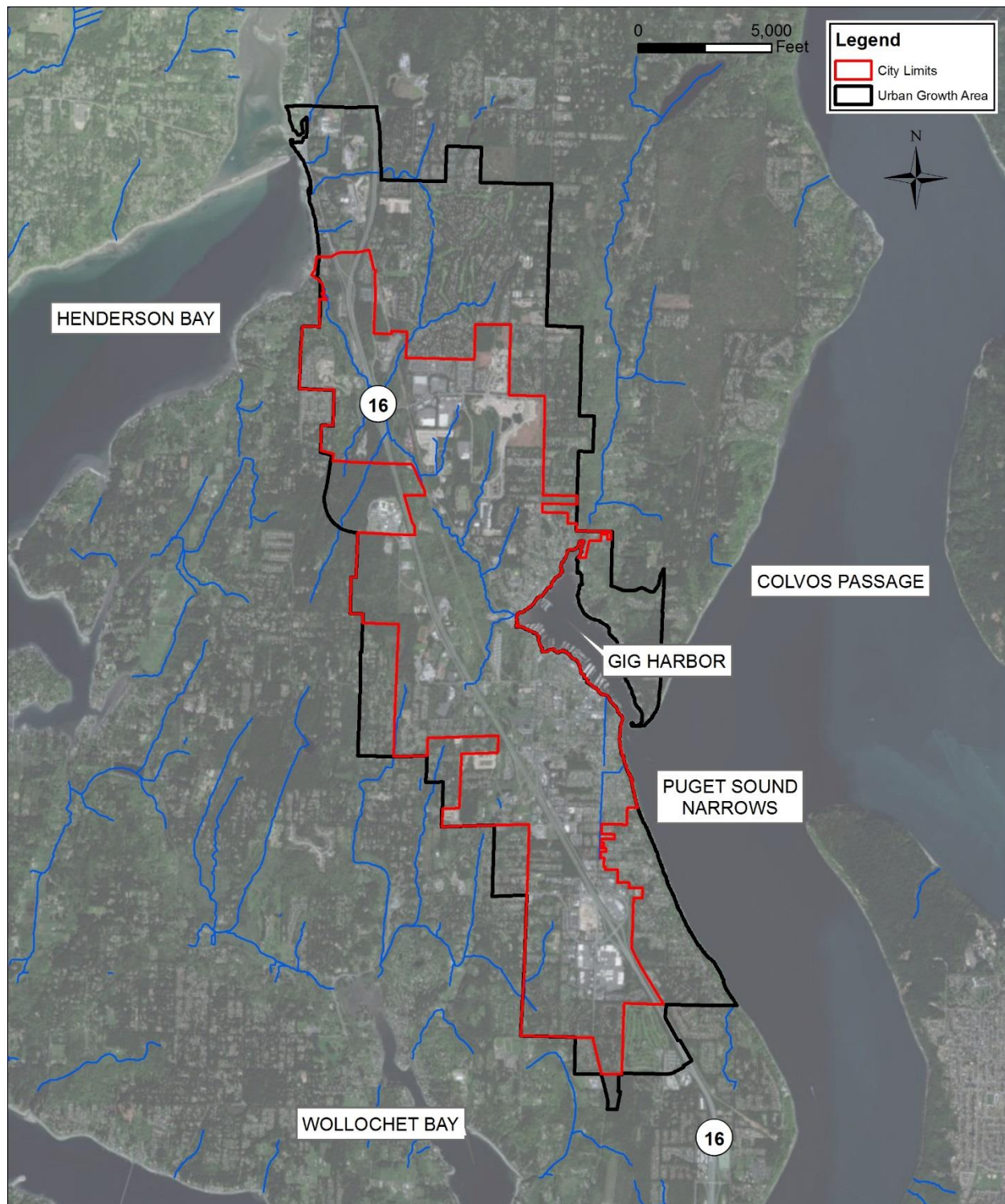


Figure 3-1: Planning Area

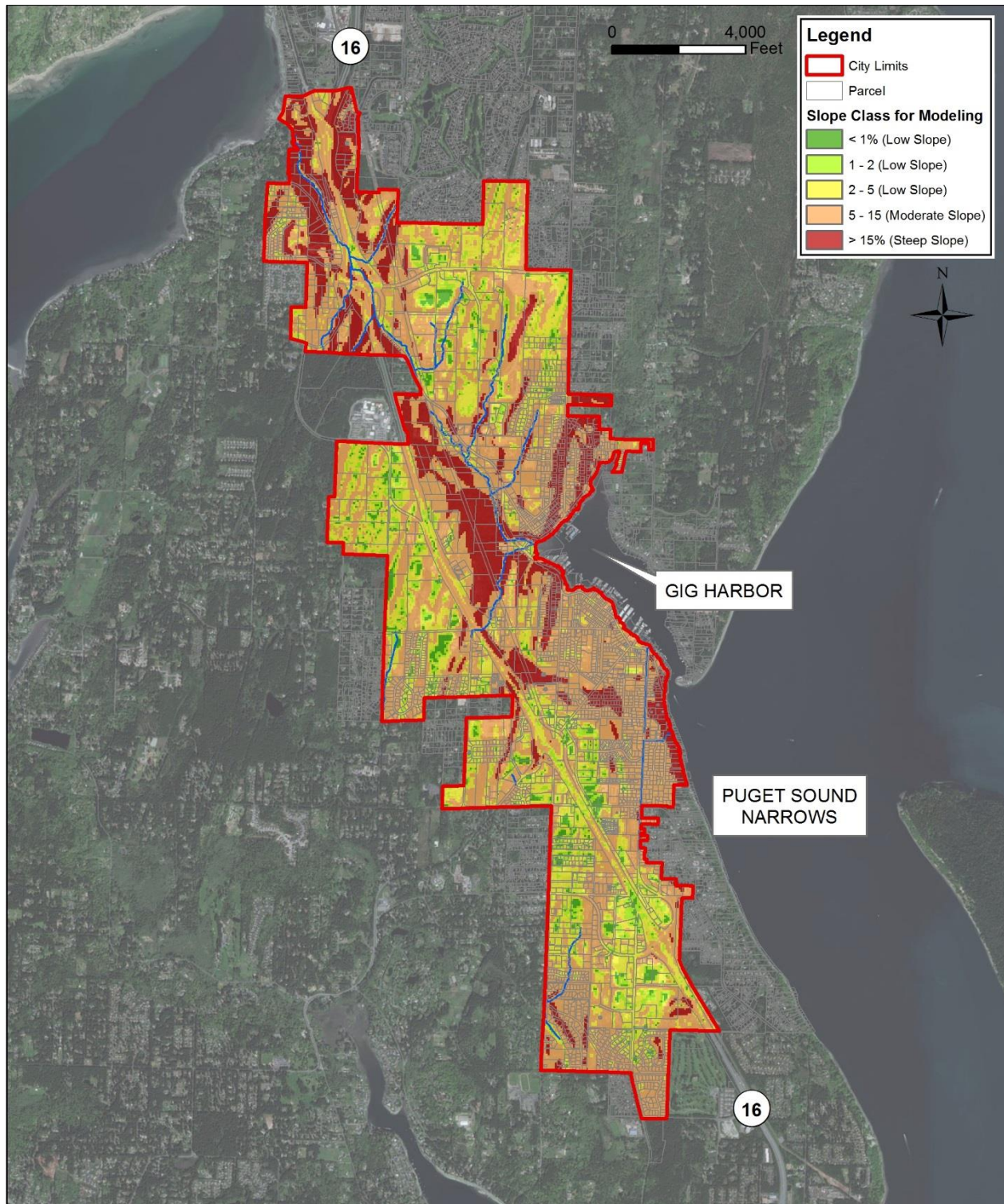


Figure 3-2: Ground Slopes within Planning Area

LAND USES

Land uses define properties of the ground surface and its corresponding properties in translating precipitation to runoff. Land uses are regulated under the City's Comprehensive plan, and in greater detail under its zoning code. Critical areas regulations, in part, restrict land uses in areas of steep slopes, landslide and erosion hazards, seismic hazards, flood hazards, habitat, and aquifer recharge.

With greater land use intensity, ground surfaces are increasingly covered with impervious surfaces, with maximum impervious area lot coverage ranging from 40 to 80 percent depending on the applicable zoning classification. Impervious surfaces are most efficient in generating runoff meaning that rain falling on pavements, rooftops, compacted ground and other impermeable surfaces runs off more rapidly to drainage collection systems and then to receiving waters. Figures 3-3 through 3-11 delineate the zoning across the ten main watersheds modeled within the Gig Harbor and indicate the estimated impervious area density within each zone under full buildout conditions. The hydrologic and hydraulic modeling analyses of the City's drainage networks was performed assuming the indicated impervious densities.

Undeveloped land in the Gig Harbor area is typically densely covered with forest and brush understory, providing significant interception, storage and evapotranspiration of rainfall. The pervious areas within developed landscapes feature evenly graded ground with less intense vegetation such as grass lawns and landscaped area; vegetated ground within developed areas has largely been trafficked by construction equipment, compacting the surface soils. This ground provides substantially less retention of rainfall than native vegetation. Guidelines for developing property using Low Impact Development (LID) practices were recently adopted by Gig Harbor; these practices can improve the ability of sites to retain runoff and enhance the quality of runoff discharged from the site.

GEOLOGY AND SOILS

Surficial geologic conditions within the City are primarily the result of multiple periods of continental glaciation, during which a vast ice sheet advanced south from the mountains of British Columbia as a broad ice tongue called the "Puget lobe" and covered much of the Puget Lowland during the last 2.4 million years. During each glacial advance and retreat, rivers emanating from the ice sheet deposited thick sequences of coarse-grained material (glacial outwash) and glacial till (an assorted mixture of sand, silt, clay and gravel). The outwash deposits are typically permeable and form the primary aquifers from which ground water is drawn, while till is less permeable.

Following the retreat of the Vashon-age ice sheet in the Gig Harbor study area, modern streams incised through Vashon-age outwash sediments. Mass-wasting deposits of landslides and colluvium (small incoherent deposits from upper slopes) are common along the margins of incised drainages. Post-glacial streams, such as McCormick Creek, North (Donkey) Creek and Crescent Creek created relatively steep slopes that expose pre-Vashon-age sediments in the valley walls near the creek outlets to Henderson Bay and Gig Harbor. Narrow bands of alluvium have been deposited within the stream channels and are composed mainly of sand and gravel. Wetlands occur throughout the study area, particularly in closed depressions in the till-mantled surface.

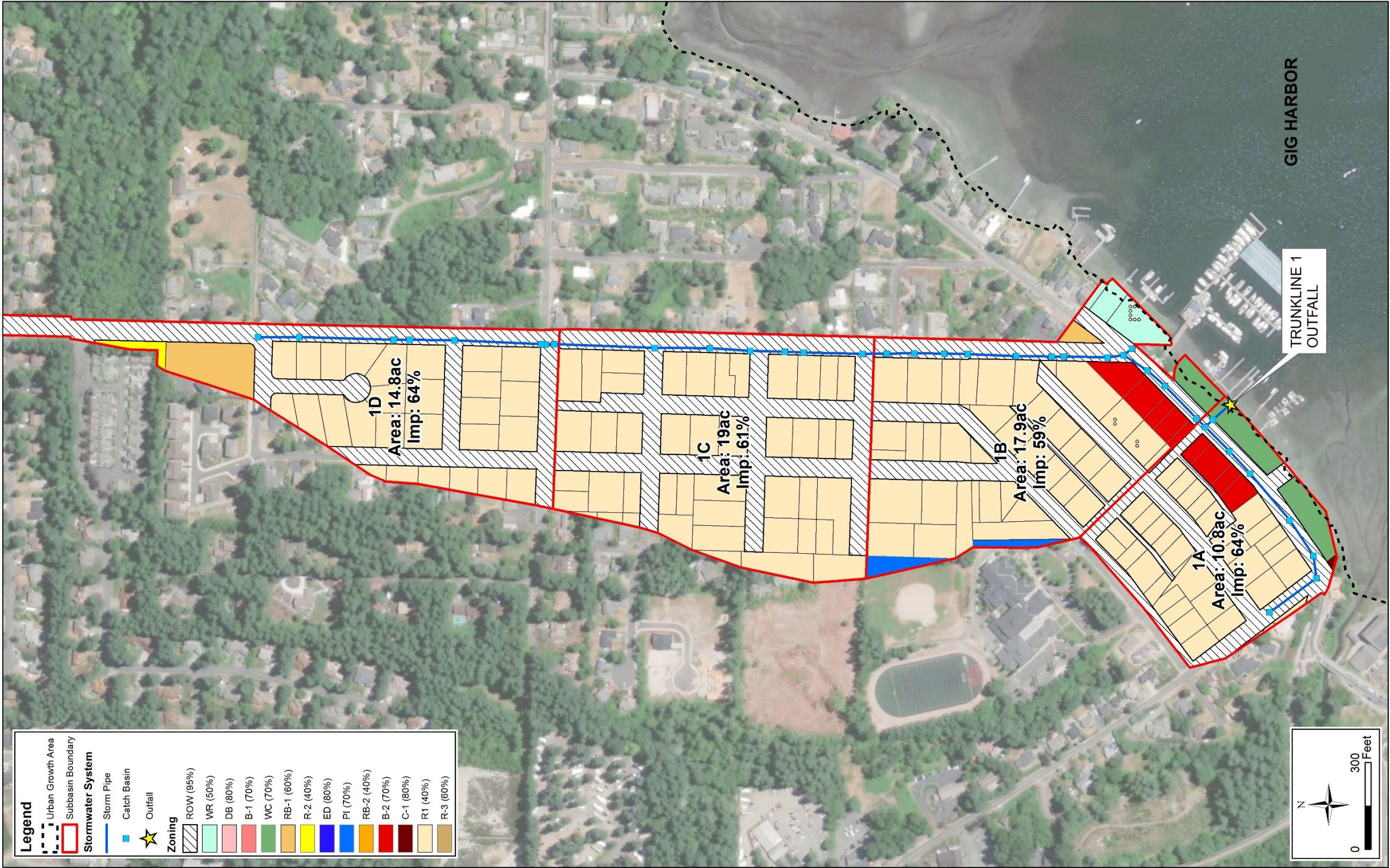


Figure 3-3:Trunkline 1 Zoning and Impervious Surface Area Densities

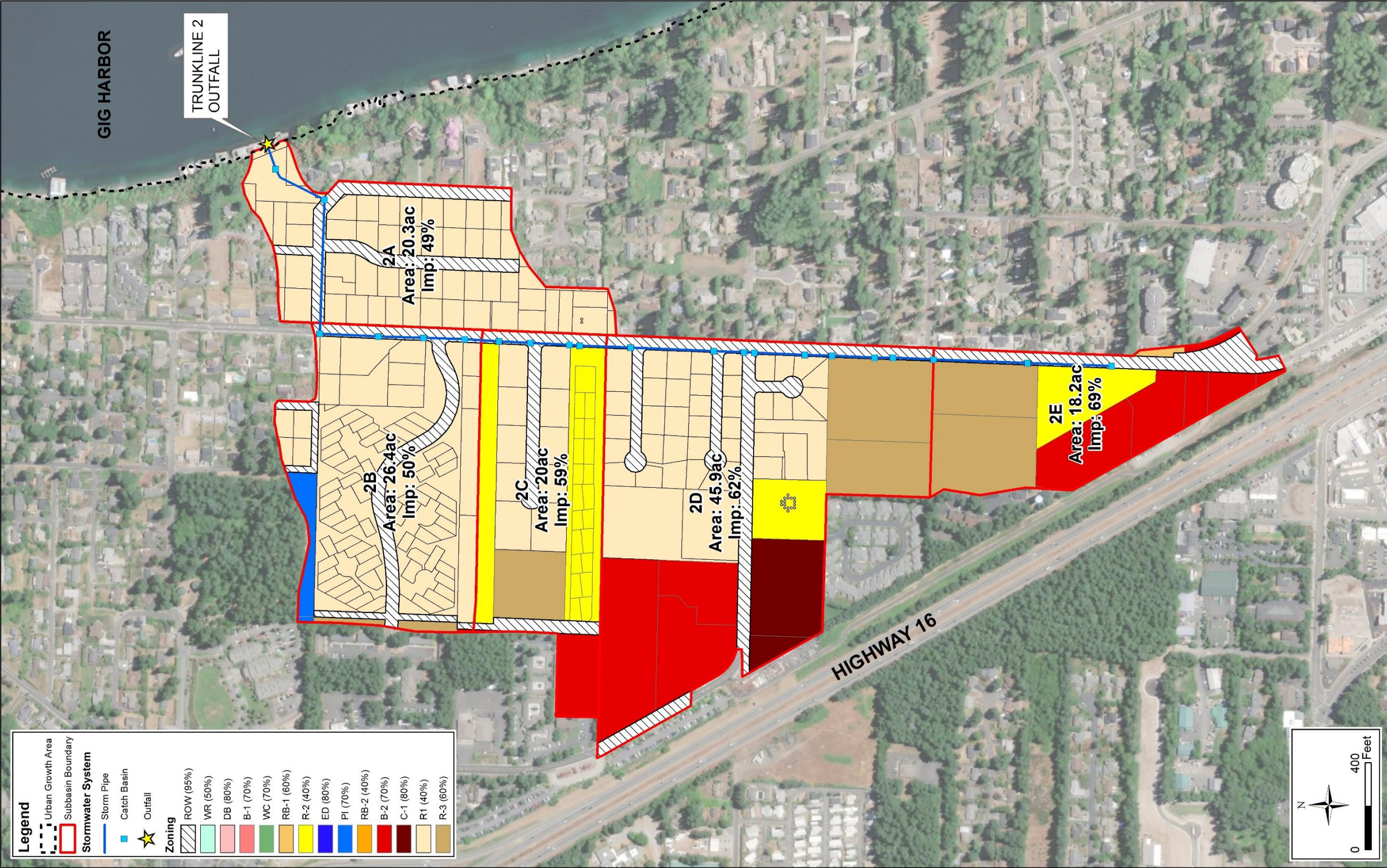


Figure 3-4:Trunkline 2 Zoning and Impervious Surface Area Densities

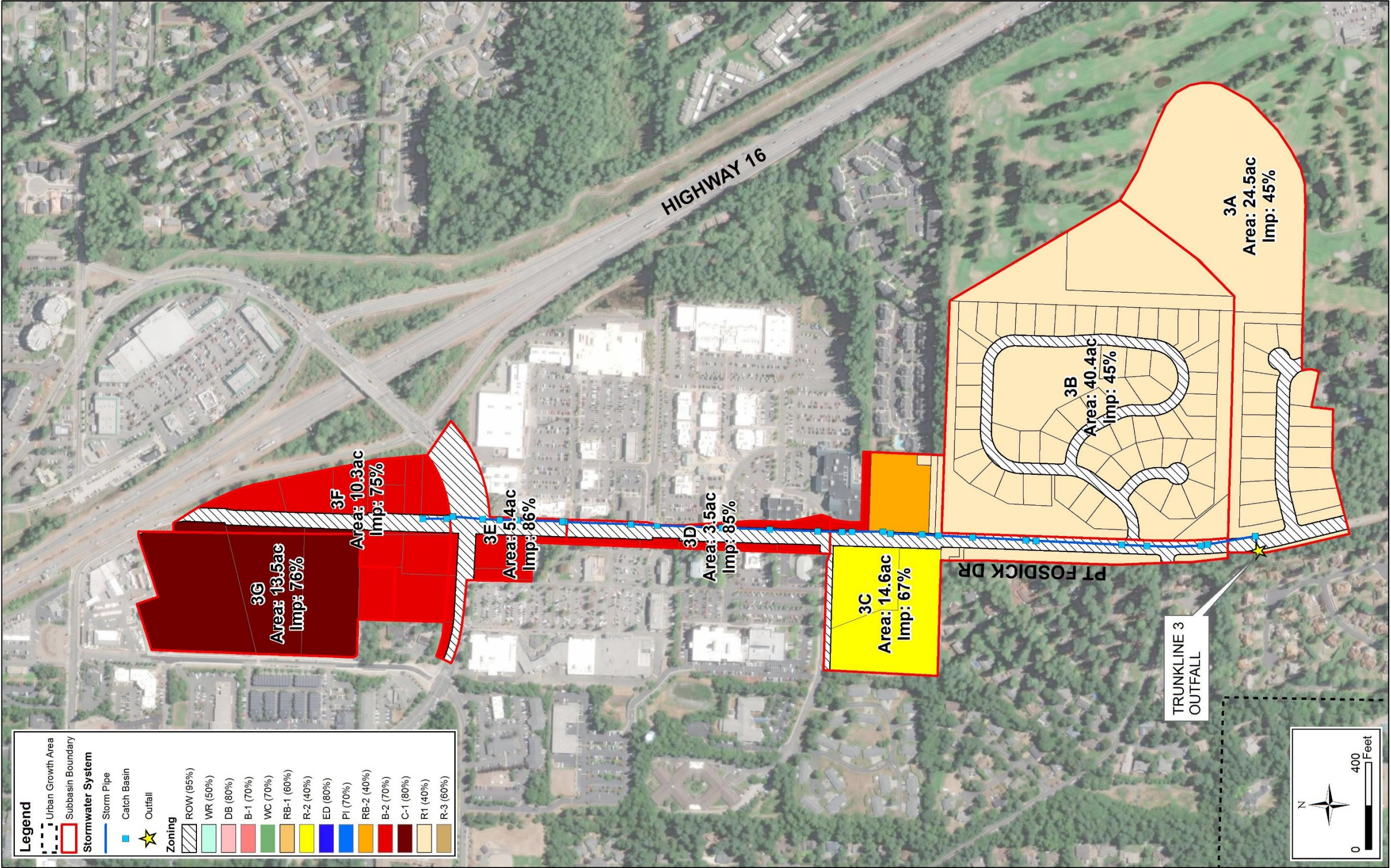


Figure 3-5:Trunkline 3 Zoning and Impervious Surface Area Densities

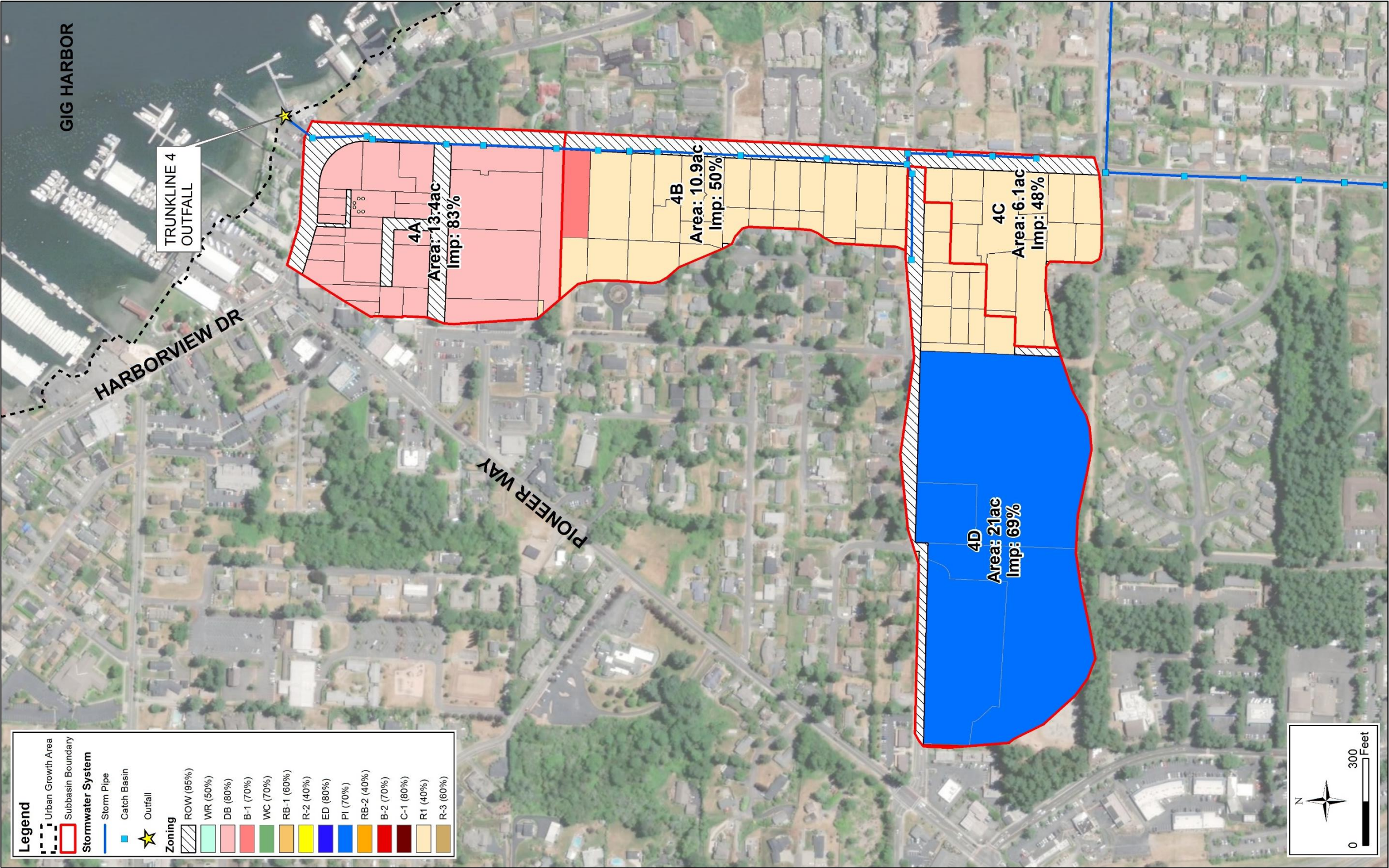


Figure 3-6:Trunkline 4 Zoning and Impervious Surface Area Densities

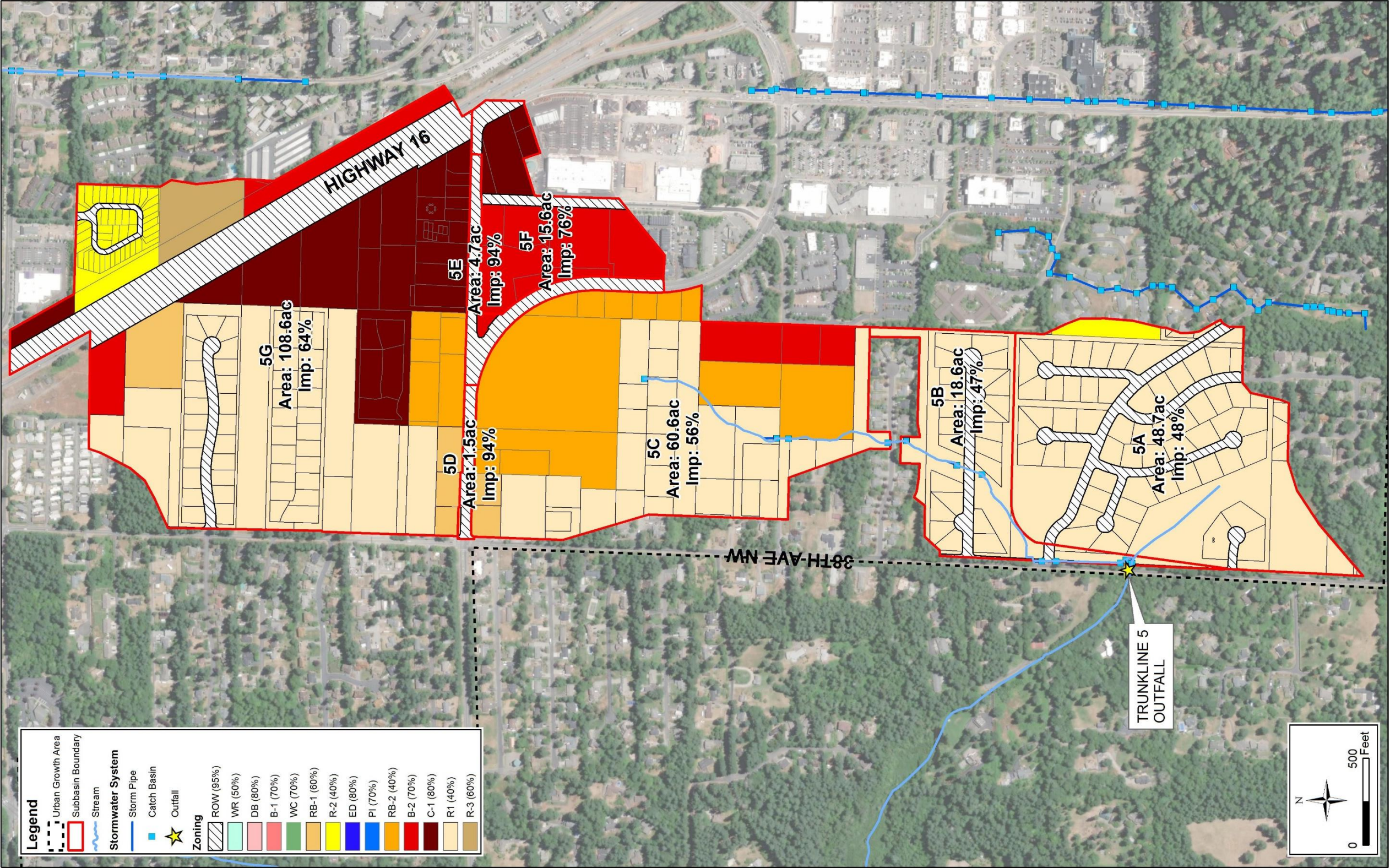


Figure 3-7:Trunkline 5 Zoning and Impervious Surface Area Densities

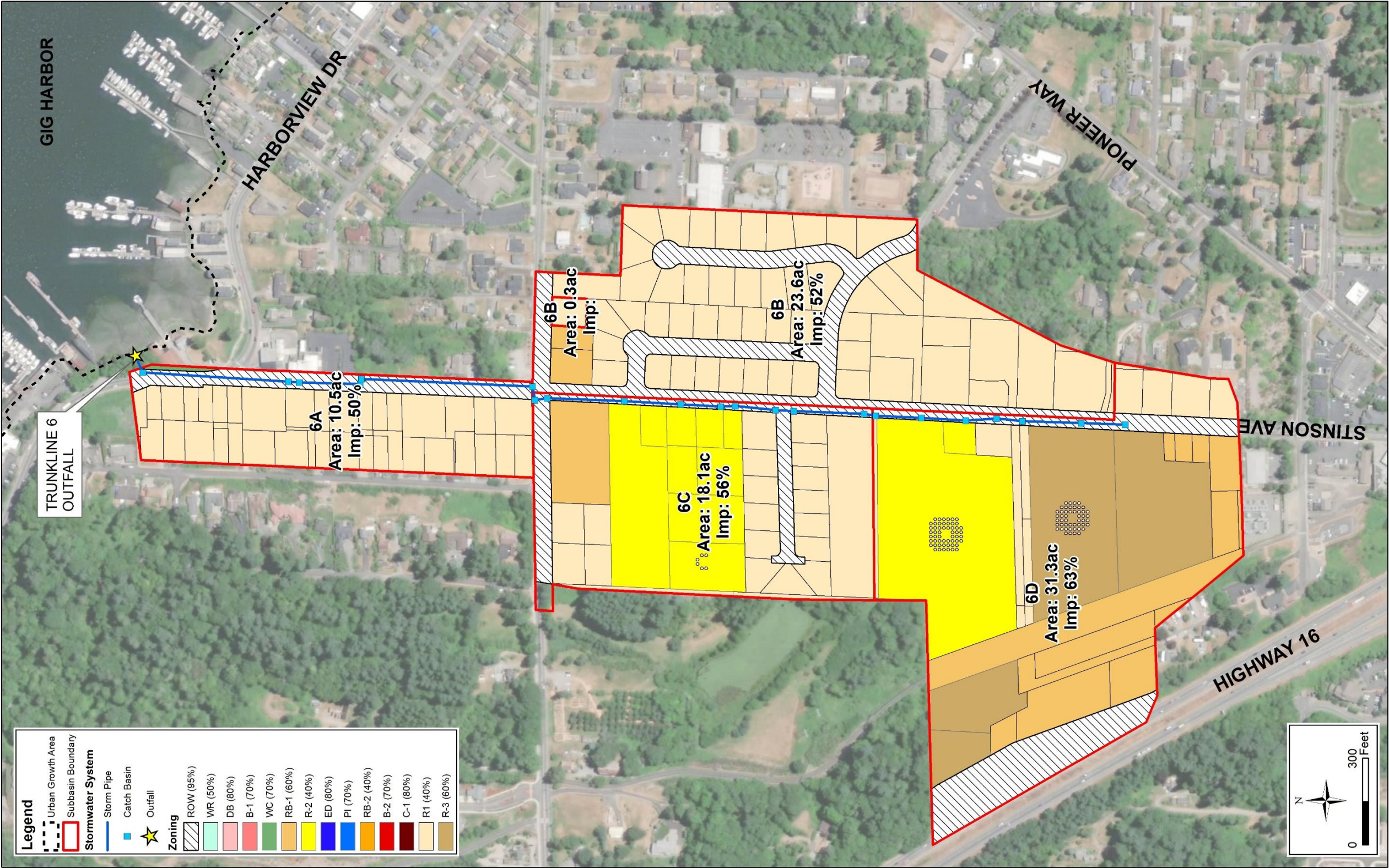


Figure 3-8:Trunkline 6 Zoning and Impervious Surface Area Densities

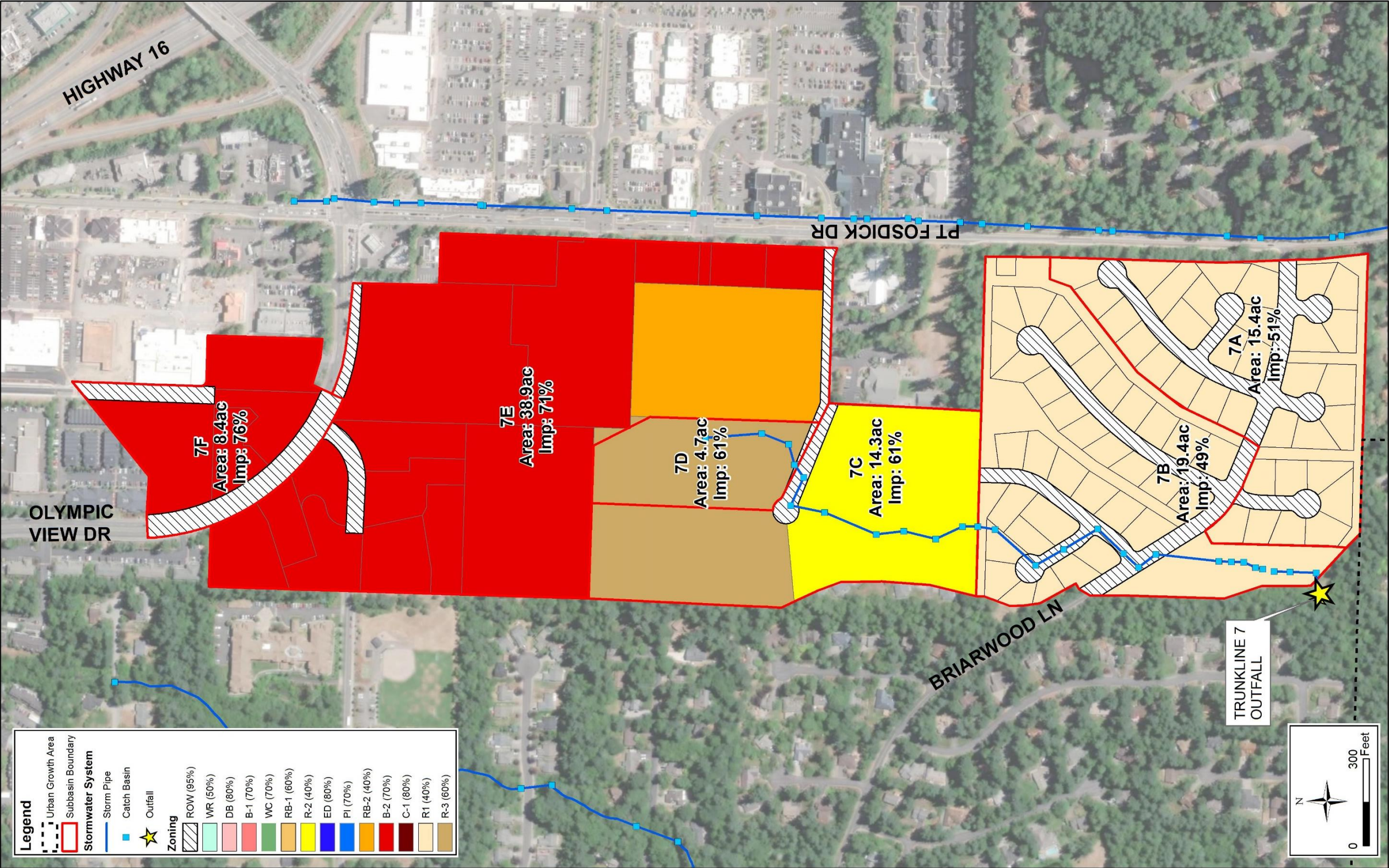


Figure 3-9:Trunkline 7 Zoning and Impervious Surface Area Densities

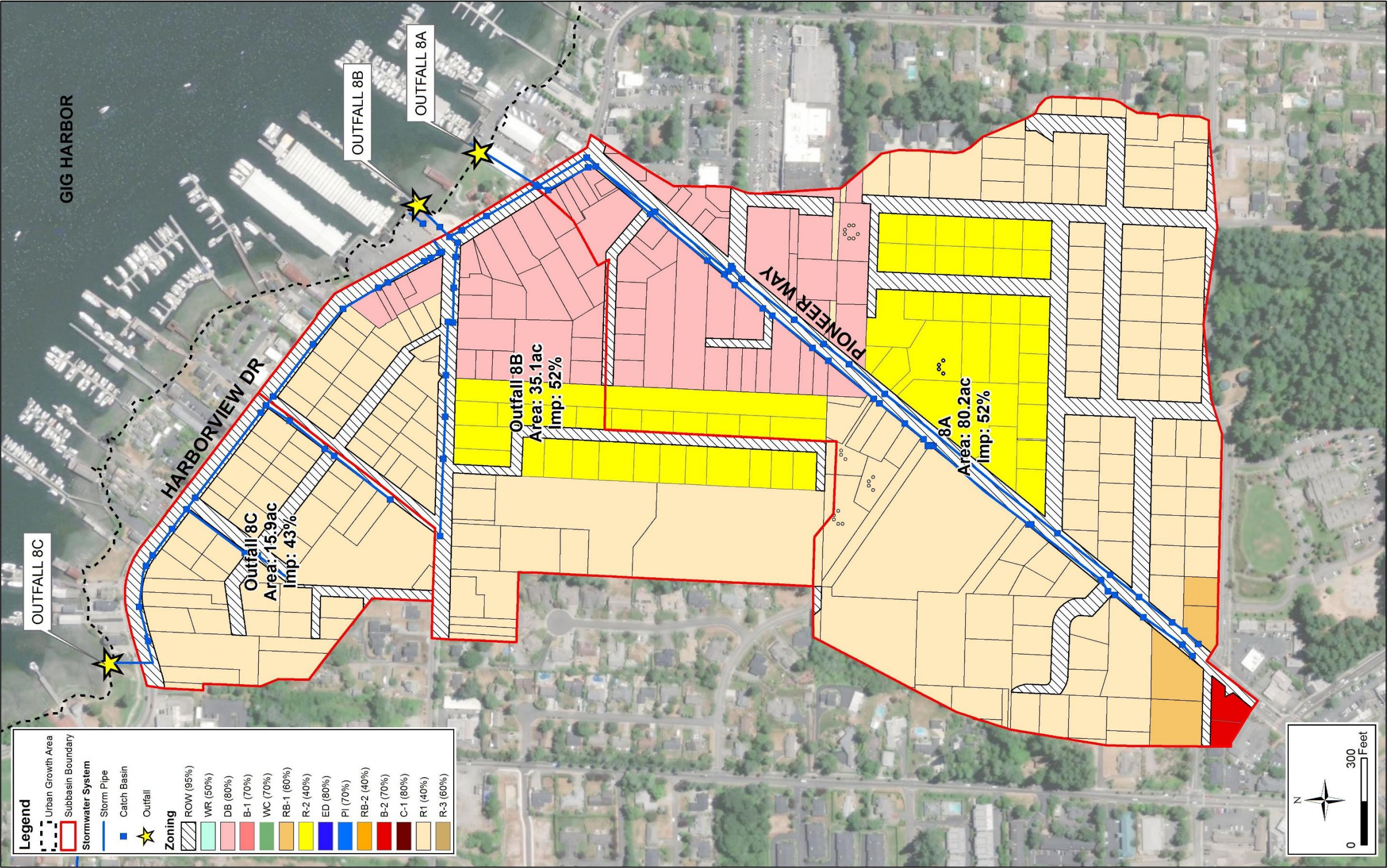


Figure 3-10:Trunkline 8 Zoning and Impervious Surface Area Densities

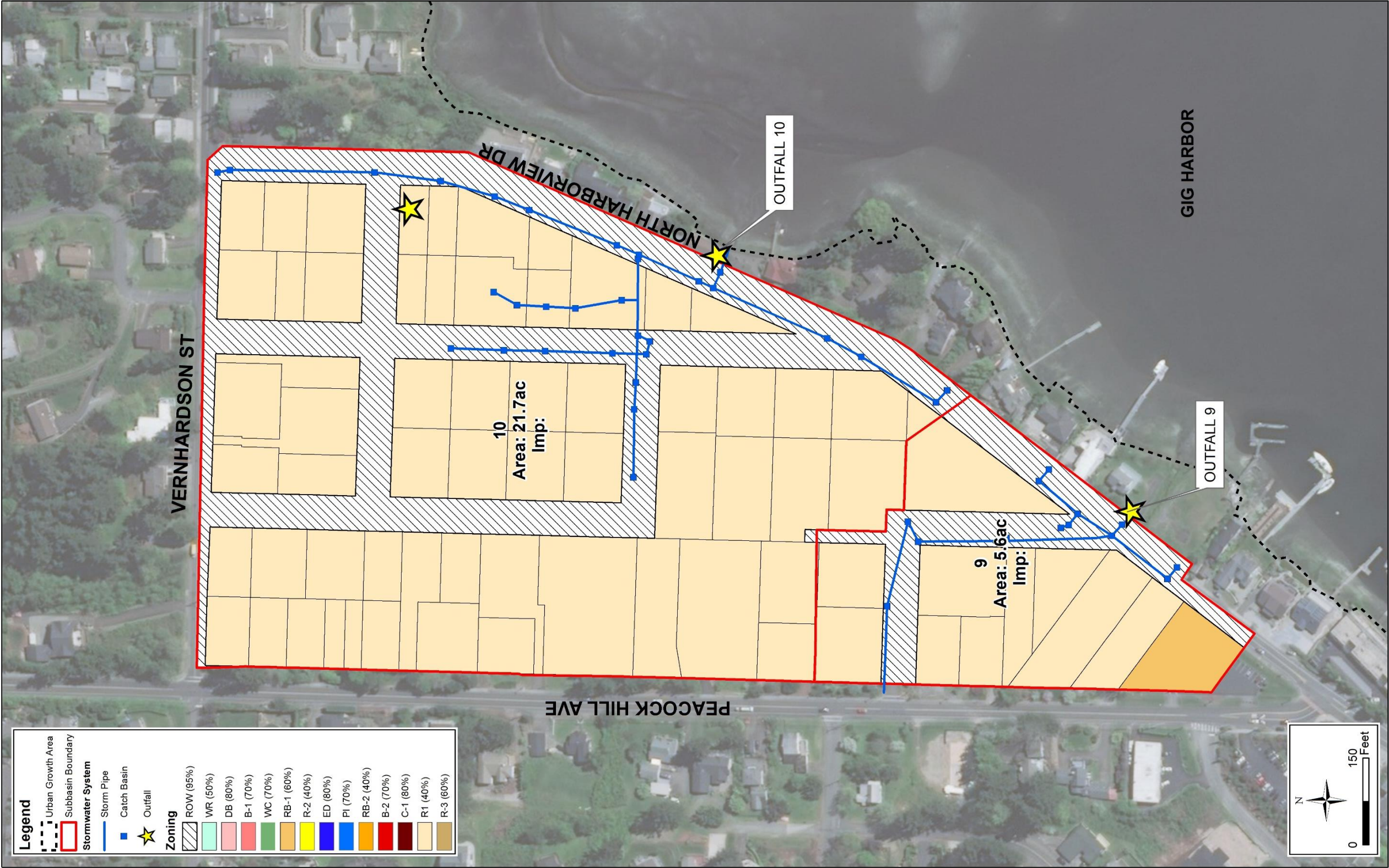


Figure 3-11:Trunkline 9 and 10 Zoning and Impervious Surface Area Densities

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A geologic analysis and infiltration assessment was performed by Associated Earth Sciences, Inc. (AESI) as a component effort of this Comprehensive Stormwater Plan Update. AESI analyzed surface and subsurface conditions to identify areas potentially suitable for shallow and deep infiltration of stormwater. The analysis was prepared to support consideration of stormwater management alternatives that promote infiltration of stormwater to effectively address stormwater system needs and to meet management objectives in receiving waters. The geologic investigation identifies where infiltration may be a feasible technique to dispose of storm runoff as:

- a cost-effective alternative to increasing the capacity of an overloaded drainage system, and
- a preferred means of controlling runoff on-site as properties develop or redevelop.

To determine the infiltration feasibility at a specific location, or the feasibility of a specific infiltration technique, site-specific hydrogeologic and geotechnical assessments would be required. Documentation of AESI's analysis is provided in Appendix B. Chapter 4 describes how the results of the infiltration analysis were considered in the analysis of the City's stormwater system and development of management strategies in watersheds.

STORMWATER SYSTEM

The Puget Sound and locally Gig Harbor, Henderson Bay, and Wollochet Bay are the receiving water bodies of Gig Harbor's stormwater system. The stormwater system consists of catch basins, pipes, drainage ditches, natural streams such as Donkey Creek and McCormick Creek, wetlands, ponds, and stormwater management facilities providing flow control and water quality treatment of storm runoff.

