



# Water Quality

## Chapter 7

### CHAPTER 7 – WATER QUALITY

The need to prevent pollution due to stormwater runoff is one of the major “Why’s” determining the strategies recommended in the Plan for the next ten years (**Chapter 10**).

This chapter describes what is known about water quality in South Sound waters, based on data derived from many studies done over the past several decades. The findings of these studies are briefly summarized below and an analysis of data is presented in **Appendix 3**. The chapter also presents the results of an analysis showing that the water quality of runoff from watersheds is correlated with the level of water quality treatment.

In addition to monitoring water quality, the Utility’s role in pollution prevention includes education and outreach, illicit discharge prevention and investigation, spill response, stormwater facility inspection and maintenance, street sweeping, and sediment management. These activities are described in **Chapter 9**.

The main sources of pollutants are stormwater runoff from basins developed before current pollution control standards and onsite sewage systems. The Utility’s pollution prevention efforts are focused by the requirements of two sets of regulations imposed under the federal Clean Water Act:

- The 303(d) listing of many local water bodies as having water quality not meeting State surface water quality standards. The listings have driven Total Maximum Daily Load (TMDL) studies which have identified actions to improve impaired water quality.
- The City’s Municipal Stormwater Permit (Permit) issued as part of the National Pollutant Discharge Elimination System (NPDES).

Meeting these requirements, summarized in **Section 7.5**, is one of the major challenges facing the City in the years ahead.

#### 7.1 Sources of Pollutants

Most of Olympia was developed prior to the Clean Water Act or any regulations requiring water quality treatment. All developed land uses from pasture and agriculture to industrial have water quality implications. In urban environments, the main source of surface water contamination is stormwater runoff from impervious (hard) surfaces. Other sources of concern are inadequate onsite sewage systems, contamination from cross-connections with the wastewater system, illegal discharges, and spills.

##### Impervious Surfaces

When rain falls on pavement and other hard surfaces in an urban setting, it runs off and is often conveyed by pipes and ditches directly to lakes, wetlands, streams, and Puget Sound. This stormwater runoff has been declared the most severe pollution problem in the region because it carries oil and grease from paved surfaces, fertilizers and pesticides from lawns, heavy metals from wear and tear on brakes and tires, and animal waste (Weis et al. 2009).

Any substance found on the ground and especially on paved surfaces can wind up in stormwater runoff. Development standards in place since 1991 are designed to filter pollutants and prevent stormwater from leaving the property. However, runoff from more than 60 percent of Olympia's land surface receives no treatment. For the most part, when oil, antifreeze, detergents, and other materials are deposited in the roadway or into the storm drainage system, it is the same as dumping directly into a lake or stream. Even well-maintained motor vehicles are significant contributors to runoff pollution through normal wear of brakes (copper) and tires (zinc).

Extensive research has demonstrated how reducing tree cover and increasing impervious surfaces can negatively affect water quality and aquatic habitat (**Chapter 4, Section 4.2**). Utility analysis of local data has confirmed this relationship, showing a correlation between water quality and the land area subject to stormwater controls on new development.

**Figure 7.1** and **Map 7.1** demonstrate that older parts of the City, which drain to Budd Inlet, Moxlie Creek, and Indian Creek basins, have the largest areas (percentages and acres) of impervious surface that do not receive water quality treatment. These areas thus have the greatest potential for pollution loading. **Figure 7.1** quantifies the level of water quality treatment for runoff from arterial and collector roadways in each basin. Map 7.1 depicts impervious surfaces by basin and the portion of the impervious surface that does not receive water quality treatment. For more on the relationship between impervious surfaces and water quality, see Chapter 8, **Figures 8.3** and **8.4**. A detailed analysis is in **Appendix 3**.

### **Onsite Sewage Systems**

Within Olympia there are approximately 1,900 onsite sewage systems (OSS), also called septic systems. Even well-functioning OSS discharge only partially treated effluent to the environment. The level of treatment thereafter is highly dependent upon loading and soil properties within the OSS drain field. Failing OSS can be significant sources of such pollutants as fecal coliform and nitrates. The risk to water quality from OSS increase with density (dwelling units per acre), proximity to surface water bodies, and inadequate maintenance.

