CHAPTER 4
STORMWATER DRAINAGE SYSTEM

INTRODUCTION

Gig Harbor, Henderson Bay, Wollochet Bay, and the Puget Sound are the receiving water bodies of the City's storm system. The storm system consists of curb inlets, catch basins, pipe, open ditches, natural streams, wetlands, ponds, and stormwater detention and water quality facilities. This chapter presents a physical description of the stormwater systems in the City and briefly discusses the land use and fishery resources for the various drainage basins. The inventory information presented in this chapter is based on the City's Geographic Information System (GIS) storm data. The City has partnered with Pierce County in the GIS mapping of their storm system. The storm system mapping is an on-going project as private development projects, CIP projects and annexations add to the City's storm system inventory. Drainage basin boundaries were reviewed using the City's storm system inventory and topographic information.

EXISTING STORMWATER DRAINAGE SYSTEM

The City uses a Global Positioning System (GPS) unit and GIS to collect and map the storm system data. Information included in the GIS storm inventory includes pipe diameter, material and length, depths at catch basins and inlets, catch basin type, depth, open ditch dimension and material, and stormwater facilities (vaults and ponds). An inventory summary of the City's public storm system is shown in Table 4-1.

Table 4-1 Public Storm System Inventory

Components	Quantity
Catch Basins	2,039 each
Ponds	31 each
Vaults	7 each
Open Ditch/Channel	63,210 feet
10-inch or less Pipe	14,516 feet
12-inch Pipe	140,343 feet
15-inch Pipe	6,895 feet
18-inch Pipe	25,135 feet
21-inch Pipe	934 feet
24-inch Pipe	11,127 feet
30-inch Pipe	4,488 feet
36-inch Pipe	3,863 feet
48-inch or greater Pipe	2,958 feet

The majority of the storm system is 12-inch pipe. Approximately 23% of the system is open ditch. The inventory and drainage basin characteristics are used in the hydrologic and hydraulic analysis of the City's existing storm system. The analysis is discussed in Chapter 5, Storm System Model. The GIS inventory can also be used to record maintenance information such as date of last cleaning, determination of cleaning frequencies, observations, conditions or problems. Past record drawings of the storm system can be scanned and linked to the City's GIS.

The storm system map is included in Appendix A. Following are recommendations for the City's GIS storm system inventory:

- Continue to partner with the Pierce County GIS and Mapping Department.
- Continue to develop and maintain a detailed set of storm system maps for use by staff, general public, and developers.

- Continue to update the City drainage basin map. Coordinate with Pierce County as needed.

- The City currently requires developers to submit a digital file in GIS or AutoCAD with their record drawings. It is recommended that the City require the developer submit the file in the defined coordinate system that is used by the City and Pierce County GIS Department.

- Include in the storm system data; project name, year constructed, datum and surface water design manual used in design.

- Include names for all tributaries and flow direction in the stream data.

- Provide "truck" maps to maintenance, inspector and field staff. These can be used for information purposes and to note any corrections, additions, repair needs, problem areas or observations.

- Include a data field in all stormwater related GIS inventory mapping data for the basin name.

- Link storm system drawings to the GIS inventory map.

BASIN DESCRIPTIONS

The City is located on a peninsula and water is adjacent to, or not far from the City limits in most directions. The southeast City limits is adjacent to Gig Harbor and the Puget Sound. There are multiple stormwater discharge locations along the shoreline that have been mapped by the City. The City's northwest UGA boundary extends to Henderson Bay. There are four creeks with multiple tributaries that flow through the City. These are described later in this chapter. The City has six major drainage basins:

- Gig Harbor

- Donkey Creek

- Wollochet Bay

- McCormick Creek

- Crescent Creek

- Puget Sound

None of the six major drainage basins are entirely within the City limits. The Gig Harbor and Donkey Creek drainage basins are entirely within the City's UGA. All of the other basins extend into Pierce County. The Crescent Creek basin extends into Pierce and Kitsap County. The majority of the City's storm system is separate from the Pierce County storm system. There are areas in the north part of the City that are connected to Pierce County. Donkey Creek and Crescent Creek convey flows from Pierce County through the City. There is a small area in Kitsap County that is conveyed by Crescent Creek through the City. Figure 4-1 shows the drainage basins and creeks.