The Operations and Maintenance Department is responsible for approximately 49 stormwater ponds (of which 13 are publicly owned), 4,583 catch basins, 16 miles of drainage ditch, 7 bioretention swales, 2 miles of stormwater detention pipe, 2 rain gardens, 49 stormwater vaults, and 72 miles of storm drainage pipe. This inventory has grown substantially over the past decade with continuing development and annexations to the City.

Proper development and regular maintenance of the City's stormwater infrastructure is critical to assuring proper function, effective control of stormwater discharges and water quality, and minimized effects upon receiving water environments and downstream property. Responsibilities for facility inspection and maintenance are determined by facility ownership, and is performed by the City's Public Works Department, homeowner associations, business owners, and property management companies. Operation and maintenance of the stormwater system is discussed in Chapter 6.

RECEIVING WATERS AND WATER QUALITY

The general health of monitored receiving streams in the study area vicinity has remained stable over the past decade, as reported by Pierce County in their annual Surface Water Health report cards, initiated in Water Year 2008. Area streams included in the monitoring program are Artondale Creek, Crescent Creek and McCormick Creek. Measured water quality indices (WQI) in the streams have fluctuated year to year, but indices have trended stable in all three streams. The biological health of the streams, measured using the Benthic Index of Biotic Integrity (BIBI), has also trended stable except in Crescent Creek where benthic quality has improved. The BIBI scoring system was revised effective in WY2014, creating the false appearance that benthic health had markedly improved in all three monitored streams.

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4. STORM SYSTEM ANALYSIS

STORM DRAINAGE SYSTEM

The Puget Sound and in particular Gig Harbor, Henderson Bay, and Wollochet Bay are the receiving water bodies of the City of Gig Harbor's stormwater system. The stormwater system consists of catch basins, pipes, drainage ditches, natural streams such as Donkey Creek and McCormick Creek, wetlands, ponds, and stormwater management facilities providing flow control and water quality treatment of storm runoff. The Operations and Maintenance Department is responsible for approximately 49 stormwater ponds (of which 13 are publicly owned); 4,583 catch basins; 16 miles of drainage ditch; 7 bioretention swales; 2 miles of stormwater detention pipe; 2 rain gardens; 49 stormwater vaults; and 72 miles of storm drainage pipe. This inventory has grown substantially over the past decade with continuing development and annexations to the City.

As noted, the City's stormwater network relies upon natural streams. Characterizations of these stream systems are provided in the 2009 plan document.

In preparing the 2009 Stormwater Comprehensive Plan, seven storm drainage networks in across Gig Harbor were hydrologically and hydraulically modeled to assess their level of service in conveying and controlling runoff. Modeling conducted for this 2018 update to the Plan encompassed the seven prior basins, denoted Trunkline 1 through Trunkline 7, and was expanded to include additional drainage basins labeled Trunkline 8 through Trunkline 10, shown Figure 4-1. In addition, modeling analyses were conducted of multiple drainage basins which sit adjacent to and directly outfall to the harbor.

This section of the report discusses the methodology and findings of the storm system analyses.

LAND USE

Land use is characterized to determine the response of the ground surface to rainfall, i.e. the degree and rate at which rainfall infiltrates to the ground, transpires to the atmosphere, or runs off. Taking a long-term view in analyzing system capacity, the hydrologic analysis characterizes land use in the basins tributary to the storm drainage systems assuming full build-out to the current zoning densities. Land uses defined by zoning were characterized in terms of relative pervious and impervious surface areas for each sub-basin represented in the hydrologic models. Impervious areas translate to runoff most of the rain falling upon it and include surfaces such as rooftops, pavements, and graveled surfaces subject to compaction by vehicular traffic. The remaining areas of bare, grassed, landscaped or forested ground are classified as pervious and exhibit varying rates of runoff depending on the ground slope and the type of vegetative cover.

Gross impervious area represents the impervious area within a subbasin that is hydraulically connected to the storm drain system. Gross impervious area was calculated based on the City of Gig Harbor's updated zoning coverage published in March of 2017. Zoning categories were assigned a maximum allowable percentage of impervious area consistent with the methodology applied and described in the 2009 Plan. Coverages are based on the city's zoning code designations and modified to include sidewalks and driveways. Figure 4-1 depicts an overview of zoning across the ten trunkline drainage basins; Figures 3-3 through 3-11 provide detailed zoning delineations within these basins.

Effective Impervious Area (EIA) is the net impervious area assumed in the hydrologic modeling to be connected to the storm drainage system. EIA represents the net area of impervious coverage after accounting for opportunities for runoff to be intercepted by infiltration or depressional storage. Gross impervious area was reduced based on a combination of visual inspection of aerial photography and

regionally published data for similar land use types (Snohomish County, 2016). Table 4-1 provides a breakdown of land use characteristics and assumptions in each basin, with the effective impervious area results used to update the hydrologic model.

Table 4-1: Land Use Characteristics

Trunkline / Basin	Total Area (ac)	Gross Imp. Area (ac)	EIA (ac)	EIA (%)
1	62.6	39.7	34.2	55%
2	130.7	76.4	64.9	49%
3	112.1	65.9	56.2	50%
4	51.4	34.5	31.1	56%
5	257.7	154.4	129.9	49%
6	83.6	48.1	39.0	45%
7	101.1	63.5	56.4	56%
8A	80.2	49.0	41.5	52%
8B	35.1	30.2	18.4	52%
8C	15.9	12.0	6.8	43%
9	5.6	3.3	2.8	50%
10	21.7	12.2	10.0	46%

HYDROLOGIC MODELING

The model used for translating rainfall into runoff was the Western Washington Hydrologic Model (WWHM), a continuous-simulation model maintained by the Department of Ecology (WDOE). Stormwater runoff is simulated from pervious and impervious land surfaces, soil moisture dynamics, slope, and hydrologic routing on a continuous basis for the duration of the precipitation time series used.

Soil characteristics were obtained from NRCS mapping and slope was processed using a digital terrain map provided by Pierce County. No routing was performed within the hydrologic model. The SWMM EXTRAN module was used for all conveyance analysis. Processing of model input was performed using ArcGIS software and the resultant modeling inputs are summarized in Appendix C.

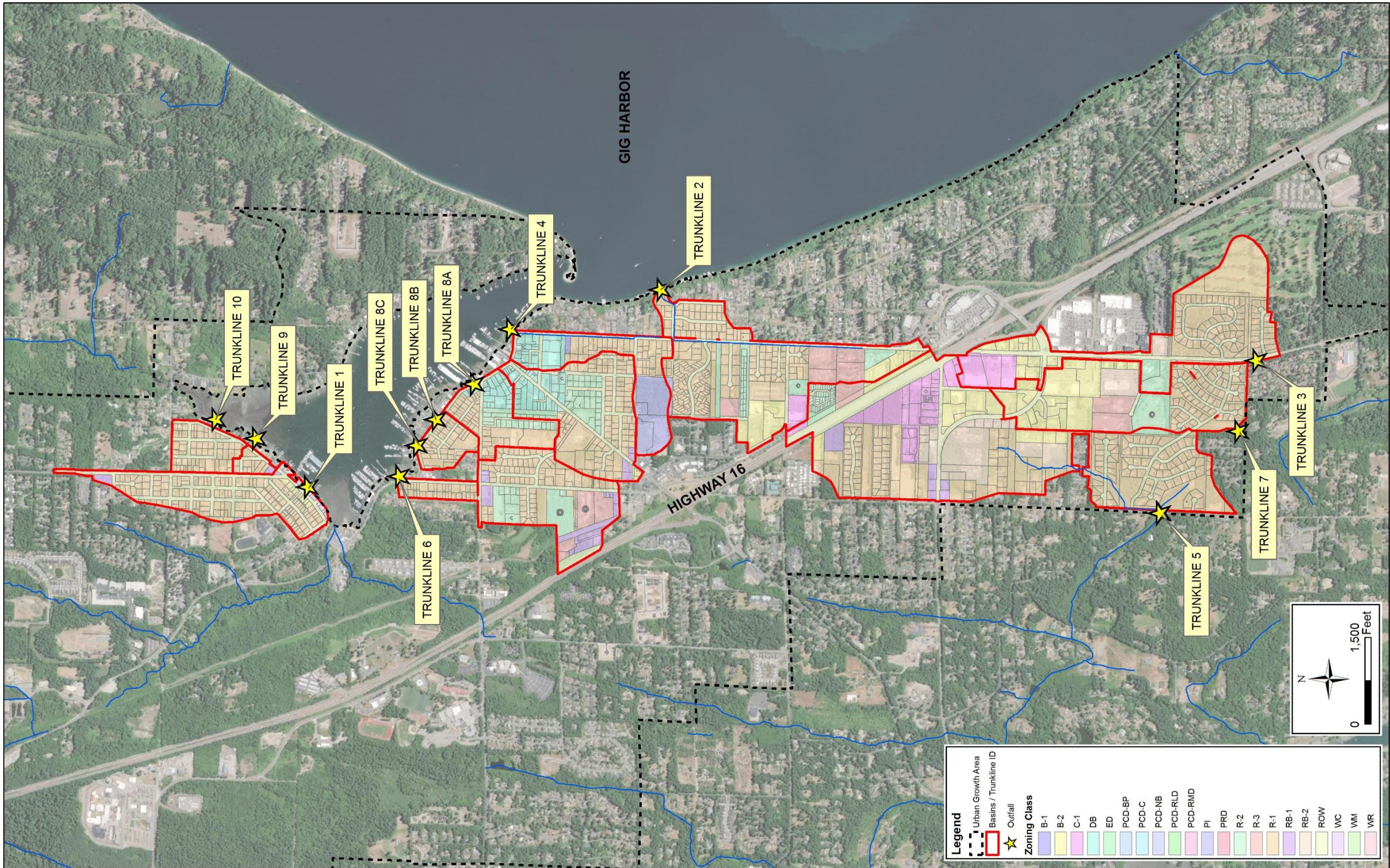


Figure 4-1: Trunkline and Zoning Class Overview

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DESIGN EVENT SELECTION

An analysis on available rainfall data was performed to determine the suitability of the April 25th, 1963 25-year rainfall event chosen for the 2009 Stormwater Comprehensive Plan. For the 2009 Stormwater Comprehensive Plan, rainfall from the McMillin Reservoir Rainfall gage was used to simulate inflow for the hydraulic model. The gage is located approximately 20 miles to the southeast of the study area and contains a 50-year data record at 1-hour time-step intervals. A comparison was performed of the 25-year rainfall event from the prior analysis to the rainfall data for the Gig Harbor area currently accepted by WDOE. The current rainfall dataset is the Pierce County synthetic rainfall, comprising 158 years of data with a 15-minute time-step. Rainfall was scaled to a total annual precipitation of 44-inches based on average annual recorded rainfall. To compare runoff, a typical sub basin was chosen that provided an average effective impervious area based on the entire project area. Flows were simulated, and a peak flow analysis was performed to determine the 25-year event. A representative storm was selected to compare both events. The results of the comparison are characterized in Table 4-2.

Table 4-2: Representative Storm Comparison

Gage	Duration (hrs)	Cumulative Rainfall (in)	Peak Intensity (in / hr)	Total Volume (ac-ft)	25-Year Peak (cfs) (Basin 1D)
McMillin	3	0.90	0.80	0.70	5.67
Pierce County	24	3.40	0.65	3.59	8.86

The Pierce County synthetic rainfall time series depicts a more representative rainfall event in shape, duration, and volume, as illustrated in Figure 4-2. The Pierce County rainfall provided a 25-year peak flow rate approximately 1.8 cfs (20%) greater than the McMillin gage for the same subbasin size and land use. The Pierce County 44-in synthetic rainfall was selected for use in the hydrologic analyses for this Plan update.

HYDRAULIC MODELING

For the storm system analysis, a PCSWMM model was built to perform updated capacity analyses for the seven trunk lines evaluated in the previous comprehensive plan. PCSWMM was developed by Computational Hydraulic International for hydraulic analysis, sizing of conveyance systems and stormwater facilities. PCSWMM is an interface for the U.S. Environmental Protection Agency's Stormwater Management Model (SWMM). PCSWMM conveniently allows for drainage basin data to be directly imported from the City's GIS shapefiles describing the storm drainage system.

Hydraulic models created for the 2009 analysis could not be procured for reuse in this plan; however, the models were recreated using modeling schematics documented in Appendix E of the 2009 Plan. All hydraulic models developed as part of the 2018 Comprehensive Plan Update were run using dynamic wave routing in order to account for pressure and momentum within the storm pipe system. The model was not calibrated, as current flow data was not available for the system.

Appendix E in the 2009 plan documented the Pipe Identifier (ID), structure rim elevation, and pipe inverts for each catch basin or manhole structure represented in the earlier model. Pipe IDs were maintained from the previous modeling effort where available. The City's stormwater GIS layers were used to fill in

data gaps where identified, including pipe material and pipe diameter. An entrance loss of 0.5 and an exit loss coefficient of 1.0 was applied on a case-by-case basis. Loss coefficients are typically found at the transition of an open channel and closed conduit flow due to the change in velocity head found from expansion and contraction. Loss coefficients may also be applied at sudden transitions or bends within a storm drain pipe.

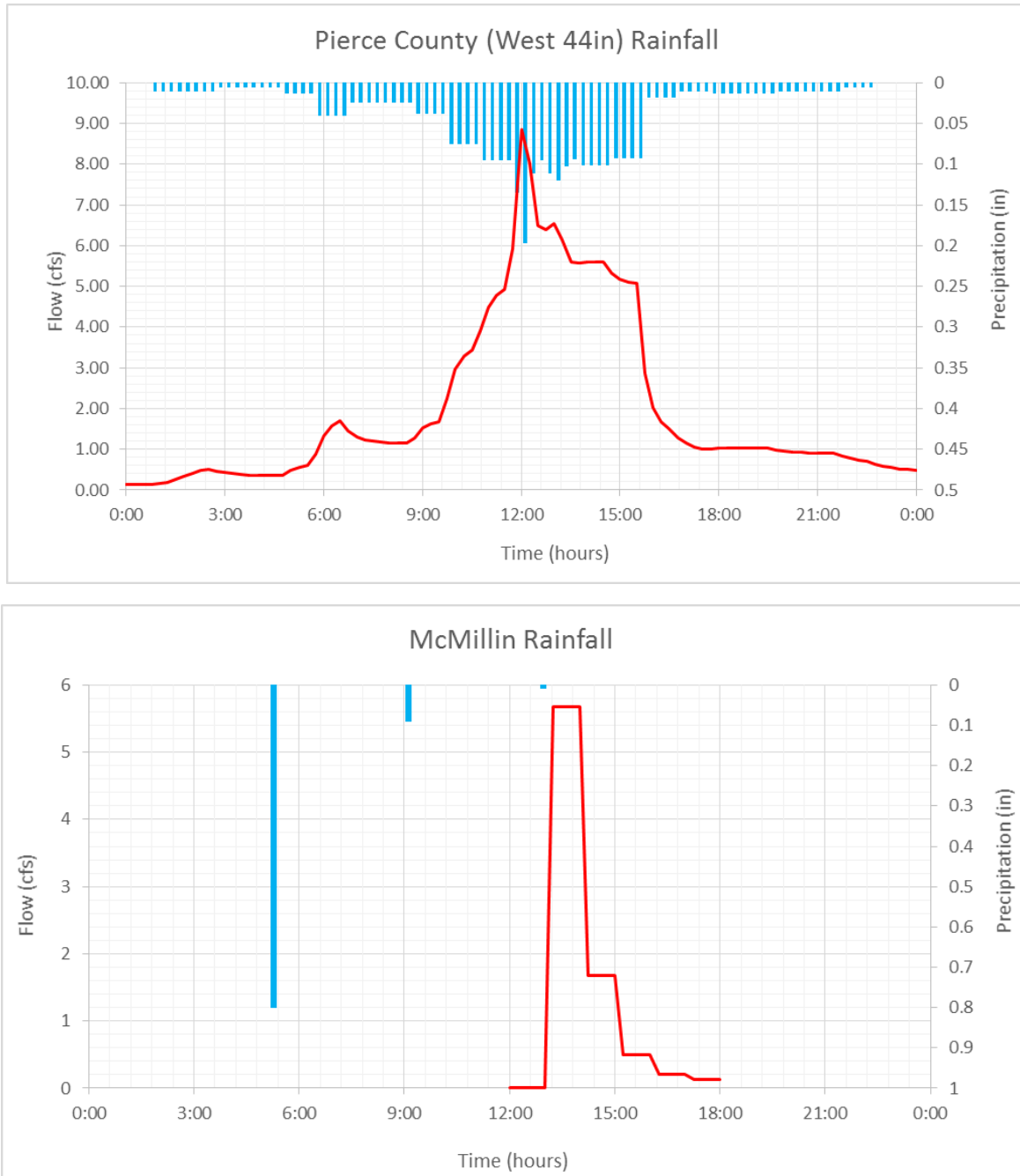


Figure 4-2: Rainfall Time Series Comparison

In addition to the seven trunk lines re-evaluated from the 2009 Plan, three additional trunk lines were evaluated using PCSWMM. This includes a multiple outfall basin (Trunkline 8) draining toward Harborview Drive and two basins (Trunklines 9 and 10) draining toward North Harborview Drive.

In evaluating the hydraulic performance of the drainage system networks, the desired level of service is the ability to convey the 25-year return period discharge without overflow.

Where information was insufficient for a SWMM analysis, 21 additional outfalls were evaluated using the Bentley Culvert Master software. These pipe segments are primarily located on private property and have relatively small drainage areas and upstream drainage networks. Hydraulic capacity of the discharging pipe was calculated based on GIS inventory and as-built drawings provided by the City. In assessing the hydraulic performance of the drainage system networks, the ability to convey the 100-year return period discharge was evaluated.

Manning's roughness coefficients were documented in the 2009 Plan and applied based on the documented pipe material. The pipe roughness value varied from 0.012 for high density polyethylene (HDPE) pipe to 0.024 for corrugated metal pipe (CMP). When determining the effectiveness of proposed improvements, proposed new pipelines were modeled assuming a roughness value of 0.011 as a characteristic of the commonly used corrugated polyethylene (CPE) pipe. For open channels, a value of 0.030 was used for the roadside drainage ditches and 0.040 for natural channels. Lengths of channels and pipe segments were determined using the GIS storm system map and City surveys.

BASIN ANALYSES

Findings of the hydrologic and hydraulic analyses for each of the trunkline basins are described below. Maps delineating the basins and subbasin extents are included in Figures 3-3 through 3-11. Detailed modeling results are provided in Appendix C. Where the analyses indicated a need for drainage system improvements to provide the desired level of service, capital projects were conceptually developed and are presented in Chapter 5.

TRUNKLINE 1

The Trunkline 1 basin is depicted in Figure 3-3 with its subbasins delineated. Trunkline 1 is located on Peacock Hill Avenue NW between 101st Court NW and North Harborview Drive and discharges into Gig Harbor. This trunkline is located northeast of the Donkey Creek discharge pipe. It is approximately 4,400 linear feet of pipe with diameters varying from 12 to 18 inches. Pipe material consists mostly of concrete and HDPE. The system drains a basin area of 62.6 acres; Table 4-3 presents the land coverage applied in the analysis for each of the subbasins. Elevations in this basin vary from approximately 25 feet to 270 feet. Approximately 85% of the basin is residential with 15% designated for commercial business use.

The outfall for Trunkline 1 is an 18-inch concrete pipe located southeast of Fuller Street/North Harborview Drive. Southwest of Fuller Street, there is an area of Burnham Drive NW that also is conveyed to this outfall. The Burnham Drive NW area is designated as Sub Basin 1A. Sub Basins 1B, 1C and 1D are conveyed by the Peacock Hill Avenue NW storm system.

Table 4-3: Trunkline 1 Land Coverage

Subbasin	Effective Impervious Area (ac)	Pervious Area (ac)	Total Area (ac)
1A	6.2	4.6	10.8
1B	9.1	8.6	17.9
1C	10.2	8.8	19.0
1D	8.5	6.4	14.9

Table 4- 4 summarizes the flow frequency analysis under future build-out conditions for Trunkline 1 based on the land coverage data.

Table 4- 4: Trunkline 1 Flow Frequency

Event	Flow (cfs)			
	1A	1B	1C	1D
2 Year	3.2	4.8	5.3	4.2
5 Year	4.4	6.7	7.5	5.8
10 Year	5.4	8.1	9.1	7.0
25 Year	6.7	10.2	11.3	8.7
50 Year	7.7	11.9	13.2	10.1
100 Year	8.9	13.7	15.2	11.6

Findings

Under full buildout conditions, the 25-year storm event would generate a peak flow of 36.1 cfs to the outfall, although upstream restrictions in capacity would limit the discharge to the outfall to 17.5 cfs. The system analysis showed that the pipes within Subbasins 1B and 1C do not have sufficient capacity to convey the future flows. Three storm conveyance projects have been recommended to increase capacity and eliminate flooding for future build-out conditions. The outfall has sufficient capacity to convey the future 25-year discharge, but it cannot pass the 100-year return period discharge.

TRUNKLINE 2

The Trunkline 1 basin is depicted in Figure 3-4 with its subbasins delineated. Trunkline 2 is located on Soundview Drive between Ryan Street and Hollycroft Street NW and discharges to the harbor. It is approximately 4,880 linear feet of pipe with diameters varying from 12 to 36 inches. Pipe material consists mostly of concrete and HDPE. The drainage basin is 130.5 acres and delineated as five subbasins as described in Table 4-5. Elevations in this basin vary from approximately 60 feet to 325 feet. Approximately 80% of the basin is residential with 20% commercial business. At the north end of the basin there is City park property comprising less than 1% of the basin. Historically, Trunkline 2 ran north along the full extent of Soundview Drive; however, the system was modified to split away the south half of Soundview Drive to a 24-inch HDPE outfall pipe constructed southeast of Ryan Street/Cascade Avenue.

Table 4-6 summarizes the flow frequency analysis under future build-out conditions for Trunkline 2 based on the land coverage data.

Table 4-5: Trunkline 2 Land Coverage

Subbasin	Effective Impervious Area (ac)	Pervious Area (ac)	Total Area (ac)
2A	8.0	12.2	20.2
2B	10.6	15.7	26.3
2C	10.0	10.0	20.0
2D	25.0	20.9	45.9
2E	11.3	6.8	18.1

Table 4-6: Trunkline 2 Flow Frequency

Event	Flow (cfs)				
	2A	2B	2C	2D	2E
2 Year	4.4	5.7	4.8	11.1	6.2
5 Year	6.3	8.1	6.6	15.0	8.4
10 Year	7.7	9.9	7.9	17.9	10.0
25 Year	9.8	12.5	9.8	21.9	12.2
50 Year	11.5	14.6	11.3	25.1	14.0
100 Year	13.3	17.0	13.0	28.6	15.9

Findings

Under full buildout conditions, the 25-year storm event would generate a peak flow of 67.9 cfs to the outfall, although upstream restrictions in capacity would limit the discharge to the outfall to 60.8 cfs. The system analysis showed that the pipes within Sub-Basins 2B and 2C do not have sufficient capacity to convey the future flows. A stormwater conveyance project has been identified between Soundview Court and Erickson Street to correct this condition. The outfall capacity is insufficient to convey the future 25-year discharge.

TRUNKLINE 3

The Trunkline 3 basin is depicted in Figure 3-5 with its subbasins delineated. Trunkline 3 is located on Point Fosdick Drive NW between SR 16 and 39th Street NW. It is approximately 2,440 linear feet of pipe with diameters varying from 12 to 18 inches, and 1,090 linear feet of open ditch. Pipe material consists mostly of concrete and HDPE with some CMP. There are two in-line detention tanks within this trunkline constructed of arched CMP. One is located approximately 440 feet south of Olympic Drive, the other is located just south of 45th Street Court NW. Two infiltration galleries, part of the Olympic Towne Center development, are located north of Olympic View Drive (DEA, 2016).

The drainage basin comprises 7 subbasins totaling 106.5 acres in area, as described in Table 4-7. Elevations in this basin vary from approximately 200 feet to 290 feet. Approximately 70% of the basin is residential with 25% commercial business. The remaining 5% is Public Institution which includes a Pierce County Library. The outfall for Trunkline 3 is an 18-inch concrete culvert located south of Briarwood Lane NW/ Point Fosdick Drive NW.

Table 4-7: Trunkline 3 Land Coverage

Subbasin	Effective Impervious Area (ac)	Pervious Area (ac)	Total Area (ac)
3A	8.3	16.2	24.5
3B	14.0	26.4	40.4
3C	8.4	6.2	14.6
3D	3.0	0.5	3.5
3E	4.6	0.7	5.4
3F	2.5	7.7	10.3
3G	12.1	4.1	13.5

Table 4-8 summarizes the flow frequency analysis under future build-out conditions for Trunkline 3 based on the land coverage data.

Table 4-8: Trunkline 3 Flow Frequency

Event	Flow (cfs)						
	3A	3B	3C	3D	3E	3F	3G
2 Year	4.1	7.5	3.8	1.2	1.9	3.2	4.3
5 Year	5.7	10.7	5.3	1.7	2.6	4.4	5.8
10 Year	6.9	13.1	6.3	2.0	3.0	5.2	6.9
25 Year	8.5	16.6	7.8	2.4	3.7	6.3	8.3
50 Year	9.9	19.6	9.0	2.7	4.2	7.2	9.5
100 Year	11.4	22.7	10.2	3.1	4.7	8.2	10.8

Findings

Under full buildout conditions, the 25-year storm event would generate a peak flow of 49.7 cfs to the outfall, although upstream restrictions in capacity would limit the discharge to the outfall to 6.2 cfs. There are 4 detention facilities located with the subbasin. Table 4-9 provides a summary of the Trunkline 3 public stormwater facilities.

Table 4-9: Trunkline 3 Stormwater Facilities

Facility Name	Basin Area (ac)	Volume (ac-ft)
SR 16 / Olympic View Drive Tank	12.8	0.33
Point Fosdick Drive Tank	16.1	0.18
Quail Park Pond	40.5	0.52
Olympic Towne Center	13.5	1.36

All three facilities except the Olympic Towne Center infiltration galleries would be in overflow condition during the peak of the 25-year storm event. Based on their size and modeled performance, it appears the three smaller facilities were designed to provide flow control for the 2- and 10-year storm events, and their capacities are overwhelmed by larger storm discharges. The drainage ditches were modeled as trapezoidal channels based on the top width and depth included in the GIS storm system map and 1:1 side slopes were assumed. The drainage channels have capacity to convey the future flows; however, three driveway culverts within the roadside ditch system are undersized for the 25-year storm condition.

Four projects are recommended within Trunkline 3 to replace the three driveway culverts south of Harbor County Road NW and the 18 -inch culvert crossing under Point Fosdick Drive at the south end of the basin. With the recommended conveyance improvements in service, the outfall would have sufficient capacity to convey the future 25-year discharge but cannot pass the 100-year return period discharge.

TRUNKLINE 4

The Trunkline 4 basin is depicted in Figure 3-6 with its subbasins delineated. Trunkline 4 basin is located just north of the Trunkline 2 basin on Soundview Drive between Harborview Drive and Ryan Street. The drainage system comprises approximately 2,790 linear feet of pipe with diameters varying from 12 to 18 inches. Pipe material consists mostly of concrete and HDPE. The drainage basin area totals 51.4 acres in four subbasins as shown in Table 10. Elevations in this basin vary from approximately 25 feet to 205 feet. Approximately 40% of the basin is residential with 25% commercial business. The remaining 35% is Public Institution, which includes the City Civic Center and park property. The outfall for Trunkline 4 is an 18-inch concrete pipe located northeast of Harborview Drive/Soundview Drive.

Table 4-10: Trunkline 4 Land Coverage

Subbasin	Effective Impervious Area (ac)	Pervious Area (ac)	Total Area (ac)
4A	2.6	10.8	13.4
4B	6.4	4.4	10.9
4C	3.8	2.3	6.1
4D	7.4	13.6	21.0

Table 4-11 summarizes the flow frequency analysis under future build-out conditions for Trunkline 4 based on the land coverage data.

Table 4-11: Trunkline 4 Flow Frequency

Event	Flow (cfs)			
	4A	4B	4C	4D
2 Year	4.8	2.4	1.3	6.3
5 Year	6.6	3.4	1.9	8.6
10 Year	7.8	4.2	2.3	10.3
25 Year	9.6	5.3	2.9	12.7
50 Year	11.0	6.2	3.3	14.6
100 Year	12.6	7.2	3.9	16.7

Findings

Under full buildout conditions, the 25-year storm event would generate a peak flow of 30.4 cfs to the outfall. The system analysis concludes that the Trunkline 4 storm system has adequate capacity under the future flow conditions. The outfall capacity is sufficient to convey both the future 25-year and 100-year discharge. No projects have been identified for Trunkline 4.

TRUNKLINE 5

The Trunkline 5 basin is depicted in Figure 3-7 with its subbasins delineated. Trunkline 5 is a tributary to Garr Creek. The modeled drainage system is located east of 38th Avenue and begins in the vicinity of 56th Street NW and drains south crossing under 38th Avenue south of Briarwood Lane. The drainage basin area totals 263.3 acres, across seven subbasins as described in Table 12. The majority of this system is a natural channel and has approximately 980 linear feet of pipe and road crossing culverts with diameters varying from 12 to 24 inches; these culverts are identified as fish passage barriers in prior studies.

The natural channel's cross section was surveyed by the City, and a geomorphic assessment was performed in 2011. Pipe material consists of concrete and HDPE. Elevations in this basin vary from approximately 100 feet to 300 feet. Approximately 60% of the basin is residential with 40% commercial business. The outfall from the Trunkline 5 system to Garr Creek is a pair of 18-inch concrete culverts crossing 38th Avenue NW located south of Briarwood Lane NW; this outfall system also presents a fish passage barrier. The City has observed sediment accumulating throughout this system, presenting an ongoing maintenance problem.

Table 4-12 shows the land coverage areas for Trunkline 5.

Table 4-12: Trunkline 5 Land Coverage

Subbasin	Effective Impervious Area (ac)	Pervious Area (ac)	Total Area (ac)
5A	29.9	18.3	48.2
5B	11.8	6.8	18.6
5C	33.8	26.8	60.6
5D	0.1	1.4	1.5
5E	0.3	4.4	4.7
5F	4.0	11.6	15.6
5G	47.9	60.7	108.6

Table 4-13 summarizes the flow frequency analysis under future build-out conditions for Trunkline 5 based on the land coverage data.

Table 4-13: Trunkline 5 Flow Frequency

Event	Flow (cfs)						
	5A	5B	5C	5D	5E	5F	5G
2 Year	10.0	3.8	13.2	0.6	1.9	5.0	28.7
5 Year	14.1	5.4	18.3	0.7	2.6	6.7	39.7
10 Year	17.2	6.6	22.1	0.9	3.1	8.0	47.9
25 Year	21.6	8.2	27.2	1.1	3.8	9.8	59.4
50 Year	25.2	9.6	31.4	1.2	4.4	11.2	68.8
100 Year	29.1	11.0	35.8	1.4	5.1	12.7	78.9

In 56th Street NW there are two 72-inch CMP tanks (Tanks A and B) that detain roadway runoff. Table 4-14 is a summary of the Trunkline 5 public stormwater facilities. A review of the tanks' hydraulic performance was conducted to determine whether the basin model should be extended to incorporate their storage. Due to the limited storage capacity in the tanks, it was determined that including them in the model would not substantially revise the analysis findings.

Table 4-14: Trunkline 5 Stormwater Facilities

Facility Name	Basin Area (ac)	Volume (ac-ft)
Tank A	1.6	0.14
Tank B	4.8	0.15

Findings

Under full buildout conditions, the 25-year storm event would generate a peak flow of 74.6 cfs to the twin outfalls, although storage in the stream channel and impoundments behind a series of culverts would limit the discharge to the outfall. Considering the storage available in the system, the opportunities to infiltrate storm runoff from future development (refer to Infiltration Assessment, below in this chapter), the system has sufficient capacity to convey future 25-year storm peak discharges. Replacing the fish barriers with recommended fish passable culverts will maintain 25-year capacity throughout the trunkline system and provide 100-year storm capacity at the outfall.

TRUNKLINE 6

The Trunkline 6 basin is depicted in Figure 3-8 with its subbasins delineated. Trunkline 6 is located on Stinson Avenue between Harborview Drive and Grandview Street. It is approximately 3,500 linear feet of pipe with diameters varying from 12 to 36 inches. Pipe material consists mostly of PVC and HDPE, with some CMP and concrete. The drainage basin is 83.6 acres. Elevations in this basin vary from approximately 50 feet to 300 feet. Approximately 75% of the basin is residential with 25% commercial business. The outfall for Trunkline 6 is a 36-inch HDPE pipe located northeast of Harborview Drive/ Stinson Avenue. Table 4-15 shows the land coverage, by subbasin, within the Trunkline 6 basin.

Table 4-15: Trunkline 6 Land Coverage

Subbasin	Effective Impervious Area (ac)	Pervious Area (ac)	Total Area (ac)
6A	4.2	6.2	10.4
6B	10.1	13.5	23.6
6C	8.3	9.9	18.2
6D	16.3	15.0	31.3

Table 4-16 summarizes the flow frequency analysis under future build-out conditions for Trunkline 6 based on the land coverage data.

Table 4-16: Trunkline 6 Flow Frequency

Event	Flow (cfs)			
	6A	6B	6C	6D
2 Year	2.5	5.4	4.3	8.2
5 Year	3.6	7.6	6.1	11.5
10 Year	4.4	9.3	7.4	13.9
25 Year	5.6	11.7	9.2	17.3
50 Year	6.6	13.6	10.8	20.1
100 Year	7.7	15.8	12.4	23.1

Findings

Under full buildout conditions, the 25-year storm event would generate a peak flow of 46.5 cfs to the outfall. Two projects have been defined along Stinson Avenue to reduce surcharge conditions identified through this analysis. Outfall capacity is sufficient to convey the future 100-year discharge.

TRUNKLINE 7

The Trunkline 7 basin is depicted in Figure 3-9 with its subbasins delineated. Trunkline 7 is routed through a series of private properties west of Point Fosdick Drive NW between 50th Street Court NW and Briarwood Lane NW. The trunkline system comprises approximately 3,890 linear feet of pipe with diameters varying from 12 to 48 inches. The 48-inch CMP functions as a detention tank for a multi-family residential development. Harbor Pond is located north of 45th St Ct NW and functions as a regional detention facility. There is no formal control structure at the pond outlet, and the pond is privately maintained. Drainage system pipe material consists mostly of HDPE, with some CMP, PVC and concrete. The drainage basin area is 111.8 acres, as described in Table 17. Elevations in this basin vary from approximately 160 feet to 330 feet. Approximately 40% of the basin is residential with 60% commercial business. The outfall for Table 4-17 is a 24-inch concrete pipe located southwest of Briarwood Lane NW/32nd Avenue Court NW.

Table 4-17: Trunkline 7 Land Coverage

Subbasin	Effective Impervious Area (ac)	Pervious Area (ac)	Total Area (ac)
7A	6.4	9.0	15.4
7B	7.7	11.7	19.4
7C	7.1	7.2	14.3
7D	2.3	2.4	4.7
7E	26.5	12.3	38.8
7F	6.4	2.0	8.4

Table 4-18 summarizes the flow frequency analysis under future build-out conditions for Trunkline 7 based on the land coverage data.

Table 4-18: Trunkline 7 Flow Frequency

Event	Flow (cfs)					
	7A	7B	7C	7D	7E	7F
2 Year	3.3	4.1	3.5	1.2	11.7	2.8
5 Year	4.7	5.8	4.9	1.6	15.8	3.7
10 Year	5.8	7.1	5.9	2.0	18.9	4.4
25 Year	7.2	8.9	7.4	2.5	23.2	5.4
50 Year	8.5	10.4	8.5	2.9	26.6	6.2
100 Year	9.8	12.1	9.8	3.3	30.2	7.0

There are five detention facilities within the Trunkline 7 drainage area; however, with the exception of Harbor Pond the facilities are small in scale and were not included in the previous trunkline model. Our review determined these ponds, if added to the model, would not significantly affect outcomes of the analysis. The Trunkline 7 model was therefore constructed with Harbor Pond functioning as a detention facility, and the other four facilities were omitted as having negligible effect on the downstream discharges. Table 4-19 provides a summary of the Trunkline 7 stormwater facilities.

Table 4-19: Trunkline 7 Storm Facilities

Facility Name	Basin Area (ac)	Volume (ac-ft)
Harbor Pond	48.2	4.73
Harbor Tank	4.7	0.20
Quail Run Pond 1	96.3	0.12
Quail Run Pond 2	96.3	0.51
Quail Run Pond 3	111.7	1.48

Findings

Under full buildout conditions, the 25-year storm event would generate a peak flow of 30.4 cfs to the outfall; however, the detention storage provided in Harbor Pond reduces the peak discharge at the outfall to 17.3 cfs. A project constructed in 2009 added conveyance capacity to the system downstream of the Harbor Pond, and there were no other capacity problems identified in the basin requiring correction. The outfall capacity is sufficient to convey both the future 25-year and 100-year discharge.

TRUNKLINE 8

The Trunkline 8 basin is depicted in Figure 3-10 with its subbasins delineated. Trunkline 8 borders Harborview Drive between Stinson Avenue and Soundview Drive and is bisected by Pioneer Way. Trunkline 8 was divided into three subbasins, 8A, 8B, and 8C, each with separate outfalls to the harbor. The tributary basins to each system are described in Table 4-20. The 8A reach extends up Pioneer Way with approximately 3,000 linear of storm pipe on both sides of the street and varies in diameter from 12 to 36 inches in diameter. Pioneer Way is a relatively steep storm drain with elevations that vary from 30 to 300 feet. The 8B reach extends further north past Rosedale Street. The outlets of 8A and 8B are proximate to one another and interconnected. The 8C reach drains north along Harborview Drive toward Stinson Avenue. The system is interconnected to Trunkline 8B at Dorotich Street. System characteristics including inverts, material, and diameter were obtained from the *Pioneer Stormwater Trunk Main Capacity Report* (Contour 2017) and supplemented from the GIS storm database. Pipe material is primarily concrete.

Table 4-20: Trunkline 8 Land Coverage

Subbasin	Effective Impervious Area (ac)	Pervious Area (ac)	Total Area (ac)
8A	41.5	38.8	80.3
8B	18.4	16.7	35.1
8C	6.9	9.0	15.9

Table 4-21 summarizes the flow frequency analysis under future build-out conditions for Trunkline 8 based on the land coverage data.

Table 4-21: Trunkline 8 Flow Frequency

Event	Flow (cfs)		
	8A	8B	8C
2 Year	19.7	8.7	3.4
5 Year	27.7	12.2	4.8
10 Year	33.7	14.8	5.9
25 Year	42.1	18.5	7.4
50 Year	49.1	21.6	8.7
100 Year	56.6	24.9	10.1

Findings

Under full buildout conditions, the 25-year storm event would generate peak discharges of 42.6 cfs to the 8A outfall, 18.5 cfs to the 8B outfall, and 7.4 cfs to the 8C outfall. The system analysis concludes that the Trunkline 8 storm systems have adequate capacity under the future flow conditions. The outfall capacities are sufficient to convey both the future 25-year discharges, but the 8A outfall cannot pass the 100-year return period discharge.

TRUNKLINES 9 & 10

The Trunklines 9 and 10 are both depicted in Figure 3-11. Trunklines 9 and 10 consist of two smaller storm networks situated to the east of Peacock Hill Avenue and south of Vernhardson Street. The existing storm drain is primarily 12-inch diameter concrete pipes that drain smaller residential neighborhoods. Table 4-22 shows the land coverage areas for Trunklines 9 and 10.

Table 4-22: Trunklines 9 and 10 Land Coverage

Subbasin	Effective Impervious Area (ac)	Pervious Area (ac)	Total Area (ac)
9	2.8	2.8	5.6
10	10.0	11.7	21.7

Table 4-23 summarizes the flow frequency analysis under future build-out conditions for Trunklines 9 and 10 based on the land coverage data.

Table 4-23: Trunkline 9 and 10 Flow Frequency

Event	Flow (cfs)	
	9	10
2 Year	1.4	5.1
5 Year	1.9	7.3
10 Year	2.4	9.0
25 Year	3.0	11.4
50 Year	3.5	13.5
100 Year	4.0	15.8

Findings

No conveyance issues were identified in either the Trunkline 9 or Trunkline 10 systems. The outfalls have capacities sufficient to convey their respective 25- and 100-year return period discharges.

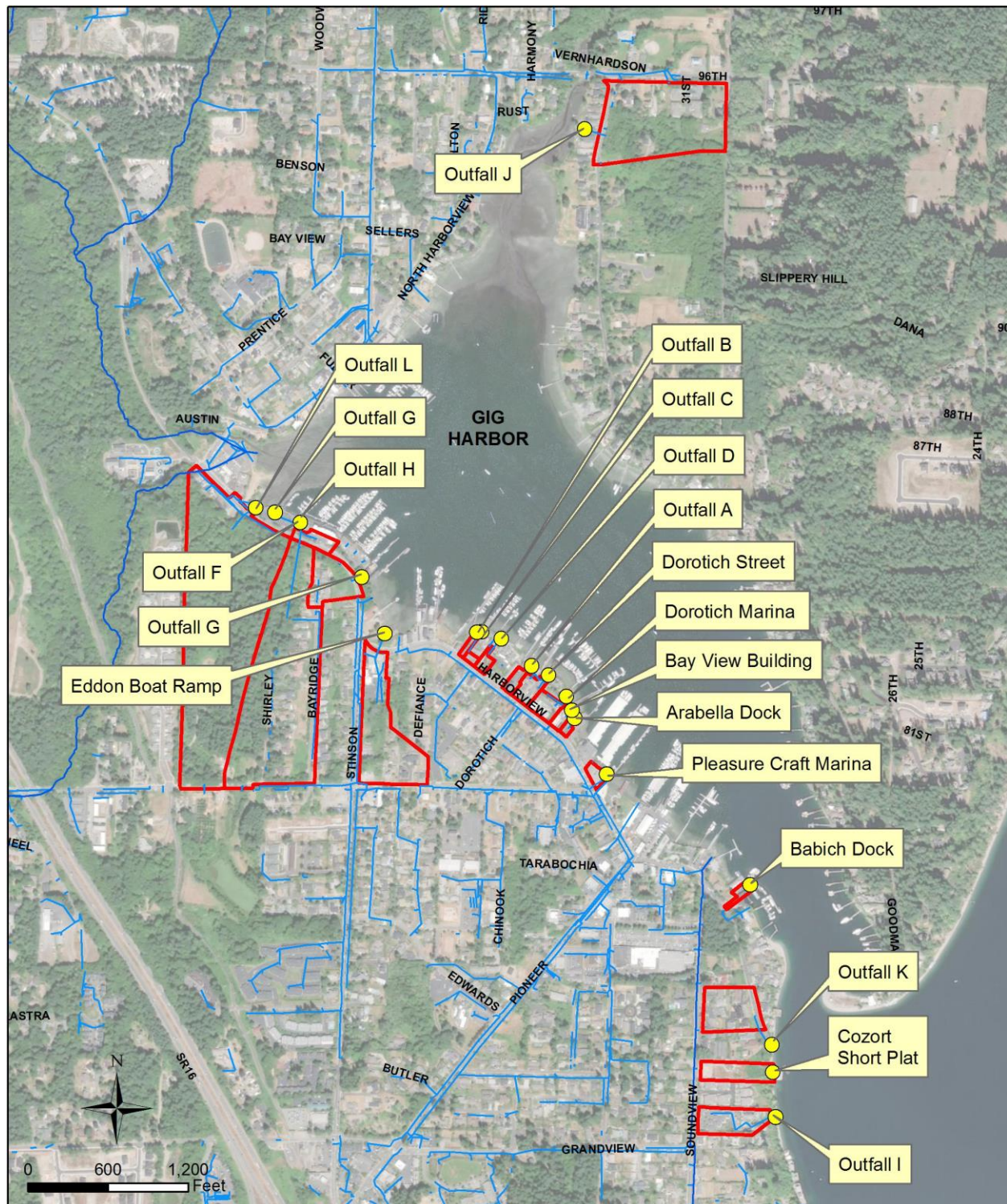
OUTFALL CAPACITY ANALYSIS

In addition to the Trunkline systems, the hydraulic capacities of other outfalls along Harborview Drive were assessed for their abilities to convey future buildout 100-year return period peak discharges. These analyses were conducted to: (1) identify potential capacity issues that may suggest priority rehabilitation or replacement of these older facilities, and (2) inform policies surrounding the on-site flow control requirements for developing and redeveloping properties within the tributary drainages.

Basin limits were delineated from aerial photography, topography, and GIS mapping. Hydrology was developed using WWHM. SWMM hydraulic models were not applied due to the small size of the storm drain systems and because there are gaps in databases describing these older systems; in some instances, only the outfall pipe diameter was available to the analysis. Manning's equation was applied to estimate effective capacities of outfalls under full flow conditions and, where elevation data was unavailable, an assumed pipe slope of 2 percent. Results are presented in Table 4-24; Figure 4-3 identifies the local outfall locations (for clarity, the trunkline outfalls are omitted from Figure 4-3). The analysis concludes the outfalls from these smaller systems have sufficient capacity to convey the 100-year return period storm peak discharge.

Table 4-24: Direct Discharge Capacity Analysis

Outfall	Diameter	100-Year Flow (cfs)	Max Capacity (cfs)
Arabella Dock	12"	0.15	4.0
Babich Dock	8"	0.30	1.0
Bay View Building	10"	0.35	2.0
Cozort Short Plat	12"	1.25	4.0
Dorotich Marina	12"	0.75	4.0
Dorotich Street	12"	0.75	4.0
Eddon Boat Yard	18"	4.10	10.0
Pleasure Craft Marina	24"	0.40	20.0
Outfall A	8"	0.50	1.0
Outfall B	6"	0.30	0.6
Outfall C	8"	0.20	1.0
Outfall D	8"	0.40	1.0
Outfall E	18"	5.30	10.0
Outfall F	24"	9.20	20.0
Outfall G	12"	2.20	4.0
Outfall H	8"	0.70	1.0
Outfall I	12"	1.60	4.0
Outfall J	18"	6.50	6.6
Outfall K	12"	5.00	4.0
Outfall L	30"	14.7	58.0



Note: Figure depicts local drainage outfalls; trunkline outfall locations are shown in Figures 3-3 through 3-11.