### **Illicit Discharges**

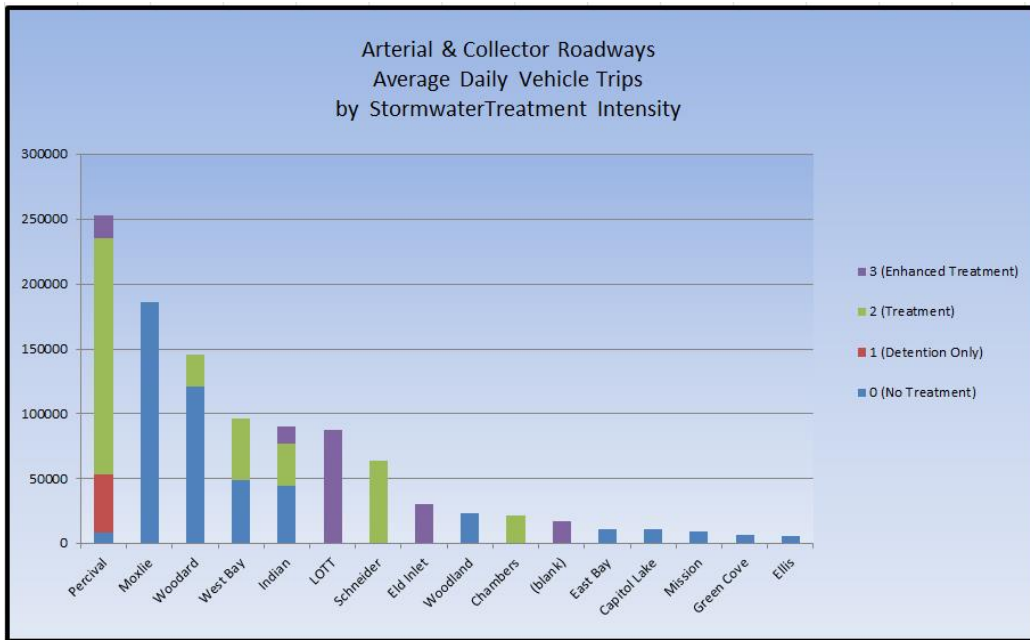
Illicit discharges are any discharges to the City's municipal separate storm sewer system (MS4) that are not composed entirely of stormwater. The Permit allows for a few exceptions, including irrigation runoff, firefighting activities, and street and sidewalk wash water. Common illicit discharges include dumping in storm drains, leaking vehicles, sediment runoff from construction sites, carwash wastewater, carpet cleaning wastewater, recreational vehicle dumping, concrete washout water, paint washout water, and failing OSS.

### **Cross-Connection with Wastewater System**

Cross-connections, also referred to as Illicit connections, are any connections to the MS4 that were not intended, permitted, or used for collecting and conveying stormwater or specifically allowed non-stormwater discharges. Examples include sanitary sewer connections, floor drains, channels, pipelines, conduits, inlets, or outlets that are connected directly to the MS4.

### **Spills**

Spills are unintentional, transitory illicit discharges. Very common examples are oil, gas, or antifreeze spills from vehicular accidents that are washed across the road and into the storm drain system.



**Figure 7.1 Runoff from Arterial and Collector Roadways**

# Storm and Surface Water Plan Impervious Surface by Basin

Olympia

Basin Area in City Limits:  
% Impervious

9.7%	Chambers
11%	Ellis
18.1%	Green Cove
21.3%	Deschutes
25.1%	Mission
29.1%	Eld Inlet
31.6%	East Bay
33.9%	Indian
34%	Schneider
35.2%	Ward Lake
36.2%	West Bay
36.2%	Woodard
40.8%	Capitol
41.2%	Moxlie
45%	Percival
58.7%	Woodland
59.6%	LOTT
79.4%	Budd Inlet