The most recent information available regarding the basins are the Gig Harbor Basin Plan (Basin Plan) dated August 2005 which was completed by Pierce County and the Inventory of Streams and Wetlands Memorandum (Inventory Memo) dated October 17, 2005 (revised) completed by Adolfson Associates, Inc. for the City. In the Basin Plan, Pierce County summarized the conditions of the streams and habitat and identified projects to reduce flood hazards, improve water quality and associated habitat. Basin descriptions, water quality and flow data, fish usage, and recommended projects were included in the Basin Plan. The majority of the recommended projects are outside the City limits. There are projects however identified in the City for both Donkey Creek and McCormick Creek basins. The 2001 Stormwater Comprehensive Plan recommended Fish Enhancement Studies for Donkey Creek, Crescent Creek, McCormick Creek and Gooch Creek.

Water quality information from the Basin Plan is summarized in Chapter 6 of this Plan. According to the WDFW and the Basin Plan, the salmon identified in the Gig Harbor area are Chum and Coho.

Streams and wetlands were inventoried, categorized and mapped in the Inventory Memo. The Inventory Memo also included a table listing the priority species in the Gig Harbor area, which included the bald eagle, osprey, mountain quail, purple martin, great blue heron, Chinook salmon, chum salmon, coho salmon, steelhead and cutthroat trout.

Within each of the basins there are a variety of land uses. The majority of the Crescent Creek and Gig Harbor Basins are residential with some commercial/business. McCormick Creek Basin is mostly commercial/business with a small area in the north where there is some residential. The amount of commercial/business and residential uses in the Donkey Creek and Wollochet Creek Basins is approximately evenly divided.

Gig Harbor

Although Gig Harbor is the receiving body for Donkey Creek and Crescent Creek, the Gig Harbor Basin will be defined as the area on the southwestern shoreline of the harbor. The Gig Harbor Basin is approximately 435 acres and the boundaries are basically SR 16 and the City limits, north of Ryan Street. The northern boundary is

located just north of Rosedale Street. The City's downtown area along Harborview Drive is within this basin. Within the basin there are residences, parks, businesses, offices, restaurants, shops, marinas and repair/maintenance facilities.

Due to the proximity of the various businesses along the harbor shores, it is important to educate the owners about water quality impacts and what they can do to prevent pollutant discharges from their businesses. By understanding their business processes, recommendations can be made to implement proper best management practices (BMP's) that apply to their businesses. The 2008 Pierce County Stormwater Management Manual Volume IV, Source Control, has an activities checklist and a section on BMP's for commercial and industrial activities that can be used as a reference. Volume IV also has best management practices for single family residences.

The majority of the Gig Harbor Basin storm system consists of pipes and catch basins. Ditches and culverts exist in the upper basin, mostly in the residential areas. There are multiple drainage outfalls along the shore that range in size from 12- to 24-inch diameter. There are three public vaults identified by the GIS storm system inventory within the Gig Harbor drainage basin.

The City has been informed of flooding at businesses along Soundview Drive near Harborview Drive. Flows are bypassing the catch basins and sheet flowing on across the Soundview Drive. There are catch basins that are above road grade and debris from trees that block the grate openings and prevent the catch basin from collecting the flows. The City regularly sweeps the streets in this area, but cannot keep up with the amount of leaves, needles and other tree/vegetation debris. The Soundview Drive storm system consists of 18-inch pipe and discharges into Gig Harbor north of Soundview Drive/Harborview Drive. There were no detention facilities mapped in this area. Possible alternatives to resolve the flooding problem include:

- Reset the catch basins to a proper grade to improve the collection of flows and use a high capacity grate.
- Install curb inlet type catch basins.
- Require flow control for all future developments in this area.
- Evaluate the possibility for regional flow control. Retrofit detention facilities. Partner with property owners.