Figure 4-3: Local Outfall Locations - Capacity Analysis

INFILTRATION ASSESSMENT

Associated Earth Sciences, Inc. (AESI) conducted a screening-level infiltration assessment based on the infiltration characteristics of surface and subsurface soils across Gig Harbor. The purpose of this investigation was to identify where infiltration may be a feasible technique to dispose of storm runoff as:

- a cost-effective alternative to increasing the capacity of an overloaded drainage system, and
- a preferred means of controlling runoff on-site as properties develop or redevelop.

Infiltration feasibility is primarily dependent on soil permeability, soil depth to ground water, and the proximity to geologic hazards and critical areas. To develop an understanding of potential infiltration opportunities, AESI reviewed existing literature documenting hydrogeology within the area, reviewed available soil borings, conducted a qualitative evaluation of infiltration potential, delineated areas of varying infiltration potential, and incorporated GIS mapping as part of the investigation. Results of the study assigned infiltration potential to varying soil layers within the city. Infiltration potential was characterized in the following categories, which are delineated in Figures 4-3 and 4-4:

- Not Recommended
- Shallow Infiltration Potential
- Shallow and Deep Infiltration Potential
- Deep Infiltration Potential

Infiltration feasibility mapping was laid under existing basin boundaries to identify areas where opportunities may exist to use suitable soils as an alternative to conventional infrastructure improvements. In drainages identified as having insufficient hydraulic capacity, sites suitable for intercepting, treating and infiltration runoff were sought upslope of the capacity problems; such sites must have:

- the tributary drainage area to sufficiently relieve the downstream system of runoff,
- sufficient area to site a facility capable of treating and infiltrating the diverted runoff, and
- the underlying geology to efficiently and safely infiltrate.

Four drainages were initially investigated for candidate sites; however, it was concluded that the feasible basin in which to apply stormwater infiltration at sufficient scale to positively benefit the drainage system and in stream resources is in the Trunkline 5 basin which is tributary to Garr Creek.

The Trunkline 5 basin offers substantial undeveloped area in its upper reaches, and the geology is suitable to support either shallow or deep infiltration, thereby offering opportunities to intercept and infiltrate runoff before entering the creek. It is recommended that shallow infiltration be emphasized so as to maintain base flows in the creek system. Garr Creek is a fish-bearing stream in which bank stability and fish-passage problems have been identified. Implementing a shallow infiltration strategy in the upper reaches of the basin would reduce the magnitude and duration of scouring storm discharges, recharge the shallow aquifer to support base flows, and thereby beneficially support riparian and aquatic habitat.

The feasibility mapping provided in the AESI analysis is suitable only for identifying areas for further investigation and not as a warranty of subsurface conditions. Onsite investigation will need to be performed to validate if infiltration can be utilized for storm drainage projects. Figure 3 below provides an overview of infiltration mapping laid against the basin boundaries. A more detailed discussion of the AESI Infiltration Assessment can be found in Appendix B.

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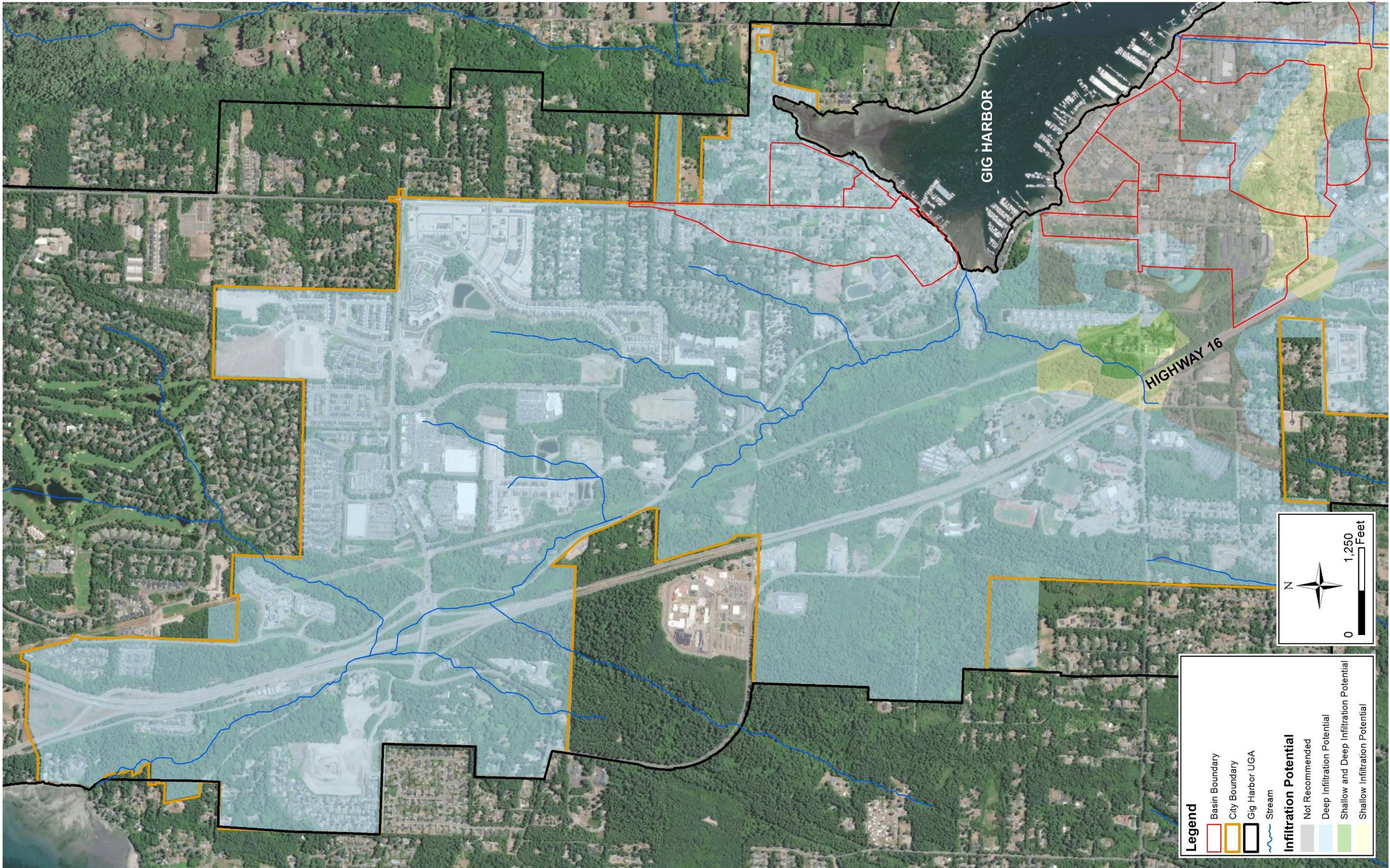


Figure 4-4: Infiltration Opportunities Overview (North)

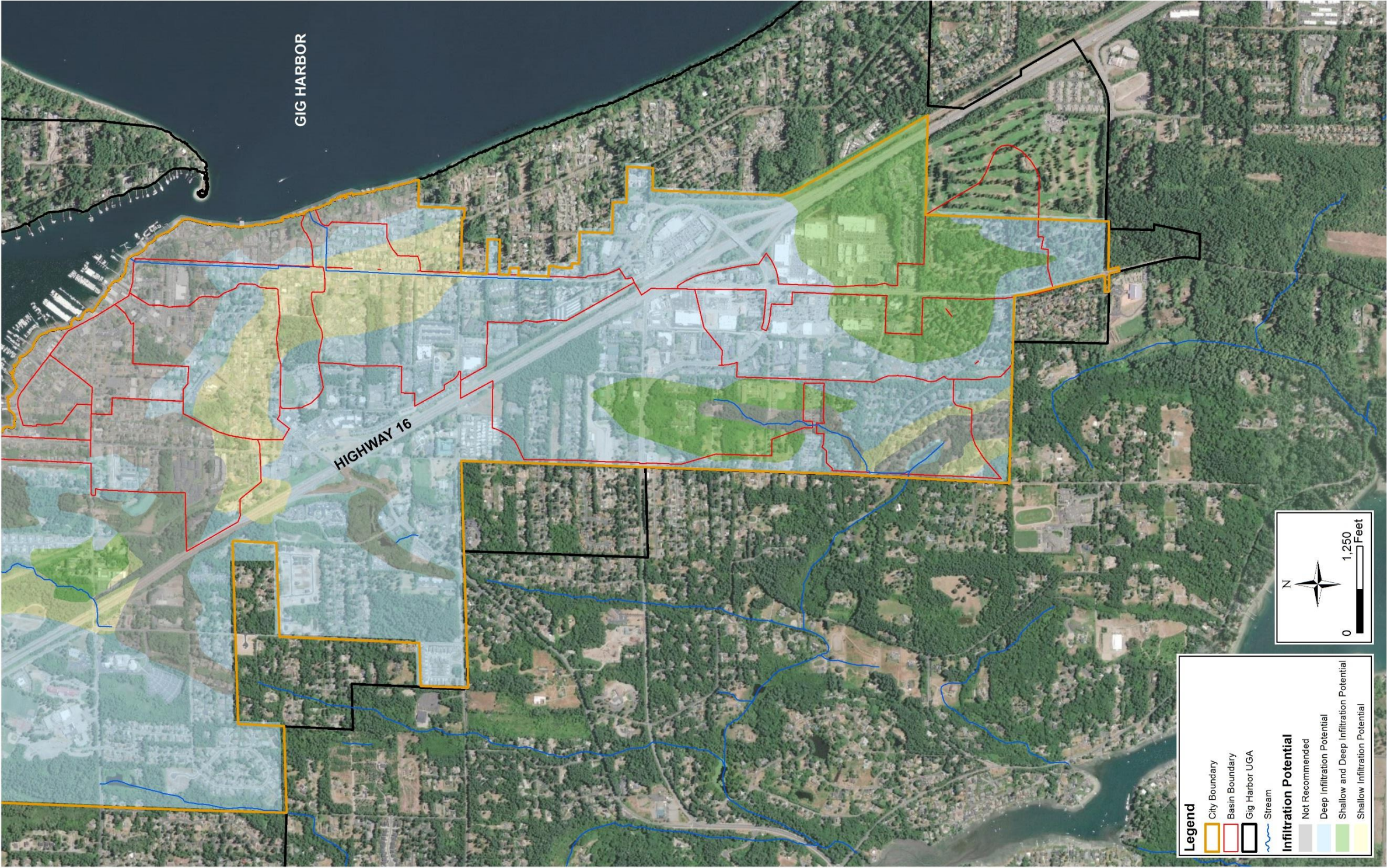


Figure 4-5: Infiltration Opportunities Overview (South)

5. CAPITAL IMPROVEMENT PLAN

INTRODUCTION

This chapter presents the recommended storm system improvements to the Capital Improvement Plan (CIP) to meet the needs of the environment, future development and growth. The types of improvements identified and scheduled include capacity, facility and habitat projects. Also included are habitat studies and annual programs such as general storm system repairs and mapping. As defined by the City Comprehensive Plan, Chapter 13 Capital Facilities Element, capital improvements are those major projects, activities or maintenance costing over \$25,000. The objectives of the CIP are to group various system needs, evaluate alternatives that are cost-effective and operationally sound, and ultimately, organize and prioritize the recommended improvements for implementation during the annual budgeting process.

As described in Chapter 7, Finance, the City initiated a Stormwater Capital Fund for stormwater CIP projects. As cited in the 2016 Comprehensive Plan, the storm drainage fund is projected to be approximately \$2.5 million recurring annually, limiting the projects that can be completed. Additional budget must be transferred to this fund periodically to complete the CIP projects. CIP projects described in this Chapter are prioritized within a ten-year planning period (2018 to 2027) for which this Plan has been developed. Projects anticipated beyond this date range are also identified to allow for longer range planning. Funding sources are discussed in Chapter 7. Project funding depends on a variety of factors, including project type and scheduling. Priorities are subject to updates, particularly when outside funding opportunities are presented, or to coordinate with other projects in a roadway corridor.

New development or changing land uses within the service area may necessitate or negate project improvements well in advance of scheduled renewal and replacements. Under such circumstances as deterioration of facilities in advance of the anticipated useful life, an identified or unidentified project may require system improvements in advance of the projected scheduled and/or developer requests for service. Development and redevelopment of existing properties was considered for future flow control. In these instances, on-site system improvements would be completed by the developing property owner meeting the flow control standards for development and redevelopment set by the City's Stormwater Management and Site Development Manual. Implementation of flow control standards may reduce or eliminate the necessity for the city to provide improvements to existing storm drain infrastructure. The likelihood of this occurrence with respect to identified capital improvement projects was addressed as part of project prioritization and scheduling.

CAPITAL IMPROVEMENT PLAN

Storm system and habitat improvement projects identified in the CIP were based on the staff's knowledge of the service conditions in the storm drainage network, prior studies, and the hydrologic/hydraulic analysis discussed in this plan update. Projects identified in prior plans that have not been completed were reviewed with staff and in the hydraulic analyses to affirm whether they should be maintained in the CIP. Miscellaneous improvements such as replacement of damaged pipes or catch basins, control structure repairs, regrading of ponds or ditches, and bank stabilization can be included in the storm pipe replacement programs. This also provides funds for unforeseen problems that can be easily repaired or otherwise taken care of quickly. A typical example might be a short section of pipe that has been crushed or the addition of a single catch basin in an area that frequently suffers from localized flooding. The money could also be used in case of emergencies, thereby providing some buffer against the unavoidable expenditure of money that had been budgeted for a much-needed capital improvement

project. Capacity problems can also be resolved with flow control facilities similar to those constructed on Point Fosdick Drive NW. Onsite or regional facilities can reduce flows to minimize capacity impacts on the existing storm system. Regional facility locations should be considered as an alternative to pipe replacement.

The cost of the NPDES program is not included because it varies from year to year. Appendix A provides information on the proposed storm and habitat improvements by proposed project number and is coordinated with the CIP Map. According to the 2016 Comprehensive Plan, the cost of the NPDES Phase II Program for the next six years is about \$96,000 annually. This cost will be dependent on the final program annual needs and future requirements from Ecology during future permit cycles.

PROJECT ESTIMATES AND SCHEDULES

The planning level cost estimates provided in this Plan are intended to be conservative estimates that will be refined during the design process of each improvement project. It is important to realize that the actual design of the improvements and possible changes made during that design could significantly alter the cost of the project from the estimate provided. Prior to the initiation of the projects shown in the Plan, any changes should be reviewed and the cost estimate updated to reflect current conditions. The cost estimates presented in the CIP are based on 2018 dollars and reflect total project costs. The City is required to pay state sales tax on drainage construction improvements. The rate of 9-percent is applied to the construction cost and is included in the estimate.

Cost estimates were developed for each identified project and are included in Appendix A. The “contingency” assigned to each project is 30-percent. This relatively high but typical value is used since there is considerable uncertainties associated with the identified projects. These uncertainties include lack of detailed site survey, uncertain geotechnical conditions and associated design constraints, potential utility interference, alignment and property/easement requirements, and other ancillary drainage components (such as inlets) that may require replacement.

The “mobilization” element represents the cost of the contractor gathering and transporting his equipment to the construction site and the removal of the equipment when the project is completed. A value of 5-percent of the construction cost is used.

The “Engineering/legal/admin” element represents the cost to design the improvement, the City’s legal costs, and the City administration costs. It is assigned using a sliding scale based upon the construction cost, using the following relationship:

- Construction cost range less than \$100,000, use 35% of the construction cost
- Construction cost range \$100,001 to \$250,000, use 30% of the construction cost
- Construction cost greater than \$250,000, use 25% of the construction cost

The “Construction management” cost is assigned 15-percent of the construction cost and covers the cost of City staff or engineering consultant to monitor and document the construction to ensure it is built to the plans and specifications of the project. “Permitting” costs are also assigned based upon a sliding scale based upon the construction cost and uses the following relationship:

- Water Quality / Fish Passage, use 20% of the total construction cost
- No Water Quality / Fish Passage, use 8% of the total construction cost
- General site restoration was given a value of 7-percent of the construction cost.

Cost estimates do not include such items as right-of-way acquisition, utility relocations, or other unforeseen complications. Table 5-1 shows the proposed schedule for the recommended capital improvements and costs for each year.

RECOMMENDATIONS

Following are recommendations related to the CIP:

- Continued coordination between the Planning Department, Permit Center and Public Works to ensure efficient implementation of the Capital Improvement Plan. Provide a CIP map to the departments and one copy at the counter to be used while reviewing a proposed development.
- Investigate opportunities for regional flow control facilities. This may eliminate some of the capacity improvement projects identified in the CIP.
- Investigate opportunities for regional water quality facilities. There may be areas where offsite flows from public roads or facilities are conveyed through private properties. This may be an opportunity for the City to partner with the developer to construct a regional water quality facility to treat water from the developer's site and offsite.
- Investigate opportunities to use Low Impact Development methods in projects or developments to reduce the amount of runoff from the site.
- Following studies were identified in the 2009 Stormwater Comprehensive Plan. In order of priority they should be completed to evaluate the fish and wildlife habitat within the City and identify possible projects to improve the habitat and remove fish barriers:
 - Donkey Creek Habitat Enhancement Study
 - McCormick Creek Habitat Enhancement Study
 - Crescent Creek Habitat Enhancement Study
 - Gooch Creek Habitat Enhancement Study
- In addition to the studies, the acquisition of property or conservation easements along Donkey Creek and the other creeks should be evaluated to preserve the habitat corridor. Request the dedication of conservation easements from properties along the creek corridor as they develop or develop a City program to inform property owners adjacent to the creek in the importance of preserving the habitat along the creek corridor.
- Continue to update the storm system map. This is an on-going project that will continue as the City develops and annexes new areas. Developers can assist in the mapping by providing the project record drawings in a file format that can be imported into GIS. The City should require that these drawing files be submitted in the City's standard coordinate system that is used in the GIS mapping.
- Begin a monitoring program for the Garr Creek Tributary east of 38th Avenue NW. Develop a standard reporting schedule and format, document any observed erosion through photographs and written description. Map the erosion locations. Visit the site after heavy rainstorm events. Inspect the upstream stormwater flow control facilities to verify that they are operating properly. Implement a Low Impact Development requirement for all development within this basin.
- Developers could assist with the identified storm improvements by constructing the recommended improvement, providing a level of funding as determined by the City or implement Low Impact Development methods.
- Review the habitat projects with the outside permitting agencies (WDFW, ACOE, Ecology...) to determine permitting requirements, permit review time, funding and partnership opportunities.
- Continue relationships with the public and neighboring jurisdiction within common watersheds and seek partnership opportunities.

- Establish stormwater facility inspection program. Proper maintenance can reduce future problems.

Table 5-1: CIP Summary Table

CIP No.	Description	Target Date	Location	Cost (2018 \$s)	Project Type
2018-01	WWTP Cr Reroute to Donkey Cr	2028	Harborview Dr. near North Harborview Dr.	\$4,760,000	Habitat
2018-02	Crescent Creek Culvert Replacement	2025	Vernhardson St. near N Harborview road	\$3,000,000	Habitat
2018-03	Stormwater Share for PW Decant Facility	2019	Maintenance Facility Site	\$394,500	Facility
2018-04	38 th Garr Cr Box Culvert	2028	38 th at Garr Cr	\$554,000	Habitat
2018-05	Harborview Dr Sediment Vault	2019	Harborview Drive	\$750,000	Habitat
2018-06	50 th St Box Culvert	2020	50 th Street Ct. NW	\$840,000	Habitat
2018-07	Annual NPDES Permit Implementation Expenses	Ongoing	N/A	\$20,000/yr.	Permit
2018-08	Stinson Ave Stormwater Replacement and Extension	2028	Stinson Avenue South of Edwards Dr.	\$268,000	Capacity
2018-09	Public Works Operation Center - Building	2020	89th and Skansie Ave	\$538,300	Facility
2018-10	Outfall to Marine Waters Study	2021	Multiple Outfall Locations	\$200,000	Condition
2018-11	Outfalls to Marine Waters Upgrades	2023	Multiple Outfall Locations	\$500,000	Condition
2018-12	Pipe Slip Line Mountainview to Peacock	2019	Mountainview to Peacock	\$40,000	Condition
2018-13	Pipe Slip Line Vernhardson	2019	Vernhardson St. near N. Harborview Road	\$40,000	Condition
2018-14	Pipeline Upgrade Program	Ongoing	Throughout the City	\$30,000/yr.	As Noted
	2001-07 Burnham Drive Storm Drain Replacement		Burnham Drive	\$46,700	Capacity
	2001-08 Replace 60' of 12-inch storm pipe with 18-inch		Peacock Hill	\$32,500	Capacity

CIP No.	Description	Target Date	Location	Cost (2018 \$s)	Project Type
	2017-03 Fairway Estates Flood Improvement		26 th Ave Ct NW at 37 th St NW	\$107,000	Capacity
	T1-01 Peacock Hill Ave Storm Drain Improvement		Peacock Hill near N Harborview Dr.	\$637,000	Capacity
	T1-02 North Harborview Ave Storm Drain Improvement		N. Harborview Drive near Peacock Hill Ave.	\$185,000	Capacity
	T1-03 North Harborview Drive Outfall		N. Harborview Drive near Peacock Hill Ave	\$190,000	Capacity
	T2-01 Soundview Dr. Storm Drain Improvement		Soundview Drive south of Ryan Street	\$427,000	Capacity
	T3-01 Point Fosdick Dr. Culvert Replacement 1		Point Fosdick Drive	\$68,000	Capacity
	T3-02 Point Fosdick Dr. Culvert Replacement 2		Point Fosdick Drive	\$57,000	Capacity
	T3-03 Point Fosdick Dr. Culvert Replacement 3		Point Fosdick Drive	\$15,000	Capacity
	T3-04 Point Fosdick Dr. Culvert Replacement 4		Point Fosdick Drive	\$48,000	Capacity
	T5-01 Garr Creek Tributary Box Culvert at 50 th Street NW		50 th Street Ct. NW	\$608,000	Habitat
	T5-02 Garr Creek Tributary Box Culvert at 48 th Street NW		48 th Street Ct. NW	\$608,000	Habitat
	T5-03 Garr Creek Tributary Box Culvert at 47 th Street NW		47 th Street Ct. NW	\$608,000	Habitat
	T5-04 38 th Avenue NW Storm Drain Daylighting		38 th Ave NW south of Briarwood Ln	\$963,000	Habitat
2018-15	Stormwater Comprehensive Plan Update	Re- curring	City Wide	\$120,000	Plan

CIP No.	Description	Target Date	Location	Cost (2018 \$s)	Project Type
2018-16	Public Works Operations Center – Site Development	2019	89 th St and Skansie Ave	\$193,000	Facility
2018-17	Public Works Shop – Metal Building	2019	89 th St and Skansie Ave	\$10,000	Facility

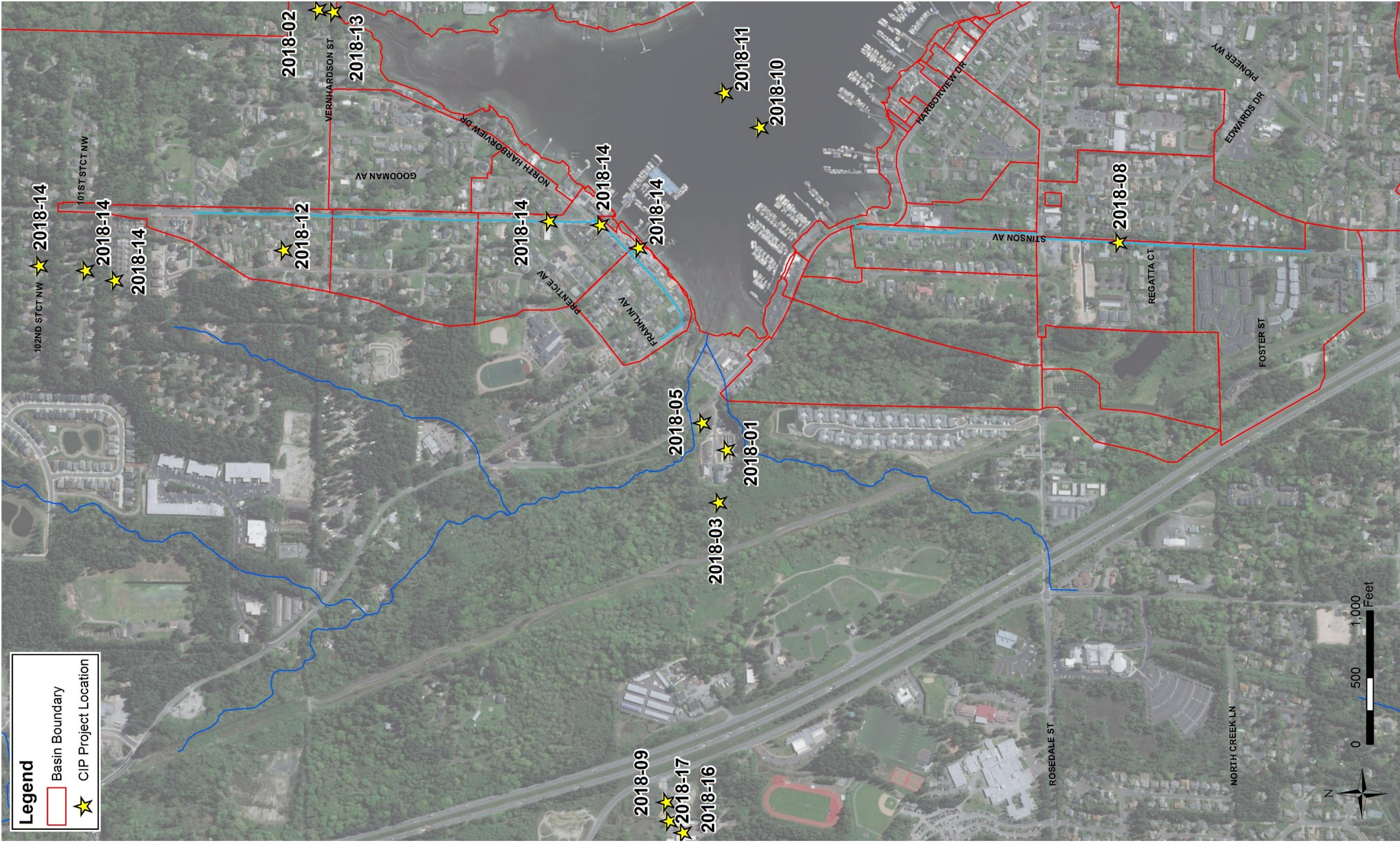


Figure 5-1: Locations of Identified Projects (North)



Figure 5-2: Locations of Identified Projects (Central)



Figure 5-3: Locations of Identified Projects (South)

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EVALUATION MATRIX

A matrix was developed to provide guidance in the prioritization of the recommended projects. The matrix consists of several criteria that are summarized below. The projects are assigned points varying from one to five. A value of one indicates a low value or risk, such as a minor flooding problem or a problem that has little flooding impact to the citizens of Gig Harbor. A value of five indicates a project that has a high value or risk and corrects a major flooding problem or one that impacts a large number of citizens. In addition, a weighting factor is applied to emphasize criteria considered more important to the City. A larger value indicates a greater importance to the City. As a result of applying the scoring and weighting factor, the project that receives a higher score is considered more urgent/important to implement over a project that receives a lower score.

Historical Immediacy

This criterion flags problem areas which the City has had to address repeatedly over the years. A low score indicates that the problem is infrequent and requires minimal staff effort to correct. A high value reflects a frequently occurring problem area that requires significant staff effort to correct.

Weighting factor = 1.5.

Frequency of Flooding Problem

This criterion scores projects based on the frequency of predicted flooding. A low score indicates that the proposed project corrects infrequent flooding, such as that which would occur during a 100-year, 24-hour storm event. A high score would be assigned to a project that corrects frequent and chronic flooding, such as in an area that has received frequent citizen complaints or that which floods during the 2-year, 24-hour storm event.

Weighting factor = 2.0.

Risk Consequence

This criterion is based upon the predicted flooding areas identified through the modeling performed for the study area. A low score indicates a problem area predicted to have a low magnitude of flood volume, consequently one which has little impact to the citizens of Gig Harbor. An example of this problem is a predicted flooding location with minor flood volume not fronted with developed property. A high score indicates a significant flooding location with high likelihood of impacting traffic or flooding of developed property.

Weighting factor = 2.0.

Construction Related Impacts

Many construction project elements can be objectionable to the public during construction. Depending on the type and location of construction, construction noise or impacts on transportation or recreation can be issues. This criterion assigns a low score to a project that would have a significant adverse impact on transportation or recreation, or is located where construction noise would be especially undesirable. A project would receive a high score if few or no adverse construction impacts are anticipated.

Weighting factor = 2.0.

Associated Risk

This criterion provides an additional factor in order to differentiate projects that are considered high risk and low risk with respect to private property that may occur if the identified problem is left unresolved.

Weighting factor = 3.0.

Project Order

This criterion provides an additional factor in order to make sure that projects that appear in series are constructed from downstream to upstream. This factor is not shown in the summary table.

PROJECT PRIORITIZATION / RANK

Using the evaluation matrix, the priorities of the projects that compose the recommended plan are calculated using the scoring and weighting factors discussed above and assigned using a combination of the City's input and the Engineer's best judgement. Table 5-2 summarizes the matrix and its results. The results of the evaluation were used in developing the capital improvement project list and sequencing. This is discussed in Chapter 7.

Table 5-2: Evaluation Matrix

CIP	Historical Immediacy (Factor=1.5)	Flood Frequency (Factor = 2.0)	Risk / Consequence (Factor =3.0)	Construction Impacts (Factor=1.5)	Total	Rank
2017-05	3	5	3	1	21.25	1
T3-03	2	5	1.5	1	17.15	2
CFE-03A	2	5	1	1	16.5	3
CFE-07	2	5	1	1	16.5	3
CFE-11	2	5	1	1	16.5	3
T1-03	1	5	2.5	1	15.5	6
T8-01	1	5	2	1	15	7
T2-01	1	5	1.5	1	14.5	8
T1-01	1	3	2.5	3	11.75	9
T3-04	1	3	2.5	3	11.7	10
T1-02	1	3	2	1	11.13	11
2017-03	2	2	1.5	1	11	12
2017-04	3	1	1	1	11	12
T7-01	1	3	2	5	11	12
T5-05	2	1	3	1	10.75	15
T5-04A	2	1	3	5	10.65	16
T5-04B	2	1	3	5	10.65	16
T5-03	2	1	3	5	10.6	18
T5-02	2	1	3	5	10.55	19
T5-01	2	1	3	5	10.5	20
T3-02	2	1	2.5	3	10.1	21
T3-01	2	1	2.5	3	10.05	22
T6-02	1	1	2	1	7.1	23
T6-01	1	1	2	1	7.05	24
2017-01	2	0	1	1	6.5	25
2017-02	1	0	1	1	4	26
2001-03	2	5	1	1	16.5	N/A
2001-04	2	5	1	1	16.5	N/A
2001-05	2	5	1	1	16.5	N/A
2001-06	2	5	1	1	16.5	N/A
2001-07	2	5	1	1	16.5	N/A

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6. OPERATIONS AND MAINTENANCE

Operations and maintenance is critical to both reliable performance and dependable function of the city's drainage infrastructure, and to meeting water quality objectives and regulatory compliance. The 2009 Stormwater Comprehensive Plan provided recommendations for developing an active stormwater operations and maintenance program, and the City has acted upon those recommendations to advance management of the stormwater system, highlighted by:

- completed mapping of the storm system and its outfalls
- implemented public education and engagement efforts toward water quality source controls
- implemented an illicit discharge detection and elimination (IDDE) program
- expanded inspections and maintenance efforts
- implemented new standards and controls
- obtained necessary training for staff, and
- documented its efforts and progress.

City has met its operational responsibilities under its current NPDES MS4 permit, as documented in its annual reporting to the Department of Ecology (refer to Appendix E for the City 2017 report summary).

FACILITIES INSPECTION AND MAINTENANCE

The City is responsible for an extensive network of inlets, catch basins, pipes, culverts, ditches, outfalls, ponds, vaults, tanks bioretention swales, rain gardens and other hydraulic and treatment facilities. This inventory has grown substantially over the past decade with continuing development and annexations to the City. The City inspects city-owned infrastructure and performs indicated maintenance and repairs; for privately owned facilities that discharge to the City's drainage system, the City is responsible for performing regular inspections and, where maintenance or repairs are needed, providing technical guidance. In cases where facility owners do not complete needed repairs or maintenance, the City is in the position of enforcing compliance. Table 6-1 summarizes Gig Harbor's drainage system assets.

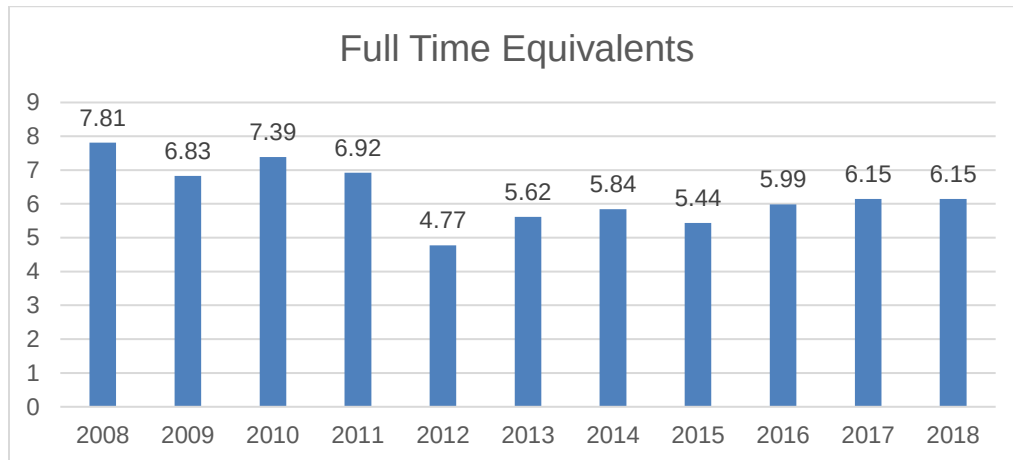
Table 6-1: Current Stormwater Facilities Inventory

Infrastructure Asset	Units	Current Inventory		
		Public	Private	Combined
Manholes	each	27	90	117
Catch Basins	each	2,115	2,468	4,583
Pipe Conveyance	l.f.	219,430	175,213	394,643
Retention/Detention Ponds	each	25	23	48
Retention/Detention Vaults/Tanks	each	14	104	118
Infiltration Systems/Dry Wells	each	5	83	88
Oil/Water Separators	each		4	4
Ditches/Swales	l.f.	72,687	13,410	86,097
Outfalls	each	13	20	33
Bioretention Swales/Raingardens	each	9		9

Growth in the storm drainage network reflects both annexations and robust development within the city. With system growth comes demands for project reviews and approvals; construction phase inspections of temporary site controls and permanent storm drainage improvements; expanded regular inspections and maintenance of publicly-owned storm drains, catch basins and control facilities; greater inventory of privately-owned control facilities to inspect regularly; more lane miles of streets to sweep; and additional storm drains, culverts and outfalls to maintain, repair and rehabilitate.

Despite growth in the construction activity and storm drainage system inventories, stormwater program budgeted staffing levels have remained flat for several years, as shown in Figure 6-1.

Figure 6-1: Stormwater Program Staffing



Currently the stormwater program is staffed as follows:

<u>Account</u>	<u>FTEs</u>
Storm Administration – Public Works	1.97
Storm Administration - General	0.77
Storm - Customer Service: Billing	0.20
Storm Drainage Maintenance	1.75
Storm – Inspection (Construction)	0.25
Storm Capital	<u>0.55</u>
Total	5.49

Most inspection and maintenance performed by City forces. The City contracts with Pierce County to perform approximately one mile of ditch maintenance annually. The City also participates in regional forums to cost effectively comply with some provisions of the NPDES MS4 permit.

To establish a target level of service and estimate the maintenance resources required to achieve, an analysis was prepared that:

- quantifies the public and private drainage infrastructure components (inventory),
- defines maintenance activities and intervals applicable to the system components (level of service),
- defines the crew and equipment configurations and corresponding hourly costs to efficiently and safely perform each activity (unit costs), and

- estimates the amount of time required for the crew to perform the specified inspection or maintenance (productivity), and calculates annual labor, equipment and contracted costs to provide the defined levels of service.

Table 6-2 is derived from a spreadsheet model provided to the City with this plan update for use in annual maintenance programming and budgeting. Areas where additional efforts are indicated include:

Catch basins. The City's practice over recent years has demonstrated that regular catch basin maintenance results in fewer problems with debris collecting in storm drains. The City has further inspected each of its catch basins over the past 5 years, complying with provisions of the NPDES MS4 permit. Going forward, the permit requires the City to inspect each of its catch basins every two years and maintain them as necessary. With an inventory of more than 2,000 catch basins, annual inspections exceeding 1,000 will require additional resources. This effort can be reduced by conducting inspections on a 'circuit basis', i.e. checking key catch basins within a drainage network that are shown to be indicative of conditions in associated catch basins within a specific drainage network. Documenting conditions in Cartegraph system offers the capacity to define such circuits and to justify less frequent inspections in specific locations.

Pipes. Besides ongoing growth in the City's storm drainage network, the system overall is aging with portions reaching the end of their expected service life. The service conditions of corrugated metal culverts, tanks and storm drain pipes are particularly suspect due to their material characteristics and age. It is recommended the City initiate routine video inspection of the storm drainage network to assess the structural and service conditions of pipes and culverts so that rehabilitation and replacement needs can be identified prior to failure, as such failures lead to property damages (both public and private) and to significant expense. Routine video inspections also afford opportunity to identify and correct illicit discharges to the storm drainage system; this supports water quality protection, and such inspections are anticipated to be added to the City's NPDES MS4 permit in an upcoming renewal cycle.

Private Facilities. Although maintenance responsibility rests with the owners of private facilities, the City is responsible for ensuring such private systems that flow into the City's drainage system do not degrade the quality of discharges from the City's system. Therefore, the City is required to periodically inspect private facilities such as ponds, tanks, treatment swales, and oil-water separators to confirm they are adequately maintained and functioning properly. Where maintenance efforts are found to be insufficient, the City must work with the owner to see that corrections are made.

Under the recently adopted stormwater design standards, the number and variety of best management practices (BMPs) are expanding, and training should be provided in the proper maintenance and operation of these types of facilities.

Decant. The limited capacity of decant facilities at the City's wastewater treatment plant places limits on the catch basin effort. This capacity will be increased with the construction of a dedicated decant facility which provides the capacity to meet cleaning demands of the growing stormwater system.

Channels/Ditches. The City's inventory includes approximately 16 miles of roadside ditches and swales. The contracts with Pierce County to clean approximately one mile of ditch annually. To better assure the ditches are cleaned with sufficient frequency to control sediment from discharging downstream and to avoid compromising hydraulic performance of channels, it is recommended this effort by the County be doubled to achieve an overall 8-year cleaning cycle.

Table 6-2: Inspection and Maintenance Staff Requirements

Activity	Total Units		Frequency (times/ year)	Production (units/ day)	Crew Size	Vactor	Dump Truck	Mower	Service Vehicle	Backhoe/ Trailer	Flatbed Truck	Annual Staff Days	
Clean and inspect	27	each	0.5	30	3	1			1		1	1	
Clean and inspect	2,115	each	0.5	30	3	1			1			106	
Clean	219,430	I.f.	0.1	600	3	1			1			73	
Video inspection	219,430	I.f.	0.1	500	2						1	59	
Clean & inspect control structure	25	each	1.0	2	2	1					1	25	
Vegetation control	25	each	2.0	2	2			1	1			50	
Remove sediment	25	each	0.2	1	3		1			1	1	15	
Inspect only (Private)	23	each	1.0	5	3		1			1	1	9	
Clean & inspect control structure	14	each	1.0	2	2	1					1	14	
Remove sediment	14	each	0.2	1	3	1			1			8	
Inspect only (Private)	104	each	1.0	5	3	1			1			42	
Inspect	5	each	0.2	2	2						1	1	
Clean & inspect	0	each	0.2	4	2	1			1			-	
Inspect only (Private)	4	each	0.2	4	3			1	1			0	
Vegetation control	72,687	I.f.	1.0	2,500	1			1				29	
Remove sediment	72,687	I.f.	0.1	0	(Performed by County)								
Inspect	13	each	0.5	4	2				1			3	
Clean	13	each	0.2	1	2		1		1			8	
Vegetation control	9	each	1.0	3	1			1		1		3	
Remove Sediment	9	each	0.2	3	4		1		1	1		1	
Solids - tons	161	tons	1.0	1	1		1			1		52	
Decanted liquid - gallons	34,272	gal.	1.0	1								-	
Phone system + weekly locates	1	I.s.	52.0	1.00	1				1			52	
Total												551	days
												2.5	FTEs

Based on the recommended service levels to the asset inventory the City is currently responsible for, a labor force of 2.5 full time equivalents (FTEs) is indicated. For 2018 there are 1.4 FTEs budgeted for maintenance field activities. It is recommended that the City's stormwater maintenance program increase field staffing by 1 FTE to increase levels of effort in the areas described above.

POLICIES

Direct Discharge without Flow Control. The City's current Stormwater and Site Development Manual provides for a waiver of flow control requirements (referred to as "direct discharge") under specific conditions for projects that do not directly abut marine waters, but which discharge to piped systems that outfall to marine waters (refer to Volume I - Section 2.4.7 of the manual). The conditions that must be met to authorize a direct discharge include, among others:

- The conveyance system between the project site and the exempt receiving water shall have sufficient hydraulic capacity to convey discharges from future build-out conditions (under current zoning) of the site, and the existing condition from non-project areas from which runoff is or will be collected.
- Any erodible elements of the manmade conveyance system must be adequately stabilized to prevent erosion under the conditions noted above.

The hydrologic and hydraulic analyses performed in preparing the Plan update conclude that several of the larger trunkline systems do not have the required hydraulic capacity under full build-out conditions to satisfy the first of the two cited conditions. Outfalls receiving drainage from smaller catchments along the harbor appear to have sufficient capacity.

Several outfalls along the harbor front exhibit evidence of erosional scour with the potential compromise the structural integrity of the outfall, headwall or surrounding shoreline. The Plan recommends detailed condition assessments of marine outfalls and the design and construction of repair measures.

To minimize further degradation of outfall conditions due to excessive scour, and inadequate capacity for future build out, the City intends to amend the Gig Harbor Municipal Code by Ordinance. The Ordinance will revise, by reference, the 2016 Gig Harbor Stormwater and Site Development Manual the first paragraph of Volume I, Section 2.4.7, Minimum Requirement #7: Flow Control, to read as follows:

"Projects must provide flow control to reduce the impacts of stormwater runoff from hard surfaces and land cover conversions. The requirements below apply to projects that discharge stormwater directly, or indirectly through a conveyance system, into a fresh waterbody or a saltwater body. Projects on parcels that immediately abut a saltwater body or tidally influenced waters which do not discharge stormwater runoff through a municipal stormwater system, are exempt from the flow control requirements below."

Seasonal Work Limitations. Under the City's current standards, the phasing of project construction is required during the 'wet' season from October 1st through April 30th. However, a limitation on the extent of clearing, grading and other soil disturbing activity is not specified (refer to manual Volume II – Section 2.3.3, Element #12). Limiting the extent of open ground is critical to minimizing the risk of large failures on construction sites that can release sediment to streets, storm drains, neighboring properties, and to stream, wetlands, ponds and marine waters. It is recommended that a specific limitation be included in the City's manual to clarify expectations on the ability to manage site conditions during the wet season.

STORMWATER PROGRAM OPERATIONS

Operations comprises a broad set of activities essential to ensuring the City's stormwater program meets current local service needs, provides for efficient delivery of future services, and complies with regulatory mandates. Stormwater program Operations activities can be grouped into several functional areas:

management, administration, engineering, water quality, and customer relations. There are drivers creating added demands upon staff resources, and additional staffing is indicated; these drivers include drainage system growth, development activity, regulatory compliance and enforcement, and capital projects.

It is recommended that staffing be increased by 1 FTE to implement the stormwater program activities and provide the resources necessary to address the program's ongoing commitments, regulatory risk, continuity, and effectiveness. Areas where additional staff resources are indicated include:

- Employing Cartegraph and condition monitoring for asset management to realize efficiencies and timely rehabilitation/replacement of infrastructure
- Continuity in engagement in regional collaborations to manage water quality and regulatory compliance
- Capital project support, development reviews.

7. FINANCE

INTRODUCTION

This chapter provides a review of the existing stormwater utility's financial performance as well as a forecast of future operating and capital expenses projected over the next ten years. Based on this forecast, the City's ability to fund planned capital improvements is assessed and monthly rate increases required to fund required capital are identified.

EXISTING RATES

Table 7-1 lists existing (2018) stormwater monthly rates. The City performed a rate study in 2014 and by ordinance has passed annual rate increases through the year 2020. Table 7-1 lists the rate increases that will occur in 2019 and 2020. Commercial customer stormwater rates (shown in Table 8-1 as All Other) are based on the number of equivalent billing units as determined by the City multiplied by the monthly rate listed. The determination of equivalent billing units utilizes such factors as the ratio of impervious surface area of the commercial customer relative to that of an average single-family residence and other factors such as onsite retention and or detention facilities.

Table 7-1: Existing Stormwater Monthly Rates

Customer Classes	Monthly Charge	2019 Rate Increase	2020 Rate Increase
Single-family residences & mobile homes	\$13.93	3%	3%
Duplex	\$20.90	3%	3%
All other (per equivalent billing unit)	\$13.93	3%	3%

Note: Rates do not include State or City taxes

HISTORICAL OPERATING CASH FLOWS

Table 7-2 and Table 7-3 provide a list of historical operating cash flows from 2015 and 2016 as well as the stormwater utility's budgets for 2017. The City's 2017 budget (department request) is used in this analysis since at the time of this report the City has not completed their 2017 annual report.

Only revenues and expenses associated with month-to-month operations are included. Historical cash flows are presented since they indicate whether existing rates can fund existing operations and since future operating expenses and revenues are based in large part on historical levels. Revenues and expenses associated with capital are not presented since historical capital cash flows are unrelated to future capital cash flows that are addressed in a subsequent section.