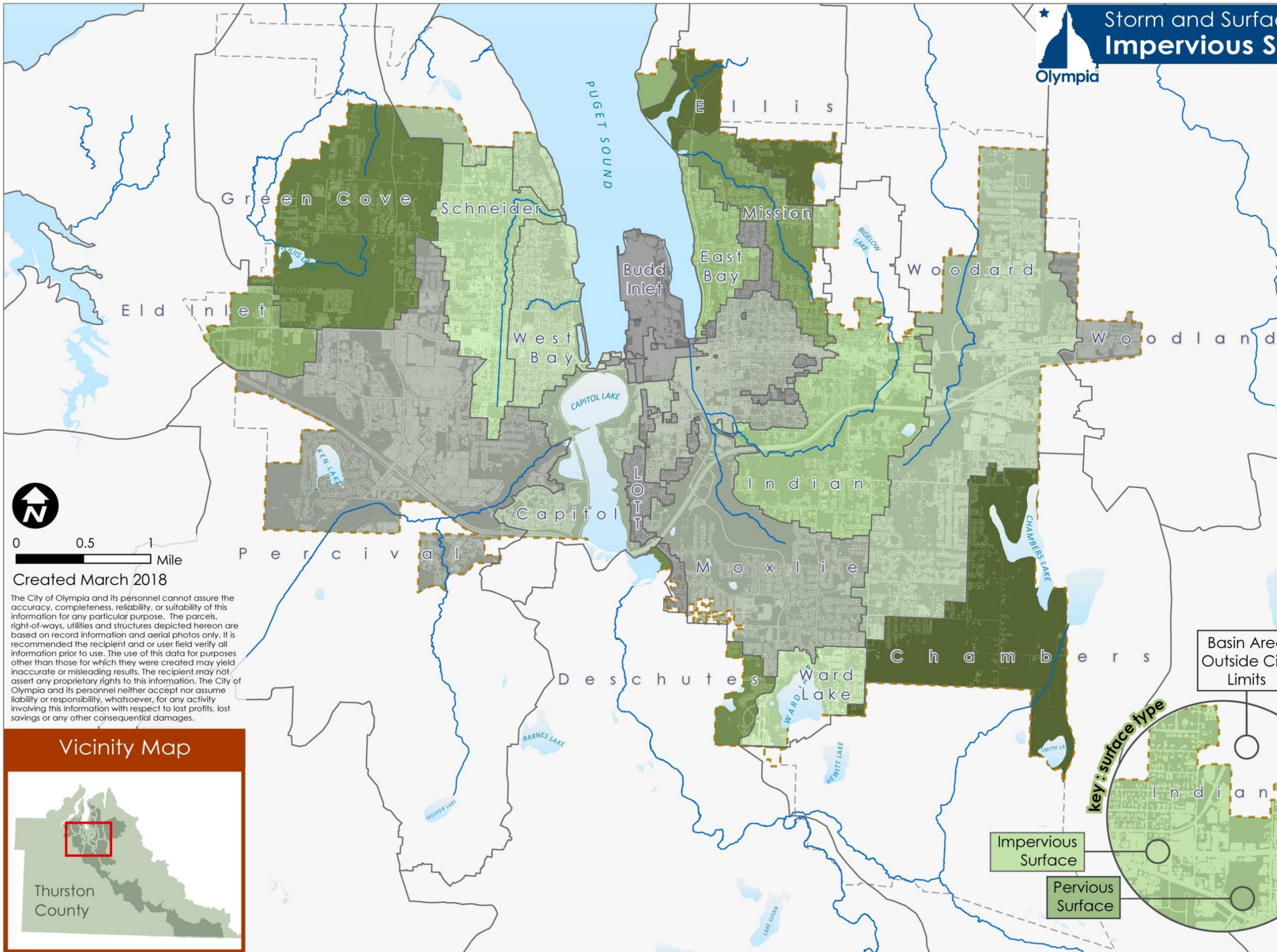
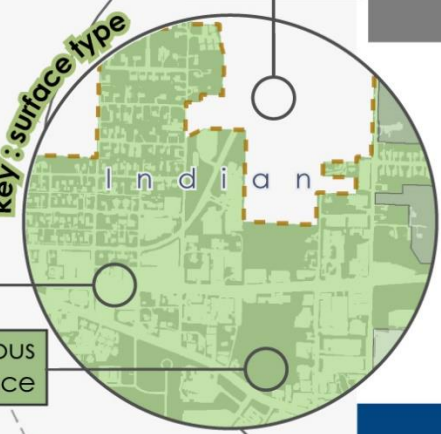
Basin Area  
Outside City  
Limits