The Soundview Drive system was included in the hydraulic analysis as Trunkline 4. Chapter 5, System Analysis discusses the results from the analysis.

The City's 1994 Shoreline Master Program has categorized the Gig Harbor shorelines as Urban Residential. Any development or project along the shoreline will require a Substantial Development Permit or permit exemption from the City.

According to the Inventory Memo, there were no streams identified within this basin. There were three wetlands identified in an area east of Stinson Avenue and north of Rosedale Street. Not all wetlands were rated in the report. The wetland along Harborview Drive east of Stinson Avenue was rated as a Category IV.

Chum, Coho, Chinook, Steelhead and Cuthroat have been observed in the Gig Harbor Bay. Bald eagles, herons and other wildlife and marine life have been observed in the area of the harbor.

Donkey Creek

As stated previously, the Donkey Creek Basin is within the City's UGA. It is approximately 1,250 acres and is located west of Peacock Hill Avenue NW and east of SR 16. Donkey Creek is a tributary to Gig Harbor. It flows into Gig Harbor near Austin Street/North Harborview Drive through a 30-inch culvert. This culvert was identified as a fish barrier in the Basin Plan. The headwaters are located west of State Route 16 and north of 96th Street NW. Within the basin there are residences, school, businesses, offices, restaurants, and shops.

The majority of the basin storm system consists of pipes and catch basins. Ditches and culverts exist in the upper basin, mostly in the residential areas. There are multiple drainage outfalls along the shore that range in size from 12- to 24-inch diameter. There were two stormwater ponds and two vaults identified by the GIS storm system inventory within the Donkey Creek drainage basin.

The City's 1994 Shoreline Master Program has categorized the Gig Harbor shorelines near the mouth of Donkey Creek as Urban Residential. Any development or project in that area will require a Substantial Development Permit or permit exemption from the City. It is stated in the Program's Section 3.01 as Policy No. 5, "The estuarine areas of Crescent Valley Creek as designated in the City of Gig Harbor Wetlands Map of May, 1992 and the intertidal area at the mouth of Donkey Creek, should receive special consideration due to their potential as aquatic habitats."

Donkey Creek was included in the Inventory Memo and was categorized as a stream Type 2. There are areas in the upper basin, south of Borgen Boulevard, along the North Creek tributary that are forested and not developed. In the Inventory Memo, approximately 75 acres of wetlands adjacent to Donkey and North Creek were identified.

According to the Basin Plan, the fish habitat and riparian corridor were rated as good to fair. It was stated in the 2001 Plan that the creek has very low flows during the summer. This typically indicates a lack of groundwater recharge. Low Impact Development methods for future developments within this basin may improve the recharge in this area. Chum, Coho, Steelhead and Cuthroat have been observed in Donkey Creek.