Table 7-2: Historical Operating Revenues

Operating Revenues	2015	2016	2017 Dept. Request
Storm – State utility taxes	11,737	12,808	13,481
Storm drainage fees	785,261	854,066	899,648
All other	227,676	864	516
Total Revenues	1,024,674	867,738	913,645

Note: This data is summarized from Table D-1 in Appendix D

Table 7-3: Historical Expenses from Operations

Operating Expenses	2015	2016	2017 Dept. Request
Administration – Public Works	250,144	277,659	294,775
Administration - General	111,261	104,497	117,140
Customer Service – Billing/Accntg	9,409	14,436	15,400
Street Maintenance	209,640	252,956	433,352
Inspection	33,271	31,414	22,100
Capital Expenditures	42,430	15,112	167,250
Road & Street Construction	62,726	71,470	22,544
Total Operating Expenses	718,881	767,544	1,072,561

Note: This data is summarized from Table D-2 in Appendix D

Table 7-4: Net Income from Operations (2015 - 2018)

Operating Cash Flows	2015	2016	2017 Dept. Request
Total revenues from Table 7-2	1,024,674	867,738	913,645
Total expenses from Table 7-3	(718,881)	(767,544)	(1,072,561)
Net Income from Operations	307,808	102,210	(158,916)

FINANCIAL ASSESSMENT OF EXISTING OPERATIONS

As shown in Table 7-4, the stormwater utility's existing monthly rates were sufficient to fund ongoing operations in 2015 and 2016 but not 2017. However, total expenses in 2017 include \$160K in professional services to fund the ongoing stormwater comprehensive plan and since this is more appropriately considered as a capital expense (consistent with how future comprehensive plan costs are budgeted), the operating revenues were in fact just enough to fund operating expenses in 2017.

The City funds all utility debt payments using operating revenues; however, the stormwater utility has no outstanding debt service.

PROJECTED OPERATING CASH FLOWS

A projection of future operating revenues and expenses is required to analyze whether additional rate increases will be required to fund future operations. Table 7-6 and Table 7-7 present a forecast of future revenues and expenses based on historical cash flows, discussions with staff, and annual inflationary/forecast factors. Inflationary factors include such items as general inflation, annual cost of living adjustments (COLAs), and annual increases in benefit costs (Benefits). Forecast factors are variables such as the State's excise tax rate on sewer revenues and the interest-earning rate on deposited cash. The inflationary/forecast factors listed in Table 7-5 are annual and are applied to appropriate revenues and expenses to forecast future cash flows from operations.

The projection of future operating expenses also includes the addition of new maintenance and administrative personnel. The analysis includes the addition of the following FTEs (full time equivalent employees): 0.2 FTEs in 2019, 0.7 FTEs in 2020, 0.5 FTEs in 2021, and 1.0 FTEs in 2025.

Customer growth is also required to project future operating revenues and expenses. Growth increases revenues from rates as well as marginally increasing some expenses such as pumping costs. In consultation with City staff, this analysis uses an annual growth of 3% per year for the years 2018 through 2021 and 1% a year from 2022 through 2027. Growth is only predicted to occur in the residential and commercial classes but not in either the City or County governmental classes (including the department of corrections).

Two expense categories "Capital Expenditures" and "Road & Street Construction", listed under operating expenses in Table 7-7, are projected at zero dollars since they are costs associated with capital construction and therefore stormwater's share of these costs have been projected under capital costs in Table 7-10.

Since the City pays debt payments from operating revenues, this analysis includes projected annual debt payments as operating expenses.

Table 7-8 lists scheduled debt payments for the stormwater utility through the year 2027. Based on the financial projection documented herein, the City will need to issue debt for stormwater's share of the new decant facility and the Harborview Drive Sediment Vault in 2019 as well as the Crescent Creek Culvert Replacement project in 2025. Projected debt payments are based on bonds with an annual interest rate of 4% and a term of 20 years.

Table 7-5: Annual Inflationary Forecast Factors

Forecast Factors	Annual Increase
Interest earnings rate	1.00%
COLA	3.00%
Benefits	4.00%
Inflation	2.50%
Electricity	5.00%
State Storm Excise Tax	1.86%

CAPITAL CASH FLOWS

Capital revenues and expenses need to be incorporated into the budget forecast to provide a complete economic outlook and assess the ability of monthly rates to fund future operations and construct capital improvements. Capital revenues include funds generated from general facility charges, earned interest income from cash deposits, and proceeds from any new loans. Capital expenses include the capital improvement costs identified in Chapter 5 as well as scheduled debt payments.

Table 7-9 lists projected capital revenues. General facility charge revenues (GFCs) are one-time payments made by new customers connecting to the wastewater system and are based on the City's existing GFC fee of \$1,770 per equivalent residential connection. Projected GFC revenue is based on the current GFC fee of \$1,770 per ERU multiplied by approximately 150 new ERUs per year from 2018 through 2021 and 60 new ERUs from 2022 through 2027. Earned interest income is based on an interest rate of 1.0% annual return and is projected based on estimated cash reserve balances that are listed in Table 7-10.

Annual capital expenses are listed in Table 7-10 and are as detailed in Table 5-1 in Chapter 5. The capital costs listed in Table 7-10 are inflated to the year scheduled using 3% annual cost inflation.

SUMMARY

A comprehensive picture of the future of the stormwater utility's financial outlook can now be created based on the cash flows in Table 7-6, 7-7, 7-8, and 7-9. Table 7-11 shows a summary projection of all cash flows and cash reserves as well as any assumed annual rate increases.

The stormwater utility is relatively new and as a result has had insufficient time to accumulate reserves available for funding extensive capital costs. The utility is generating sufficient revenue from monthly rates to fund all operating costs and have a \$100K a year surplus (or about 10% of rate revenues). Utilities typically generate from 5% to 10% in excess revenues to ensure all expenses can be paid as well as to provide an operating cash reserve for unplanned for costs. In long term planning, net revenue from rates (before debt costs are funded) should fund long term depreciation costs from which debt payments and ongoing capital costs can be funded. This analysis assumes existing operating costs will increase by roughly 3% a year and also increases costs for additional personnel. For these reasons the analysis utilizes 3% annual rate adjustments in each year through 2027.

The cash flow analysis summarized in Table 7-11 indicates that the stormwater utility will need to issue debt to fund its share of the decant facility and Harborview Drive sediment vault in 2019 and the Crescent Creek culvert replacement in 2025. The City expects to issue revenue bonds in 2019 for the stormwater utility as well as the water and wastewater utilities and therefore will minimize bond issuance costs.

Implementing 3% annual rate adjustments and issuing the specified debt will enable the utility to fund ongoing operations, staff increases, new debt service, and fund scheduled capital improvements. As shown in Table 7-11, the utility's limited cash reserves are further depleted but are building in the last three years.

It is important that the City monitor growth because revenues from general facility charges are a significant source of funds needed to pay for the planned capital improvements. This analysis forecasts about \$1.6M in GFC revenue over the next ten years and this represents 20% of the total cost of planned capital improvements.

Table 7-6: Projected Operating Revenues

Operating Revenues	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Storm – State utility taxes	18,400	19,500	20,700	21,900	22,800	23,700	24,700	25,700	26,700	27,800
Storm drainage fees	986,800	1,046,900	1,110,700	1,178,300	1,225,800	1,275,200	1,326,600	1,380,100	1,435,700	1,493,600
All other	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Total Operating Expenses	1,006,200	1,067,400	1,132,400	1,201,200	1,249,600	1,299,900	1,352,300	1,406,800	1,463,400	1,522,400

Note: This data is summarized from Table D-3 in Appendix D

Table 7-7: Projected Operating Expenses

Operating Expenses	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Administration – Public Works	293,900	302,400	327,300	393,900	447,600	460,500	474,200	580,300	597,200	614,500
Administration - General	122,600	126,100	129,700	133,400	137,300	141,300	145,300	149,400	153,700	158,200
Customer Service – Billing/Accntg	15,600	16,000	16,600	17,000	17,600	18,100	18,700	19,200	19,800	20,300
Street Maintenance	410,400	422,700	434,700	447,400	457,100	470,000	483,200	497,200	511,000	525,300
Inspection	22,500	23,200	23,900	24,600	25,400	26,100	26,900	27,700	28,500	29,300
Capital Expenditures	-	-	-	-	-	-	-	-	-	-
Road & Street Construction	-	-	-	-	-	-	-	-	-	-
Total Operating Expenses	865,000	890,400	932,200	1,016,300	1,085,000	1,116,000	1,148,300	1,273,800	1,310,200	1,347,600

Note: This data is summarized from Table D-4 in Appendix D

Table 7-8: Projected Debt Payments

Annual Debt Payments	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
New debt: 2018-02 Crescent Creek Culvert Replacement	-	-	-	-	-	-	-	-	(13,600)	(36,900)
New debt: 2018-03 Stormwater Share for PW Decant Facility	-	-	(8,500)	(25,900)	(25,900)	(25,900)	(25,900)	(25,900)	(25,900)	(25,900)
New debt: 2018-05 Harborview Dr. Sediment Vault	-	-	(56,800)	(56,800)	(56,800)	(56,800)	(56,800)	(56,800)	(56,800)	(56,800)
Totals	-	-	(65,300)	(82,700)	(82,700)	(82,700)	(82,700)	(82,700)	(96,300)	(119,600)

Table 7-9: Capital Revenues

Capital Revenues	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
GFC revenue	247,800	265,500	265,500	283,200	88,500	88,500	88,500	106,200	106,200	106,200
New debt: 2018-02 Crescent Creek Culvert Replacement	-	-	-	-	-	-	-	184,500	316,700	3,392,400
New debt: 2018-03 Stormwater Share for PW Decant Facility	-	115,100	300,000	-	-	-	-	-	-	-
New debt: 2018-05 Harborview Dr. Sediment Vault	-	772,500	-	-	-	-	-	-	-	-
Earned interest income	12,600	14,300	9,600	4,900	6,100	6,800	5,300	4,200	5,300	5,500
Total Capital Revenues	260,400	1,167,400	575,100	288,100	94,600	95,300	93,800	294,900	428,200	3,504,100

Note: The \$79,800 in CIAC (contributions in aid of construction) in 2018 represents a developer contribution for project LS-9.

Table 7-10: Planned Capital Improvements (2018 - 2027)

Capital Expenses	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
2018-02 Crescent Creek Culvert Replacement								(184,500)	(316,700)	(3,392,400)
2018-03 Stormwater Share for PW Decant Facility		(115,000)	(300,000)							
2018-05 Harborview Dr. Sediment Vault		(772,500)								
2018-06 50th St Box Culvert			(891,200)							
2018-07 Annual NPDES Permit Implementation Expenses	(20,000)	(20,600)	(21,200)	(21,900)	(22,500)	(23,200)	(23,900)	(24,600)	(25,300)	(26,100)
2018-09 Public Works Operations Center - Building		(64,300)	(504,900)							
2018-10 Outfall to Marine Waters Study				(218,500)						
2018-11 Outfalls to Marine Waters Upgrades						(115,900)	(477,600)			
2018-12 Pipe Slip Line Mountainview to Peacock		(41,200)								
2018-13 Pipe Slip Line Vernhardson		(41,200)								
2018-14 Pipeline Upgrade Program			(31,800)	(32,800)	(33,800)	(34,800)	(35,800)	(36,900)	(38,000)	(39,100)
2018-15 Stormwater Comprehensive Plan Update	(120,000)									(156,600)
2018-16 Public Works Operations Center - Site Development		(198,800)								
2018-17 Public Works Shop – Metal Building		(10,300)								
Totals	(140,000)	(1,263,200)	(1,749,100)	(273,200)	(56,300)	(173,900)	(537,300)	(246,000)	(380,000)	(3,614,200)

Table 7-11: Summary of Stormwater Utility Cash Flows & Cash Reserves

Annual Rate Increase	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Operational Summary	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Total Operating Revenues	1,006,200	1,067,400	1,132,400	1,201,200	1,249,600	1,299,900	1,352,300	1,406,800	1,463,400	1,522,400
Total Operation & Maintenance	(865,000)	(890,400)	(932,200)	(1,016,300)	(1,085,000)	(1,116,000)	(1,148,300)	(1,273,800)	(1,310,200)	(1,347,600)
Total Debt	-	-	(65,300)	(82,700)	(82,700)	(82,700)	(82,700)	(82,700)	(96,300)	(119,600)
Net Revenue	141,200	177,000	134,900	102,200	81,900	101,200	121,300	50,300	56,900	55,200
Capital Summary										
Start of Year Cash	1,132,000	1,393,600	1,474,800	435,800	552,800	673,000	695,600	373,400	472,600	577,700
Connection Charges & Interest Income	260,400	279,800	275,100	288,100	94,600	95,300	93,800	110,400	111,500	111,700
Transfer from Operations	141,200	177,000	134,900	102,200	81,900	101,200	121,300	50,300	56,900	55,200
Total Loan Funds	-	887,600	300,000	-	-	-	-	184,500	316,700	3,392,400
Total CIAC Funds	-	-	-	-	-	-	-	-	-	-
Total Capital Expenses	(140,000)	(1,263,200)	(1,749,100)	(273,200)	(56,300)	(173,900)	(537,300)	(246,000)	(380,000)	(3,614,200)
Transfer to Operations	-	-	-	-	-	-	-	-	-	-
Net Capital Revenue	261,600	81,200	(1,039,100)	117,100	120,200	22,600	(322,200)	99,200	105,100	(54,900)
End of Year Cash	1,393,600	1,474,800	435,800	552,800	673,000	695,600	373,400	472,600	577,700	522,800

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Gig Harbor Public Works Department

Stormwater Comprehensive Plan Update Appendices

APPENDIX A. CAPITAL IMPROVEMENT PROJECT DESCRIPTIONS

PROJECT 2018-01 WWTP CREEK REROUTE TO DONKEY CREEK

Problem ID: 2018-01
Location: Harborview Drive near North Harborview Drive
Description: Twawelkax Creek discharges to the harbor through a storm drain passing beneath the museum with heavy sediment loads depositing in the outfall and the harbor. Project will realign the creek to a confluence with Donkey Creek, providing improved fish passage. Sediment control will be installed in the existing pipe system under CIP 2018-05.
Cost Estimate: \$4,760,000
Related Projects: 2018-05

Project Description:

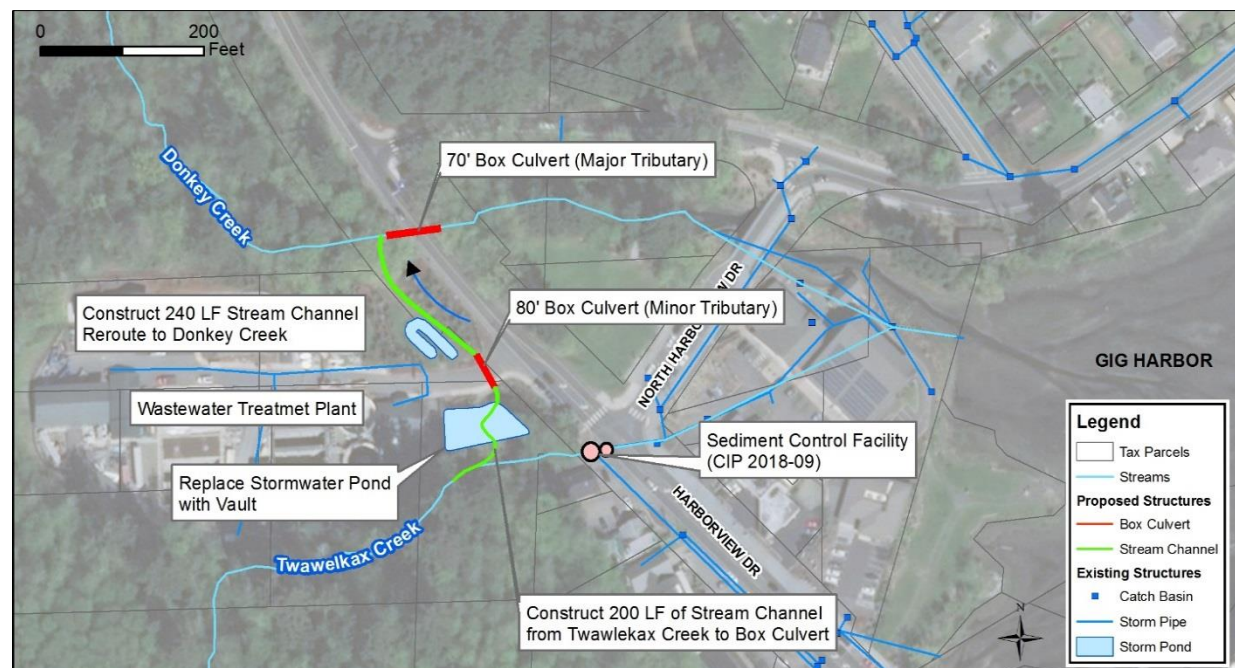
Install 80 LF fish passable box culvert on minor tributary under access road to wastewater treatment plant.

Install 70 LF fish passable box culvert on major tributary (Donkey Creek) under Harborview Drive.

Construct approximately 440 LF of stream channel between Twawelkax Creek and Donkey Creek.

Stream and riparian area restoration / enhancement.

Construct detention / water quality control vault to replace existing storm pond.



CONSTRUCTION COST OPINION					
PROJECT: 2018-01				BY:	GW
DESCRIPTION: WWTP Cr Reroute to Donkey Cr				CHECKED BY:	GG
BASIN/SUBBASIN: N/A				DATE:	17-May-18
BID ITEM		QUANTITY	UNIT	UNIT PRICE	AMOUNT
PREPARATION					
ROADWAY EXCAVATION INCL. HAUL		58	CY	\$ 100	\$ 5,900
STRUCTURE EXCAVATION CLASS B, INCLUDING HAUL		1200	CY	\$ 15	\$ 18,000
CLEARING AND GRUBBING		1	AC	\$ 20,000	\$ 20,000
CHANNEL EXCAVATION INCL. HAUL		1000	CY	\$ 40	\$ 40,000
DRAINAGE					
BOX CULVERT (MINOR TRIBUTARY)		1	EA	\$ 200,000	\$ 200,000
BOX CULVERT (MAJOR TRIBUTARY)		1	EA	\$ 500,000	\$ 500,000
SEDIMENT / WATER QUALITY VAULT		1	EA	\$ 100,000	\$ 100,000
TEMPORARY ROAD BYPASS		1	LS	\$ 250,000	\$ 250,000
RESTORATION					
STREAMBED SEDIMENT MIX		228	CY	\$ 150	\$ 34,300
STREAM RESTORATION / ENCHANCEMENT		1	LS	\$ 398,000	\$ 398,000
EROSION AND POLLUTION CONTROL		1	LS	\$ 20,000	\$ 20,000
TEMP. CHANNEL BYPASSES		1	LS	\$ 99,900	\$ 99,900
ROAD RESTORATION		1	LS	\$ 100,000	\$ 100,000
				Subtotal	\$ 1,786,100
DEWATERING		10%			\$ 178,610
TRAFFIC CONTROL		7%			\$ 125,027
SITE RESTORATION		7%			\$ 125,027
MOBILIZATION (GENERAL REQUIREMENT)		10%			\$ 178,610
				Subtotal	\$ 2,393,374
CONTINGENCY		30%			\$ 718,012
		Construction Subtotal (Rounded)			\$ 3,111,000
STATE SALES TAX		9%			\$ 279,990
ENGINEERING > \$250K CONST		14%			\$ 435,540
CONSTRUCTION MANAGEMENT		10%			\$ 311,100
PERMITTING - FISH PASSAGE		10%			\$ 311,100
SENSITIVE AREA PERMITTING		10%			\$ 311,100
2018 Dollars		Total Estimated Project Cost (Rounded)			\$ 4,760,000
Notes:					
1. The above cost opinion is in 2018 dollars & doesn't include future escalation, financing, land acquisition, or O&M costs.					
2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for assumptions stated. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs for individual projects must be scrutinized prior to establishing the final project budgets.					

PROJECT 2018-02 CRESCENT CREEK CULVERT REPLACEMENT

Problem ID: 2018-02
Location: Vernhardson Street east of North Harborview Road
Description: Existing 115 LF concrete box culvert (6' x 6') on Crescent Creek is tidally influenced and causing scour. Downstream end is submerged at high tide and has been fish passage barrier at low tide.
http://apps.wdfw.wa.gov/fishpassagephotos/Reports/105%20K060620a_Report.pdf
Cost Estimate: \$3,000,000
Related Projects: 2017-02

Project Description:

Replace existing concrete box culvert with a 10' span box culvert and lower invert to improve passage to Crescent Creek.



PROJECT 2018-03 STORMWATER SHARE FOR PW DECANT FACILITY

Problem ID: 2018-03
Location: Maintenance Facility Site
Description: Stormwater division cost contribution to the Public Works decant facility.
Cost Estimate: \$394,500
Related Projects:

Project Description:

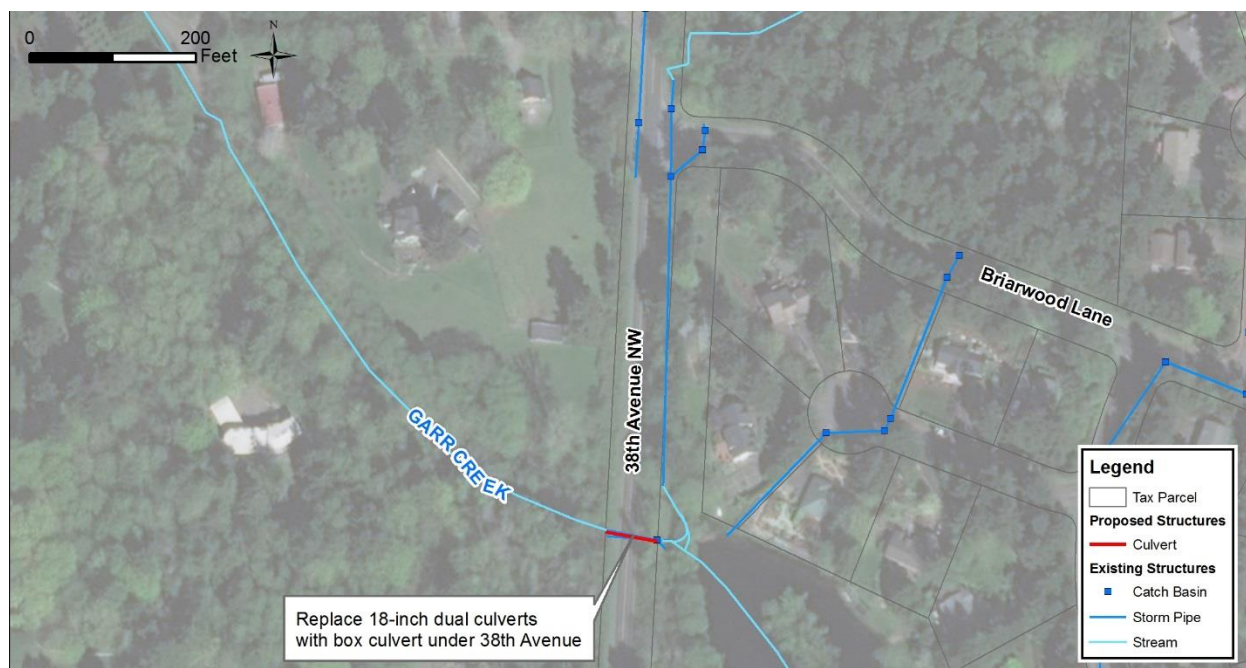
Stormwater division cost contribution to the Public Works decant facility.

PROJECT 2018-04 38TH GARR CREEK BOX CULVERT

Problem ID: 2018-04
Location: 38th Avenue NW and Briarwood Lane
Description: The existing twin 18-inch culverts crossing under 38th Avenue have insufficient capacity, overtops during the 25-year event, and presents a barrier to fish passage. Garr Creek is listed as a fish bearing stream by WDFW. The existing storm drain system running parallel to 38th Avenue is also fish passage barrier. Project will replace the twin 18-inch culverts with a fish passable box culvert crossing 38th Avenue NW south of Briarwood Lane.
Cost Estimate: \$554,000
Related Projects: T5-01, T5-02, T5-03, T5-04

Project Description:

Install 75 LF box culvert under 38th Avenue NW.



CONSTRUCTION COST OPINION					
PROJECT: 2018-04				BY:	GW
DESCRIPTION: 38th Ave. Garr Creek Box Culvert				CHECKED BY:	GG
BASIN/SUBBASIN: Trunkline 5				DATE:	17-May-18
BID ITEM		QUANTITY	UNIT	UNIT PRICE	AMOUNT
PREPARATION					
ROADWAY EXCAVATION INCL. HAUL		20	CY	\$ 100	\$ 2,000
STRUCTURE EXCAVATION CLASS B, INCLUDING HAUL		300	CY	\$ 15	\$ 4,500
CLEARING AND GRUBBING		0.1	AC	\$ 20,000	\$ 2,000
CHANNEL EXCAVATION INCL. HAUL		400	CY	\$ 40	\$ 16,000
DRAINAGE					
5' RISE x 9' SPAN CONCRETE BOX CULVERT		1	LS	\$ 150,000	\$ 150,000
REMOVE PIPE		60	LF	\$ 5	\$ 300
SURFACING					
CRUSHED SURFACING TOP COURSE		1	TN	\$ 60	\$ 54
COMMERCIAL HMA CL. 1/2 IN. PG 64-22		2	TN	\$ 175	\$ 263
RESTORATION					
STREAMBED SEDIMENT MIX		47	CY	\$ 150	\$ 7,000
STREAM RESTORATION / ENCHANCEMENT		1	LS	\$ 10,000	\$ 10,000
EROSION AND POLLUTION CONTROL		1	LS	\$ 10,000	\$ 10,000
				Subtotal	\$ 202,117
DEWATERING		10%			\$ 20,212
TRAFFIC CONTROL		3%			\$ 6,063
SITE RESTORATION		7%			\$ 14,148
MOBILIZATION (GENERAL REQUIREMENT)		5%			\$ 10,106
				Subtotal	\$ 252,646
CONTINGENCY		30%			\$ 75,794
				Construction Subtotal (Rounded)	\$ 328,000
STATE SALES TAX		9%			\$ 29,520
ENGINEERING > \$250K CONST		25%			\$ 82,000
CONSTRUCTION MANAGEMENT		15%			\$ 49,200
PERMITTING - FISH PASSAGE		20%			\$ 65,600
2018 Dollars	Total Estimated Project Cost (Rounded)				\$ 554,000
Notes:					
1. The above cost opinion is in 2018 dollars & doesn't include future escalation, financing, land acquisition, or O&M costs.					
2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for assumptions stated. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs for individual projects must be scrutinized prior to establishing the final project budgets.					

PROJECT 2018-05 HARBORVIEW DRIVE SEDIMENT VAULT

Problem ID: 2018-05
Location: Harborview Drive near North Harborview Drive
Description: Vault to capture sediment.
Cost Estimate: \$750,000
Related Projects: N/A

Project Description:

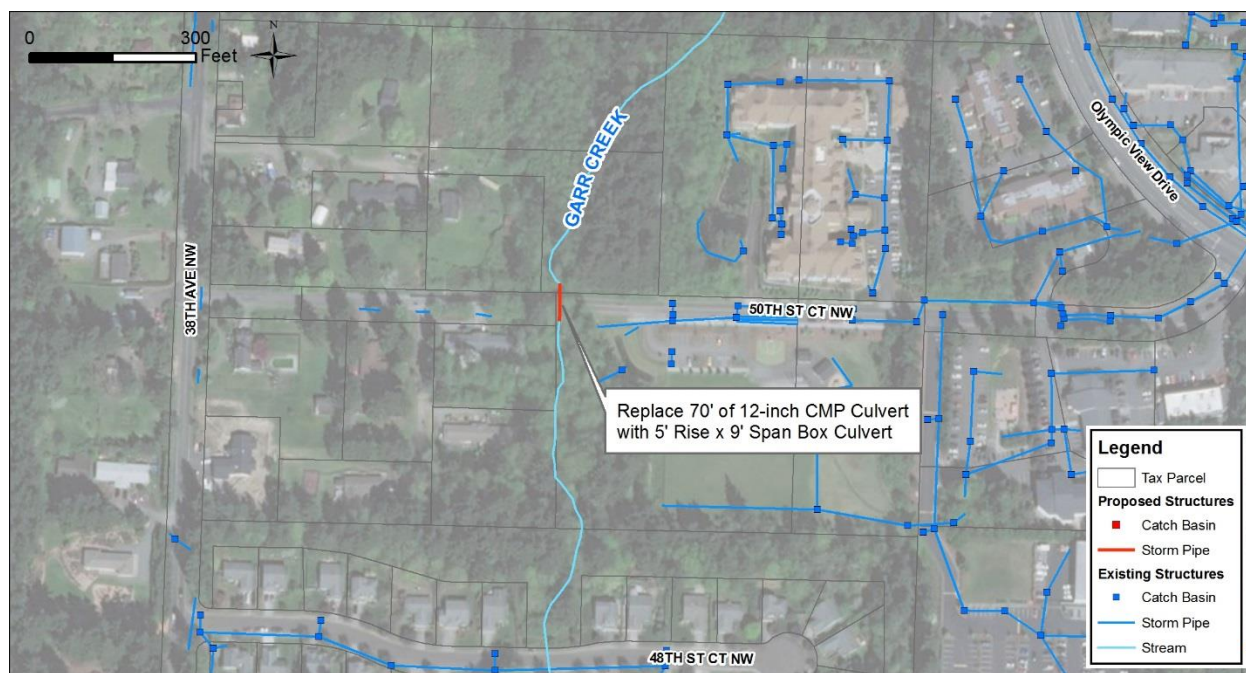
Underground concrete vault to capture sediment before outfalling into Gig Harbor.

PROJECT 2018-06 50TH STREET BOX CULVERT

Problem ID: 2018-06
Location: 50th St Ct NW East of 38th Avenue NW.
Description: Hydraulic modeling shows the existing 18-inch diameter concrete culvert has insufficient capacity to pass the 2-year design storm and greater. Previously studies have documented scour pools forming on the downstream side of culverts creating an impact on stream stability. Garr Creek is listed as a fish bearing stream by WDFW and the existing culvert is a fish passage barrier.
Cost Estimate: \$840,000
Related Projects: 2018-14(T5-02), 2018-14(T5-03), 2018-14(T5-04)

Project Description:

Replace 70 feet of 12-inch CMP with a fish passable 5' rise by 9' span concrete box culvert.



CONSTRUCTION COST OPINION					
PROJECT: T5-01				BY: GW	
DESCRIPTION: 38th Avenue Culvert Replacement 1			CHECKED BY: GG		
BASIN/SUBBASIN: Trunkline 5				DATE: 17-May-18	
BID ITEM		QUANTITY	UNIT	UNIT PRICE	AMOUNT
PREPARATION					
ROADWAY EXCAVATION INCL. HAUL		30	CY	\$ 100	\$ 3,000
STRUCTURE EXCAVATION CLASS B, INCLUDING HAUL		900	CY	\$ 15	\$ 13,500
DRAINAGE					
5' RISE x 9' SPAN CONCRETE BOX CULVERT		1	LS	\$ 150,000	\$ 150,000
RESTORATION					
STREAM RESTORATION / ENCHANCEMENT		1	LS	\$ 50,000	\$ 50,000
EROSION AND POLLUTION CONTROL		1	LS	\$ 5,000	\$ 5,000
				Subtotal	\$ 221,500
DEWATERING		10%			\$ 22,150
TRAFFIC CONTROL		3%			\$ 6,645
SITE RESTORATION		7%			\$ 15,505
MOBILIZATION (GENERAL REQUIREMENT)		5%			\$ 11,075
				Subtotal	\$ 276,875
CONTINGENCY		30%			\$ 83,063
Construction Subtotal (Rounded)					\$ 360,000
STATE SALES TAX		9%			\$ 32,400
ENGINEERING > \$250K CONST		25%			\$ 90,000
CONSTRUCTION MANAGEMENT		15%			\$ 54,000
PERMITTING - FISH PASSAGE		20%			\$ 72,000
2018 Dollars Total Estimated Project Cost (Rounded)					\$ 608,000
Notes:					
1. The above cost opinion is in 2018 dollars & doesn't include future escalation, financing, land acquisition, or O&M costs.					
2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for assumptions stated. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs for individual projects must be scrutinized prior to establishing the final project budgets.					

PROJECT 2018-07 ANNUAL NPDES PERMIT IMPLEMENTATION EXPENSES

Problem ID: 2018-07
Location: City-wide
Description: Continue the implementation of comprehensive city-wide Stormwater Management Program in accordance with the City's current NPDES Phase 2 municipal stormwater permit, including sustained efforts for community outreach and education, inspection and enforcement of storm drainage and pollution regulations.
Cost Estimate: \$20,000 annually
Related Projects:

Project Description:

Includes sustained efforts for community outreach and education, inspection and enforcement of storm drainage and pollution regulations.

PROJECT 2018-08 STINSON AVENUE STORMWATER REPLACEMENT AND EXTENSION

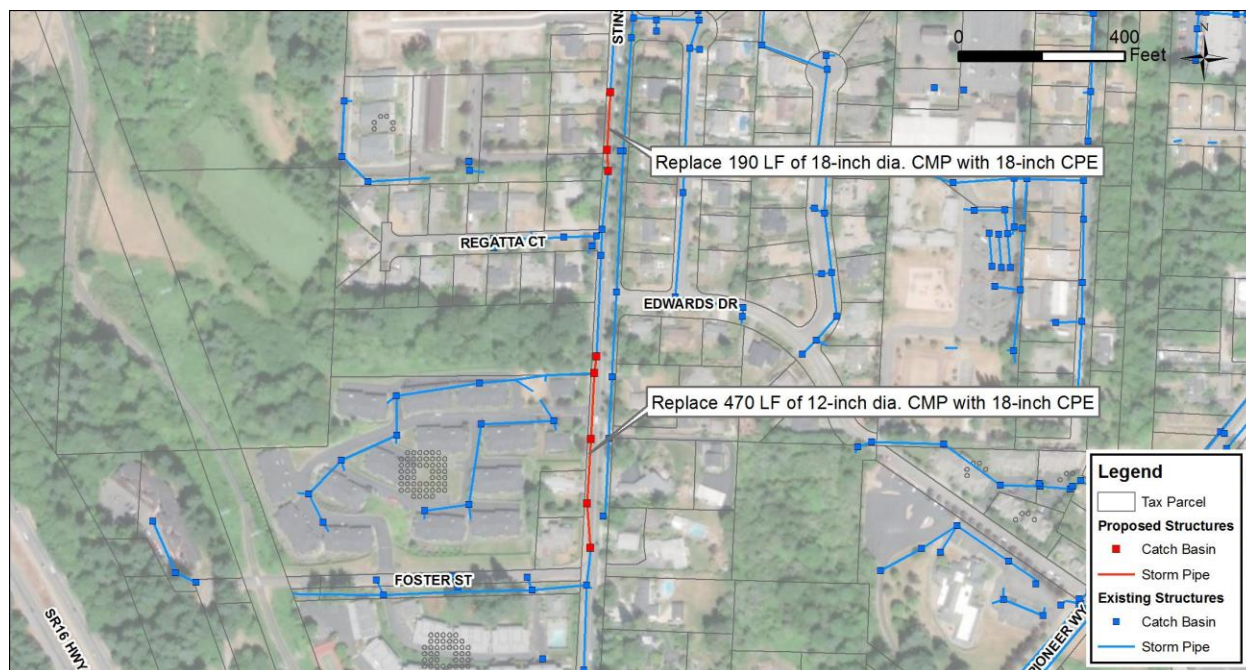
Problem ID: 2018-08
Location: Stinson Avenue at Harbormaster Lane
Description: Hydraulic modeling shows the existing 18-inch CMP storm pipe is shown to be surcharging during the 25-year design event and floods during the 100-year design event. Pipe is identified as CMP and assumed to be in poor condition.
Cost Estimate: \$268,000
Related Projects: N/A

Project Description:

Replace 470 LF of 12-inch diameter CMP storm pipe with 18-inch diameter CPE.

Replace 190 LF of 18-inch diameter CMP storm pipe with 18-inch diameter CPE.

Replace 8 catch basin structures with Type 2 catch basin structures.



CONSTRUCTION COST OPINION					
PROJECT:	2018-08			BY:	GW
DESCRIPTION:	Stinson Avenue Stormwater Replacement and Extension			CHECKED BY:	GG
BASIN/SUBBASIN:	Trunkline 6			DATE:	17-May-18
BID ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	
PREPARATION					
SAWCUT & REMOVE PAVEMENT	138	SY	\$40	\$ 5,520	
ROADWAY EXCAVATION INCL. HAUL	46	CY	\$ 100	\$ 4,600	
SHORING OR EXTRA EXCAVATION CLASS B	3675	SF	\$ 3	\$ 11,025	
STRUCTURE EXCAVATION CLASS B, INCLUDING HAUL	465	CY	\$ 15	\$ 6,975	
DRAINAGE					
REMOVE PIPE	660	LF	\$ 5	\$ 3,300	
CATCH BASIN TYPE 2, 48-IN DIAM	8	EA	\$ 3,000	\$ 24,000	
18-INCH DIAM CPE	660	LF	\$ 60	\$ 39,600	
CONNECTION TO EXISTING PIPE	4	EA	\$ 585	\$ 2,340	
SURFACING					
CRUSHED SURFACING TOP COURSE	18	TN	\$ 60	\$ 1,080	
COMMERCIAL HMA CL. 1/2 IN. PG 64-22	37	TN	\$ 175	\$ 6,475	
ASPHALT CONCRETE PAVEMENT PATCHING	13	TN	\$ 176	\$ 2,288	
CEMENT CONC. TRAFFIC CURB AND GUTTER	80	LF	\$ 40	\$ 3,200	
CEMENT CONCRETE SIDEWALK	44	SY	\$ 177	\$ 7,867	
				Subtotal	\$ 110,403
TRAFFIC CONTROL	3%			\$ 3,312	
SITE RESTORATION	7%			\$ 7,728	
MOBILIZATION (GENERAL REQUIREMENT)	5%			\$ 5,520	
				Subtotal	\$ 126,963
CONTINGENCY	30%			\$ 38,089	
				Construction Subtotal (Rounded)	\$ 165,000
STATE SALES TAX	9%			\$ 14,850	
ENGINEERING \$100-250K CONST	30%			\$ 50,160	
CONSTRUCTION MANAGEMENT	15%			\$ 24,750	
PERMITTING	8%			\$ 13,200	
2018 Dollars				Total Estimated Project Cost (Rounded)	\$ 268,000
Notes:					
1. The above cost opinion is in 2018 dollars & doesn't include future escalation, financing, land acquisition, or O&M costs.					
2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for assumptions stated. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs for individual projects must be scrutinized prior to establishing the final project budgets.					

PROJECT 2018-09 PUBLIC WORKS OPERATIONS CENTER - BUILDING

Problem ID: 2018-09
Location: 89th and Skansie Ave
Description: Complete the building design and building permitting of the new Public Works Operations Center.
Cost Estimate: \$538,300
Related Projects:

Project Description:

Complete the building design and building permitting of the new Public Works Operations Center/

PROJECT 2018-10 OUTFALL TO MARINE WATERS STUDY

Problem ID:	2018-10
Location:	Multiple outfall locations within the City of Gig Harbor
Description:	Existing outfalls are experiencing scouring due to high velocities resulting from upstream development.
Cost Estimate:	\$200,000 Analysis and Study Report
Related Projects:	2018-11

Project Description:

A special study is needed to define the scope of needed improvements, and associated costs and permitting requirements.



PROJECT 2018-11 OUTFALLS TO MARINE WATERS UPGRADES

Problem ID: 2018-11
Location: Multiple outfall locations within the City of Gig Harbor
Description: Existing outfalls are experiencing scouring due to high velocities resulting from upstream development.
Cost Estimate: \$500,000 Design and Construction
Related Projects: 2018-10

Project Description:

Following the study in 2018-10, construction costs to be updated and necessary improvements constructed.



PROJECT 2018-12 PIPE SLIP LINE MOUNTAINVIEW TO PEACOCK

Problem ID: 2018-12
Location: Mountainview to Peacock
Description: The existing storm drain is in need of rehabilitation. This project consists of slip lining the existing storm drain on Mountainview approximately between Woodworth Ave to Peacock Hill Ave.
Cost Estimate: \$40,000
Related Projects: N/A

Project Description:

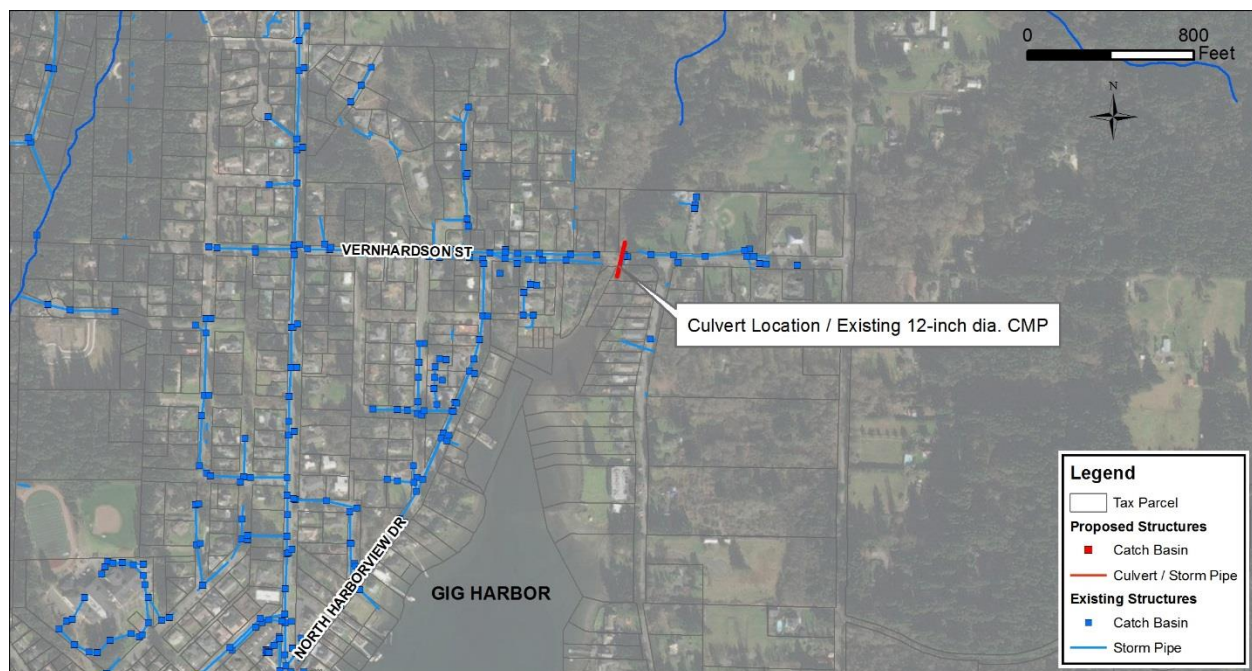
Clean and inspect the existing storm drain.
Slip line approximately 400 feet of existing pipe.

PROJECT 2018-13 PIPE SLIP LINE VERNHARDSON

Problem ID: 2018-13
Location: Vernhardson Street east of North Harborview Road
Description: Existing box culvert at Crescent Creek has a perched 12-inch diameter CMP pipe laying over the top of the structure draining Vernhardson Street.
Cost Estimate: \$40,000
Related Projects: 2018-02

Project Description:

Slip-line 120 linear feet of 12-inch diameter CMP storm drain with 12-inch diameter HDPE.
Replace 1 catch basin structure with a Type 2 catch basin structure.



CONSTRUCTION COST OPINION					
PROJECT:	2018-13			BY:	GW
DESCRIPTION:	Pipe Slip Line Vernhardson			CHECKED BY:	GG
BASIN/SUBBASIN:	N/A			DATE:	17-May-18
BID ITEM		QUANTITY	UNIT	UNIT PRICE	AMOUNT
PREPARATION					
SAWCUT & REMOVE PAVEMENT		15	SY	\$40	\$ 600
ROADWAY EXCAVATION INCL. HAUL		2	CY	\$ 100	\$ 200
STRUCTURE EXCAVATION CLASS B, INCLUDING HAUL		2	CY	\$ 15	\$ 30
DRAINAGE					
CATCH BASIN TYPE 2, 48-IN DIAM		1	EA	\$ 3,000	\$ 3,000
12-INCH DIAM HDPE		120	LF	\$ 65	\$ 7,800
SURFACING					
CRUSHED SURFACING TOP COURSE		2	TN	\$ 60	\$ 120
COMMERCIAL HMA CL. 1/2 IN. PG 64-22		2	TN	\$ 175	\$ 350
ASPHALT CONCRETE PAVEMENT PATCHING		2	TN	\$ 176	\$ 352
CEMENT CONCRETE SIDEWALK		6	SY	\$ 75	\$ 450
				Subtotal	\$ 12,902
TRAFFIC CONTROL		3%			\$ 387
SITE RESTORATION		7%			\$ 903
MOBILIZATION (GENERAL REQUIREMENT)		5%			\$ 645
				Subtotal	\$ 14,837
CONTINGENCY		50%			\$ 7,419
		Construction Subtotal (Rounded)			\$ 22,000
STATE SALES TAX		9%			\$ 1,980
ENGINEERING < \$100K CONST		35%			\$ 7,700
CONSTRUCTION MANAGEMENT		15%			\$ 3,300
PERMITTING - PUGET SOUND		20%			\$ 4,400
2018 Dollars		Total Estimated Project Cost (Rounded)			\$ 40,000
Notes:					
1. The above cost opinion is in 2018 dollars & doesn't include future escalation, financing, land acquisition, or O&M costs.					
2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for assumptions stated. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs for individual projects must be scrutinized prior to establishing the final project budgets.					

PROJECT 2018-14 (T1-01) PEACOCK HILL AVE. STORM DRAIN IMPROVEMENT

Problem ID: T1-01
Location: Peacock Hill Road north of N Harborview Drive
Description: An existing 12-inch diameter storm drain runs along Peacock Hill Road toward North Harborview Drive. Hydraulic modeling shows flooding along Peacock Hill Avenue at the 10-year event and greater. Flooding has not been observed by the city; however, storm pipe has been observed near full capacity.
Cost Estimate: \$637,000
Related Projects: T1-02, T1-03

Project Description:

Replace 1,640 feet of 12-inch concrete pipe with 18-inch CPE.

Replace 15 catch basin structures with Type 2 catch basins.