- City Limits
- UGA
- Basin Border

key: surface type

Impervious  
Surface

Pervious  
Surface



0 0.5 1 Mile

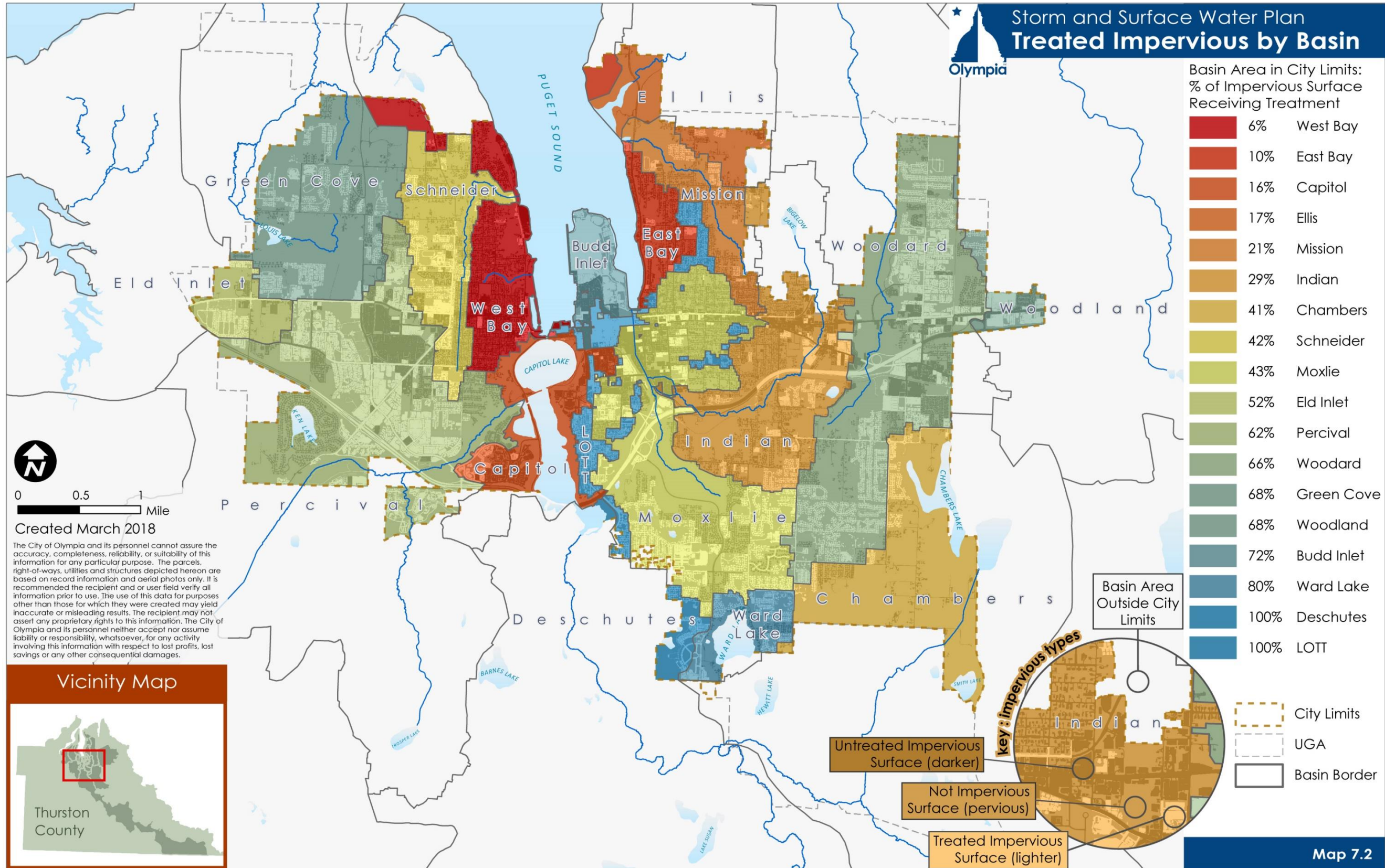
Created March 2018

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Map 7.1

Map 7.1 Impervious Surfaces by Basin with Untreated Acreage and Percentages



Map 7.2 Impervious Surfaces by Basin with Treated Percentages

## 7.2 Regulatory Requirements

Ecology's analysis of water quality problems has resulted in specific regulatory requirements placed upon the City in the form of NPDES Permits (the Municipal Stormwater Permit as well as permits for wastewater treatment plants, industrial stormwater, and construction stormwater), and implementation of Total Maximum Daily Loads (TMDLs) for the Henderson and Deschutes watersheds. The following discussion summarizes these requirements.

### **Municipal Stormwater Permit**

The Clean Water Act established the NPDES permitting system to regulate the discharge of wastewater and stormwater into "waters of the United States." In Washington, Ecology is the regulatory authority for issuing NPDES permits. The City of Olympia is subject to the *2013-2018 Western Washington Phase II Municipal Stormwater Permit* (Permit). The Permit covers discharges from the City's MS4 into surface water and groundwater.

The Permit guides much of the Utility's work efforts. The Utility is responsible for meeting the requirements listed below. These requirements are likely to be revised in the future permit cycles (every five years). The Utility's actions to meet these requirements are discussed throughout this Plan, primarily in Chapters 6, 7, 8, and 9.

#### ***Education and Outreach***

- Maintain an education and outreach program for source control. The program is designed to reduce or eliminate behaviors and practices that cause or contribute to adverse stormwater impacts and encourage the public to participate in stewardship activities.

#### ***Illicit Discharge Detection and Elimination***

- Implement an Illicit Discharge Detection and Elimination (IDDE) program to characterize, trace, and eliminate illicit discharges of pollutants.
- Implement an IDDE training program for all municipal field staff.
- Maintain a hotline telephone number for public reporting of spills.