Donkey Creek essentially flows north to south with several tributary streams that generally lie parallel to the main stem of the creek, in steep ravines that are covered with thick vegetation. The main stem has several depressions and wetlands that allow stormwater flows to be somewhat attenuated. The total length of Donkey Creek from headwaters to the harbor is approximately 2.9 miles. There are three main tributaries that flow into Donkey Creek and they are North Creek, the Avalon Woods tributary and a smaller tributary that flows between the main stem and the Avalon Woods tributary. North Creek is located east of Harbor Hill Drive. North Creek and the smaller tributary enter into Donkey Creek approximately 3,400 feet upstream of the outfall into Gig Harbor. The Avalon Woods tributary combines with Donkey Creek approximately 2,400 feet upstream of the outfall. Another small tributary, originating near 72nd Street NW combines with Donkey Creek a few hundred feet from the harbor. There were three fish barriers identified in the Basin Plan located near the mouth of the creek. The primary barrier to fish migrating into the Donkey Creek system is the outfall pipe into Gig Harbor. The pipe is completely inundated during high tide and sediment has blocked approximately 50% of the inlet. Saltwater may actually back up the creek above North Harborview Drive. This is evident from the presence of marine sediment depositions in the reach between Burnham Drive and North Harborview Drive. It is unlikely, but possible, that adult salmon would be able to migrate during high tide, but passage above Burnham Drive is not possible due to the four-foot drop off the box culvert underneath this road. A project has been developed by the City to remove this fish barrier. The Donkey Creek Restoration Project proposes to remove 300-feet of the 36-inch culvert and restore the creek to an open channel from the harbor outlet to North Harborview Drive. Removal of the culvert and restoration of the creek to the upper reaches of the watershed will improve the fish passage and habitat in Donkey Creek. This project has been submitted to the West Sound Watershed Council for Salmon Recovery Funding.

Wollochet Bay

The Wollochet Bay Basin is defined as the area south of Bujacich Road NW, southwest of SR 16 to the western City limits. This basin is approximately 4,600 acres. There are four creeks on the east side of Wollochet Bay that convey flows from the City to the bay: Wollochet Creek, Garr Creek, Bitter Creek and Sullivan Gulch Creek. The runoff from northern area of this basin east of Beardsley Avenue NW is discharged into Wollochet Creek. The headwaters of Wollochet Creek is a Category I wetland approximately 51.5 acres, north of Rosedale Street that is included in the City's Inventory Memo. The

majority of the basin north of 40th Street Court NW is discharged into Garr Creek. There are four wetlands located in the area of 56th Street NW that are the headwaters of Garr Creek. Wollochet Creek and Garr Creek are tributaries to Bitter Creek which flows into Wollochet Bay. Bitter Creek is in Pierce County. A small area south of 40th Street Court NW discharges into Sullivan Gulch Creek.

Within this basin, there are single family and multi-family neighborhoods, schools, businesses, offices, auto centers, shopping centers and movie theaters. The majority of the basin storm system consists of pipes and catch basins. Ditches and culverts exist in the western area of the basin, mostly in the residential areas. Although the discharge pipes range in size from 12- to 24-inch diameter, the majority are 12-inch pipes. There were fifteen vaults identified by the GIS storm system inventory within the Gig Harbor drainage basin.

There are two 18-inch culverts on 38th Avenue NW, south of Briarwood Lane NW that has been identified by the City as a conveyance problem. The two 18-inch culverts convey Garr Creek across 38th Avenue NW. Sediment is being transported to this location and accumulating in the culvert, decreasing its capacity. This has caused flooding at 38th Avenue NW. Scour in the upstream channel has also been observed. An analysis of the upstream system to determine the source of the sediment and location of possible erosion is recommended. The Basin Plan did a survey of Garr Creek from its confluence with Wollochet Creek to approximately 1,500 feet upstream. There was no mention of any scour or erosion. In 2007, the City constructed a detention facility that was associated with the 56th Street NW and Olympic Drive NW Street Improvement Project. This detention facility controlled flows from 56th Street NW and Olympic Drive NW Improvement Project that discharge into Garr Creek. Other opportunities for constructing detention facilities in this basin should be evaluated. This will decrease flows and may reduce the amount of sediment that is transported to the 18-inch culvert.

The 38th Avenue NW system was included in the hydraulic analysis as Trunkline 5. Chapter 5, System Analysis discusses the results from the analysis.

The City's 1994 Shoreline Master Program did not include any of the stream bank area of the creeks within the City shoreline inventory. Pierce County did include the shorelines of Wollochet Bay in their shoreline inventory. The City's southwest UGA boundary does not extend to Wollochet Bay.