CONSTRUCTION COST OPINION					
PROJECT:	T1-01			BY:	GW
DESCRIPTION:	Peacock Hill Ave. Storm Drain Improvement			CHECKED BY:	GG
BASIN/SUBBASIN:	Trunkline 1			DATE:	17-May-18
BID ITEM		QUANTITY	UNIT	UNIT PRICE	AMOUNT
PREPARATION					
SAWCUT & REMOVE PAVEMENT		342	SY	\$40	\$ 13,667
ROADWAY EXCAVATION INCL. HAUL		114	CY	\$ 100	\$ 11,389
STRUCTURE EXCAVATION CLASS B, INCLUDING HAUL		797	CY	\$ 15	\$ 11,958
DRAINAGE					
REMOVE PIPE		1640	LF	\$ 5	\$ 8,200
CATCH BASIN TYPE 2, 48-IN DIAM		15	EA	\$ 3,000	\$ 45,000
18-INCH DIAM CPE		1640	LF	\$ 60	\$ 98,400
CONNECTION TO EXISTING PIPE		10	EA	\$ 585	\$ 5,850
SURFACING					
CRUSHED SURFACING TOP COURSE		46	TN	\$ 60	\$ 2,760
COMMERCIAL HMA CL. 1/2 IN. PG 64-22		92	TN	\$ 175	\$ 16,100
CEMENT CONCRETE SIDEWALK		778	SY	\$ 75	\$ 58,333
				Subtotal	\$ 271,657
TRAFFIC CONTROL		3%			\$ 8,150
SITE RESTORATION		7%			\$ 19,016
MOBILIZATION (GENERAL REQUIREMENT)		5%			\$ 13,583
				Subtotal	\$ 312,406
CONTINGENCY		30%			\$ 93,722
				Construction Subtotal (Rounded)	\$ 406,000
STATE SALES TAX		9%			\$ 36,540
ENGINEERING > \$250K CONST		25%			\$ 101,500
CONSTRUCTION MANAGEMENT		15%			\$ 60,900
PERMITTING		8%			\$ 32,480
2018 Dollars				Total Estimated Project Cost (Rounded)	\$ 637,000
Notes:					
1. The above cost opinion is in 2018 dollars & doesn't include future escalation, financing, land acquisition, or O&M costs.					
2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for assumptions stated. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs for individual projects must be scrutinized prior to establishing the final project budgets.					

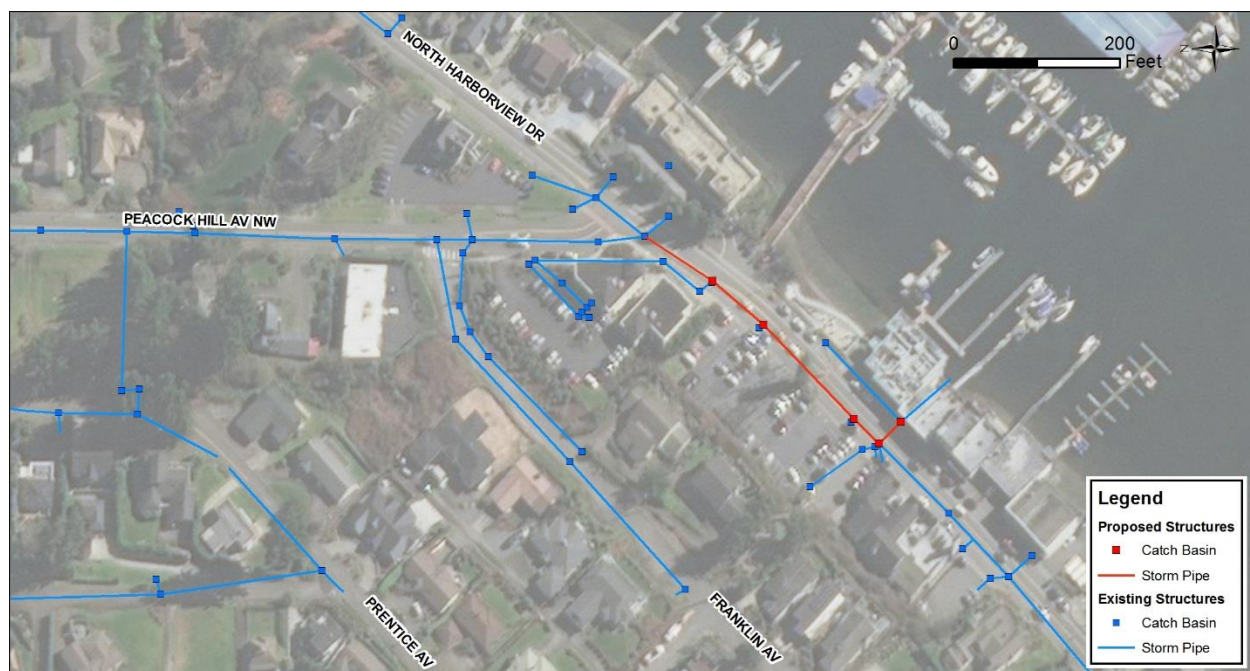
PROJECT 2018-14 (T1-02) NORTH HARBORVIEW DRIVE STORM DRAIN IMPROVEMENT

Problem ID: T1-02
Location: North Harborview Drive west of Peacock Hill Avenue
Description: Currently a 12-inch diameter storm drain runs along North Harborview Drive to the west toward an outfall adjacent to Anthony's Restaurant. Hydraulic modeling shows flooding along North Harborview Drive at the 10-year event and greater. Flooding has been observed by the city.
Cost Estimate: \$185,000
Related Projects: T1-01, T1-03

Project Description:

Replace 415 feet of 18-inch concrete pipe with 24-inch CPE.

Replace 5 Type 2 catch basin structures with Type 2 catch basins.



CONSTRUCTION COST OPINION					
PROJECT:	T1-02			BY:	GW
DESCRIPTION:	North Harborview Drive Storm Drain Improvement			CHECKED BY:	GG
BASIN/SUBBASIN:	Trunkline 1			DATE:	17-May-18
BID ITEM		QUANTITY	UNIT	UNIT PRICE	AMOUNT
PREPARATION					
SAWCUT & REMOVE PAVEMENT		104	SY	\$40	\$ 4,150
ROADWAY EXCAVATION INCL. HAUL		35	CY	\$ 100	\$ 3,458
STRUCTURE EXCAVATION CLASS B, INCLUDING HAUL		242	CY	\$ 15	\$ 3,631
DRAINAGE					
REMOVE PIPE		415	LF	\$ 5	\$ 2,075
CATCH BASIN TYPE 2, 48-IN DIAM		5	EA	\$ 3,000	\$ 15,000
24-INCH DIAM CPE		415	LF	\$ 70	\$ 29,050
CONNECTION TO EXISTING PIPE		10	EA	\$ 585	\$ 5,850
SURFACING					
CRUSHED SURFACING TOP COURSE		14	TN	\$ 60	\$ 840
COMMERCIAL HMA CL. 1/2 IN. PG 64-22		28	TN	\$ 175	\$ 4,900
CEMENT CONCRETE SIDEWALK		97	SY	\$ 75	\$ 7,292
				Subtotal	\$ 76,246
TRAFFIC CONTROL		3%			\$ 2,287
SITE RESTORATION		7%			\$ 5,337
MOBILIZATION (GENERAL REQUIREMENT)		5%			\$ 3,812
				Subtotal	\$ 87,683
CONTINGENCY		30%			\$ 26,305
				Construction Subtotal (Rounded)	\$ 114,000
STATE SALES TAX		9%			\$ 10,260
ENGINEERING \$100-250K CONST		30%			\$ 34,200
CONSTRUCTION MANAGEMENT		15%			\$ 17,100
PERMITTING		8%			\$ 9,120
2018 Dollars				Total Estimated Project Cost (Rounded)	\$ 185,000
Notes:					
1. The above cost opinion is in 2018 dollars & doesn't include future escalation, financing, land acquisition, or O&M costs.					
2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for assumptions stated. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs for individual projects must be scrutinized prior to establishing the final project budgets.					

PROJECT 2018-14 (T1-03) NORTH HARBORVIEW DRIVE OUTFALL

Problem ID: T1-03
Location: North Harborview Drive west of Peacock Hill Avenue
Description: Existing outfall along North Harborview Drive is experiencing high velocities and scouring. Hydraulic modeling shows the velocity exceeding 10 feet per second for the 25-year design event. Additionally, modeling shows that the existing outfall pipe has insufficient capacity for the 25-year event and greater.
Cost Estimate: \$190,000
Related Projects: T1-01, T1-02

Project Description:

Replace 80 feet of 18-inch concrete pipe with 24-inch CPE.



CONSTRUCTION COST OPINION					
PROJECT:	T1-03			BY:	GW
DESCRIPTION:	North Harborview Drive Outfall			CHECKED BY:	GG
BASIN/SUBBASIN:	Trunkline 1			DATE:	17-May-18
BID ITEM		QUANTITY	UNIT	UNIT PRICE	AMOUNT
PREPARATION					
SAWCUT & REMOVE PAVEMENT		20	SY	\$40	\$ 800
ROADWAY EXCAVATION INCL. HAUL		7	CY	\$ 100	\$ 667
STRUCTURE EXCAVATION CLASS B, INCLUDING HAUL		50	CY	\$ 15	\$ 750
SHORING OR EXTRA EXCAVATION CLASS B		320	SF	\$ 3	\$ 960
DRAINAGE					
REMOVE PIPE		80	LF	\$ 5	\$ 400
CATCH BASIN TYPE 2, 48-IN DIAM		1	EA	\$ 3,000	\$ 3,000
24-INCH DIAM CPE		80	LF	\$ 70	\$ 5,600
CONNECTION TO EXISTING PIPE		2	EA	\$ 585	\$ 1,170
SURFACING					
CRUSHED SURFACING TOP COURSE		3	TN	\$ 60	\$ 180
COMMERCIAL HMA CL. 1/2 IN. PG 64-22		5	TN	\$ 175	\$ 875
OTHER ITEMS					
OUTFALL DIFFICULTY FACTOR, ALLOWANCE		1	LS	\$ 50,000	\$ 50,000
				Subtotal	\$ 64,402
DEWATERING					
DEWATERING		10%			\$ 6,440
EROSION & SEDIMENTATION CONTROL		5%			\$ 3,220
TRAFFIC CONTROL		3%			\$ 1,932
SITE RESTORATION		7%			\$ 4,508
MOBILIZATION (GENERAL REQUIREMENT)		5%			\$ 3,220
				Subtotal	\$ 83,722
CONTINGENCY					
CONTINGENCY		30%			\$ 25,117
				Construction Subtotal (Rounded)	\$ 109,000
STATE SALES TAX					
STATE SALES TAX		9%			\$ 9,810
ENGINEERING \$100-250K CONST		30%			\$ 32,700
CONSTRUCTION MANAGEMENT		15%			\$ 16,350
PERMITTING - PUGET SOUND		20%			\$ 21,800
2018 Dollars	Total Estimated Project Cost (Rounded)				\$ 190,000
Notes:					
1. The above cost opinion is in 2018 dollars & doesn't include future escalation, financing, land acquisition, or O&M costs.					
2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for assumptions stated. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs for individual projects must be scrutinized prior to establishing the final project budgets.					

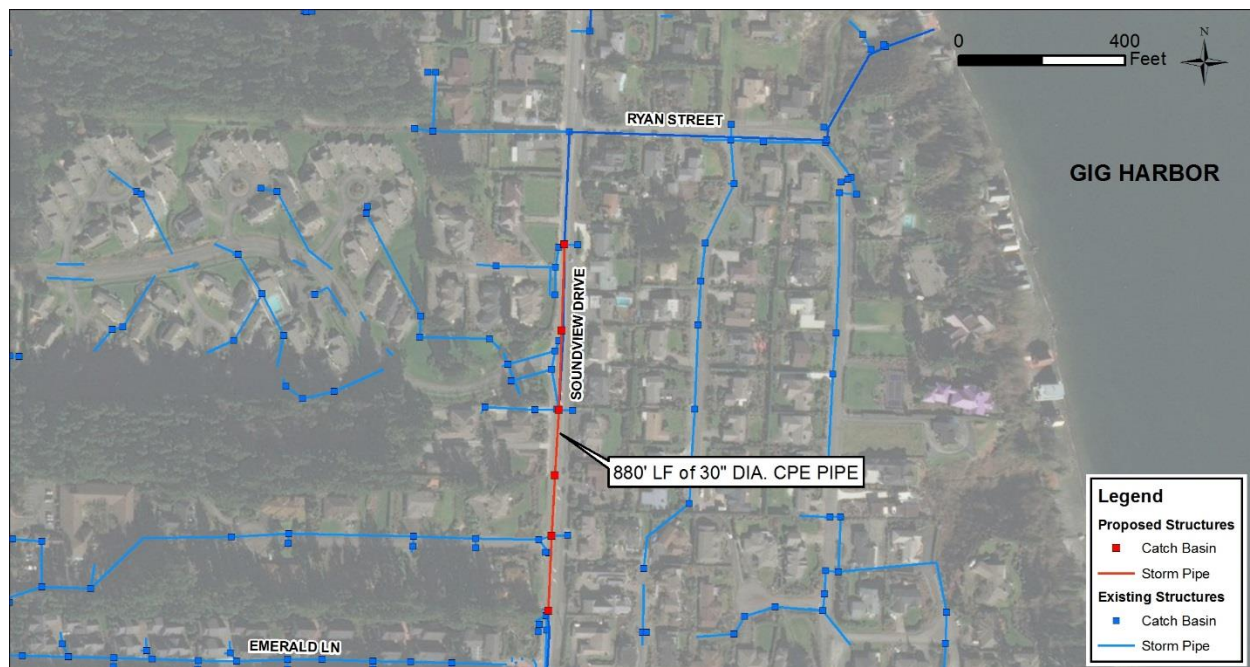
PROJECT 2018-14 (T2-01) SOUNDVIEW DRIVE STORM DRAIN IMPROVEMENT

Problem ID: T2-01
Location: Soundview Drive south of Ryan Street
Description: Existing storm pipe along Soundview Drive and south of Ryan Street floods the 25-year design event and greater. City maintenance crew has observed capacity issues at this location.
Cost Estimate: \$427,000
Related Projects: N/A

Project Description:

Replace 880 feet of 24-inch concrete pipe with 30-inch CPE.

Replace 6 catch basin structures with Type 2 catch basins.



CONSTRUCTION COST OPINION					
PROJECT:	T2-01			BY:	GW
DESCRIPTION:	Soundview Drive Storm Drain Improvement			CHECKED BY:	GG
BASIN/SUBBASIN:	Trunkline 2			DATE:	17-May-18
BID ITEM		QUANTITY	UNIT	UNIT PRICE	AMOUNT
PREPARATION					
SAWCUT & REMOVE PAVEMENT		220	SY	\$40	\$ 8,800
ROADWAY EXCAVATION INCL. HAUL		73	CY	\$ 100	\$ 7,333
SHORING OR EXTRA EXCAVATION CLASS B		7040	SF	\$ 3	\$ 21,120
STRUCTURE EXCAVATION CLASS B, INCLUDING HAUL		1100	CY	\$ 15	\$ 16,500
DRAINAGE					
REMOVE PIPE		880	LF	\$ 5	\$ 4,400
CATCH BASIN TYPE 2, 48-IN DIAM		6	EA	\$ 3,000	\$ 18,000
30-INCH DIAM CPE		880	LF	\$ 70	\$ 61,600
CONNECTION TO EXISTING PIPE		9	EA	\$ 585	\$ 5,265
SURFACING					
CRUSHED SURFACING TOP COURSE		30	TN	\$ 60	\$ 1,800
COMMERCIAL HMA CL. 1/2 IN. PG 64-22		59	TN	\$ 175	\$ 10,325
CEMENT CONCRETE SIDEWALK		356	SY	\$ 75	\$ 26,667
				Subtotal	\$ 181,810
TRAFFIC CONTROL		3%			\$ 5,454
SITE RESTORATION		7%			\$ 12,727
MOBILIZATION (GENERAL REQUIREMENT)		5%			\$ 9,091
				Subtotal	\$ 209,082
CONTINGENCY		30%			\$ 62,724
				Construction Subtotal (Rounded)	\$ 272,000
STATE SALES TAX		9%			\$ 24,480
ENGINEERING > \$250K CONST		25%			\$ 68,000
CONSTRUCTION MANAGEMENT		15%			\$ 40,800
PERMITTING		8%			\$ 21,760
2018 Dollars				Total Estimated Project Cost (Rounded)	\$ 427,000
Notes:					
1. The above cost opinion is in 2018 dollars & doesn't include future escalation, financing, land acquisition, or O&M costs.					
2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for assumptions stated. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs for individual projects must be scrutinized prior to establishing the final project budgets.					

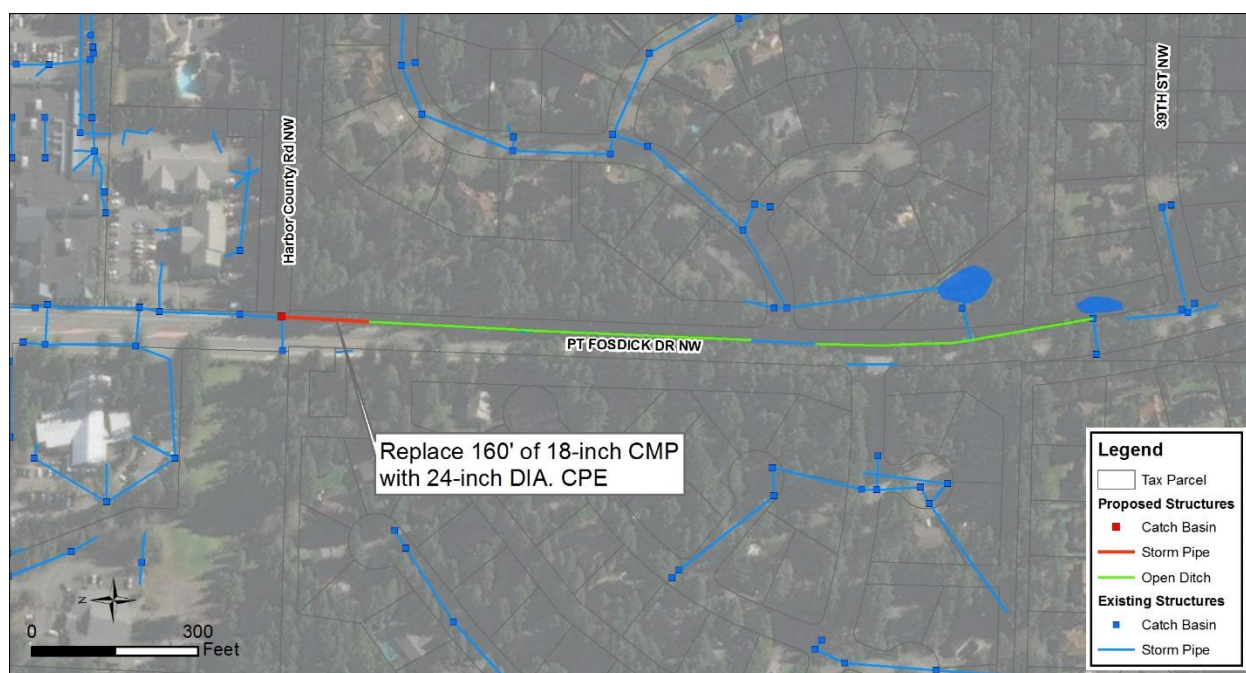
PROJECT 2018-14 (T3-01) POINT FOSDICK DRIVE CULVERT REPLACEMENT 1

Problem ID: T3-01
Location: Point Fosdick Drive at Harbor County Drive NW
Description: Hydraulic modeling shows the culvert floods during the 2-year design event and greater. Stormwater has been observed surcharging within roadside ditches near this location.
Cost Estimate: \$68,000
Priority:
Related Projects: T3-02, T3-03, T3-04

Project Description:

Replace 160 feet of 18-inch CMP with 24-inch CPE.

Replace catch basin structure with Type 2 catch basin structure.



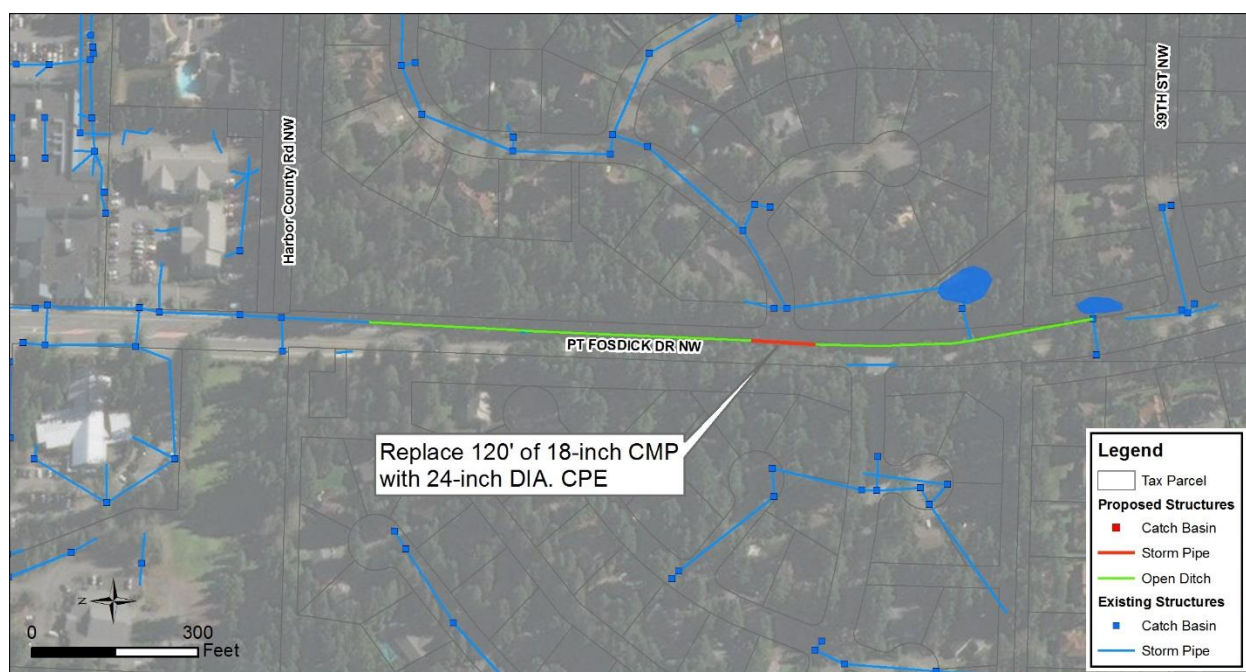
CONSTRUCTION COST OPINION					
PROJECT:	T3-01			BY:	GW
DESCRIPTION:	Point Fosdick Drive Culvert Replacement 1			CHECKED BY:	GG
BASIN/SUBBASIN:	Trunkline 3			DATE:	17-May-18
BID ITEM		QUANTITY	UNIT	UNIT PRICE	AMOUNT
PREPARATION					
SAWCUT & REMOVE PAVEMENT	40	SY	\$40	\$ 1,600	
ROADWAY EXCAVATION INCL. HAUL	13	CY	\$ 100	\$ 1,333	
SHORING OR EXTRA EXCAVATION CLASS B	720	SF	\$ 3	\$ 2,160	
STRUCTURE EXCAVATION CLASS B, INCLUDING HAUL	107	CY	\$ 15	\$ 1,600	
DRAINAGE					
REMOVE PIPE	160	LF	\$ 5	\$ 800	
CATCH BASIN TYPE 2, 48-IN DIAM	1	EA	\$ 3,000	\$ 3,000	
24-INCH DIAM CPE	160	LF	\$ 70	\$ 11,200	
CONNECTION TO EXISTING PIPE	2	EA	\$ 585	\$ 1,170	
SURFACING					
CRUSHED SURFACING TOP COURSE	5	TN	\$ 60	\$ 300	
COMMERCIAL HMA CL. 1/2 IN. PG 64-22	11	TN	\$ 175	\$ 1,925	
CEMENT CONC. TRAFFIC CURB AND GUTTER	5	LF	\$ 40	\$ 180	
			Subtotal	\$	25,268
DEWATERING	10%			\$	2,527
TRAFFIC CONTROL	3%			\$	758
SITE RESTORATION	7%			\$	1,769
MOBILIZATION (GENERAL REQUIREMENT)	5%			\$	1,263
			Subtotal	\$	31,585
CONTINGENCY	30%			\$	9,476
			Construction Subtotal (Rounded)	\$	41,000
STATE SALES TAX	9%			\$	3,690
ENGINEERING < \$100K CONST	35%			\$	14,350
CONSTRUCTION MANAGEMENT	15%			\$	6,150
PERMITTING	8%			\$	3,280
2018 Dollars			Total Estimated Project Cost (Rounded)	\$	68,000
Notes:					
1. The above cost opinion is in 2018 dollars & doesn't include future escalation, financing, land acquisition, or O&M costs.					
2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for assumptions stated. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs for individual projects must be scrutinized prior to establishing the final project budgets.					

PROJECT 2018-14 (T3-02) POINT FOSDICK DRIVE CULVERT REPLACEMENT 2

Problem ID: T3-02
Location: Point Fosdick Drive at 41st Street
Description: Hydraulic modeling shows the culvert floods during the 2-year design event and greater. Stormwater has been observed surcharging within roadside ditches near this location.
Cost Estimate: \$57,000
Related Projects: T3-01, T3-03, T3-04

Project Description:

Replace 120 feet of 12-inch CMP with 18-inch CPE.



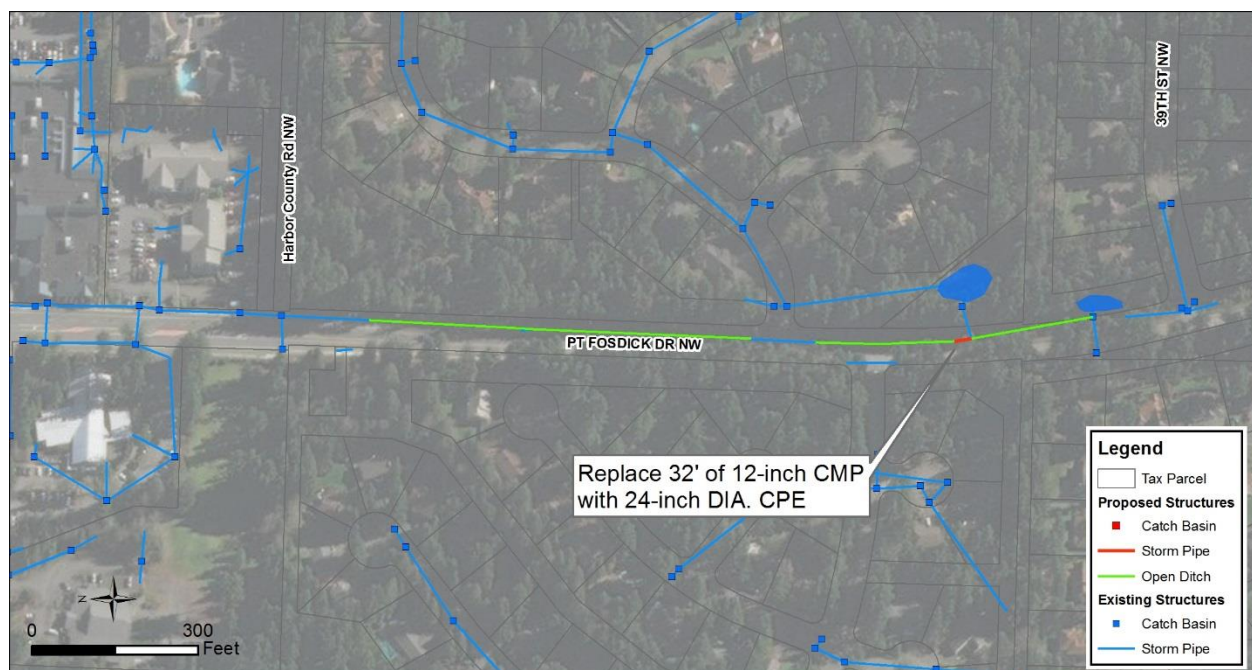
CONSTRUCTION COST OPINION					
PROJECT:	T3-03			BY:	GW
DESCRIPTION:	Point Fosdick Drive Culvert Replacement 3			CHECKED BY:	GG
BASIN/SUBBASIN:	Trunkline 3			DATE:	17-May-18
BID ITEM		QUANTITY	UNIT	UNIT PRICE	AMOUNT
PREPARATION					
SAWCUT & REMOVE PAVEMENT		8	SY	\$40	\$ 320
ROADWAY EXCAVATION INCL. HAUL		3	CY	\$ 100	\$ 267
SHORING OR EXTRA EXCAVATION CLASS B		144	SF	\$ 3	\$ 432
STRUCTURE EXCAVATION CLASS B, INCLUDING HAUL		21	CY	\$ 15	\$ 320
DRAINAGE					
REMOVE PIPE		32	LF	\$ 5	\$ 160
24-INCH DIAM CPE		32	LF	\$ 70	\$ 2,240
CONNECTION TO EXISTING PIPE		2	EA	\$ 585	\$ 1,170
SURFACING					
CRUSHED SURFACING TOP COURSE		1	TN	\$ 60	\$ 60
COMMERCIAL HMA CL. 1/2 IN. PG 64-22		2	TN	\$ 175	\$ 350
				Subtotal	\$ 5,319
DEWATERING		10%			\$ 532
TRAFFIC CONTROL		3%			\$ 160
SITE RESTORATION		7%			\$ 372
MOBILIZATION (GENERAL REQUIREMENT)		5%			\$ 266
				Subtotal	\$ 6,648
CONTINGENCY		30%			\$ 1,995
				Construction Subtotal (Rounded)	\$ 9,000
STATE SALES TAX		9%			\$ 810
ENGINEERING < \$100K CONST		35%			\$ 3,150
CONSTRUCTION MANAGEMENT		15%			\$ 1,350
PERMITTING		8%			\$ 720
2018 Dollars				Total Estimated Project Cost (Rounded)	\$ 15,000
Notes:					
1. The above cost opinion is in 2018 dollars & doesn't include future escalation, financing, land acquisition, or O&M costs.					
2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for assumptions stated. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs for individual projects must be scrutinized prior to establishing the final project budgets.					

PROJECT 2018-14 (T3-03) POINT FOSDICK DRIVE CULVERT REPLACEMENT 3

Problem ID: T3-03
Location: Point Fosdick Drive between 41st Street and 39th Street
Description: Hydraulic modeling shows the culvert floods during the 25-year design event and greater. Stormwater has been observed surcharging within roadside ditches near this location.
Cost Estimate: \$15,000
Related Projects: T3-01, T3-02, T3-04

Project Description:

Replace 32 feet of 12-inch CMP with 24-inch CPE.



CONSTRUCTION COST OPINION					
PROJECT: T3-03				BY:	GW
DESCRIPTION: Point Fosdick Drive Culvert Replacement 2			CHECKED BY:		GG
BASIN/SUBBASIN: Trunkline 3				DATE:	17-May-18
BID ITEM		QUANTITY	UNIT	UNIT PRICE	AMOUNT
PREPARATION					
SAWCUT & REMOVE PAVEMENT		8	SY	\$40	\$ 320
ROADWAY EXCAVATION INCL. HAUL		3	CY	\$ 100	\$ 267
SHORING OR EXTRA EXCAVATION CLASS B		144	SF	\$ 3	\$ 432
STRUCTURE EXCAVATION CLASS B, INCLUDING HAUL		21	CY	\$ 15	\$ 320
DRAINAGE					
REMOVE PIPE		32	LF	\$ 5	\$ 160
24-INCH DIAM CPE		32	LF	\$ 70	\$ 2,240
CONNECTION TO EXISTING PIPE		2	EA	\$ 585	\$ 1,170
SURFACING					
CRUSHED SURFACING TOP COURSE		1	TN	\$ 60	\$ 60
COMMERCIAL HMA CL. 1/2 IN. PG 64-22		2	TN	\$ 175	\$ 350
				Subtotal	\$ 5,319
DEWATERING		10%			\$ 532
TRAFFIC CONTROL		3%			\$ 160
SITE RESTORATION		7%			\$ 372
MOBILIZATION (GENERAL REQUIREMENT)		5%			\$ 266
				Subtotal	\$ 6,648
CONTINGENCY		30%			\$ 1,995
		Construction Subtotal (Rounded)			\$ 9,000
STATE SALES TAX		9%			\$ 810
ENGINEERING < \$100K CONST		35%			\$ 3,150
CONSTRUCTION MANAGEMENT		15%			\$ 1,350
PERMITTING		8%			\$ 720
2018 Dollars		Total Estimated Project Cost (Rounded)			\$ 15,000
Notes:					
1. The above cost opinion is in 2018 dollars & doesn't include future escalation, financing, land acquisition, or O&M costs.					
2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for assumptions stated. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs for individual projects must be scrutinized prior to establishing the final project budgets.					

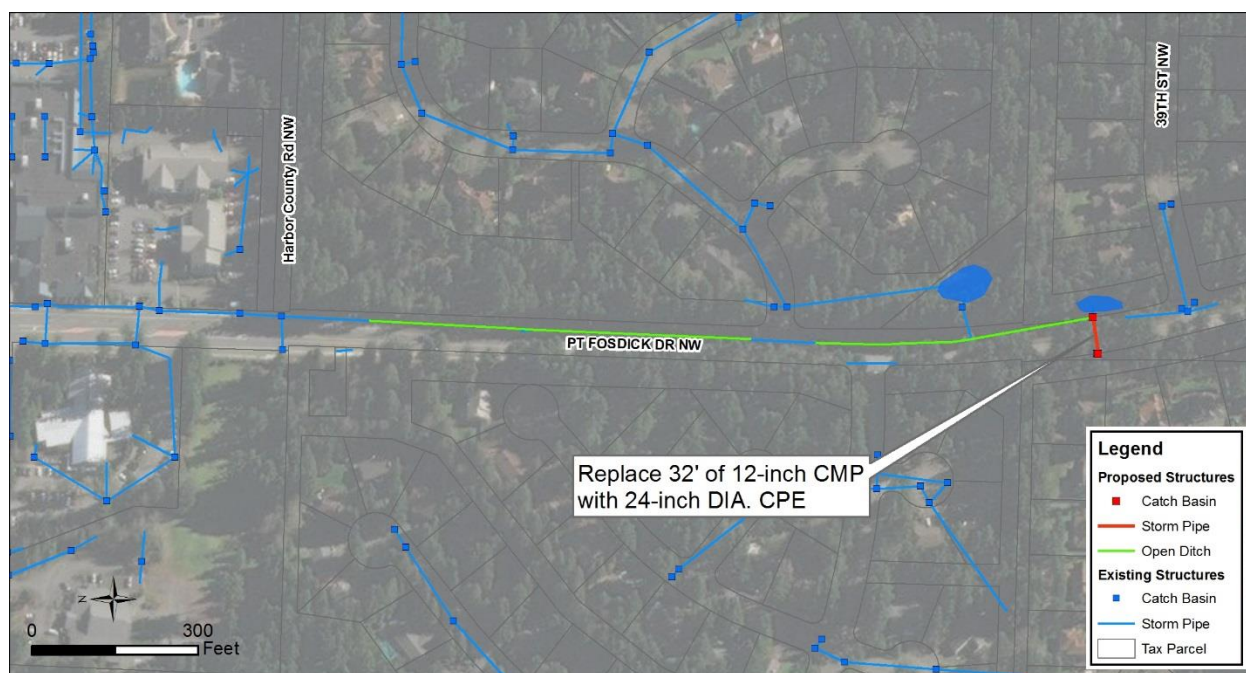
PROJECT 2018-14 (T3-04) POINT FOSDICK DRIVE CULVERT REPLACEMENT 4

Problem ID: T3-04
Location: Point Fosdick Drive north of 39th Avenue
Description: Hydraulic modeling shows the culvert floods during the 10-year design event and greater. Stormwater has been observed surcharging within upstream roadside ditches near this location.
Cost Estimate: \$48,000
Related Projects: T3-01, T3-02, T3-03

Project Description:

Replace 70 feet of 18-inch CMP with 30-inch CPE.

Replace 2 catch basin structures with Type 2 catch basin structures.



CONSTRUCTION COST OPINION					
PROJECT:	T3-04			BY:	GW
DESCRIPTION:	Point Fosdick Drive Culvert Replacement 4			CHECKED BY:	GG
BASIN/SUBBASIN:	Trunkline 3			DATE:	17-May-18
BID ITEM		QUANTITY	UNIT	UNIT PRICE	AMOUNT
PREPARATION					
SAWCUT & REMOVE PAVEMENT		20	SY	\$40	\$ 817
ROADWAY EXCAVATION INCL. HAUL		7	CY	\$ 100	\$ 681
SHORING OR EXTRA EXCAVATION CLASS B		385	SF	\$ 3	\$ 1,155
STRUCTURE EXCAVATION CLASS B, INCLUDING HAUL		68	CY	\$ 15	\$ 1,021
DRAINAGE					
REMOVE PIPE		70	LF	\$ 5	\$ 350
CATCH BASIN TYPE 2, 48-IN DIAM		2	EA	\$ 3,000	\$ 6,000
30-INCH DIAM CPE		70	LF	\$ 70	\$ 4,900
REESTABLISH DITCH		250	LF	\$ 5	\$ 1,250
SURFACING					
CRUSHED SURFACING TOP COURSE		3	TN	\$ 60	\$ 180
COMMERCIAL HMA CL. 1/2 IN. PG 64-22		6	TN	\$ 175	\$ 1,050
CEMENT CONCRETE SIDEWALK		3	SY	\$ 177	\$ 590
				Subtotal	\$ 17,993
DEWATERING		10%			\$ 1,799
TRAFFIC CONTROL		3%			\$ 540
SITE RESTORATION		7%			\$ 1,260
MOBILIZATION (GENERAL REQUIREMENT)		5%			\$ 900
				Subtotal	\$ 22,491
CONTINGENCY		30%			\$ 6,747
				Construction Subtotal (Rounded)	\$ 29,000
STATE SALES TAX		9%			\$ 2,610
ENGINEERING < \$100K CONST		35%			\$ 10,150
CONSTRUCTION MANAGEMENT		15%			\$ 4,350
PERMITTING		8%			\$ 2,320
2018 Dollars				Total Estimated Project Cost (Rounded)	\$ 48,000
Notes:					
1. The above cost opinion is in 2018 dollars & doesn't include future escalation, financing, land acquisition, or O&M costs.					
2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for assumptions stated. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs for individual projects must be scrutinized prior to establishing the final project budgets.					

PROJECT 2018-14 (T5-02) GARR CREEK TRIBUTARY BOX CULVERT AT 48TH ST CT NW

Problem ID: T5-02

Location: 48th St Ct NW east of 38th Avenue NW.

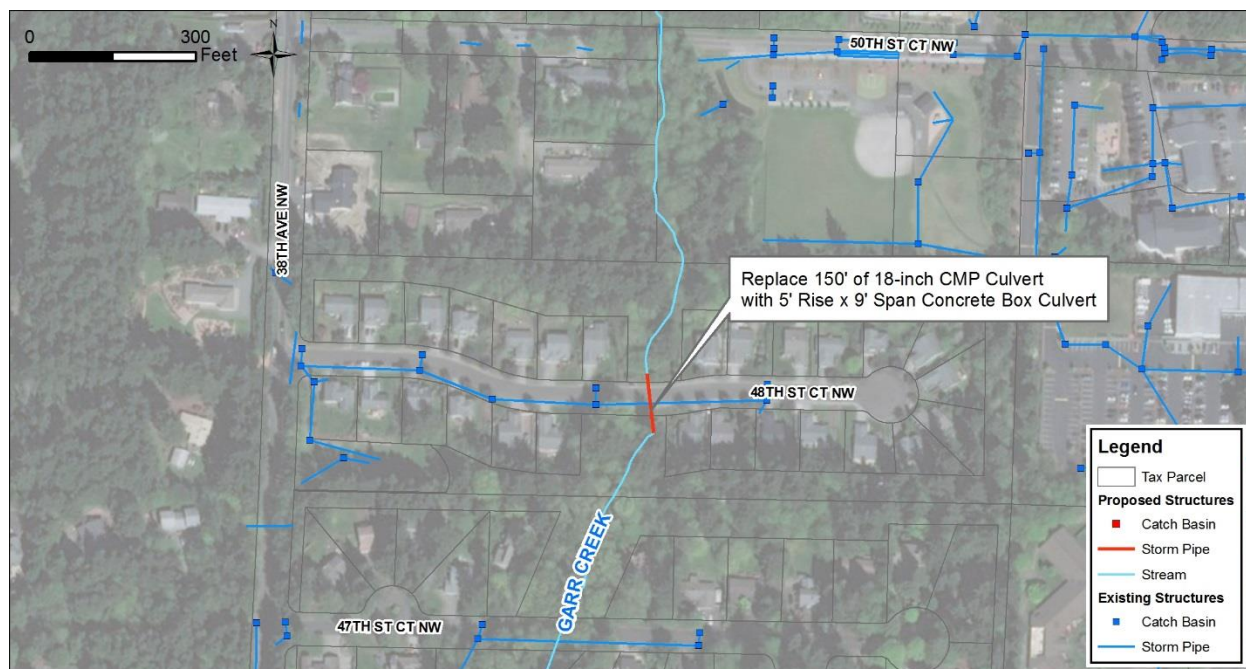
Description: Hydraulic modeling shows the existing 18-inch diameter concrete culvert has insufficient capacity to pass the 2-year design storm and greater. Previously studies have documented scour pools forming on the downstream side of culverts creating an impact on stream stability. Garr Creek is listed as a fish bearing stream by WDFW and the existing culvert is a fish passage barrier.

Cost Estimate: (See 2018-06 for Cost Estimate)

Related Projects: 2018-06, 2018-14 (T5-03, T5-04)

Project Description:

Replace 150 feet of 18-inch CMP with a fish passable 5' rise by 9' span concrete box culvert.

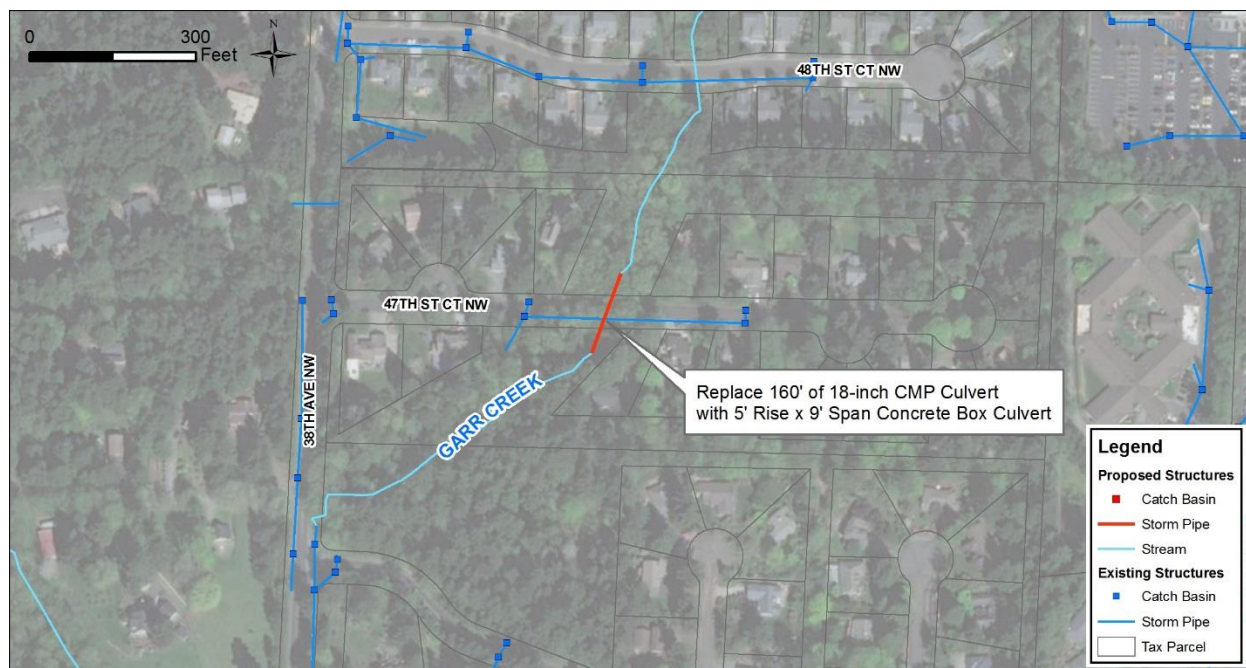


PROJECT 2018-14 (T5-03) GARR CREEK TRIBUTARY BOX CULVERT AT 47TH ST CT NW

Problem ID: T5-03
Location: 47th St Ct NW east of 38th Avenue NW.
Description: Hydraulic modeling shows the existing 18-inch diameter concrete culvert has insufficient capacity to pass the 2-year design storm and greater. Previously studies have documented scour pools forming on the downstream side of culverts creating an impact on stream stability. Garr Creek is listed as a fish bearing stream by WDFW and the existing culvert is a fish passage barrier.
Cost Estimate: (See 2018-06 for Cost Estimate)
Related Projects: 2018-06, 2018-14 (T5-02, T5-03)

Project Description:

Replace 160 feet of 18-inch CMP with 5' rise by 9' span concrete box culvert.



PROJECT 2018-14 (T5-04) 38TH AVENUE NW STORM DRAIN DAYLIGHTING

Problem ID: T5-04
Location: 38th Avenue NW and Briarwood Lane
Description: Existing storm drain system along 38th Avenue NW is a fish passage barrier and overtops during the 25-year storm event. The twin 18-inch culverts crossing under 38th Avenue NW have insufficient capacity and also present a fish barrier (See 2018-04). Garr Creek is listed as fish bearing stream by WDFW. The existing storm drain system running parallel to 38th Avenue is also fish passage barrier. A new fish passable channel will be constructed east of 38th Avenue and connect to Garr Creek. Prior to design, a study needs to be performed to confirm the optimal channel location (east or west side of 38th) and configuration.

Cost Estimate: \$963,000
Related Projects: 2018-04, 2018-14 (T5-02, T5-03)

Project Description:

Perform study to determine optimal creek alignment.
Install 100 LF Box Culvert under Briarwood Lane
Grade 600 LF of fish passable stream toward Garr Creek.
Remove storm drain infrastructure north of Briarwood Lane.