#### ***Controlling Runoff from New Development and Redevelopment Construction Sites***

- Implement and enforce the City's *Drainage Design and Erosion Control Manual* (DDECM). This involves ensuring that the design of all new development and redevelopment complies with stormwater quality and quantity control requirements intended to maintain water quality standards in downstream receiving waters. The DDECM establishes when and what level of water quality treatment is required with development.
- Inspect all permitted development sites during construction to verify proper installation and maintenance of required erosion and sediment controls. Enforce as necessary based on the inspection.
- Inspect all permitted development sites after construction to verify proper installation of permanent stormwater management facilities.
- Revise regulations to make low impact development the preferred and commonly used approach to land development.

### ***Municipal Operations and Maintenance***

- Annually inspect and maintain City-owned or City-maintained stormwater facilities.
- Inspect all City-owned catch basins on a two-year cycle and clean as necessary.
- Annually inspect and enforce maintenance of private stormwater facilities constructed after 2007.

### ***TMDL Requirements***

- Comply with the specific TMDL requirements identified in the sections below.

### ***Monitoring and Assessment***

- Contribute to the regional Stormwater Action Monitoring Program.
- Annually update the City's Stormwater Management Program, a set of actions and activities documenting how the City meets Permit requirements.
- Maintain a map of the Municipal Stormwater System (MS4).
- Notify Ecology of any discharge into or from the MS4 which could constitute a threat to human health, welfare, or the environment.
- Submit an annual report to Ecology documenting compliance with permit requirements.

### **Total Maximum Daily Load (TMDL) Studies**

TMDL studies are performed for polluted water bodies identified by Washington State's Water Quality Assessment (refer to **Section 7.4**) as requiring actions to improve water quality. TMDL studies describe the type, amount, and sources of water pollution in each water body. TMDL studies also establish a plan of required actions (targets and strategies) to control the pollution and restore water quality.