Wollochet Creek was included in the Inventory Memo and the stream type was listed as unknown. There were twenty wetlands identified in an area east of Stinson Avenue and north of Rosedale Street. The wetland near 56th Street NW east of 38th Avenue NW was rated as a Category III and as stated previously there is a Category I wetland in the

basin north of Rosedale Street. Chum, Coho and cutthroat have been observed in Wollochet Creek.

According to the Basin Plan, the riparian corridor and fish habitat was categorized as good to fair condition. Fish barriers were identified along Wollochet Creek, but they were all outside the City limits.

McCormick Creek

The McCormick Creek Basin is defined as the northwestern part of the City, east of SR 16 west of Pacific Avenue NW, to the northern City limits. A large part of the City's northwestern Urban Growth Area is within this basin. This basin is approximately 1,560 acres. McCormick Creek is a tributary to Henderson Bay which is west of the City in Pierce County. It begins within the City and flows to the northeast and crosses SR 16 north of Borgen Boulevard NW. There is a McCormick Creek Tributary to the east that begins at the Canterwood Golf and Country Club and connects to the main stem at SR 16.

Within this basin, there are single family and multi-family neighborhoods, schools, businesses, offices, hospital, and shopping centers. The majority of the basin storm system consists of pipes and catch basins with some ditches and culverts. The discharge pipes range in size from 12- to 18-inch diameter. There are no stormwater ponds or vaults identified by the GIS storm system inventory within the Gig Harbor drainage basin.

The City's 1994 Shoreline Master Program did not include any of the stream bank area of the creeks within the City shoreline inventory. Pierce County did include the shorelines of Henderson Bay in their shoreline inventory.

McCormick Creek was categorized as a Type 2 stream in the Inventory Memo. There was one wetland identified in an area east of SR 16 and north of Borgen Boulevard NW. Chum, Coho, Chinook, steelhead and cutthroat have been observed in McCormick Creek.

According to the Basin Plan, the majority of the riparian corridor and fish habitat is in good condition. The corridor adjacent to SR 16 was identified as poor due to the culvert crossings and lack of vegetation. Fish barriers were identified along McCormick Creek in the area along SR 16. As part of the Canterwood Boulevard Road Improvement Project, the City removed one of the identified fish barriers. A 64-inch culvert was removed and replaced with a 12-foot by 5-foot concrete box culvert designed for fish passage. The culvert bottom was be covered with streambed material. This project was completed in 2008.

Crescent Creek

There is a small area north of the harbor, west of Woodworth Avenue that is a part of the Crescent Creek Basin. This basin is approximately 4,200 acres. The majority of this basin is in Pierce County and extends into Kitsap County. It is a tributary to Gig Harbor and the mouth is within the City limits.

It is mostly residential within this basin. This part of the City is well developed and the majority of the basin storm system consists of pipes and catch basins with some ditches and culverts. The discharge pipes range in size from 12- to 18-inch diameter. There are no stormwater ponds or vaults identified by the GIS storm system inventory within the Crescent Creek drainage basin.

The City's 1994 Shoreline Master Program has categorized the Gig Harbor shorelines within the Crescent Creek Basin as Urban Residential. Any development or project along the shoreline will require a Substantial Development Permit or permit exemption from the City. It is stated in the Program's Section 3.01 as Policy No. 5, "The estuarine areas of Crescent Valley Creek as designated in the City of Gig Harbor Wetlands Map of May, 1992 and the intertidal area at the mouth of Donkey Creek, should receive special consideration due to their potential as aquatic habitats."

Crescent Creek was categorized as a Type 2 stream in the Inventory Memo. There were two wetlands identified in the basin along the harbor shore and Crescent Creek streambank. The wetland along the harbor shore and at the mouth of Crescent Creek was rated as a Category II. Chum, Coho, Chinook, steelhead and cutthroat have been observed in this basin.

According to the Basin Plan, the majority of the riparian corridor and fish habitat is in good condition. Upstream outside the City limits, there are stream reaches that were rated as poor due to development. A fish barrier was identified on the creek outside the City limits.