CONSTRUCTION COST OPINION					
PROJECT:	T5-04			BY:	GW
DESCRIPTION:	38th Ave NW Storm Drain Daylighting			CHECKED BY:	GG
BASIN/SUBBASIN:	Trunkline 5			DATE:	17-May-18
BID ITEM		QUANTITY	UNIT	UNIT PRICE	AMOUNT
PREPARATION					
ROADWAY EXCAVATION INCL. HAUL		40	CY	\$ 100	\$ 4,000
STRUCTURE EXCAVATION CLASS B, INCLUDING HAUL		600	CY	\$ 15	\$ 9,000
CLEARING AND GRUBBING		0.5	AC	\$ 20,000	\$ 10,000
CHANNEL EXCAVATION INCL. HAUL		800	CY	\$ 40	\$ 32,000
DRAINAGE					
5' RISE x 9' SPAN CONCRETE BOX CULVERT		1	LS	\$ 150,000	\$ 150,000
REMOVE PIPE		100	LF	\$ 5	\$ 500
SURFACING					
CRUSHED SURFACING TOP COURSE		2	TN	\$ 60	\$ 108
COMMERCIAL HMA CL. 1/2 IN. PG 64-22		2	TN	\$ 175	\$ 263
RESTORATION					
STREAMBED SEDIMENT MIX		233	CY	\$ 150	\$ 35,000
STREAM RESTORATION / ENCHANCEMENT		1	LS	\$ 100,000	\$ 100,000
EROSION AND POLLUTION CONTROL		1	LS	\$ 10,000	\$ 10,000
				Subtotal	\$ 350,871
DEWATERING		10%			\$ 35,087
TRAFFIC CONTROL		3%			\$ 10,526
SITE RESTORATION		7%			\$ 24,561
MOBILIZATION (GENERAL REQUIREMENT)		5%			\$ 17,544
				Subtotal	\$ 438,588
CONTINGENCY		30%			\$ 131,576
		Construction Subtotal (Rounded)			\$ 570,000
STATE SALES TAX		9%			\$ 51,300
ENGINEERING > \$250K CONST		25%			\$ 142,500
CONSTRUCTION MANAGEMENT		15%			\$ 85,500
PERMITTING - FISH PASSAGE		20%			\$ 114,000
2018 Dollars		Total Estimated Project Cost (Rounded)			\$ 963,000
Notes:					
1. The above cost opinion is in 2018 dollars & doesn't include future escalation, financing, land acquisition, or O&M costs.					
2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for assumptions stated. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs for individual projects must be scrutinized prior to establishing the final project budgets.					

PROJECT 2018-15 STORMWATER COMPREHENSIVE PLAN

Problem ID: 2018-15
Location: City Wide
Description: Periodic update of the City's Stormwater Comprehensive Plan
Cost Estimate: \$120,000
Related Projects:

Project Description:

Complete update to City-wide stormwater planning assessing conditions in built and natural drainage systems, recommending improvements and corrective measures to protect the community and property from flooding, protect water quality and habitats, and assure regulatory compliance.

PROJECT 2018-16 PUBLIC WORKS OPERATION CENTER – SITE DEVELOPMENT

Problem ID: 2018-16
Location: 89th and Skansie Ave
Description: Complete the site design and site permitting then construct the frontage improvements and site civil improvements related to the new Public Works Operation Center.
Cost Estimate: \$193,000
Related Projects:

Project Description:

Complete the site design and site permitting then construct the frontage improvements and site civil improvements related to the new Public Works Operation Center.

PROJECT 2018-17 PUBLIC WORKS SHOP – METAL BUILDING

Problem ID: 2018-17
Location: 89th and Skansie Ave
Description: Install the metal building (72'x40') acquired from the Harbor History Museum property at the Public Works Shop for additional covered storage. This building will need new metal siding, a concrete slab, doors, and roofing.
Cost Estimate: \$10,000
Related Projects:

Project Description:

Install the metal building (72'x40') acquired from the Harbor History Museum.

PROJECT 2017-03 FAIRWAY ESTATES FLOOD IMPROVEMENT

Problem ID: 2017-03
Location: 26th Ave CT NW at 37th Street NW
Description: Shallow flooding and scouring occurs in a small stream running through several backyards within the Fairway Estates residential community.
Cost Estimate: \$107,000
Related Projects: N/A

Project Description:

Install 450 LF of 12-inch CPE to disconnect storm drainage from stream and divert drainage toward 36th Street NW.



CONSTRUCTION COST OPINION					
PROJECT:	2017-03			BY:	GW
DESCRIPTION:	Fairw ay Estates Flood Improvement			CHECKED BY:	GG
BASIN/SUBBASIN:	N/A			DATE:	17-May-18
BID ITEM		QUANTITY	UNIT	UNIT PRICE	AMOUNT
PREPARATION					
SAWCUT & REMOVE PAVEMENT		75	SY	\$40	\$ 3,000
ROADWAY EXCAVATION INCL. HAUL		25	CY	\$ 100	\$ 2,500
STRUCTURE EXCAVATION CLASS B, INCLUDING HAUL		175	CY	\$ 15	\$ 2,625
DRAINAGE					
CATCH BASIN TYPE 1		4	EA	\$ 1,400	\$ 5,600
12-INCH DIAM CPE		450	LF	\$ 50	\$ 22,500
CONNECTION TO EXISTING PIPE		2	EA	\$ 585	\$ 1,170
SURFACING					
CRUSHED SURFACING TOP COURSE		10	TN	\$ 60	\$ 600
COMMERCIAL HMA CL. 1/2 IN. PG 64-22		20	TN	\$ 175	\$ 3,500
ASPHALT CONCRETE PAVEMENT PATCHING		7	TN	\$ 176	\$ 1,232
				Subtotal	\$ 42,727
TRAFFIC CONTROL		3%			\$ 1,282
SITE RESTORATION		7%			\$ 2,991
MOBILIZATION (GENERAL REQUIREMENT)		5%			\$ 2,136
				Subtotal	\$ 49,136
CONTINGENCY		30%			\$ 14,741
		Construction Subtotal (Rounded)			\$ 64,000
STATE SALES TAX		9%			\$ 5,760
ENGINEERING < \$100K CONST		35%			\$ 22,400
CONSTRUCTION MANAGEMENT		15%			\$ 9,600
PERMITTING		8%			\$ 5,120
2018 Dollars		Total Estimated Project Cost (Rounded)			\$ 107,000
Notes:					
1. The above cost opinion is in 2018 dollars & doesn't include future escalation, financing, land acquisition, or O&M costs.					
2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for assumptions stated. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope and schedule, and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs for individual projects must be scrutinized prior to establishing the final project budgets.					

PROJECT 2001-07 BURNHAM DRIVE STORM DRAIN REPLACEMENT

Problem ID: 2001-07
Location: Burnham Drive Storm Drain Replacement
Description: An existing 12-inch diameter storm drain in Burnham Drive is indicated to be at capacity, but overtopping or flooding have not been observed by the city.
Cost Estimate: \$46,700
Related Projects:

Project Description:

Replace 80 feet of 12-inch storm drain with 18-inch CPE.
Replace catch basins associated with the replaced pipe.

PROJECT 2001-08 PEACOCK HILL STORM DRAIN REPLACEMENT

Problem ID: 2001-08
Location: Peacock Hill Storm Drain Replacement
Description: An existing 12-inch diameter storm drain in Peacock Hill is indicated to be at capacity, but overtopping or flooding have not been observed by the city.
Cost Estimate: \$32,500
Related Projects:

Project Description:

Replace 60 feet of 12-inch storm drain with 18-inch CPE.
Replace catch basins associated with the replaced pipe.

APPENDIX B. INFILTRATION ASSESSMENT TECHNICAL MEMORANDUM



Technical Memorandum

Page 1 of 18

Date:	December 1, 2017	From:	Suzanne S. Cook, L.G.
To:	Tetra Tech, Inc.	Project Manager:	Curtis J. Koger, L.G., L.E.G., L.Hg.
	1420 Fifth Avenue, Suite 550	Principal in Charge:	Curtis J. Koger, L.G., L.E.G., L.Hg.
	Seattle, Washington 98101	Project Name:	City of Gig Harbor Infiltration Assessment
Attn:	Rick Schaefer, P.E.	Project No:	170597H001
Subject:	Infiltration Assessment, City of Gig Harbor Comprehensive Stormwater Plan Update		

1.0 INTRODUCTION

Associated Earth Sciences, Inc. (AESI) is under subcontract to Tetra Tech, Inc. (Tetra Tech) to provide consultant support for City of Gig Harbor's comprehensive stormwater plan update. We understand the City of Gig Harbor will consider stormwater management alternatives for existing and potential future stormwater capacity needs that take advantage of infiltration opportunities.

In order to identify infiltration opportunities in Gig Harbor, Washington, AESI analyzed surface and subsurface conditions to identify areas potentially suitable for shallow and deep infiltration of stormwater. This technical memorandum provides a summary of AESI's stormwater infiltration feasibility analysis and assessment of "screening level" shallow and deep infiltration potential. Figure 1 provides the study area and Gig Harbor city limits. A surficial geology map is presented on Figures 2 and 3. Figures 4 and 5 provide areas suitable for shallow and deep infiltration.

The infiltration potential assessments provided in this technical memorandum are suitable for identification and evaluation of potential stormwater infiltration locations and solutions. To determine the infiltration feasibility (or feasibility of a particular infiltration technique) at a specific location, site-specific hydrogeologic and geotechnical assessments would be required.

1.1 Objective and Scope

Infiltration facilities reduce peak stormwater runoff rates by allowing stormwater to soak into the ground, increasing ground water recharge, and maintaining baseflows to streams. This reduction in peak stormwater runoff can reduce streambank erosion and sediment discharge. Additional benefits can include improved water quality due to soil zone treatment.

The purpose of our study was to conduct a City-wide screening-level assessment of stormwater infiltration potential based on infiltration characteristics of the surface and subsurface sediments. Infiltration feasibility is primarily dependent on sediment permeability, depth to ground water or low-permeability sediments, the

rate and quantity of runoff to be infiltrated, and proximity to geologic hazards and critical areas. Other criteria which affect infiltration feasibility, including horizontal setbacks and vertical separation criteria for siting infiltration best management practices (BMPs), are described in the December 2016 *City of Gig Harbor Stormwater and Site Development Manual* (Stormwater Manual) as the reference document for the planning, design, and construction of stormwater facilities in Gig Harbor.

Four primary factors that influence infiltration potential were evaluated. This work specifically excludes subsurface exploration:

- Infiltration potential as determined by geology: This information was based on available geologic and hydrogeologic reports and maps, internal AESI files/information, and water well information on file with the Tacoma-Pierce County Health Department (TPCHD), Washington State Department of Health (DOH); and Washington State Department of Ecology (Ecology).
- Topography/slope: Based on analysis of Light Detection and Ranging (LIDAR) and United States Geological Survey (USGS) topographic data.
- Risk to environment: Based on existing maps of environmentally sensitive areas, including steep slopes, surface water, and wellhead protection zones. The steep slope assessment was based on an analysis of topography, geology, and soils.
- Thickness of unsaturated permeable horizon and depth to ground water/seasonal high water table: This information was based on available hydrogeologic studies, geology, select well data, and surface water elevations. The information is generally of poor quality and can be difficult to interpret but it should be useful for a screening-level analysis.

Infiltration facilities may be either shallow or deep or a combination of both. BMPs for conventional shallow and deep infiltration facilities are described in the Stormwater Manual. This technical memorandum discusses the feasibility of both types of infiltration systems in the City.

- Shallow infiltration facilities include conventional infiltration ponds, vaults, and basins, and may utilize permeable pavement and bioretention/raingardens. Shallow infiltration facilities are best suited in settings where moderate- to high-permeability sediments are present near the ground surface in sufficient unsaturated thickness and lateral extent to allow the stormwater to spread out, disperse, and avoid re-emergence. Moderate- to high-permeability sediments include Vashon recessional outwash and Vashon advance outwash (Section 3.2.2).
- Deep infiltration facilities include infiltration trenches and drywells, both of which are considered Class V underground injection control (UIC) wells. Some types of deeper drywells are referred to as “drilled drains” or “pit drains.” Deep infiltration facilities are designed to penetrate low-permeability sediments and allow infiltration into the more permeable underlying sediments. Deep infiltration facilities could be considered in settings where surficial low-permeability geologic units (such as glacial till) are present at the surface and more permeable sediments (such as Vashon advance outwash (Section 3.2.2) are present below in sufficient unsaturated thickness. Deep infiltration facilities may be more costly to install and maintain than shallow infiltration facilities.

1.2 Approach

AESI performed the following tasks to develop an understanding of the general hydrogeologic opportunities and constraints to evaluate both shallow and deep infiltration potential throughout the City:

- Reviewed existing literature regarding the geologic/hydrogeologic conditions within the City. The literature review is listed in the references and included:
 - Regional geology and soils maps/reports available from the USGS, the Washington State Department of Natural Resources (DNR), and United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS);
 - Pierce County LIDAR mapping;
 - City and County sensitive area maps, and Ecology shoreline slope stability maps;
 - Water supply system information on file with the TPCHD, Pierce County, and the DOH Office of Drinking Water (ODW) and Source Water Assessment Program (SWAP); and
 - Select water well reports on file with Ecology for wells located within the City.
- Described the hydrogeology of the City and conducted a qualitative evaluation of infiltration potential.
- Delineated areas potentially suitable for shallow and deep infiltration.
- Delineated areas not suitable for infiltration due to proximity to steep slopes, mapped landslide and unstable soils areas, shallow ground water and other regional features that might be impacted by increased infiltration.
- Incorporated readily available Geographic Information System (GIS) information and mapping such as geology, soils, slope stability, LIDAR, streams and wetlands, and water supply wells, available from DNR, NRCS, Ecology, Pierce County, TPCHD, and DOH. AESI also created a GIS layer of steep slopes based on existing LIDAR. Unique combinations of these criteria were used to assess infiltration feasibility.

This technical memorandum summarizes the results of the site characteristics assessment, and includes a description of the hydrogeologic setting, infiltration feasibility approach, GIS layers for shallow and deep infiltration potential, and a summary of the results.

2.0 REGIONAL SETTING

2.1 Project Location

The City of Gig Harbor, Washington is located on the Gig Harbor Peninsula and the southeastern portion of the Kitsap Peninsula in western Pierce County, as shown on Figure 1. The City is situated between major water bodies of Gig Harbor and Central Puget Sound/Tacoma Narrows to the east, Henderson Bay/Carr Inlet to the northwest, and Wollochet Bay/Hale Passage to the south. The City boundaries are irregular and generally trend northwest to southeast along State Highway 16. The City is bounded partially on the north by Goodnough Drive Northwest and on the south by 36th Street Northwest, and includes portions of Sections 25 and 36 (Township (T) 22 North (N), Range (R) 1 East (E)); Sections 30, 31, and 32 (T22N, R2E); Section 1 (T21N, R1E); and Sections 5 to 8, 17, and 20 (T21N, R2E).

2.2 Physiographic and Topographic Setting

The Kitsap Peninsula lies in a broad lowland between the Olympic Mountains and the Cascade Range. The physiographic and topographic characteristics of the area are similar to the surrounding Puget Sound area commonly known as the Puget Lowland. The Kitsap Peninsula is long, narrow, and irregular-shaped, indented by many bays or inlets of the Puget Sound. The topography, predominately formed by glaciation, consists of broad uplands with rolling ridges separated by long valleys. Glacial and subglacial meltwater channels and modern (post-glacial) streams have cut deep troughs and valleys into the uplands, many of

which have been inundated by marine and fresh water. Much of the upland areas terminate along the coast in steep bluffs created by wave action.

The topography of the City consists of rolling glacial drift uplands dissected by a northwest- to southeast-trending valley that is occupied by McCormick Creek and North Creek. The eastern boundary of the City includes steep shoreline bluffs along Gig Harbor and the Tacoma Narrows. Elevations in the City ranges up to about 350 feet. Several smaller streams and wetland areas are present in the City. The topography is illustrated on Figure 1.

City development has caused modifications to the landscape including waterfront fills along Gig Harbor, residential and commercial development, grading the ground into level building pads, and infrastructure including roadways and drainage facilities.

3.0 GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

Our interpretation of surface and subsurface geologic/hydrogeologic conditions in the City is based on a review of the available geologic and hydrogeologic information and our experience on similar projects. We also reviewed a limited number of water well reports acquired from TPCD, DOH, and Ecology. Detailed review of water well logs was beyond the scope of this project. We reviewed several geologic maps and publications that cover the City including a comprehensive study that correlates previous stratigraphic relationships to current geologic mapping that included age-dating (Troost, 2016). Figures 2 and 3 present the most recent regional geologic mapping of the City, *Geologic Map of the Gig Harbor 7.5-minute Quadrangle, Washington* (Troost et al., in review). Select soils mapping and slope stability mapping is represented on Figures 4 and 5. Shallow and deep infiltration potential areas and water supply wells are also shown on Figures 4 and 5.

3.1 Regional Geology

The Puget Lowland is a north-south-trending structural basin that is flanked by Mesozoic and Tertiary rocks of the Cascade Range on the east and by Eocene rocks of the Olympic Mountains on the west. Quaternary glaciations and subsequent fluvial systems have shaped the basin by leaving behind a thick blanket of sediments (Barnett et al., 2010). The Puget Lowland encompasses this formerly glaciated plain, which fringes the surrounding mountains and contains Puget Sound and the eastern part of the Strait of Juan de Fuca. Most of the City is situated near the Tacoma Fault Zone, a major fault zone trending northwest to southeast from the Hood Canal through the City of Tacoma (Barnett et al., 2010).

Surficial geologic conditions within the Puget Lowland and the City are primarily the result of multiple periods of continental glaciation, during which a vast ice sheet advanced south from the mountains of British Columbia as a broad ice tongue called the “Puget lobe” (Bretz, 1913) and covered much of the Lowland during the last 2.4 million years (Blunt et al., 1987). During each glacial advance and retreat, rivers emanating from the ice sheet deposited thick sequences of coarse-grained material (glacial outwash) and glacial till (an unsorted mixture of sand, silt, clay, and gravel). The outwash deposits are typically permeable and form the primary aquifers from which ground water is drawn, while the till is less permeable.

The ice sheets disrupted drainage systems and caused rivers to back up and form large lakes. These lake (lacustrine) sediments consist of fine sands and silts. During the time period between glaciations, the Puget Lowland was likely much like today; this non-glacial or inter-glacial time period was characterized by primarily low-energy fine-grained deposition occurring within floodplains and deltas, sedimentation in tide

flats, lakes, wetlands, bogs and streams, weathering of existing soils, and occasional large lahars or other volcanic events.

The most recent glacial episode, the Vashon Stade of the Fraser Glaciation, is largely responsible for the present topography throughout the Puget Lowland. Elongated hills and swales on uplands parallel the flow direction of the Vashon ice sheet that occupied the Puget Lowland about 15,000 years ago. The upland areas are bordered by lower-elevation valleys formed by meltwater streams emanating from the retreating ice sheet. These valleys are filled with recessional outwash deposits. Glacial swales on the uplands were formed by lower-energy meltwater streams, leaving a thin veneer of recessional outwash overlying till.

Following the retreat of the Vashon-age ice sheet in the study area, modern streams incised through Vashon-age outwash sediments. Mass-wasting deposits of landslides and colluvium (small incoherent deposits from upper slopes) are common along the margins of incised drainages. Post-glacial streams, such as McCormick Creek, North Creek, and Crescent Creek, created relatively steep slopes that expose pre-Vashon-age sediments in the valley walls near the creek outlets (Henderson Bay and Gig Harbor). Narrow bands of alluvium have been deposited within stream channels, and are composed mainly of sand and gravel. Wetlands occur throughout the study area, particularly in closed depressions in the till-mantled surface.

3.2 Summary of Project Geology

3.2.1 Project Geology

The City of Gig Harbor is generally comprised of two upland areas that are mantled by Vashon lodgement till (Qvt, Figures 2 and 3). The upland areas, herein referred to as the “north” and “south” upland areas, are separated by a broad northwest- to southeast-trending valley occupied by McCormick Creek and North Creek. Vashon advance outwash (Qva) is mapped at the ground surface along the margins of the uplands. Regional studies and well logs indicate that a continuous layer of Vashon advance outwash is present under the till-mantled uplands. Older sediments are expected to underlie the Vashon advance outwash and are exposed on steep slopes along upland margins near the shoreline bluffs of Gig Harbor, the Tacoma Narrows, and Henderson Bay.

Vashon recessional outwash (Qvr) is present in the major drainage valley occupied by McCormick Creek and North Creek and in glacial swales of the south upland, overlying till. Small isolated areas of Vashon recessional lacustrine (Qvrl) and Vashon ice-contact (Qvi) deposits are also present in glacial swales on the south upland.

Narrow bands of modern stream alluvium (Qal) have been deposited within the modern stream channels, and are composed mainly of sand and gravel. Wetlands and associated deposits (Qw) occur throughout the City, particularly in closed depressions on the till-mantled surfaces. Landslides (Qls) and mass-wasting (Qmw) deposits are mapped within stream channels and along shoreline bluffs in several locations: 1) at the northern City limit, along Highway 16 near Henderson Bay; 2) along an unnamed stream channel near its confluence with McCormick Creek; 3) at the confluence of an unnamed stream and North Creek near Gig Harbor; 4) along the Gig Harbor northwest shore and Crescent Creek; and 5) along steep shoreline bluffs of Tacoma Narrows.

3.2.2 Recharge Characteristics

Table 1 presents the infiltration and recharge considerations of the geologic units from youngest to oldest.

Table 1
Recharge Characteristics of Geologic Units

Geologic Unit	Grain Size	Density	Permeability	Distribution	Infiltration Suitability	Comments
Recent Sediments: Qal, Qw, Qb	Variable	Very loose to loose or very soft to medium stiff	Variable	Thin and limited	Variable	Contains shallow aquifer in places or interacts with surface water
Vashon Recessional Lacustrine (Qvrl)	Silt/clay, silty sand	Very soft to stiff or Loose to medium dense	Low to Moderate	Thin and limited	Not suitable	Contains shallow aquifer in places
Vashon Recessional Outwash (Qvr)	Sand, gravel, variable silt	Loose to medium dense	Moderate to High	Upland: thin and limited, typically thicker in valleys	Moderate to High (shallow), where unsaturated	Contains shallow aquifer in places, may provide baseflow to streams, underlain by Qvt on uplands
Vashon Ice-Contact Deposits (Qvi)	Silty sand, variable gravel	Medium dense to very dense	Variable	Thin and limited	Not suitable	May contain silt or till lenses
Vashon Lodgement Till (Qvt)	Silty sand, variable gravel	Very dense, glacially consolidated	Low	Averages ~60 feet thick, regionally up to 185 feet	Not suitable	Aquitard, limits shallow infiltration, unweathered till has very low permeability (1×10^{-6} cm/sec)
Vashon Advance Outwash (Qva)	Sand, gravel, variable silt	Dense to very dense, glacially consolidated	Moderate to High, Low where silt exceeds ~15%	Extensive laterally and vertically	Moderate to High (shallow or deep), where unsaturated	Can contain regional aquifer in places, used for domestic water supply, provides baseflow to streams
Lawton Clay, Pre-Fraser Undifferentiated (Qpf), Pre-Fraser Nonglacial Deposits (Qpfn)	Generally silt/clay, some sand, gravel	Very stiff to hard or dense to very dense, glacially consolidated	Low, Moderate where coarse-grained fluvial	Can be extensive laterally and vertically	Not suitable	Aquitard, permeable sand and gravel intervals can contain regional aquifers used for municipal water supply, permeable intervals typically saturated
Pre-Olympia Units (Qpo): Qpdc, Qwb, Qwbc, Qdbf, Qds, Qdg, Qgg	Variable	Very stiff to hard or dense to very dense, glacially consolidated	Typically Low, Moderate where coarse-grained fluvial	Can be extensive laterally and vertically	Not suitable	Limited surface exposures, aquitard where fine-grained, permeable sand and gravel intervals can contain regional aquifers used for municipal water supply, permeable intervals typically saturated

Notes: Qal = recent stream alluvium, Qw = wetland deposit, Qb = beach deposit
 Qpo = Pre-Olympia-age deposits, locally differentiated along shorelines of Gig Harbor and the Tacoma Narrows as:
 Qpdc = Possession Drift, coarse; Qwb = Whidbey Formation; Qwbc = Whidbey Formation, coarse; Qdbf = Double Bluff Drift, fine; Qdg = Defiance Gravel; Qds = Defiance Silt; Qgg = Gig Harbor Gravel
 cm/sec = centimeters per second

3.2.3 Project Soils

We reviewed the *Soil Survey of Pierce County Area, Washington* (Zulauf, 1979) and available online soil data at the web soil survey website. The soil survey identifies different soil map units based on parent material, climate, topography (slope), organisms (biota), and time. The soils of the City formed primarily from young glacial deposits and have not had sufficient time to develop the deep weathering profiles present in soils in unglaciated terrains. Instead, they exhibit a direct relationship to the underlying parent material, local climate, topography, and vegetation.

The majority of the City soils are part of the Harstine Soils series which are derived from till parent materials. For soils derived from deposits of glacial till, capacity of the most limiting layer to transmit water is described as very low to moderately low. These till soils are typically Hydrologic Class C. For soils derived from deposits of outwash, the infiltration capacity typically increases with depth if not saturated. These outwash soils are typically Hydrologic Class A or B.

The NRCS provides building site development ratings and erosion hazards ratings based on soils characteristics such as slope and depth to a saturated zone. These ratings were used in combination with other factors to determine areas of potential infiltration. Generally, the soils mapping units are consistent with the regional geologic mapping presented on Figures 2 and 3. Select soils units are represented on Figures 4 and 5 when soil ratings significantly influenced the infiltration potential determination.

3.3 Hydrogeology

Ground water conditions and aquifer properties are important considerations for siting of infiltration facilities. Stormwater infiltration increases ground water recharge. Increases in ground water recharge are beneficial to stream baseflow and for maintaining ground water levels, but the effects of increasing ground water recharge can include ground water mounding and potentially ground water loading in areas of geologic instability. This section contains an overview of hydrogeologic conditions and for purposes of infiltration feasibility assessment, describes principal ground water “regimes” and intervening aquitard units in the City.

3.3.1 Overview

Water that is present in the pore spaces and sediments is part of the hydrologic cycle. In the natural state, the hydrologic cycle begins with infiltration of precipitation (recharge) and ends with discharge to springs, streams, wetlands, and/or wells. Under natural conditions, ground water recharge and discharge may shift with climatic cycles, but remain in overall balance. Ground water will flow under saturated conditions, preferentially through materials with greater porosity and permeability, such as clean gravels and sands. Where geologic conditions limit discharge, ground water accumulates in such permeable zones, which, if they can support production from wells, are termed aquifers.

City of Gig Harbor and regional hydrogeology is primarily described in the following reports:

- Washington State Department of Conservation, Division of Water Resources, 1965, *Water Supply Bulletin No. 18, Water Resources and Geology of the Kitsap Peninsula and Certain Adjacent Islands* (including Plates 1 to 5): Prepared by M.E. Garling and Dee Molenaar, Olympia, Washington.
- USGS, Open-File Report OF-81-1021, 1981, *Water Resources of the Gig Harbor Peninsula and Adjacent Areas, Washington*: Prepared by B.W. Drost, scale 1:30,000.

- USGS Scientific Investigations Report 2014-5106, 2014, *Hydrogeologic Framework, Groundwater Movement, and Water Budget of the Kitsap Peninsula, West-Central Washington*: Prepared by Wendy B. Welch, Lonna M. Frans, and Theresa D. Olsen in cooperation with the Kitsap Public Utility District, Tacoma, Washington.

The USGS Gig Harbor report (Drost, 1981) builds on the fundamental hydrogeologic field data contained in Garling and Molenaar (1965) and includes more local geologic and hydrogeologic information. The Kitsap Peninsula Hydrogeologic Framework (Welch et al., 2014) compiled significant hydrogeologic and water system data information into numerical databases and GIS software.

Ground water in the City is contained within unconsolidated sediments of glacial and nonglacial origin. The uppermost water-bearing units include Recent alluvium, Vashon recessional outwash, and the weathered soils above Vashon lodgement till. The presence of shallow ground water is important to the locations of infiltration facilities and may inhibit the performance of infiltration facilities. Recent alluvium, Vashon recessional outwash, and the weathered till soils would provide fairly limited quantities of water to wells, but shallow water contained within these units may provide substantial baseflow to wetlands and small streams. The Kitsap Peninsula Framework (Welch et al., 2014) divided the deeper geologic units into hydrogeologic units using names that correspond to aquifer (QA) or confining unit (QC). The hydrogeologic units are generally consistent with the geologic units on Figures 2 and 3.

For purposes of infiltration feasibility assessment, the principal ground water “regimes” and aquitard units in the city include shallow perched ground water, shallow alluvial aquifer(s), Vashon lodgement till “aquitard,” Vashon advance aquifer, an early Vashon to pre-Vashon-age aquitard, and undifferentiated deeper aquifers and aquitards.

3.3.2 Shallow Perched Water

In upland areas, perched ground water occurs when surface water infiltrates down through relatively permeable soils, such as thin Vashon recessional outwash (Qvr) and the weathered portions of the glacial till (Qvt), and becomes trapped or “perched” atop a comparatively impermeable barrier, such as lacustrine deposits (Qvrl) or unweathered till. This zone of shallow perched ground water is also commonly referred to as the “interflow zone.” The perched ground water can only slowly penetrate the underlying low-permeability zones. Wetlands form where interflow accumulates in low-lying areas. Several wetlands and small lakes exist on the north and south uplands.

3.3.3 Shallow Alluvial Aquifers

In areas of low-lying valleys such as along McCormick Creek, North Creek, Crescent Creek (northern drainage of the Gig Harbor waterbody), and Garr Creek (drainage at southern city limit), thicker alluvial water table aquifers exist. The combined thickness of alluvium and recessional outwash, can exceed several tens of feet. Recharge to the shallow aquifers occurs from direct precipitation, runoff from topographically higher till-covered upland areas or other surface water features discharging into the low-lying areas, and direct communication with the regional underlying aquifer. Ground water level fluctuations can vary considerably within the different aquifers. Narrow or laterally constrained alluvial/recessional valleys typically have more fluctuation between seasonal high and seasonal low water levels.

Surface water features identified at lower elevations within the recessional/alluvial deposits in the McCormick Creek/North Creek Valley and in Garr Creek appear to be the surface expression of the regional

Vashon advance aquifer (Section 3.3.5). This indicates that the shallow alluvial aquifer and the Vashon advance outwash may be hydraulically connected in this area.

3.3.4 Vashon Lodgement Till “Aquitard” (Qvt)

Vashon lodgement till is exposed at the ground surface across much of the City. Where the lodgement till underlies the Vashon recessional and ice-contact deposits, it forms an aquitard to ground water flow. The lodgement till is comprised of very dense, glacially compacted silty sand with varying amounts of gravel. The high silt content and high density impedes the movement of ground water in the lodgement till. The presence of till limits shallow infiltration opportunities because unweathered till is a very low-permeability material (less than 1×10^{-6} centimeters per second [cm/sec]) (NRCS-USDA, 2016)). The lodgement till has been eroded along the upland margins exposing the underlying Vashon-age advance outwash and older geologic units.

3.3.5 Vashon Advance Outwash Aquifer (Qva)

A regional aquifer exists in the Vashon advance outwash. According to well logs and cross-sections provided in the regional hydrogeologic studies, thicknesses of the advance outwash deposits is up to 150 to 200 feet in the study area (Garling and Molenaar, 1965 and Welch et al., 2014). The advance outwash aquifer typically terminates abruptly in bluffs and steep slopes along the upland margins.

The advance outwash aquifer is typically an unconfined aquifer. Many domestic well logs identified in Garling and Molenaar (1965) and Drost (1981) are completed in the Qva aquifer. Ground water elevation in wells interpreted as completed within Qva within the City (and located within the “south” upland) ranges from about 100 feet above sea level (asl) to about 150 feet asl and regionally up to 300 feet asl in the center of the uplands (Garling and Molenaar, 1965). Garling and Molenaar (1965) and Welch et al. (2014) indicate that the Qva aquifer water levels are higher on the “north” upland. AESI project experience near the City also indicates that water levels may be higher. Ground water elevation within the Qva aquifer approximately ½ mile north of the City limits near Highway 16 was about 216 feet elevation relative to mean sea level (AESI, 2007).

Welch et al. (2014) indicates that ground water on the north upland is flowing generally south toward the valley and radially west and east toward the marine water bodies. On the south upland, ground water in the Qva aquifer is flowing radially out from the center toward the valley and marine water bodies. AESI interprets that ground water is elevated near the center of both uplands and the center of the valley containing McCormick Creek/North Creek, forming a ground water divide. In the valley, the divide is approximately ½ mile south of the intersection of Borgen Boulevard and Highway 16 where ground water elevations are estimated to be about 160 feet asl. Ground water levels are lowest near regional discharge zones at Henderson Bay and the Gig Harbor shoreline.

Recharge to the advance outwash aquifer is likely from downward migration of precipitation and shallow ground water seepage through the lodgement till, where present. Discharge from the advance outwash aquifer is likely in the form of seeps and springs where the advance outwash aquifer has been exposed in slopes and bluffs, downward seepage to underlying aquifers in the older undifferentiated sediments, and from withdrawal by water supply wells. In the stream valleys of McCormick Creek, North Creek, Crescent Creek, and Garr Creek, the shallow alluvial and Qva aquifers may be hydraulically connected.

3.3.6 Vashon Lawton Clay and Pre-Vashon-Age Fine-Grained Deposits “Aquitard” (QC1)

Confining unit (QC1) is generally a thick and laterally extensive low-permeability unit consisting mostly of early Vashon advance lacustrine silt and clay (Lawton Clay) and underlying pre-Vashon-age nonglacial deposits of silt, sand, and gravel with numerous lenses of silt and clay or silty peat (Welch et al., 2014). However, the unit is locally absent in some portions of the City and is not present along the southern shoreline of Gig Harbor or the Tacoma Narrows bluffs south of the Gig Harbor outlet. Welch et al. (2014) maps the QC1 aquitard along Henderson Bay and the western valley wall of Crescent Creek where geologic units Qpfn and Qpf are mapped (Figures 2 and 3).

The low-permeability clay, silt, and silty sand deposits have been consolidated by the weight of an ice sheet and act as a regional aquitard. Spring flow commonly discharges at the geologic contact with overlying coarse-grained material and underlying fine-grained deposits.

3.3.7 Pre-Vashon-Age Undifferentiated Deep Aquifer(s) (QA1)

The sea-level aquifer (QA1) is extensive and widely used (Welch et al., 2014). It is generally confined, but is exposed at the ground surface along some shorelines in the City. QA1 consists primarily of glacial sand and gravel, with silt interbeds and of coarse Possession Drift (Qpdc), mapped by Troost et al. (in review) and Troost (2016) along the southern shoreline of Gig Harbor and the Tacoma Narrows shoreline. The sea-level aquifer regionally extends from several hundred feet below sea level to 300 feet asl. Typical thickness ranges from 50 to 250 feet (Welch et al., 2014). Many community water systems identified in Garling and Molenaar (1965) and Drost (1981) are completed in this interval.

3.3.8 Pre-Vashon-Age Fine-Grained Deposits “Aquitard” (QC2)

According to Welch et al. (2014), confining unit (QC2) is a low-permeability unit consisting of nonglacial sandy silty clay and glacial sand and gravel, with significant amounts of silt and clay layers. Unit QC2 is mapped at the base of the southern shoreline of Gig Harbor and the Tacoma Narrows bluffs and includes sediments mapped as the Whidbey Formation (Qwb, Figures 2 and 3) by Troost et al. (in review) and Troost (2016). According to Welch et al. (2014), unit QC2 is present underlying the entire City at elevations up to about 100 feet asl. Regionally, the unit ranges to depths of more than 500 feet below sea level and is generally 100 to 300 feet thick (Welch et al., 2014).

Deeper aquifers and aquitards are present underlying QC2 in pre-Olympia-age deposits.

3.3.9 Recharge and Discharge

Recharge to the shallow ground water aquifers and surface water systems of the Gig Harbor Peninsula is from precipitation falling directly on the land surface and infiltrating to the water table. Natural and artificial surface storage basins, such as infiltration or retention facilities, collect precipitation or subsequent runoff and release the water slowly to the ground water system. Ground water recharge is areally distributed throughout the City, whereas ground water discharge is concentrated around surface water features, such as streams, rivers, lakes, wetlands, and marine bodies. Discharge tends to occur at lower elevations to both surface water and springs, but also occurs to wells regardless of their location.

Many springs and seeps discharge at the top of low-permeability silts and clays of pre-Vashon-age deposits. The silts and clays serve as perching layers that impede downward migration of infiltrating ground water.

Seeps and springs contribute year-round baseflow to streams, and during summer and early autumn can be the only source of stream flow.

3.3.10 Ground Water - Surface Water Interaction

Stream channels and wetlands in the City are surface water features which interact directly with ground water. Three general processes occur: 1) the surface water features gain water from inflowing ground water; 2) the surface water features lose water to ground water by outflow through the streambed or depression sidewalls or base; or 3) the systems vary between gaining water and losing water either seasonally or spatially, in particular for streams as the streambed intersects different geologic units or ground water discharge zones.

Wetlands also receive water from ground water, provide a source of recharge to ground water, or both. Wetlands located on the upland surfaces generally result from interflow or direct runoff collecting in depressions between till ridges, and can be an expression of a very shallow perched water table in topographically low areas on shallow, low-permeability sediments.

4.0 CRITICAL AREAS AND AREAS NOT RECOMMENDED FOR INFILTRATION

This section describes mapped areas where infiltration is not recommended based on criteria presented in the Stormwater Manual and the *Gig Harbor Municipal Code* (GHMC) and associated data. Key criteria that constrain infiltration feasibility include geologic hazards, degree of slope, water supply wells, wetlands and shallow ground water.

4.1 Geologically Hazardous Areas and Slope Considerations

The Stormwater Manual does not allow siting of shallow infiltration facilities within certain geologically hazardous areas including a landslide hazard or erosion hazard area. GHMC Chapter 18.08 Critical Areas provides the follow definitions:

- ***“Geologically hazardous areas”*** means those areas as designated in the city of Gig Harbor comprehensive plan as “landslide hazards,” in the Washington Department of Ecology Coastal Zone Atlas, Volume 7, and “areas that because of their susceptibility to erosion, sliding, earthquake, or other geological events, are not suited to siting commercial, residential, or industrial development consistent with public health or safety concerns” (WAC 365-190-030(9)).
- ***“Landslide hazard area”*** means those areas which are susceptible to risk of mass movement due to a combination of geologic, topographic and hydrologic factors.
- ***“Erosion hazard areas”*** means those areas which are vulnerable to erosion due to natural characteristics including vegetative cover, soil texture, slope, gradient or which have been induced by human activity. Those areas which are rated severe or very severe for building site development on slopes or cut banks, in accordance with the United States Department of Agriculture Soil Conservation Service Soil Survey for Pierce County Area (February 1979), are included within this definition.

Slope stability mapping presented in the *Ecology Coastal Zone Atlas of Washington* (Ecology, 1979) and by DNR (Smith, 1976) map areas of unstable soil, recent landslides, and old landslides along Henderson Bay, Gig Harbor, and the Tacoma Narrows. The regional geology map refined some of the previous slope stability mapped areas and identified additional landslides (Qls) and mass-wasting (Qmw) deposits within stream

channels and along shoreline bluffs in several locations (Figures 2 and 3): 1) at the northern City limit, along Highway 16 near Henderson Bay; 2) along an unnamed stream channel near its confluence with McCormick Creek; 3) at the confluence of an unnamed stream and North Creek near Gig Harbor; 4) along the Gig Harbor northwest shore and Crescent Creek; and 5) along steep shoreline bluffs of Tacoma Narrows. Areas of mapped mass wastage and any area designated as a landslide hazard were included as infeasible areas for infiltration.

The Stormwater Manual allows a finding of infiltration infeasibility within 50 feet of slopes of greater than 20 percent. According to the GHMC “erosion hazard areas” definition above and the referenced soil survey for Pierce County, soils rated severe or very severe for building site development have slopes of greater than 30 percent. The GHMC Section 18.08.190 requires site-specific studies for projects that disturb ground on slopes of 15 percent to 25 percent; therefore only areas of greater than 25 percent slopes are considered infeasible for infiltration for the purposes of this study. Areas of advance outwash that are exposed on slopes greater than 15 percent may be infeasible for infiltration and require site-specific geotechnical studies to determine slope and stability.

Areas identified as not recommended for infiltration on Figures 4 and 5 include:

- Areas with slopes greater than 25 percent.
- Unstable soil or shoreline classified as “unstable” (U), “unstable old slides” (Uos), or “unstable recent slides” (Urs) by the Ecology *Coastal Zone Atlas of Washington*, Volume 7 (Ecology, 1979) and by Smith (1976).
- Geologic map unit: landslide deposits (Qls), mass-wasting deposits (Qmw) (Troost et al., in review).
- NRCS soil units: Harstine gravelly ashy sandy loam, 30 to 45 percent slopes; Kitsap silt loam, 30 to 60 percent slopes; Kitsap-Indianola complex, 45 to 70 percent slopes; and Xerochrepts, 45 to 70 percent slopes (NRCS-USDA, 2016).

AESI applied a 300-foot buffer around all mapped landslide hazard and mass-wastage areas in accordance with the Stormwater Manual setback recommendations.

The mapped landslide, mass-wasting, unstable soils and steep slope areas represent approximate locations and should be considered guidelines that generally identify the potential unstable ground conditions that may be impacted by stormwater infiltration. The actual risk should be evaluated and critical areas ordinance should be consulted and applied on a site-specific basis.

4.2 Wetlands and Shallow Ground Water

The Stormwater Manual does not allow infiltration where an appropriate minimum separation (of 1 to 3 feet, depending on the drainage area and type of BMP facility) from seasonal high water table or other impervious layer cannot be achieved. Wetlands are an indicator of very shallow ground water. GHMC Chapter 18.08 Critical Areas provides the following definitions:

- **“Wetland” or “wetlands”** means areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands do not include those artificial wetlands intentionally created from nonwetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, retention facilities, wastewater

treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990, that were unintentionally created as a result of the construction of a road, street or highway. Wetlands include those artificial wetlands intentionally created from nonwetland areas created to mitigate conversion of wetlands.

GHMC Section 18.08.038 designates wetlands as critical areas and mapping sources as United States Fish and Wildlife Service's National Wetland Inventory (NWI) and Pierce County wetland atlas. The geologic unit Qw (wetland deposits) (Troost et al., in review) identifies areas of organic and typically wet soil, and is indicative of shallow seasonal high ground water. The NRCS rates soils as very limited for development due to a shallow depth to saturated soils and those soils are seasonally saturated.

Areas designated as not recommended for infiltration on Figures 4 and 5 due to shallow ground water and wetlands were identified based on a combination of the following data sources:

- Mapped wetlands from NWI and Pierce County.
- Geologic map unit: Wetland deposits (Qw).
- NRCS soil units: Bellingham silty clay loam, Dupont muck, Hydraquents, Kitsap silt loam, Kitsap-Indianola complex, Norma fine sandy loam (NRCS-USDA, 2016).

These mapped shallow ground water areas are in depressions in the till-mantled uplands and in the stream valleys of North Creek, McCormick Creek, Crescent Creek, and Garr Creek, and the landslide hazard area in the central part of the City south of the outlet of North Creek.

4.3 Wellhead Protection Zones

The Stormwater Manual does not allow siting of shallow infiltration facilities within 100 feet of a water supply well. Based on the wellhead protection data provided by TCPHD, Pierce County, DOH, and the DOH SWAP maps, portions of the City are located within the delineated wellhead protection areas for City of Gig Harbor water supply wells, and other Group A water supply wells, and Group B water supply wells. One-year, five-year, and ten-year time-of-travel wellhead protection zones are available from DOH and TPCPD. Buffers of 100 feet circle all Group A and Group B wells on Figures 4 and 5. Well locations presented may not be exact and should be verified by site-specific studies. Individual domestic water supply well locations are not mapped and should also be verified by site-specific studies.

5.0 INFILTRATION POTENTIAL

5.1 Conceptual Infiltration Strategies

Infiltration feasibility is dependent on the permeability of the infiltration receptor horizon, the vertical and lateral extent of the unsaturated material, the depth to ground water for perched water, the transmissivity of the underlying aquifer, proximity to geologic hazards, and considerations for other nearby water users such as water wells, springs, and streams.

Infiltration facilities may be either shallow or deep. Shallow infiltration facilities could be considered in settings where high-permeability sediments (such as Vashon recessional outwash) are present in sufficient unsaturated thickness and lateral extent to allow the stormwater to spread out, disperse, and avoid re-emergence. Deep infiltration facilities could be considered in settings where low-permeability geologic units (such as glacial till) are present at the surface and more permeable sediments are present below. Deep

infiltration facility strategies would be dependent on the thickness of the low-permeability unit at the surface and the depth to ground water in the infiltration receptor horizon. The unsaturated portion of the Vashon advance outwash layer would be the receptor for deep infiltration.

Shallow infiltration strategies include:

- Long or linear infiltration systems that spread out recharge such as infiltration trenches, bioretention swales, or permeable pavements.
- Concentrated infiltration facilities may be considered, such as a series of basins, ponds, or bioretention cells if the infiltration receptor horizon has sufficient unsaturated thickness and lateral extent.

Deep infiltration strategies include:

- Conventional large infiltration ponds, trenches, or vaults that are excavated through the surficial glacial till (or surficial fill and fine-grained sediments) and into underlying higher-permeability units (such as Vashon advance outwash). If the infiltration receptor horizon is present within 10 to 15 feet of the ground surface, this type of deep infiltration facility could be considered. In our experience, large conventional infiltration ponds, trenches, or vaults situated in Vashon advance outwash have long-term design infiltration rates on the order of 0.5 to 5 inches per hour (iph).
- Combination large infiltration pond, trench, or vault modified with a series of pit drains (short infiltration trenches) to increase the effective infiltration rate. In our experience, including pit drains increases the effective infiltration rate on the order of 4 to 10 times, resulting in facilities with long-term design infiltration rates typically ranging from 2 to 20 iph.
- UIC Well Systems. UIC wells could be considered if the infiltration receptor horizon is too deep to make conventional infiltration ponds, trenches, or vaults feasible. UIC well systems for this setting would be drilled through the surficial low-permeability unit and into the underlying higher-permeability unit (such as Vashon advance outwash). In practice, our projects have had UIC design flow rates that ranged from 50 gallons per minute (gpm) per UIC well using short screens or in more sandy deposits to greater than 350 gpm per UIC well using longer screens or in more gravelly sands or gravel deposits.