The four TMDLs affecting Olympia are described below for:

- Henderson Inlet Watershed Area
- Deschutes River Basin (Deschutes River, Percival Creek, and Budd Inlet Tributaries)
- Budd Inlet and Capitol Lake
- Totten, Eld, and Little Skookum Inlets

### ***Henderson Inlet TMDL***

In 2008, Ecology completed a technical study on the Henderson Inlet watershed including the Woodard and Woodland Creek watersheds. Portions of Woodard and Woodland Creek watersheds are located within the City of Olympia's jurisdiction and its Urban Growth Area (UGA.) The findings indicated violations of Washington State surface water quality standards for temperature, fecal coliform bacteria, dissolved oxygen, pH, and fine sediment levels. Complete documentation of water quality improvement reports and implementation plans are available at the Ecology's [Henderson Inlet Watershed Area Water Quality Improvement Project website](#). The Henderson Inlet TMDL is complete and required actions from the implementation plan are in **Section 7.4**, the fecal coliform and phosphorus discussions.

### ***Deschutes River TMDL***

In 2003, Ecology began the Deschutes TMDL study to find solutions for water pollution problems in the Deschutes River, Percival Creek, and Budd Inlet watersheds. In 2015, Ecology finalized an improvement plan for water quality in the Deschutes River, Capitol Lake, and Budd Inlet tributaries and submitted it to the EPA for approval. The findings indicated violations of Washington State surface water quality standards for temperature, fecal coliform bacteria, dissolved oxygen, pH, and fine sediment levels. Complete documents associated with the *Deschutes River TMDL* are available at the Ecology [website](#). Recommended actions for pollutants in the Deschutes basin are in **Section 7.4**.

### ***Budd Inlet and Capitol Lake TMDL***

The marine waters of Budd Inlet currently do not meet water quality standards for dissolved oxygen, and Capitol Lake does not meet standards for bacteria and total phosphorus. High levels of phosphorus can cause algae blooms. The nature of the dissolved oxygen impairments in Budd Inlet is complex, but human sources of nitrogen from north of Budd Inlet are recognized as major contributors to water pollution in Budd Inlet. Ecology therefore separated the Budd Inlet and Capitol Lake TMDL from the Deschutes TMDL. Additional computer modeling work was published in a supplemental report in 2015. More computer modeling is underway and a project timeline for the TMDL is being developed. Documents associated with the Budd Inlet and Capitol Lake TMDL are available at the Ecology website.

### ***Totten, Eld, and Little Skookum Inlet TMDL***

In 2006, Ecology completed a technical study on the Totten, Eld, and Little Skookum Inlet watersheds. The findings indicate fecal coliform bacteria violated Washington State surface water quality standards. Green Cove Creek in Olympia is tributary to Eld Inlet. However, the study did not identify water quality problems in Green Cove Creek and the City is not required to take any actions. Complete documents associated with the Totten, Eld, and Little Skookum Inlets TMDL are available at the Ecology [website](#).

## **7.3 Water Quality Monitoring**

The Utility staff participates in water quality monitoring as part of several State, regional and local monitoring programs: the Washington Water Quality Assessment, the regional Stormwater Action Monitoring (SAM) Program, and the Thurston County Interlocal Monitoring Program. The Utility occasionally performs specific monitoring on its own. Monitoring results are used to assess the health of streams, wetlands, lakes, and marine waters and develop programs, policies, and capital facility plans to protect these resources.

### **Washington Water Quality Assessment**

The federal Clean Water Act requires states to maintain a list of water bodies that fail to meet water quality standards. Washington State's Water Quality Assessment lists the status of water quality at particular locations in one of five categories recommended by the US Environmental Protection Agency:

- Category 1. Meets tested standards for clean waters:
- Category 2. Waters of concern: waters where there is some evidence of a water quality problem.
- Category 3. Insufficient data: water where there is insufficient data to meet minimum requirements according to Policy 1-11.
- Category 4. Polluted waters that do not require a TMDL.
- Category 5. Polluted waters that require a TMDL or other Water Quality Improvement ([WQI project](#)).