Puget Sound

The Puget Sound Basin is defined as the area east of SR 16 and south of Grandview Street. This basin is approximately 2,070 acres.

Within this basin, there are single family and multi-family neighborhoods, a fire station, businesses, offices, hotel and shopping centers. This part of the City is well developed and the majority of the basin storm system consists of pipes and catch basins with some ditches and culverts. The discharge pipes range in size from 12- to 24-inch diameter. There are no stormwater ponds and one vault identified by the GIS storm system inventory within the Puget Sound drainage basin.

The City's 1994 Shoreline Master Program has categorized the Puget Sound shoreline south of the harbor entrance to the City limit as Urban Residential. Any development or project along the shoreline will require a Substantial Development Permit or permit exemption from the City.

There were no wetlands or streams identified in this basin in the Inventory Memo.

Other than a few steep ravines flowing directly to the bluff/sound, there are no natural drainage features in this basin. Runoff is typically conveyed in roadside ditches and pipes, with piped systems conveying runoff down the steep areas into the Sound. There were not any identified stormwater problems in this basin, although, as is typical with any drainage along the bluffs of Puget Sound, the potential for erosion and landslide hazard is higher than in other areas of the City. Flow control requirements in this basin may require a higher level to protect the bluff and steep slopes. Discharge pipes should be extended to the toe of slope.

Currently, there are no areas within the City limits that drain to Colvos Passage in Puget Sound. However, there is a small sliver of land that is designated as lying within the UGA boundary of the city and therefore should be addressed. Similar to the Narrows drainage basin, the area lies on the bluffs and steep slopes overlooking the Puget Sound. All of the developed properties are single family residences. Similar concerns regarding erosion and landslide hazard areas apply to this basin as did for the Narrows Basin.

URBAN GROWTH AREA

The UGA will mostly affect the northern parts of the City. The McCormick Creek Basin will increase by more than four times its current size. North of the McCormick Creek Basin, Gooch Creek and Goodnough Creek convey flows from the UGA to Henderson Bay. Also in the north, the runoff from the northwest corner of the UGA will be conveyed by Purdy Creek to Henderson Bay. Figure 4-2 shows the area of the City and UGA within each drainage basin.

To the southwest a small area less than10 acres will be a part of the Artondale Creek Basin. Another new basin area would be the east shores of Gig Harbor. The East Gig Harbor and Point Richmond drainage basins would include the east shore area. The majority of this area is residential with opportunities for future development. Similar to the Puget Sound Basin there are slopes and discharge locations along the shore that should be evaluated and monitored for erosion. If necessary, a higher level of flow control could be required for this basin.

The other basins will also increase in size. Table 4-2 shows the basin areas within the City limits and the UGA boundaries. Land uses in the UGA are similar in each basin to those currently in the City limits.

Table 4-2 Drainage Basin Areas (acres)

Basin	City	UGA	Total
Gig Harbor	435	9	423
Donkey Creek	774	475	1,250
Wollochet Bay	1,184	434	4,630
McCormick Creek	374	1,005	1,558
Crescent Creek	147	225	3,565
Puget Sound	241	375	2,045
Gooch Creek	25	510	1,188
Henderson Bay	0	14	614
Purdy Creek	0	159	2,300
East Gig Harbor	0	221	300
Artondale Creek	0	7	2,132
Point Richmond	0	7	1,750

CONCLUSION

As the City continues to grow through annexation and new developments, the service area will grow and maintenance responsibilities will increase. It will be important to maintain the storm system inventory map and data. The mapping will also be helpful in fulfilling some of the NPDES Phase II permit requirements such as tracking spills and illicit discharges, recording inspection observations and maintenance activities, mapping of the service area, outfalls and system. By 2011 field assessments of high priority water bodies will be required. The City will have to prioritize the water bodies and determine which will be assessed for illicit discharges. Spill reports, water quality complaints, storm system inventory, zoning and land use maps can be used as resources in the prioritization and assessment.