5.2 Infiltration Potential Assessment

Areas where infiltration may be recommended are designated as “Shallow Infiltration Potential,” “Deep Infiltration Potential,” or “Shallow and Deep Infiltration Potential” on Figures 4 and 5. All areas designated as having potential for infiltration may be found to be infeasible for infiltration based on a site-specific analysis.

5.2.1 Shallow Infiltration Potential

The shallow infiltration potential areas were determined based on mapped geologic and select soil units based primarily on permeability and saturation level of the surficial sediments. Critical areas and other areas identified as not recommended for infiltration in Section 4.0 were eliminated from consideration. The areas potentially recommended for shallow infiltration are illustrated on Figures 4 and 5 and summarized below.

- Areas of mapped high-permeability sediments with adequate unsaturated thickness, such as Vashon advance outwash exposed at the ground surface primarily along the margins of the upland and along the valley walls of McCormick Creek/North Creek, and small portions of Crescent Creek. Areas of advance outwash that are exposed on slopes greater than 15 percent may be infeasible for infiltration and require site-specific geotechnical studies to determine slope and stability.
- Areas of mapped permeable sediments with likely thin or unknown unsaturated thickness, such as Vashon recessional outwash and recent stream alluvium located in the McCormick Creek/North Creek valley and Garr Creek, as well as unsaturated upland recessional outwash (located on the south upland).

5.2.2 Deep Infiltration Potential

Unsaturated Vashon advance outwash is the primary deep infiltration receptor layer in Gig Harbor. AESI reviewed the extent of mapped Vashon advance outwash as a first step in assessing deep infiltration potential. The Vashon advance outwash is underlain by older, lower-permeability pre-Fraser-age and pre-Olympia-age sediments (e.g., Qpfn, QC1, QC2) that form hydraulically restrictive layers. Depth to ground water is also a critical element for deep infiltration. The regional ground water table is expected to perch on low-permeability units of aquitard QC1 and QC2 (Section 3.3). The contact between Vashon advance outwash and pre-Fraser-age and pre-Olympia-age sediments where exposed in the City vicinity is between about 100 and 125 feet elevation. In order to allow sufficient clearance from the base of a deep infiltration facility and the ground water table, locations below approximately 125 feet elevation (and up to 160 feet elevation locally) were designated “not recommended” for infiltration (Section 4.0). This elevation was modified based on geologic contacts and the ground water table. A ground water high within the Vashon advance outwash aquifer is identified near the center of the McCormick Creek/North Creek valley and near the center of the uplands. Critical areas and other areas identified as not recommended for infiltration in Section 4.0 were eliminated from consideration.

AESI delineated deep infiltration potential areas illustrated on Figures 4 and 5.

- Deep infiltration potential areas include upland areas covered with low-permeability till, recessional lacustrine, and ice-contact deposits. These areas are generally above elevation 125 feet (adjusted up to 160 feet elevation locally based on geologic contacts and expected high ground water).

5.2.3 Shallow and Deep Infiltration Potential

Areas with both shallow and deep infiltration potential include areas of recessional outwash located on the south upland that are underlain by till. The recessional deposits, where unsaturated, may contain adequate thickness for stormwater to infiltrate, disperse, and avoid re-emergence. Deep infiltration is also possible in these areas. Deep infiltration could occur into the advance outwash that is expected beneath the recessional and till sediments when unsaturated.

6.0 CONCLUSIONS

Our review of the available site information indicates the following regarding the general infiltration potential of the City:

- The City is primarily located on till-mantled uplands as shown on Figures 2 and 3. The distribution of till is also reflected in the areas of “Deep Infiltration Potential” shown on Figures 4 and 5. The presence of till limits shallow infiltration opportunities because unweathered till has very low-permeability (less than 1×10^{-6} cm/sec (NRCS-USDA, 2016)). Varying amounts of ground water seepage should be expected within the weathered till and would also inhibit infiltration in the wetter winter months.
- A number of domestic and community water supply wells are located in the study area. When siting stormwater facilities, a 100-foot sanitary control radius around the wellhead must be maintained.
- Shallow infiltration opportunities are reflected in the areas of “Shallow Infiltration Potential” and “Shallow and Deep Infiltration Potential” areas (Figures 4 and 5):
 - Opportunities exist where advance outwash is mapped at the ground surface. These include portions of the McCormick Creek and North Creek valley, portions of Crescent Creek, and along Garr Creek on the southern end of the City. Areas of advance outwash that are exposed on slopes greater than 15 percent may be infeasible for infiltration and require site-specific geotechnical studies to determine slope and stability. Shallow ground water limits infiltration potential in the valleys.
 - Opportunities exist where recessional outwash is present in adequate unsaturated thickness in the uplands and in the valley. Upland recessional outwash is overlying till and is generally thin and limited in extent. Valley recessional outwash may be thicker, include alluvium, is generally overlying advance outwash, and may be in hydraulic connectivity with the regional Qva aquifer. Varying amounts of ground water seepage may be encountered within the recessional outwash deposits, and may inhibit infiltration in the wetter winter months.
- Deep infiltration opportunities exist where Vashon advance outwash is present in sufficient unsaturated thickness beneath surficial till or other low-permeability deposits. Deeper infiltration techniques such as deep drywells (UIC wells) or deep infiltration trenches could be considered. Ground water should be expected at depth within Vashon advance outwash and limits deep infiltration systems.
- The base of the Vashon advance aquifer is likely at or near the contact with the underlying pre-Fraser-age and pre-Olympia-age units that generally crop out at about 100 to 125 feet elevation. To allow for aquifer thickness and separation to ground water from the base of a potential infiltration system, an elevation of 125 feet (and up to 160 feet locally) was used to delineate the lowest elevation for deep or shallow infiltration systems. This elevation was modified based on geologic contacts and the ground water table. A ground water high within the Vashon advance outwash aquifer is identified near the center of the McCormick Creek/North Creek valley and near the center of the uplands.

7.0 LIMITATIONS

The feasibility mapping provided in this technical memorandum is suitable for identification and evaluation of potential infiltration solutions. For infiltration projects, additional subsurface explorations, infiltration testing, and analysis will be required and are recommended to verify the information that provides the basis for the assessments included in this technical memorandum and to refine the analysis for site-specific infiltration areas.

We have prepared this technical memorandum for use in the City of Gig Harbor’s comprehensive stormwater plan update. The conclusions and interpretations presented in this technical memorandum should not be construed as a warranty of the subsurface conditions. Our conclusions and recommendations are based on

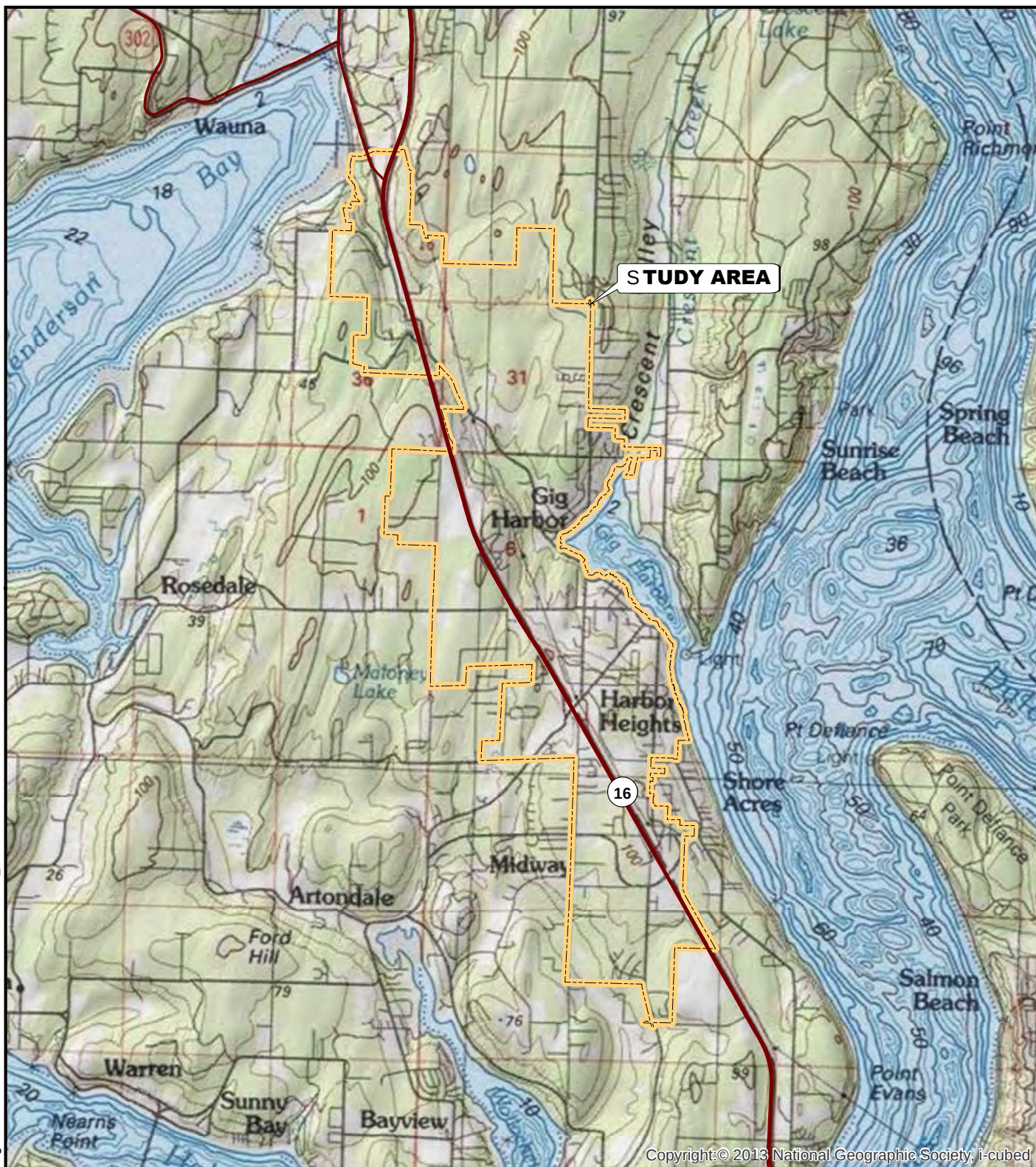
information provided by others and our experience in the area. Our experience has shown that soil and ground water conditions can vary significantly over small distances.

Within the limitations of scope, schedule, and budget, AESI attempted to execute these services in accordance with generally accepted professional principles in the fields of geology and hydrogeology at the time this memorandum was prepared. No warranty, express or implied, is made. If you should have any questions, or require further assistance, please do not hesitate to call.

Attachments: Figure 1. Study Area
 Figure 2. Geology – North
 Figure 3. Geology – South
 Figure 4. Infiltration Potential – North
 Figure 5. Infiltration Potential – South

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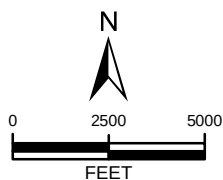


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DATA SOURCES / REFERENCES:
USGS: 100K SERIES TOPOGRAPHIC MAP
PIERCE CO: STREETS, CITY LIMITS 02/17

LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE



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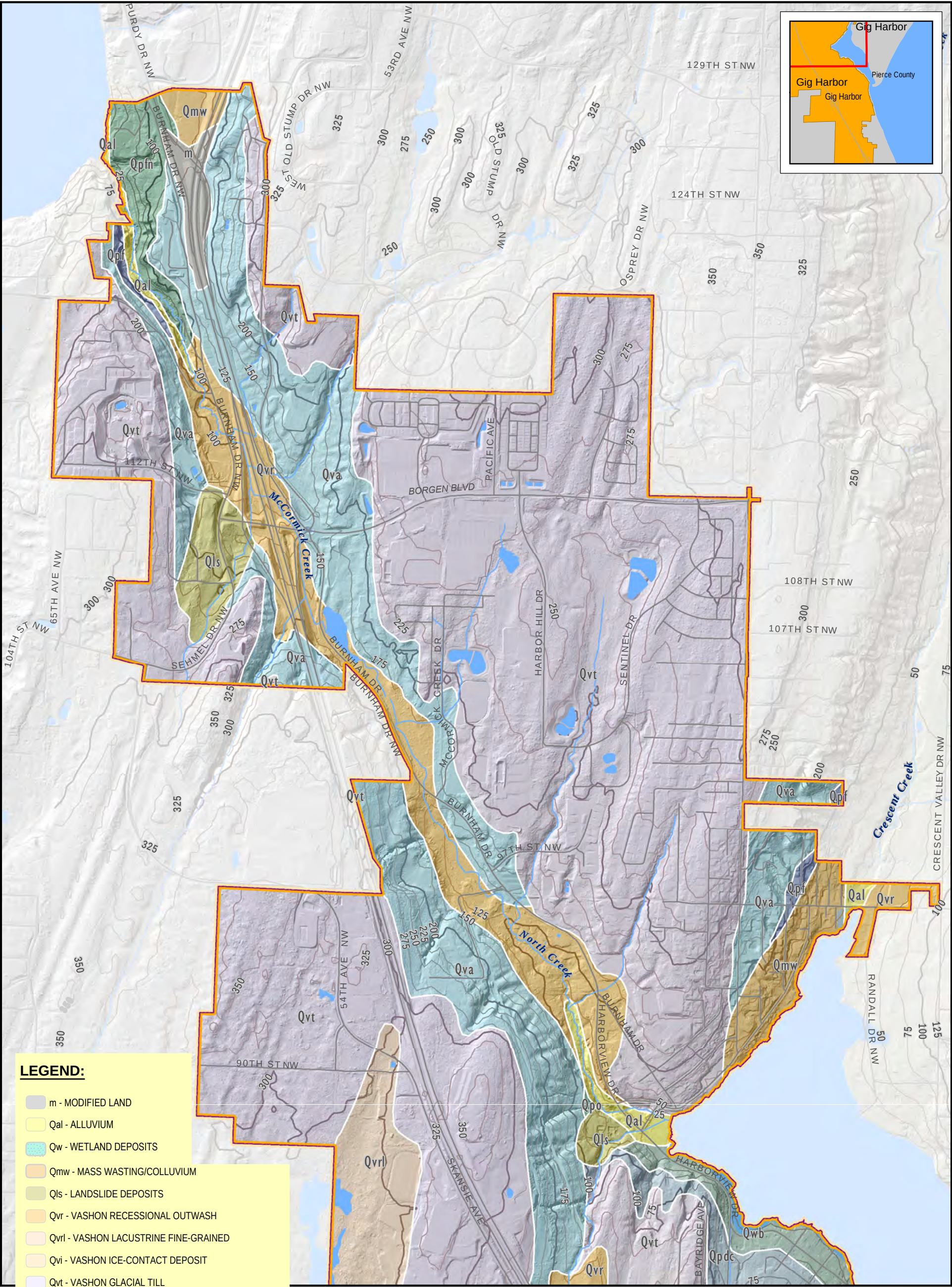
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GIG HARBOR STUDY AREA

GIG HARBOR INFILTRATION ASSESSMENT
GIG HARBOR, WASHINGTON

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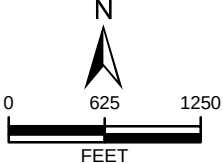


LEGEND:

- m - MODIFIED LAND
- Qal - ALLUVIUM
- Qw - WETLAND DEPOSITS
- Qmw - MASS WASTING/COLLUVIUM
- Qls - LANDSLIDE DEPOSITS
- Qvr - VASHON RECESSONAL OUTWASH
- Qvrl - VASHON LACUSTRINE FINE-GRAINED
- Qvi - VASHON ICE-CONTACT DEPOSIT
- Qvt - VASHON GLACIAL TILL
- Qva - VASHON ADVANCE OUTWASH
- Qpf - PRE-FRASER DEPOSITS, UNDIFFERENTIATED
- Qpfn - PRE-FRASER NON-GLACIAL DEPOSITS
- Qpo - PRE-OLYMPIA DEPOSITS UNDIFFERENTIATED
- Qpdc - POSSESSION DRIFT COARSE-GRAINED
- Qwb - WHIDBEY FORMATION, c - COARSE-GRAINED
- Qdbf - DOUBLE BLUFF FINE-GRAINED
- Qds/g - DEFIANCE SILT/GRAVEL
- Qgg - GIG HARBOR GRAVEL

LEGEND:

- CITY BOUNDARY
- CONTOUR 25 FT



DATA SOURCES / REFERENCES:
LIDAR ACQUIRED BY PIERCE COUNTY 2010/2011. GRID CELL SIZE IS 3'.
WA STATE PLANE SOUTH COORDINATE SYSTEM.
NAD83(1991 HARN). VERTICAL NAVD88 GEOID09.
ELEVATION UNITS IN US SURVEY FEET. CONTOURS FROM LIDAR
GEOMAPNW GIG HARBOR 7.5' GEOLOGY DRAFT, 1/99
PIERCE CO: STREETS, WATER, PARCELS 3/17
WADOE: COASTAL ZONE 2008
LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

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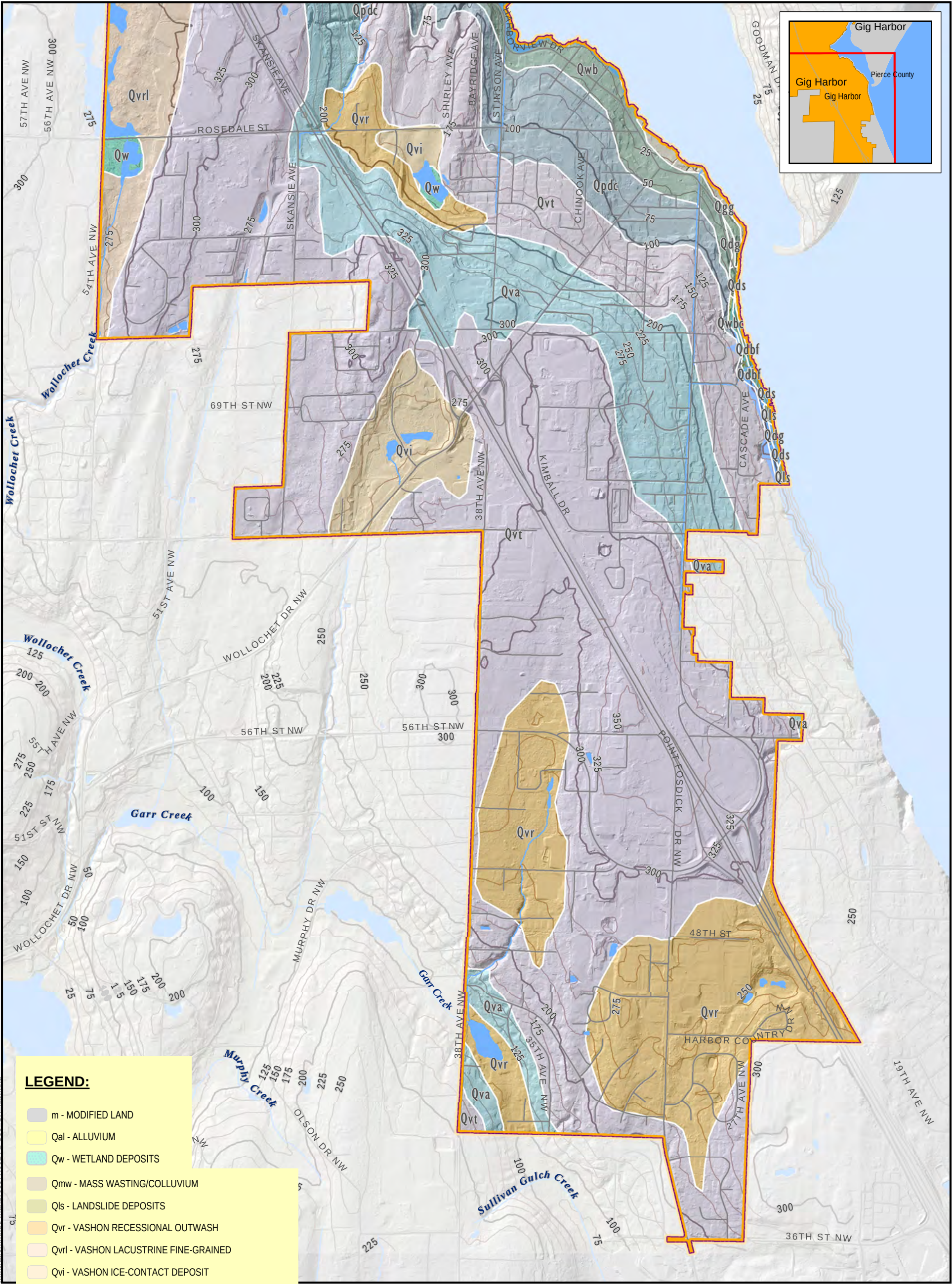
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GEOLOGY - NORTH

**GIG HARBOR INFILTRATION ASSESSMENT
GIG HARBOR, WASHINGTON**

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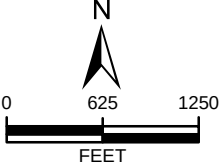


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WADOE: COASTAL ZONE 2008
LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION



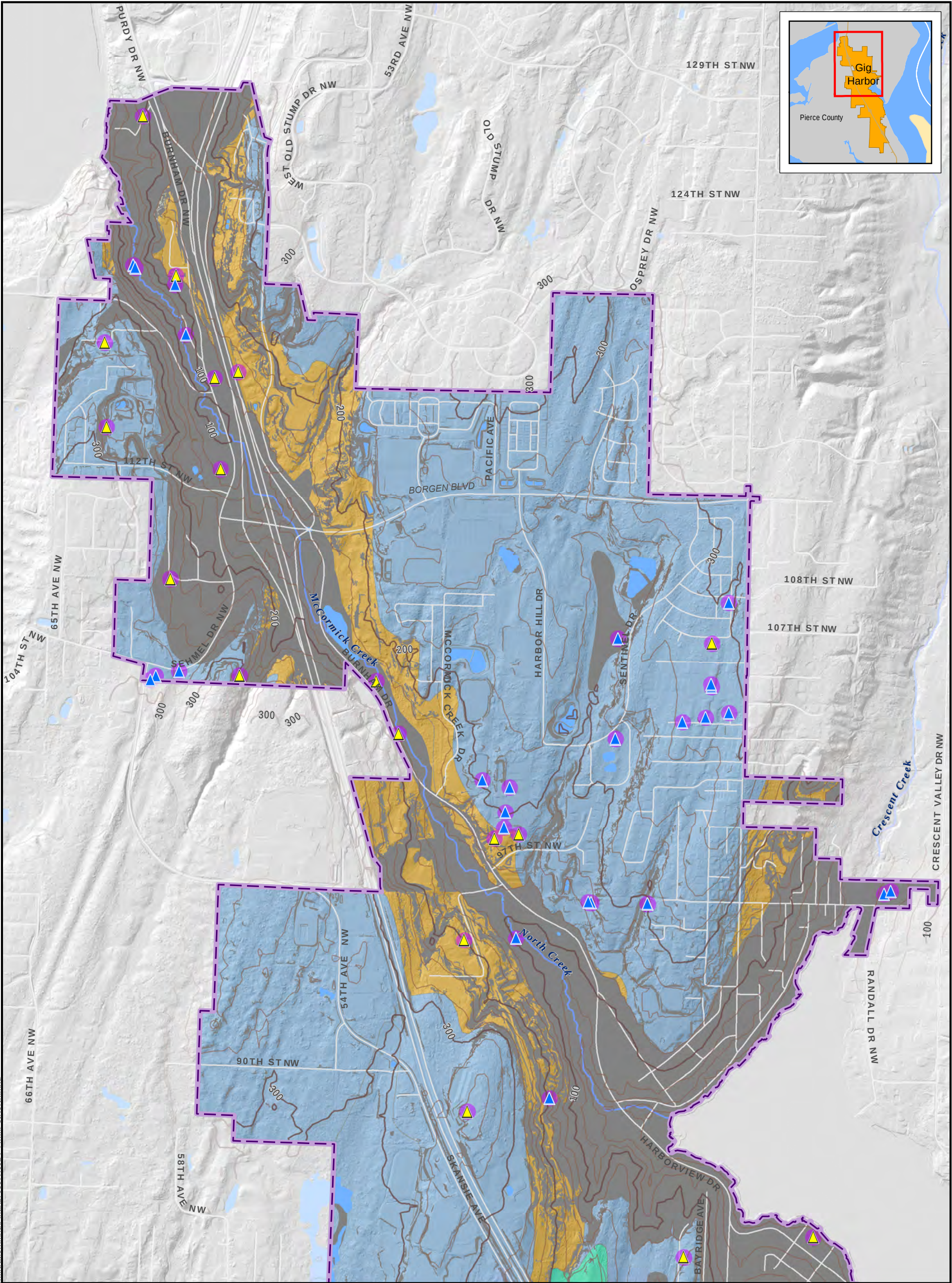
associated
earth sciences
incorporated

GEOLOGY - SOUTH

GIG HARBOR INFILTRATION ASSESSMENT
GIG HARBOR, WASHINGTON

PROJ NO.	170597H001	DATE:	11/17	FIGURE:	3
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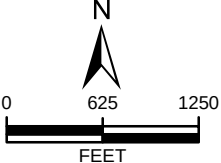
LEGEND:

- NOT RECOMMENDED
- SHALLOW INFILTRATION POTENTIAL
- SHALLOW AND DEEP INFILTRATION POTENTIAL
- DEEP INFILTRATION POTENTIAL
- DRINKING WATER WELL BUFFER
- WATER WELL (GROUP A)
- WATER WELL (GROUP B)

LEGEND:

- CONTOUR 25 FT
- CONTOUR 100 FT
- CITY BOUNDARY

DATA SOURCES / REFERENCES:
LIDAR ACQUIRED BY PIERCE COUNTY 2010/2011. GRID CELL SIZE IS 3'.
WA STATE PLANE SOUTH COORDINATE SYSTEM.
NAD83(1991 HARN). VERTICAL NAVD88 GEOID09.
ELEVATION UNITS IN US SURVEY FEET. CONTOURS FROM LIDAR
GEOMAPNW GIG HARBOR 7.5' GEOLOGY DRAFT, 1/99
PIERCE CO: STREETS, WATER, PARCELS 3/17
WADOE: COASTAL ZONE 2008
LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE



BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION

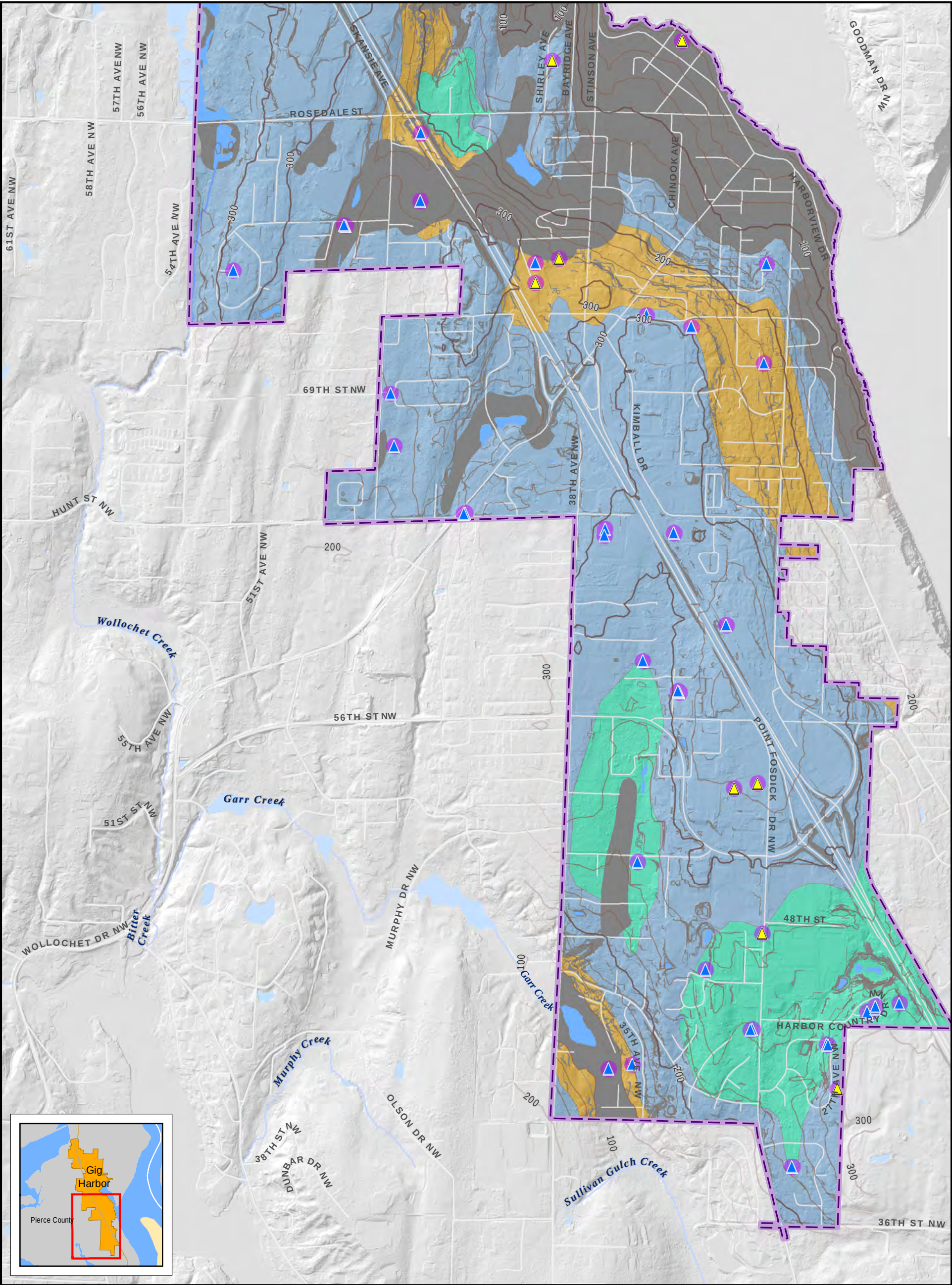


associated
earth sciences
incorporated

**INFILTRATION POTENTIAL
NORTH**
GIG HARBOR INFILTRATION ASSESSMENT
GIG HARBOR, WASHINGTON

PROJ NO.	170597H001	DATE:	11/17	FIGURE:	4
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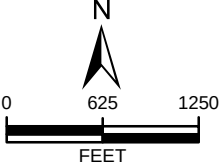
LEGEND:

- NOT RECOMMENDED
- SHALLOW INFILTRATION POTENTIAL
- SHALLOW AND DEEP INFILTRATION POTENTIAL
- DEEP INFILTRATION POTENTIAL
- DRINKING WATER WELL BUFFER
- WATER WELL (GROUP A)
- WATER WELL (GROUP B)

LEGEND:

- CONTOUR 25 FT
- CONTOUR 100 FT
- CITY BOUNDARY

DATA SOURCES / REFERENCES:
LIDAR ACQUIRED BY PIERCE COUNTY 2010/2011. GRID CELL SIZE IS 3'.
WA STATE PLANE SOUTH COORDINATE SYSTEM.
NAD83(1991 HARN). VERTICAL NAVD88 GEOID09.
ELEVATION UNITS IN US SURVEY FEET. CONTOURS FROM LIDAR
GEOMAPNW GIG HARBOR 7.5' GEOLOGY DRAFT, 1/99
PIERCE CO: STREETS, WATER, PARCELS 3/17, TIME OF TRAVEL
WADOE: COASTAL ZONE 2008
LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE



BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION



associated
earth sciences
incorporated

**INFILTRATION POTENTIAL
SOUTH**
GIG HARBOR INFILTRATION ASSESSMENT
GIG HARBOR, WASHINGTON

PROJ NO.	170597H001	DATE:	11/17	FIGURE:	5
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APPENDIX C. DRAINAGE SYSTEM MODELING DATA

Hydrologic and hydraulic modeling data, including input files, output, and mapping, will be provided to the City in appropriate electronic formats.

APPENDIX D. DETAILS OF FINANCIAL ANALYSIS

Table D-1: Historical Revenues from Operations (2015-2017)

OPERATING REVENUES	2015	2016	2017 Dept Req
Storm - State utility taxes	11,737	12,808	13,481
DOE grant	37,048		
Inspection fees		54	16
Storm drainage fees	785,261	854,066	899,648
Late penalties	821	669	500
Engineering plan review fees			
Other gov. revenues		141	-
Transfer - general gov't	189,807		
TOTAL REVENUES	1,024,674	867,738	913,645

Table D-2: Historical Expenses from Operations (2015-2017)

OPERATING EXPENDITURES	2015	2016	2017 Dept Req
ADMIN - PUBLIC WORKS			
Regular salaries	142,949	149,136	147,200
Overtime	2,545	2,314	3,000
Personnel benefits	69,052	69,918	73,700
New Personnel			
Office & operating supplies	324	137	3,625
Small tools & minor equipment	362	560	4,000
Professional Services	30,865	50,651	61,250
Communications	-		1,000
Miscellaneous	4,047	4,943	1,000
SUBTOTAL ADMIN - PUBLIC WORKS	250,144	277,659	294,775
ADMIN - GENERAL			
Regular salaries	61,194	61,759	62,800
Overtime	353	236	500
Personnel benefits	25,102	24,748	26,600
Professional Services	416	437	1,000
Legal fees	3,077	2,553	10,000
Insurance	21,119	14,764	16,240
SUBTOTAL ADMIN - GENERAL	111,261	104,497	117,140
CUST SERVICE BILLING			
Salaries	6,096	10,608	11,100
Overtime		-	
Personnel Benefits	3,313	3,828	4,300
SUBTOTAL CUST SERVICE BILLING	9,409	14,436	15,400

Table D-2 cont'd

ADMIN - PUBLIC WORKS	2015	2016	2017 Dept Req
STREET MAINTENANCE			
Regular salaries	79,901	84,064	134,156
Overtime	4,326	3,795	1,000
Personnel benefits	39,669	39,147	60,744
Uniforms	1,213	1,375	1,000
Office & operating supplies	12,824	23,007	22,000
Small tools & minor equipment	16,380	7,903	4,000
Professional services	10,349	10,036	156,000
Video inspection	-	-	-
Communications	15,045	13,728	16,000
Travel	256	237	500
Advertising	348	337	500
Operating rentals & leases	996	3,239	5,000
Street debris disposal	4,523	4,499	7,000
Repairs & maintenance	2,149	5,844	2,000
Miscellaneous	3,938	29,201	3,000
Conference Training	2,051	1,985	2,000
Intgov't professional services	-	-	-
External taxes & assessments	15,672	24,559	18,452
Interfund taxes	-	-	-
SUBTOTAL STREET MAINTENANCE	209,640	252,956	433,352
INSPECTION			
Regular salaries	17,564	18,865	16,300
Overtime	5,801	2,492	-
Personnel benefits	9,906	10,057	5,800
Professional Services	-	-	-
Prior year corrections	-	-	-
SUBTOTAL INSPECTION	33,271	31,414	22,100

Table D-2 cont'd

ADMIN - PUBLIC WORKS	2015	2016	2017 Dept Req
CUSTOMER SVC/BILLING			
Regular salaries	-	-	-
Personnel benefits	-	-	-
SUBTOTAL CUSTOMER SVC/BILLING	-	-	-
CAPITAL EXPENDITURES			
Buildings			
Machinery & equipment	42,430	15,112	167,250
SUBTOTAL CAPITAL EXPENDITURES	42,430	15,112	167,250
ROAD & STREET CONSTRUCTION			
Construction projects			
Regular salaries	45,235	51,279	16,180
Overtime		15	-
Personnel benefits	17,491	20,176	6,364
Office & operating supplies	-	-	-
SUBTOTAL ROAD & STREET CONST.	62,726	71,470	22,544
TOTAL O&M EXPENSES	718,900	767,500	1,072,600

Table D-3: Project Operating Revenue (2018-2027)

OPERATING REVENUES	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Storm - State utility taxes	18,400	19,500	20,700	21,900	22,800	23,700	24,700	25,700	26,700	27,800
Inspection fees	500	500	500	500	500	500	500	500	500	500
Storm drainage fees	986,800	1,046,900	1,110,700	1,178,300	1,225,800	1,275,200	1,326,600	1,380,100	1,435,700	1,493,600
Late penalties	500	500	500	500	500	500	500	500	500	500
TOTAL REVENUES	1,006,200	1,067,400	1,132,400	1,201,200	1,249,600	1,299,900	1,352,300	1,406,800	1,463,400	1,522,400

Table D-4: Project Operating Expenses (2018-2027)

OPERATING EXPENDITURES	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
ADMIN - PUBLIC WORKS										
Regular salaries	148,700	153,200	157,800	162,500	167,400	172,400	177,600	182,900	188,400	194,000
Overtime	3,000	3,100	3,200	3,300	3,400	3,500	3,600	3,700	3,800	3,900
Personnel benefits	76,900	79,200	81,600	84,000	86,600	89,100	91,800	94,600	97,400	100,300
New Personnel	-	-	15,900	73,800	118,200	121,700	125,400	221,400	228,000	234,900
Office & operating supplies	3,000	3,100	3,200	3,200	3,300	3,400	3,500	3,600	3,700	3,700
Small tools & minor equipment	4,000	4,100	4,200	4,300	4,400	4,500	4,600	4,800	4,900	5,000
Professional Services	56,300	57,700	59,200	60,600	62,100	63,700	65,300	66,900	68,600	70,300
Communications	1,000	1,000	1,100	1,100	1,100	1,100	1,200	1,200	1,200	1,200
Miscellaneous	1,000	1,000	1,100	1,100	1,100	1,100	1,200	1,200	1,200	1,200
SUBTOTAL ADMIN - PUBLIC WORKS	293,900	302,400	327,300	393,900	447,600	460,500	474,200	580,300	597,200	614,500
ADMIN - GENERAL										
Regular salaries	65,200	67,200	69,200	71,200	73,400	75,600	77,900	80,200	82,600	85,100
Overtime	500	500	500	500	600	600	600	600	600	700
Personnel benefits	28,000	28,800	29,700	30,600	31,500	32,500	33,400	34,400	35,500	36,500
Professional Services	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Legal fees	10,000	10,300	10,500	10,800	11,000	11,300	11,600	11,900	12,200	12,500
Insurance	17,900	18,300	18,800	19,300	19,800	20,300	20,800	21,300	21,800	22,400
SUBTOTAL ADMIN - GENERAL	122,600	126,100	129,700	133,400	137,300	141,300	145,300	149,400	153,700	158,200
CUST SERVICE BILLING										
Salaries	11,200	11,500	11,900	12,200	12,600	13,000	13,400	13,800	14,200	14,600
Overtime	-	-	-	-	-	-	-	-	-	-
Personnel Benefits	4,400	4,500	4,700	4,800	5,000	5,100	5,300	5,400	5,600	5,700
SUBTOTAL CUST SERVICE BILLING	15,600	16,000	16,600	17,000	17,600	18,100	18,700	19,200	19,800	20,300

Table D-4 cont'd

OPERATING EXPENDITURES	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
STREET MAINTENANCE										
Regular salaries	135,300	139,400	143,500	147,800	152,300	156,800	161,600	166,400	171,400	176,500
Overtime	1,000	1,000	1,100	1,100	1,100	1,200	1,200	1,200	1,300	1,300
Personnel benefits	63,000	64,900	66,800	68,800	70,900	73,000	75,200	77,500	79,800	82,200
Uniforms	1,000	1,000	1,100	1,100	1,100	1,100	1,200	1,200	1,200	1,200
Office & operating supplies	22,000	22,600	23,100	23,700	24,300	24,900	25,500	26,200	26,800	27,500
Small tools & minor equipment	4,000	4,100	4,200	4,300	4,400	4,500	4,600	4,800	4,900	5,000
Professional services	126,000	129,200	132,400	135,700	139,100	142,600	146,100	149,800	153,500	157,400
Video inspection	-	-	-	-	-	-	-	-	-	-
Communications	16,000	16,400	16,800	17,200	17,700	18,100	18,600	19,000	19,500	20,000
Travel	500	500	500	500	600	600	600	600	600	600
Advertising	500	500	500	500	600	600	600	600	600	600
Operating rentals & leases	5,000	5,100	5,300	5,400	5,500	5,700	5,800	5,900	6,100	6,200
Street debris disposal	7,000	7,200	7,400	7,500	7,700	7,900	8,100	8,300	8,500	8,700
Repairs & maintenance	2,000	2,100	2,100	2,200	2,200	2,300	2,300	2,400	2,400	2,500
Miscellaneous	3,000	3,100	3,200	3,200	3,300	3,400	3,500	3,600	3,700	3,700
Conference Training	2,000	2,100	2,100	2,200	2,200	2,300	2,300	2,400	2,400	2,500
Intgov't professional services	-	-	-	-	-	-	-	-	-	-
External taxes & assessments	22,100	23,500	24,600	26,200	24,100	25,000	26,000	27,300	28,300	29,400
Interfund taxes	-	-	-	-	-	-	-	-	-	-
SUBTOTAL STREET MAINTENANCE	410,400	422,700	434,700	447,400	457,100	470,000	483,200	497,200	511,000	525,300
INSPECTION										
Regular salaries	16,500	17,000	17,500	18,000	18,600	19,100	19,700	20,300	20,900	21,500
Overtime	-	-	-	-	-	-	-	-	-	-
Personnel benefits	6,000	6,200	6,400	6,600	6,800	7,000	7,200	7,400	7,600	7,800
Professional Services	-	-	-	-	-	-	-	-	-	-
Prior year corrections	-	-	-	-	-	-	-	-	-	-
SUBTOTAL INSPECTION	22,500	23,200	23,900	24,600	25,400	26,100	26,900	27,700	28,500	29,300

Table D-4 cont'd

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
OPERATING EXPENDITURES										
CUSTOMER SVC/BILLING										
Regular salaries	-	-	-	-	-	-	-	-	-	-
Personnel benefits	-	-	-	-	-	-	-	-	-	-
SUBTOTAL CUSTOMER SVC/BILLING	-	-	-	-	-	-	-	-	-	-
CAPITAL EXPENDITURES										
Buildings	-	-	-	-	-	-	-	-	-	-
Machinery & equipment	-	-	-	-	-	-	-	-	-	-
SUBTOTAL CAPITAL EXPENDITURES	-	-	-	-	-	-	-	-	-	-
ROAD & STREET CONSTRUCTION										
Construction projects	-	-	-	-	-	-	-	-	-	-
Regular salaries	-	-	-	-	-	-	-	-	-	-
Overtime	-	-	-	-	-	-	-	-	-	-
Personnel benefits	-	-	-	-	-	-	-	-	-	-
Office & operating supplies	-	-	-	-	-	-	-	-	-	-
SUBTOTAL ROAD & STREET CONST.	-	-	-	-	-	-	-	-	-	-
TOTAL O&M EXPENSES	865,000	890,400	932,200	1,016,300	1,085,000	1,116,000	1,148,300	1,273,800	1,310,200	1,347,600

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APPENDIX E. 2017 STORMWATER PROGRAM REPORTING



Water Quality Program

Permit Submittal Electronic Certification

Permittee: GIG HARBOR CITY

Permit Number: WAR045009

Site Address: 3510 GRANDVIEW ST
Gig Harbor, WA 98335

Submittal Name: MS4 Annual Report Phase II Western

Version: 1

Due Date: 3/31/2017

Questionnaire

Number	Permit Section	Question	Answer
1	S5.A.2	Attach updated annual Stormwater Management Program Plan (SWMP Plan). (S5.A.2)	Gig Harbor - 2017 SWMP_1_03312017014029
2	S9.D.5	Attach a copy of any annexations, incorporations or boundary changes resulting in an increase or decrease in the Permittee's geographic area of permit coverage during the reporting period per S9.D.5.	Ordinance No. 1346_2_03272017020415
3	S5.A.3	Implemented an ongoing program to gather, track, and maintain information per S5.A.3, including costs or estimated costs of implementing the SWMP.	Yes
4	S5.A.5.b	Coordinated among departments within the jurisdiction to eliminate barriers to permit compliance. (S5.A.5.b)	Yes
5	S5.C.1.a.i and ii	Attach description of public education and outreach efforts conducted per S5.C.1.a.i and ii.	Education and Outreach_5_03282017050033
6	S5.C.1.b	Created stewardship opportunities (or partnered with others) to encourage resident participation in activities such as those described in S5.C.1.b.	Yes
7	S5.C.1.b	Used results of measuring the understanding and adoption of targeted behaviors among at least one audience in at least one subject area to direct education and outreach resources and evaluate changes in adoption of targeted behaviors. (Required no later than February 2, 2016, S5.C.1.b)	Yes
7b	S5.C.1.b	Attach description of how this requirement was met.	Mutt Mitt Survey Summary final_7b_03282017050033
8	S5.C.2.a	Describe the opportunities created for the public to participate in the decision making processes involving the development, implementation and updates of the Permittee's SWMP. (S5.C.2.a)	The public may participate in public meetings, input comments on City website, City Council meetings and at Operations and Public Public Project Committee meetings.