The list of Category 5 “impaired” water bodies is known as the 303(d) list. The Clean Water Act requires states to ensure that these water bodies are restored to healthy water quality. The Total Maximum Daily Load (TMDL) process is typically used to do this.

The cleanup process begins with a water quality study to identify and evaluate sources of pollution. It includes analysis to determine how much pollution from those sources needs to be reduced to meet the TMDL requirement. Study findings are then used as a guide to help develop and implement a cleanup. **Table 7.1** shows the Category 5 (303(d)) listings and results of assessment for Olympia water bodies.

### **Stormwater Action Monitoring Program**

Olympia pays into a collective fund to implement the Stormwater Action Monitoring (SAM) Program, an Ecology-administered, collaborative program with western Washington jurisdictions having NPDES Municipal Stormwater Permits. This program samples small streams and marine nearshore waters to monitor water quality status and trends in Puget Sound. Participating in the SAM program is the most cost-effective means

for Olympia to fulfill the Permit requirement for water quality status and trends monitoring. The SAM program collects monthly samples from 60 locations throughout the Puget Sound region; none of the sample locations are within Olympia or its Urban Growth Area.

The monthly monitoring includes sampling or measuring the following:

- Conventional parameters: dissolved oxygen, pH, conductivity, temperature, dissolved organic carbon, chloride, fecal coliform, hardness; nitrogen as ammonia (NH<sub>3</sub>), nitrite (NO<sub>2</sub>), nitrate (NO<sub>3</sub>), and total nitrogen; total phosphorus, orthophosphate, total suspended solids (TSS), and turbidity.
- Metals: totals and dissolved (arsenic, cadmium, chromium copper, lead silver, and zinc).
- Organics: polycyclic aromatic hydrocarbons (PAHs).
- Stage and stream discharge.

All SAM contracts, scopes of work, deliverables, quarterly budget reports, and annual reports are posted at Ecology's SAM [website](#).

### **Interlocal Monitoring Program**

Through an Interlocal agreement, Olympia participates in a storm and surface water monitoring program administered by Thurston County. This program has been continuously active since 1991, but the type of data collected and the frequency of collection has varied. The program currently monitors Capitol Lake, Ward Lake, and Moxlie, Indian, Chambers, and Percival Creeks monthly for conventional water quality parameters including temperature, pH, fecal coliform bacteria, dissolved oxygen, turbidity, total phosphorus, and total nitrogen. The streams are also monitored for flow rates. The local program does not test for organic compounds or metals. Mission, Ellis, and Schneider Creeks had previously been sampled, but have been cut from the local stream monitoring program because funding was diverted to Ecology's SAM program. Appendix 3 provides water quality and flow data collected for each water body and key findings are summarized below. Complete results of the surface water monitoring program can be viewed at <http://www.co.thurston.wa.us/health/ehswat/swater.html>

## **7.4 Results of Water Quality Monitoring**

Understanding water quality in Olympia's surface water bodies requires an evaluation of monitoring data and a review of agency reports and scientific literature. These are combined with an understanding of land cover, land use, and the infrastructure that has been built to mitigate the negative impacts associated with stormwater.

This section reports on the results of the Washington Water Quality Assessment's 303(d) listing of Olympia's water bodies that require a TMDL; local findings on monitored pollutants; non-monitored stormwater pollution from roadways; and special studies conducted by the Utility.

### **Surface Water Listings and Total Maximum Daily Loads (TMDLs)**

Most surface water bodies in Olympia are on Ecology's 303(d) list of polluted waters requiring actions to achieve surface water quality standards (**Table 7.1**). Note that in 2016, based on more current monitoring data, Ecology lowered the bacteria ranking for Black Lake Ditch and Percival Creek from Category 5 (highest significance requiring action) to Category 1 (meets water quality standards).