9	S5.C.2.b	Posted the updated SWMP Plan and latest annual report on your website no later than May 31. (S5.C.2.b)	Yes
9b	S5.C.2.b	List the website address.	www.cityofgigharbor.net
10	S5.C.3.a.i - vi	Maintained a map of the MS4 including the requirements listed in S5.C.3.a.i.-vi.	Yes
11	S5.C.3.b.v	Implemented a compliance strategy, including informal compliance actions as well as enforcement provisions of the regulatory mechanism described in S5.C.3.b. (S5.C.3.b.v)	Yes
12	S5.C.3.b.vi	Updated, if necessary, the regulatory mechanism to effectively prohibit illicit discharges into the MS4 per S5.C.3.b.vi. (Required no later than February 2, 2018)	Not Applicable
12b		Cite the Prohibited Discharges code reference	
13	S5.C.3.c.i	Implemented procedures for conducting illicit discharge investigations in accordance with S5.C.3.c.i.	Yes
13b	S5.C.3.c.i	Cite methodology	Track pollution source upstream in MS4 to source. Reference storm maps, plans and the Illicit Discharge Detection and Elimination Guidance Manual, Oct. 2004.
14	S5.C.3.c.i	Percentage of MS4 coverage area screened in reporting year per S5.C.3.c.i. (Required to screen 40% of MS4 no later than December 31, 2017 (except no later than June 30, 2018 for the City of Aberdeen) and 12% on average each year thereafter. (S5.C.3)	0
15	S5.C.3.c.ii	List the hotline telephone number for public reporting of spills and other illicit discharges. (S5.C.3.c.ii)	(253) 851-6170
15b	S5.C.3.c.ii	Number of hotline calls received.	3
16	S5.C.3.c.iii	Implemented an ongoing illicit discharge training program for all municipal field staff per S5.C.3.c.iii.	Yes
17	S5.C.3.c.iv	Informed public employees, businesses, and the general public of hazards associated with illicit discharges and improper disposal of waste. (S5.C.3.c.iv)	Yes

17b	S5.C.3.c.iv	Describe the information sharing actions. (S5.C.3.c.iv)	Information on City website, provided two video trainings on IDDE to Public Works Operations Staff, education and outreach at public events, Rain Barrel Workshop, Natural Yard Care Workshops, Storming the Sound with Salmon, "Spills Happen" at city buliton boards, information on Drain markers and at Pet Waste Stations.
18	S5.C.3.d	Implemented an ongoing program to characterize, trace, and eliminate illicit discharges into the MS4 per S5.C.3.d.	Yes
19	S5.C.3.d.iv	Number of illicit discharges, including illicit connections, eliminated during the reporting year. (S5.C.3.d.iv)	9
20	S5.C.3.d.iv	Attach a summary of actions taken to characterize, trace and eliminate each illicit discharge found by or reported to the permittee. For each illicit discharge, include a description of actions according to required timeline per S5.C.3.d.iv	IDDE Actions_20_032920170 81425
21	S5.C.3.e	Municipal illicit discharge detection staff are trained to conduct illicit discharge detection and elimination activities as described in S5.C.3.e.	Yes
22	S5.C.4.a	Implemented an ordinance or other enforceable mechanism to address runoff from new development, redevelopment and construction sites per the requirements of S5.C.4.a.	Yes
23	S5.C.4.a.i-iii	Revised ordinance or other enforceable mechanism to effectively address runoff from new development, redevelopment and construction sites per the requirements of S5.C.4.a.i-iii. (Required no later than December 31, 2016, except no later than June 30, 2017 for Permittees in Lewis and Cowlitz counties, and no later than June 30, 2018 for the City of Aberdeen)	Yes
23b	S5.C.4.a.i-iii	Cite code reference for revised ordinance or other enforceable mechanism to address runoff from new development, redevelopment and construction sites.	Ordinance No. 1347 and GHMC 14.20.040
24	S5.C.4.a.i	Number of exceptions granted to the minimum requirements in Appendix 1. (S5.C.4.a.i., and Section 6 of Appendix 1)	0
25	S5.C.4.a.i	Number of variances granted to the minimum requirements in Appendix 1. (S5.C.4.a.i., and Section 6 of Appendix 1)	0
26	S5.C.4.b.i	Reviewed Stormwater Site Plans for all proposed development activities that meet the thresholds adopted pursuant to S5.C.4.a.i. (S5.C.4.b.i)	Yes

26b	S5.C.4.b.i	Number of site plans reviewed during the reporting period.	145
27	S5.C.4.b.ii	Inspected, prior to clearing and construction, permitted development sites that have a high potential for sediment transport as determined through plan review based on definitions and requirements in Appendix 7 Determining Construction Site Sediment Damage Potential, or alternatively, inspected all construction sites meeting the minimum thresholds adopted pursuant to S5.C.4.a.i. (S5.C.4.b.ii)	Yes
27b	S5.C.4.b.ii	Number of construction sites inspected per S5.C.4.b.ii.	0
28	S5.C.4.b.iii	Inspected permitted development sites during construction to verify proper installation and maintenance of required erosion and sediment controls. (S5.C.4.b.iii)	Yes
28b	S5.C.4.b.iii	Number of construction sites inspected per S5.C.4.b.iii.	141
29	S5.C.4.b.ii, iii and	Number of enforcement actions taken during the reporting period (based on construction phase inspections at new development and redevelopment projects). (S5.C.4.b.ii, iii and v)	5
30	S5.C.4.b.iv	Inspected all permitted development sites that meet the thresholds in S5.C.4.a.i upon completion of construction and prior to final approval or occupancy to ensure proper installation of permanent stormwater facilities. (S5.C.4.b.iv)	Yes
31	S5.C.4.b.ii-iv	Achieved at least 80% of scheduled construction-related inspections. (S5.C.4.b.ii-iv)	Yes
32	S5.C.4.b.iv	Verified a maintenance plan is completed and responsibility for maintenance is assigned for projects. (S5.C.4.b.iv)	Yes
33	S5.C.4.c	Implemented provisions to verify adequate long-term operation and maintenance (O&M) of stormwater treatment and flow control BMPs/facilities that are permitted and constructed pursuant to S5.C.4. a and b. (S5.C.4.c)	Yes
34	S5.C.4.c.i and ii	Updated provisions to verify long-term operation and maintenance of stormwater treatment and flow control BMPs/facilities that are permitted pursuant to S5.C.4.a and b. (Required no later than December 31, 2016, except no later than June 30, 2017 for Permittees in Lewis and Cowlitz counties, and no later than June 30 2018 for the City of Aberdeen, S5.C.4.c.i and ii	Yes
35	S5.C.4.c.iii	Annually inspected stormwater treatment and flow control BMPs/facilities per S5.C.4.c.iii.	Yes
35b	S5.C.4.c.iii	If using reduced inspection frequency for the first time during this permit cycle, attach documentation per S5.C.4.c.iii	Not Applicable
36	S5.C.4.c.iv	Inspected new residential stormwater treatment and flow control BMPs/facilities and catch basins every 6 months per S5.C.4.c.iv to identify maintenance needs and enforce compliance with maintenance standards.	Yes

37	S5.C.4.c.v	Achieved at least 80% of scheduled inspections to verify adequate long-term O&M. (S5.C.4.c.v)	Not Applicable
38	S4.C.4.c.vi	Verified that maintenance was performed per the schedule in S5.C.4.c.vi when an inspection identified an exceedance of the maintenance standard.	Not Applicable
38b	S5.C.4.c.vi	Attach documentation of any maintenance delays. (S5.C.4.c.vi)	Not Applicable
39	S5.C.4.d	Provided copies of the Notice of Intent for Construction Activity and Notice of Intent for Industrial Activity to representatives of proposed new development and redevelopment. (S5.C.4.d)	Yes
40	S5.C.4.e	All staff responsible for implementing the program to control stormwater runoff from new development, redevelopment, and construction sites, including permitting, plan review, construction site inspections, and enforcement are trained to conduct these activities. (S5.C.4.e)	Yes
41	S5.C.4.f.i	Reviewed, revised and made effective the low impact development-related enforceable documents per S5.C.4.f.i. (Required by December 31, 2016, except by June 30, 2017 for Permittees in Lewis and Cowlitz counties, and by June 30, 2018 for the City of Aberdeen)	Yes
41b	S5.C.4.f.ii	Attach a summary of the LID review and revision process that includes the requirements listed in S5.C.4.f.ii. (Required with annual report due no later than March 31, 2017, except no later than March 31, 2018 for Permittees in Lewis and Cowlitz counties, and with the Fifth Year annual report for the City of Aberdeen)	20170330_Gig_Harbor_NPDES_LID_41b_033 12017015155
42	S5.C.4.g	Participated and cooperated with the watershed-scale stormwater planning process led by a Phase I county. (S5.C.4.g)	Not Applicable
43	S5.C.5.a	Updated and implemented maintenance standards as protective, or more protective, of facility function as those specified in Chapter 4 of Volume V of the Stormwater Management Manual for Western Washington (as amended 2014). (Required no later than December 31, 2016, except no later than June 30, 2017 for Permittees in Lewis and Cowlitz counties, and no later than June 30, 2018 for the City of Aberdeen, S5.C.5.a).	Yes
44	S5.C.5.a	Applied a maintenance standard that is not specified in the Stormwater Management Manual for Western Washington.	No
44b	S5.C.5.a	Please note what kinds of facilities are covered by this alternative maintenance standard. (S5.C.5.a)	
45	S5.C.5.a.ii	Performed timely maintenance per S5.C.5.a.ii.	Yes
46	S5.C.5.b	Annually inspected all municipally owned or operated permanent stormwater treatment and flow control BMPs/facilities. (S5.C.5.b)	Yes

46b	S5.C.5.b	Number of known municipally owned or operated stormwater treatment and flow control BMPs/facilities. (S5.C.5.b)	44
46c	S5.C.5.b	Number of facilities inspected during the reporting period. (S5.C.5.b)	44
46d	S5.C.5.b	Number of facilities for which maintenance was performed during the reporting period. (S5.C.5.b)	20
47	S5.C.5.b	If using reduced inspection frequency for the first time during this permit cycle, attach documentation per S5.C.5.b.	Not Applicable
48	S5.C.5.c	Conducted spot checks and inspections (if necessary) of potentially damaged stormwater facilities after major storms as per S5.C.5.c.	Yes
49	S5.C.5.d	Inspected all municipally owned or operated catch basins and inlets as per S5.C.5.d, or used an alternative approach. (Required once no later than August 1, 2017 and every two years thereafter, except once no later than June 30, 2018 and every two years thereafter for the City of Aberdeen)	Yes
49b	S5.C.5.d	Number of known catch basins.	1650
49c	S5.C.5.d	Number of catch basins inspected during the reporting period.	250
49d	S5.C.5.d	Number of catch basins cleaned during the reporting period.	95
50	S5.C.5.d.i-ii	Attach documentation of alternative catch basin cleaning approach, if used. (S5.C.5.d.i or ii)	Not Applicable
51	S5.C.5.f	Implemented practices, policies and procedures to reduce stormwater impacts associated with runoff from all lands owned or maintained by the Permittee, and road maintenance activities under the functional control of the Permittee. (S5.C.5.f)	Yes
52	S5.C.5.g	Implemented an ongoing training program for Permittee employees whose primary construction, operations or maintenance job functions may impact stormwater quality. (S5.C.5.g.)	Yes
53	S5.C.5.h	Implemented a Stormwater Pollution Prevention Plan for all heavy equipment maintenance or storage yards, and material storage facilities owned or operated by the Permittee in areas subject to this Permit that are not required to have coverage under an NPDES permit that covers stormwater discharges associated with the activity. (S5.C.5.h)	Yes
54	S7.A	Complied with the Total Maximum Daily Load (TMDL)-specific requirements identified in Appendix 2. (S7.A)	Not Applicable
55	S7.A	For TMDLs listed in Appendix 2: Attach a summary of relevant SWMP and Appendix 2 activities to address the applicable TMDL parameter(s). (S7.A)	Not Applicable
56	S8.A	Attach a description of any stormwater monitoring or stormwater-related studies as described in S8.A.	Not Applicable

57	S8.B.1	Participated in cost-sharing for the regional stormwater monitoring program (RSMP) for status and trends monitoring. (S8.B.1)	Yes
57B	S8.B.2	If choosing to conduct individual status and trends monitoring, attach an annual stormwater monitoring report in accordance with S8.B.2. (Required to submit reports beginning March 31, 2016)	
58	S8.C.1	Participated in cost-sharing for the regional stormwater monitoring program (RSMP) for effectiveness studies. (S8.C.1) (Required to begin no later than August 15, 2014)	Yes
58b	S8.C.2	If choosing to conduct discharge monitoring, attach an annual stormwater monitoring report in accordance with S8.C.2 and Appendix 9. (Required to submit reports beginning March 31, 2016)	
59	S8.D.1	Contributed to the RSMP for source identification and diagnostic monitoring information repository in accordance with S8.D.1. (Required to begin no later than August 15, 2014)	Yes
60	G3	Notified Ecology in accordance with G3 of any discharge into or from the Permittees MS4 which could constitute a threat to human health, welfare or the environment. (G3)	Yes
61	G3	Number of G3 notifications provided to Ecology.	3
62	G3.A	Took appropriate action to correct or minimize the threat to human health, welfare, and/or the environment per G3.A.	Yes
63	S4.F.1	Notified Ecology within 30 days of becoming aware that a discharge from the Permittee's MS4 caused or contributed to a known or likely violation of water quality standards in the receiving water. (S4.F.1)	Yes
64	S4.F.3.a	If requested, submitted an Adaptive Management Response report in accordance with S4.F.3.a.	Not Applicable
65	S4.F.3.d	Attach a summary of the status of implementation of any actions taken pursuant to S4.F.3 and the status of any monitoring, assessment, or evaluation efforts conducted during the reporting period. (S4.F.3.d)	Not Applicable
66	G20	Notified Ecology of the failure to comply with the permit terms and conditions within 30 days of becoming aware of the non-compliance. (G20)	Not Applicable
67	G20	Number of non-compliance notifications (G20) provided in reporting year.	0
67b	G20	List the permit conditions described in non-compliance notification(s).	Not Applicable

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Wayne Matthews

3/31/2017 2:15:23 PM

Signature

Date



CITY OF GIG HARBOR

2017 STORMWATER MANAGEMENT PROGRAM (SWMP)

City of Gig Harbor, WA
March, 2017

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CITY OF GIG HARBOR 2017 STORMWATER MANAGEMENT PROGRAM

1. INTRODUCTION

1.1 Overview and Background

The National Pollutant Discharge Elimination System (NPDES) permit program is a requirement of the federal Clean Water Act, which is intended to protect and restore waters for “fishable, swimmable” uses. The federal Environmental Protection Agency (EPA) has delegated permit authority to state environmental agencies. In Washington, the NPDES-delegated permit authority is the Washington State Department of Ecology (Ecology).

Municipalities with a population of over 100,000 (as of the 1990 census) have been designated as Phase I communities and must comply with Ecology’s Phase I NPDES Municipal Stormwater Permit. With Gig Harbor’s 1990 census falling below the 100,000 threshold, the City must comply with the Phase II Municipal Stormwater Permit. About 100 other municipalities in Washington must now comply with the Phase II Permit, along with Gig Harbor, as operators of small municipal separate storm sewer systems (MS4s).

The Permit allows municipalities to discharge stormwater runoff from municipal drainage systems into the State’s waterbodies (i.e., streams, rivers, lakes, wetlands) as long as municipalities implement programs to protect water quality by reducing the discharge of “non-point source” pollutants to the “maximum extent practicable” (MEP) through application of Permit-specified “best management practices” (BMPs). The practices specified in the Permit are collectively referred to as the Stormwater Management Program (SWMP) and grouped under the following components:

- Public Education and Outreach
- Public Involvement
- Illicit Discharge Detection and Elimination
- Controlling Runoff from Development, Redevelopment, and Construction Sites
- Pollution Prevention and Municipal Operation and Maintenance
- Monitoring

The Permit requires the City to report annually (March 31st of each year) on progress in SWMP Program implementation for the prior year. The Permit also requires submittal of documentation that describes proposed SWMP Program activities for the coming year. Implementation of various Permit conditions is phased throughout the five-year Permit term from February 16, 2007 through February 15, 2012. The current Permit became effective September 1, 2012 and will expire July 31, 2013. The Department of Ecology issued the current revised Permit that became effective August 1, 2013.

This report is the City’s Stormwater Management Program (SWMP) document. The remainder of this 2017 SWMP document describes actions Gig Harbor will take to maintain compliance from February 16, 2017 through February 15, 2018.

1.2 Phased Permit Requirements

Ecology began work on the Phase II Municipal Stormwater Permit for Western Washington in the fall of 2004 and posted a preliminary draft for public comment on May 16, 2005. Ecology released a formal draft of the Permit in February 2006 and issued the final Permit on January 17, 2007. The Permit issued by Ecology became effective on February 16, 2007 and expired on February 15, 2012. The City has completed and sent to Ecology the Duty to Reapply NOI application. Ecology reissued the National Pollutant Discharge Elimination System (NPDES) municipal stormwater permits in August 2012, they will be in effect from September 2012 to July 2013. Ecology will issued a revised permit that became effective in August 2013.

Ecology is phasing in many of the Permit requirements over the Permit term. On March 31 of each year, beginning in 2008, the City must:

1. Submit its SWMP document to Ecology describing compliance activities planned for the coming year.
2. Submit an annual report documenting Permit compliance activities for the previous calendar year.
3. Post the SWMP document and annual report on the web.

This SWMP document includes the following attachments:

- Appendix A - Acronyms and Definitions from the Permit.

The Western Washington Phase II Municipal Stormwater Permit and additional information can be found on Ecology's website: http://www.ecy.wa.gov/programs/wq/stormwater/municipal/phase_II_wv/wv_ph_ii-permit.html.

1.3 Department Responsibilities

The Permit requirements affect departments across the City organization. The Engineering Division of the Public Works Department is the lead and coordinates tasks that may require some collaboration with the other departments and divisions. The other departments are Administration and Development Services. Important collaboration of the Public Works Divisions of Operations, Parks and Waste Water Management is also vital. While each task may be cross-departmental, the lead department has been identified in the task tables for each Permit component in the following sections.

1.4 Total Maximum Daily Load (TMDL) Compliance Issues

Stormwater discharges covered under the Permit are required to implement actions necessary to achieve the pollutant reductions called for in applicable TMDLs. Applicable TMDLs are TMDLs which have been approved by the EPA before the issuance date of the permit or which have been approved by the EPA prior to the date the permittee's application is received by Ecology. Information on Ecology's TMDL program is available on Ecology's website at www.ecy.wa.gov/programs/wq/tmdl.

All TMDLs approved by EPA before February 15, 2006, were reviewed by Ecology to determine whether stormwater including municipal stormwater sources were identified in the TMDL. When most of these TMDLs were developed, municipal stormwater was considered a subset of non-point discharges, rather than a permitted discharge. As a result, very few TMDLs statewide contain requirements for municipal stormwater sources. Few TMDLs completed to date have established load allocations or waste load allocations for municipal stormwater discharges covered under the Permit. Ecology is interpreting TMDL requirements as follows:

- For TMDLs where stormwater was not identified as a source of the pollutants of concern, or if all of the sources were defined in the TMDL, Ecology considers the MS4 not to be a significant contributor of pollutants.
- Where stormwater was identified as a source of pollutants and the TMDL or implementation plans developed to support the TMDL identified control measures were less than or equivalent to the requirements of this permit, Ecology sets a narrative effluent limit: “compliance with the permit compliance constitutes compliance with the TMDL.”
- If stormwater was identified as a source of pollutants and specific WLAs, LAs or control measures were established, Ecology must develop effluent limits in addition to the other requirements of the permit. These effluent limits may be narrative or numeric depending on the control measures set by the TMDL or implementation plans.

Where a TMDL or the detailed implementation plan developed for the TMDL identifies actions or activities beyond what is required by this permit, Ecology has identified the additional requirements in Appendix 2 of the permit for all TMDLs approved by EPA prior to February 15, 2006. Appendix 2 of the permit lists the cities and counties affected by the TMDL.

The City of Gig Harbor has not been listed in Appendix 2.

1.5 Document Organization

The content in this document is based upon Permit requirements and Ecology’s Draft Guidance for City and County Annual Reports for Western Washington Phase II Municipal Stormwater Permits. The remainder of the Stormwater Management Program document is organized similarly to the Permit:

- **Section 2.0** addresses Permit requirements for administration of the City’s Stormwater Management Program for 2016.
- **Section 3.0** addresses Permit requirements for Public Education and Outreach for 2017.
- **Section 4.0** addresses Permit requirements for Public Involvement and Participation for 2017.
- **Section 5.0** addresses Permit requirements for Illicit Discharge Detection and Elimination for 2017.
- **Section 6.0** addresses Permit requirements for Controlling Runoff from New Development, Redevelopment and Construction Sites for 2017.
- **Section 7.0** addresses Permit requirements for Pollution Prevention and Operation and Maintenance for Municipal Operations for 2017.
- **Section 8.0** addresses Permit requirements for the Water Quality Monitoring section of the Permit for 2017.

Each section includes a summary of the relevant Permit requirements and a description of current and planned compliance activities.

CITY OF GIG HARBOR 2017 STORMWATER MANAGEMENT PROGRAM

2. STORMWATER MANAGEMENT PROGRAM ADMINISTRATION

This Section describes Permit requirements related to overall Stormwater Management Program administration, including current and planned compliance activities.

2.1 Permit Requirements

The Permit (Section S5.A) requires the City to:

- Develop and implement a Stormwater Management Program and prepare written documentation (SWMP document) for submittal to Ecology on March 31, 2008; and update the SWMP annually thereafter. The purpose of the Stormwater Management Program is to reduce the discharge of pollutants from the municipal stormwater system to the maximum extent practicable (MEP) thereby protecting water quality. The Stormwater Management Program is to include the actions and activities described in Sections 3 through 8 of this SWMP document.
- Submit annual reports beginning in 2008 to Ecology by March 31st (for the previous calendar year). These reports are to summarize SWMP implementation status and present information from assessment and evaluation activities conducted during the reporting period.

2.2 Current Activities

The City currently has in place activities and programs that meet the Permit requirements. Current activities associated with the above Permit requirements include:

- The City is on track to comply with Ecology's requirements for submittal of the SWMP documentation by March 31, 2017. The Public Works Department, is currently leading City development of the future planned activities.
- The City has set up the systems for tracking training.
- The City has defined its strategy for cost tracking.
- The City is on track to comply with Ecology's requirements for submittal of the Annual Report by March 31, 2017.

2.3 Planned Activities

Gig Harbor has positioned itself well to maintain compliance as Ecology phases in the future Permit deadlines. Table 2-1 presents the proposed work plan for the 2016 SWMP administration activities. These tasks were developed through an iterative process of interviews and meetings with staff from affected City departments.

Table 2-1. 2017 Stormwater Management Administration Program Work Plan			
Task ID	Task Description	Lead	Schedule Notes
SWMP-1	Refine the implemented NPDES cost accounting strategy for time spent on each component of Permit.	Engineering/Finance	Refine cost tracking procedures, throughout 2017.
SWMP-2	Continue to refine and implement training and activity tracking procedures and systems.	Engineering/Operations	Add additional refinements to tracking procedures and systems, throughout 2016.
SWMP-3	The City to adopt and make effective code revisions and a new Stormwater Management and Site Development Manual; revised so that LID is the preferred and commonly-used approach for site development.	Engineering	Adopted the 2016 Stormwater Management and Site Development Manual, effective date December 31, 2016.
SWMP-4	City code authorizes access and enforcement to verify adequate long-term operation and maintenance of permitted stormwater treatment and flow control facilities	Engineering	Required by December 31, 2016.
SWMP-4	Summarize annual activities for "Stormwater Management Program" component of Annual Report; identify any updates to SWMP document.	Engineering	The SWMP and Annual Compliance Report are due on or before March 31st of each year.

CITY OF GIG HARBOR 2017 STORMWATER MANAGEMENT PROGRAM

3. PUBLIC EDUCATION AND OUTREACH

This Section describes the Permit requirements related to Public Education and Outreach, including current and planned compliance activities.

3.1 Permit Requirements

The Permit (Section S5.C.1) requires the City to:

- Prioritize and target education and outreach activities to specified audiences, including general public, businesses, residents/homeowners, landscapers, property managers, engineers, contractors, developers, review staff and land use planners and other City employees to reduce or eliminate behaviors and practices that cause or contribute to adverse stormwater impacts.
- Have an outreach program that is designed to achieve measurable improvements in the target audience's understanding of the problem and what they can do to solve it.
- Track and maintain records of public education and outreach activities.

3.2 Current Activities

The City currently has an Interlocal Agreement with Kitsap County to form the West Sound Stormwater Outreach Group (WSSOG) to work on Education and Outreach campaigns. Efforts to include a follow up survey that is used to evaluate the different outreach and education campaigns. The City website provides phone numbers to call for spills or dumping pollution into the MS4. We also continue the Pet Waste campaign that promotes provides 30 mutt-mitt stations with instructions for use in the City. The refill bags are provided by the City on a continuous basis. The City will also participated in a outreach and education campaign regarding Puget Sound Starts Here stormwater educational cup holder and coasters giveaway.

The City is in Partnership with the Pierce Conservation District/Stream Team. We plan to offer a Rain Barrel Workshop in May that will be open to the public, to provide education on rain water harvesting, reducing the runoff to storm systems. The partnership assures that their expertise will be available in organizing volunteer environmental enhancement events, providing additional public education and outreach and rendering technical assistance to the public. The City will continue to provide public education and outreach regarding water quality problems and will track activities as they are implemented throughout 2017.

The City will provide a Natural Yard Care Workshop series in April-May, in collaboration with Tacoma/Pierce County Health Department. The three workshops will be free to the public, and will be held at the Gig Harbor Civic Center. Each workshop will promote environmental stewardship and sustainable maintenance practices for yards and landscapes resulting in minimizing potential impacts upon surface water resources.

3.3 Planned Activities

The City continues to providing and building its Education and Outreach program in 2017. Gig Harbor will continue to take advantage of regional efforts intended to meet NPDES permit requirements. Continue working with the groups Stormwater Outreach for Regional Municipalities (STORM), Pierce Conservation District/Stream Team, South Sound Phase II Coordinator's Group, Tacoma-Pierce County Health Dept. and Public Works Key Peninsula-Gig Harbor-Islands Watershed Council (KGI) and West Sound Stormwater Outreach Group (WSSOG), thereby gain more unified messages, cost saving due to scale and reducing City efforts and overall costs.

Table 3-1 is the work plan for 2017 SWMP public education and outreach activities. These tasks were developed through a process of interviews and meetings with staff from affected City departments.

Table 3-1. 2017 Public Education and Outreach Work Plan			
Task ID	Task Description	Lead	Schedule Notes
EDUC-1	Continue to implement and promote our education and outreach plan. Implement appropriate activities and education outreach available to the public. Advertise stormwater pollution hotline, practical stormwater information and BMPs on the City website.	Engineering	Continue implementing education and outreach programs and events throughout the year.
EDUC-2	Continue to implement the pet waste campaign, the spill hotline, and the STORM Puget Sound Starts Here coaster and cup holder outreach program. Provide stormwater message videos to public at the Galaxy Theater. Develop a Natural Yard Care brochure	Engineering / West Sound Stormwater Outreach Group	
EDUC-3	Provide Natural Yard Care Workshops to the public this spring.	Engineering/Tacoma-Pierce County Health Dept.	
EDUC-4	Discuss and pool ideas with other jurisdictions regarding outreach and education programs and materials, PSSH program and Natural Yard Care educational program.	WSSOG, KGI Watershed Council, South Sound Phase II Coordinator's Group	
EDUC-5	School students to participate in a Storm Drain Marker installation project	Engineering/Pierce Conservation District	
EDUC-6	City will have a staff member at the Tacoma-Pierce County Children's Water Festival in March that will work with the 5 th graders.	Engineering/Pierce Conservation District/Stream Team	
EDUC-7	Implement our education and outreach at projects that include Donkey Creek Chum Salmon Festival, Puyallup Fair Stormwater booth, Rain Barrel Workshop, creek macro-invertebrates monitoring at Donkey Creek.	Engineering/Pierce Conservation District/Stream Team	
EDUC-8	Continue to provide educational "Storming the Sound with Salmon" program and equipment to raise salmon and release them to Donkey Creek. Due to a virus, the salmon eggs are not available for this year.	Harbor Wild Watch/Peninsula School District	Program underway at Goodman Middle School and a tank at Skansie Brothers Park that is open to public.
EDUC-9	Support a salmon counting station for the public to participate in, to be located at Donkey Creek Park.	Engineering/Harbor WildWatch	To be in place during salmon run.

EDUC-10	Summarize annual activities for "Public Education and Outreach" component of Annual Report; identify any updates to SWMP document.	Engineering	The SWMP and Annual Report submittal is due on or before March 31st of each year.
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CITY OF GIG HARBOR 2017 STORMWATER MANAGEMENT PROGRAM

4. PUBLIC INVOLVEMENT

This Section describes the Permit requirements related to Public Involvement, including current and planned compliance activities.

4.1 Permit Requirements

The Permit (Section S5.C.2) requires the City to:

- Provide ongoing opportunities for public involvement through advisory boards, council meetings, watershed committees, public participation, stewardship programs, environmental activities or other similar activities. The public must be able to participate in the decision-making processes involving the development, implementation and update of the Stormwater Management Program.
- The SWMP document and Annual Report are available to the public, they are posted on posting on the City's website. Make other documents required to be submitted to Ecology in response to Permit conditions available to the public.

4.2 Current Activities

The current compliance activities associated with the above Permit requirements include:

- The City implemented a series of public involvement activities intended to meet the Permit requirements for public involvement in development of its current SWMP. This process involved presentations to the City Manager and City Council at sessions open to the public.
- The City regularly attends Key Peninsula-Gig Harbor-Islands Watershed Council (KGI) to discuss projects and to share information on preserving, improving and the current health of the watershed. This meeting is open to and attended by the public and their ideas and comments are welcomed.
- The City also has on the City website the 2009 Stormwater Comprehensive Plan, 2016 Stormwater Management and Site Development Manual, Ordinance 1168 Illicit Discharge Detection and Elimination (IDDE), and Ordinance 1169 Code Revisions to Stormwater, Grading and Civil Permits, all of which the public may offer comments on to City staff, at City Council Meetings and to the mayor.
- The City posted the current SWMP document and Annual Report to the Department of Ecology on the City website.

4.3 Planned Activities

Gig Harbor will offer the public opportunities to be involved in the decision making process on stormwater issues. Actions recommended for continued compliance include:

- Make most current SWMP document and Annual Report available to public by posting on the City website.
- The City summarizes associated activities in its Annual Report by March 31st of each year

Table 4-1 is the work plan for 2017 SWMP public involvement activities. These tasks were developed through a process of interviews and meetings with staff from affected City departments.

Table 4-1. 2017 Public Involvement Work Plan			
Task ID	Task Description	Lead	Schedule Notes
PI-1	Provide public involvement opportunities for annual SWMP update.	City Management, Engineering	Public involvement opportunities will be available before 3/31/2017 submittal.
PI-2	Continue to be an active member of the KGI Watershed Council and encourage public involvement in watershed planning and improvements.	Engineering/KGI Watershed Council	
PI-3	Make SWMP document and Annual Report available to public by posting on the City website.	Engineering	
PI-4	Summarize annual activities for "Public Involvement and Participation" component of Annual Report; identify any updates to SWMP document.	Engineering	The SWMP and Annual Report submittal is due on or before March 31st of each year.

CITY OF GIG HARBOR 2017 STORMWATER MANAGEMENT PROGRAM

5. ILLICIT DISCHARGE DETECTION AND ELIMINATION

This Section describes the Permit requirements related to Illicit Discharge Detection and Elimination (IDDE), including current and planned compliance activities.

5.1 Permit Requirements

The Permit (Section S5.C.3) requires the City to:

- Implement an ongoing program to detect and remove illicit discharges, connections and improper disposal, including any spills into the municipal separate storm sewers owned or operated by the City. An illicit discharge means “any discharge to a municipal storm system that is not composed entirely of stormwater...” and illicit connection means “any man-made conveyance that is connected to a municipal storm system without a permit (excluding roof drains and other similar type connections) such as sanitary sewer connections, floor drains, etc.”
- Develop a storm sewer system map, have ordinances that prohibit illicit discharges, and create a program to detect and address illicit discharges.
- Publicly list and publicize a hotline or other local telephone number for public reporting of spills and other illicit discharges. Track illicit discharge reports and actions taken in response through close-out, including enforcement actions.
- Train staff on proper IDDE response procedures and processes and to recognize and report illicit discharges.
- Summarize all illicit discharges and connections reported to the City and response actions taken, including enforcement actions, in the Annual Report; including updates to the SWMP document.

5.2 Current Activities

The City currently implements activities and programs that meet many of the Permit requirements. The current compliance activities associated with the above Permit requirements include:

- The City currently enforces the adopted Ordinance 1168 Illicit Discharge Detection and Elimination (IDDE).
- The City has agreed to a letter of understanding with Pierce County that clarifies roles of each jurisdiction the event of a transfer of pollutants from one jurisdiction’s storm sewer to the other’s storm sewer.
- The City has an emergency phone numbers posted on the City’s website that allows citizens to report pollution spills, illicit discharges or illicit dumping. The City responds to the calls received, clean up actions are taken as needed and tracks each incident.
- The City is currently a subscriber to Pierce County’s geographic information system (GIS). The City currently has a GIS map of the City’s storm sewer system and it is available at the Civic Center. The City is also planning to place it on the City’s website. Development record drawings and GPS survey data are used to keep the map up to date.
- City codes and standards have sections that address illicit discharges and civil infractions.

- The City summarizes associated activities in its Annual Report by March 31st of each year.

5.3 Planned Activities

Gig Harbor conducts some illicit discharge detection and elimination activities but will expand current efforts in order to maintain compliance as Ecology phases in Permit requirements. Table 5-1 is the work plan for 2017 SWMP illicit discharge detection and elimination activities. These tasks were developed through an iterative process of interviews and workshops with staff from affected City departments.

Table 5-1. 2017 Illicit Discharge Detection and Elimination Work Plan			
Task ID	Task Description	Lead	Schedule Notes
IDDE-1	Continue to implement City-wide IDDE Program and develop any necessary supplemental IDDE activities.	Engineering	Ongoing program that was developed in 2011.
IDDE-2	Use the City GIS Storm drainage Inventory map to investigate, track and record spills. Observe watersheds that are affected and any hot spot areas.	Engineering	Continue through 2017.
IDDE-3	Adopted IDDE Ordinance that defines current IDDE response process into a standard, City-wide IDDE response and enforcement process and procedure.	Engineering/Operations/Legal	Ordinance 1168 adopted on 8/10/2009.
IDDE-4	Continue training of municipal field staff on the identification, investigation, termination, cleanup, and reporting of illicit discharges, improper disposal and illicit connections.	Engineering/Operations	Provide and tract training for municipal field staff as needed.
IDDE-5	Incorporate awareness of illicit discharges into public outreach and education program.	Engineering	Ongoing public education and outreach activities planned and scheduled.
IDDE-6	Summarize annual activities for "Illicit Discharge Detection and Elimination" component of Annual Report; identify any updates to SWMP document.	Engineering/Operations	The SWMP and Annual Report submittal is due on or before March 31st of each year.

CITY OF GIG HARBOR 2017 STORMWATER MANAGEMENT PROGRAM

6. CONTROLLING RUNOFF FROM NEW DEVELOPMENT, REDEVELOPMENT AND CONSTRUCTION SITES

This Section describes the Permit requirements related to Controlling Runoff from New Development, Redevelopment and Construction Sites, including current and planned compliance activities.

6.1 Permit Requirements

The Permit (Section S5.C.4) requires the City to:

- Develop, implement, and enforce a program to reduce pollutants in stormwater runoff (for example, sediment, construction site wastes, and illicit discharges) to the municipal separate storm sewer system from new development, redevelopment and construction site activities. The program must apply to both private and public projects, including roads, and address all construction/development-associated pollutant sources.
- Adopt regulations (codes and standards) and implement plan review, inspection, and escalating enforcement processes and procedures necessary to implement the program in accordance with Permit conditions, including the minimum technical requirements in Appendix 1 of the Permit (i.e., 2012 Ecology Stormwater Management Manual for Western Washington, equivalent Phase I Manual or one of the Manual options with a Gig Harbor-specific basin-planning overlay).
- Provide provisions and processes and procedures (plan review, inspection, and enforcement) to allow non-structural preventive actions and source reduction approaches such as Low Impact Development techniques (LID), measures to minimize the creation of impervious surfaces and measures to minimize the disturbance of native soils and vegetation.
- Adopt regulations (codes and standards) and provide provisions to verify adequate long-term operations and maintenance of new post-construction permanent stormwater facilities and best management practices (i.e., private drainage system inspections) in accordance with Permit conditions, including an annual inspection frequency and/or approved alternative inspection frequency and maintenance standards for private drainage systems as protective as those in Chapter IV of the 2012 Ecology Stormwater Management Manual for Western Washington.
- Provide training to staff on the new codes, standards, processes and procedures and create public outreach and education materials.
- Develop and define a process to record and maintain all inspections and enforcement actions by staff for inclusion in the Annual Report.
- Summarize annual activities for the “Controlling Runoff” component of the Annual Report; identify any update to SWMP document.

6.2 Current Activities

The City currently has activities and programs that meet many of the Permit requirements. Current compliance activities associated with the above Permit requirements include:

- The City has developed and implemented a program to reduce pollutants in stormwater runoff to the municipal separate storm sewer system from some development and construction site activities. The City enforces this program through the Gig Harbor Municipal Code including the Stormwater Management Chapter and the Illicit Discharge Detection and Elimination Chapter.
- The City requires submittal of Erosion and Sediment Control (ESC) plans and stormwater drainage plans (i.e., for stormwater quantity control, runoff treatment facilities, and conveyance requirements) of private development and City capital improvement projects.
- The City conducts regular construction and stormwater site inspections during the pre-construction and construction phases and documents the inspections in our Interlocking database.
- The City requires stormwater easements for the city that grants access to the private storm facilities of permitted new developments.
- The City inspects all stormwater facilities constructed per the 2010 and 2016 Gig Harbor Stormwater and Site Development Manuals annually and identifies maintenance deficiencies.
- The City provides copies of Notices of Intent (NOI) for construction and industrial activities during the permit review process with developers.
- The City summarizes associated activities in its Annual Report by March 31st of each year.

6.3 Planned Activities

Gig Harbor has a program to help reduce stormwater runoff from new development and construction sites but updates will be necessary to maintain compliance as Ecology phases in Permit requirements. Table 6-1 is the work plan for 2017 SWMP activities related to control of runoff from new development, redevelopment and construction sites. These tasks were developed through an iterative process of interviews and workshops with staff from affected City departments.

Table 6-1. 2017 Controlling Runoff from Development, Redevelopment, and Construction Sites Work Plan			
Task ID	Task Description	Lead	Schedule Notes
CTRL-1	Continue implementation of the 2016 Gig Harbor Stormwater Management and Site Development Manual requirements, standards and BMPs for development projects.	Engineering, Planning & Legal	Manual became effective 12/31/2016.
CTRL-2	Implement revised the City Municipal Code, that makes LID techniques the preferred and common development method.	Engineering, Planning, Building/ & Legal	Became effective no later than 12/31/2016.
CTRL-3	Adopt codes and standards to establish an program that will verify adequate long-term operations and maintenance of new post-construction permanent stormwater facilities and BMPs.	Engineering	Elements are currently in place with additional to be added in 2017.
CTRL-4	Continue to deploy system for project record keeping regarding plan review, construction site inspections, and enforcement actions.	Building, Engineering, IT	Smartgov permit management program is used.
CTRL-5	Incorporate Cartegraph asset management software to stormwater maintenance program.	Engineering	Expand use in 2017.

CTRL-6	Continue to train staff responsible for implementing the controlling runoff program from new development, redevelopment, and construction sites.	Engineering	Provide and track training.
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CITY OF GIG HARBOR 2017 STORMWATER MANAGEMENT PROGRAM

7. POLLUTION PREVENTION AND OPERATION AND MAINTENANCE FOR MUNICIPAL OPERATIONS

This Section describes the Permit requirements related to Pollution Prevention and Operation and Maintenance for Municipal Operations, including current and planned compliance activities.

7.1 Permit Requirements

The Permit (Section S5.C.5) requires the City to:

- Develop and implement an operations and maintenance (O&M) program with the ultimate goal of preventing or reducing pollutant runoff from the municipal separate stormwater system and municipal operations and maintenance activities.
- Establish maintenance standards for the municipal separate stormwater system that are at least as protective as those specified in the 2012 *Stormwater Management Manual for Western Washington*.
- Perform inspection of stormwater flow control and treatment facilities and catch basins at the required frequencies, unless previous inspection data show that a reduced frequency is justified.
- Have processes and procedures in place to reduce stormwater impacts associated with runoff from municipal operation and maintenance activities for streets, parking lots, roads or highways owned or maintained by the City, and to reduce pollutants in discharges from all lands owned or maintained by the City.
- Train staff to implement the modified processes and procedures and document that training.
- Prepare Stormwater Pollution Prevention Plans (SWPPP) for the Public Works Operations Facility owned and operated by the City.
- Summarize annual activities for the “Pollution Prevention and Operations and Maintenance for Municipal” component of the Annual Report; identify any update to SWMP document.

7.2 Current Activities

The City currently has activities and programs that meet some of the Permit requirements. The current compliance activities associated with the above Permit requirements include:

- The City has a program for detention facilities, catch basin and inlet annual inspections and maintenance.
- Many of the City’s landscape, open space, and facility management activities are managed to minimize the potential for stormwater pollution.
- The City Public Works Operations Facility, is subject to the Stormwater Pollution Prevention Plan (SWPPP).
- The City summarizes associated activities in its Annual Report by March 31st of each year.

7.3 Planned Actions

Gig Harbor performs many activities to limit stormwater pollution potential related to its municipal operations and maintenance program. However, updates will be necessary to maintain compliance as Ecology phases in Permit requirements. Table 7-1 is the work plan for 2017 SWMP activities related to pollution prevention and operations and maintenance activities. These tasks were developed through an iterative process of interviews and meetings with staff from affected City departments.

Table 7-1. 2017 Pollution Prevention and Operations and Maintenance Work Plan			
Task ID	Task Description	Responsible	Schedule Notes
PPOM-1	Update municipal storm system inspection and operations and maintenance processes and procedures per 2016 Gig Harbor Stormwater Management and Site Development maintenance standards.	Public Works Operations, Engineering	Standards were adopted on 12/31/2016.
PPOM-2	Refine data management systems to track maintenance activities and inspections.	Public Works Operations, Engineering	Cartegraph stormwater infrastructure management program is being utilized.
PPOM-3	Implement the Stormwater Pollution Prevention Plan for the Public Works Operations Facility. Revise and refine procedures as necessary.	Public Works Operations, Engineering	Implement SWPPP SOPs that are currently in place.
PPOM-4	Develop and establish policies and procedures to reduce pollutants in stormwater discharges from lands owned or maintained by the City.	Public Works Operations, Engineering	Implement SWPPP SOPs that are currently in place.
PPOM-5	Establish annual inspection program for City-owned flow control and runoff treatment facilities and perform identified maintenance within prescribed Permit timelines.	Public Works Operations, Engineering	Implement SWPPP SOPs that are currently in place.
PPOM-6	Develop curricula and define staff training requirements for pollution prevention training program.	Public Works Operations, Engineering	Continue to provide training for Operations staff.
PPOM-7	Track Washington Fish and Wildlife Hydraulic Project Approval permitted stormwater facilities maintenance.	Public Works Operations, Engineering	Track recently permitted facilities inspection and maintenance during 2017.
PPOM-8	Summarize annual activities for "Pollution Prevention and Operation and Maintenance" component of Annual Report; identify any updates to SWMP document.	Public Works Operations, Engineering	The SWMP and Annual Report submittal is due on or before March 31st of each year.

CITY OF GIG HARBOR 2017 STORMWATER MANAGEMENT PROGRAM

8. MONITORING

This Section describes the Permit requirements related to water quality monitoring, including current and planned activities.

8.1 Permit Requirements

The Permit (Section S8) does not require municipalities to conduct water quality sampling or other testing during this Permit term, with the following exceptions:

- Water quality monitoring required for compliance with TMDLs [total maximum daily pollutant loads, a.k.a., water quality clean-up plans]. The City's current Permit does not include TMDL requirements because there were no EPA-approved TMDLs affecting the City prior to the cut-off date (February 2006) for inclusion in the current Permit.
- Any sampling or testing required for characterizing illicit discharges pursuant to the Permit's Illicit Discharge Detection and Elimination conditions.
- Preparation for future, the City will review and study the results of the Status and Trends Monitoring provide through the Regional Stormwater Monitoring Program. Results of the monitoring will be used to support the adaptive management process for improving programs over time.
- Identification of two outfalls where permanent stormwater sampling stations can be installed and operated for future monitoring (by the end of the Permit term and with the 4th Annual Report). The two outfalls must represent commercial, high-density residential, and industrial land uses. The monitoring shall include plans for stormwater, sediment or receiving water monitoring of physical, chemical, and/or biological characteristics.
- Identification of two suitable SWMP Program questions and sites where targeted SWMP Program effectiveness monitoring can be conducted together with development of a monitoring plan for these questions and sites. The proposed effectiveness monitoring should be prepared to answer the following types of questions:
 - How effective is a specific targeted action or a narrow suite of actions?
 - Is the Stormwater Management Program achieving a targeted environmental outcome?

In addition, the City is required to provide the following monitoring and/or assessment data in Annual Reports:

- A description of stormwater monitoring or studies conducted by the City during the reporting period. If stormwater monitoring was conducted on behalf of the City, or if studies or investigations conducted by other entities were reported to the City, a brief description of the type of information gathered or received shall be included in the Annual Report.
- An assessment of the appropriateness of the best management practices identified by the City for components of the Stormwater Management Program; and changes made, or anticipated to be made, to the practices that were previously selected to implement the Stormwater Management Program and why those changes are desirable.

8.2 Current Activities

The City developed a list for Priority Receiving Waters for visual inspection.

The City developed the Preparation for Future, Long Term SWMP Effectiveness Monitoring Report that identifies two monitoring locations and includes two suitable SWMP Program questions.

8.3 Planned Activities

Gig Harbor will likely need to create a Water Quality Monitoring Program to maintain compliance during the next Permit term. The City has a population of less than 10,000 therefore, except for summarizing monitoring activities. The City selected Option #1 of the Regional Stormwater Monitoring Program. Table 8-1 presents the work plan for 2016 SWMP monitoring activities. These tasks were developed through a process of interviews and meetings with staff from affected City departments.

Table 8-1. 2017 Water Quality Monitoring Work Plan			
Task ID	Task Description	Lead	Schedule Notes
MNTR -1	The City selected Status and Trends Monitoring Option #1. The City will contribute to the collective fund to implement RSMP small streams and marine nearshore status and trends monitoring.	Engineering	Contribute annually to support implementation of the RSMP.
MNTR -2	Summarize annual monitoring activities for the Annual Report; identify any updates to the SWMP document.	Engineering	The SWMP and Annual Report submittal is due on or before March 31st of each year.