**Table 7.1 303(d) List of Impaired Water Bodies**

Impaired Stream/ Stream Reach	Listing ID	Parameter (Cause of Concern)	WQ Category	Jurisdictional Boundary	Likely Cause of Concern
Black Lake Ditch <sup>1</sup>	50989	pH	5	Confluence of Percival Creek to City Border (Tumwater)	The Black Lake Ditch is a manmade channel that was constructed to allow agricultural activities on the nearby land. The temperature, DO, and pH issues associated with this water body are a likely caused by this legacy activity as well as the water quality issues associated with Black Lake that drains into Black Lake Ditch.
	47761	Dissolved Oxygen	5		
	48733	Temperature	5		
Ellis Creek	45480	Bacteria	5	Priest Point Park	Unknown
Indian Creek	3758	Bacteria	5	Bigelow Lake to Wheeler Street	Past source tracing indicates bacteria likely is coming from within Urban Growth Area
	74218	Bacteria	5	West of Frederick Street along Wheeler to North of I-5	
Mission Creek	45212	Bacteria	5	Mission Creek Park Boundary to the mouth	Likely human source of bacteria.
Moxlie Creek	3759	Bacteria	5	North of I-5 along Chestnut Street to Budd Inlet	Likely human source of bacteria.
	3761	Bacteria	5	Watershed Park up to Union Avenue	
Percival Creek <sup>1</sup>	48085	Dissolved Oxygen	5	From headwaters in Tumwater downstream to the mouth – roughly half in Olympia	Percival Creek’s forested buffer is for the most part adequate in terms of shading for stream temperature. Water quality concerns are likely caused by human sources and the creek’s surface water connection to Black Lake.
	42321	Temperature	5		
Schneider Creek	45559	Bacteria	5	Lower reach of Schneider Creek	A brief analysis of the stream basin indicates a moderate number of homes connected to onsite sewage systems.
Woodland Creek	36184 36185 48066 48067	Temperature	5	Upper Reaches of Woodland Creek within Lacey	A very small part of the Woodland Creek drainage basin is within the Utility’s service area. Only Listing 48066 is downstream of Olympia.
		DO	5	Middle Reaches of Woodland Creek	
Tributary of Woodard Creek	47741	DO	5	Un-named Tributary of Woodard Creek between Pacific Avenue and Martin Way	
Green Cove Creek	74252	Bacteria	5	In UGA from just south of Kaiser Road to mouth	Green Cove Creek was evaluated with the Eld, Totten, and Skookum Inlets TMDL. No actions were required.
Ward Lake	7022	Polychlorinated Biphenyls (PCBs) <sup>2</sup>	5	Ward Lake – 90% of the Northern and Eastern Portions are in Olympia	PCBs are assumed to be associated with discontinued land uses.
Capitol Lake	22718	Total Phosphorus	5	Capitol Lake Approximately North of Interstate 5	Deschutes River is the largest contributor to Capitol Lake. The Capitol Lake TMDL is ongoing.
	40588	Bacteria	5		
Budd Inlet	5852 5853 5862 5863 5864	DO	5	Inner and outer Budd Inlet within Olympia city limits	The Budd Inlet TMDL is ongoing.
	4000 64011 64012 64013 64711	2,3,7,8-TCDD (Dioxin) <sup>2</sup>	5		
	8685 64004 64017	Benzo(b)fluoranthene <sup>2</sup>	5	Inner Budd Inlet within Olympia city limits	
	8686	Benzo(k)fluoranthene <sup>2</sup>	5		
	8688 64002 64015	Benzo(a)anthracene <sup>2</sup>	5		
	8689 64005 64018	Chrysene <sup>1</sup>	5		
	64003 64016 64712	Benzo(a)pyrene <sup>2</sup>	5		
	64006 64009 64019	Dibenzo(a,h)anthracene <sup>2</sup>	5		
	64003 64713 64009 64022	Indeno(1,2,3-c,d)pyrene <sup>2</sup>	5		
	8690	Polychlorinated Biphenyls (PCBs) <sup>2</sup>	5		
61005	Bacteria	5			

<sup>1</sup> In 2016, based on more current monitoring data, Ecology lowered Black Lake Ditch and Percival Creek from Category 5 (highest significance requiring action) to Category 1 (meets water quality standards) ranking for bacteria.

<sup>2</sup> Tissue sample medium

## Monitored Water Quality Parameters

Thurston County Environmental Health collects monthly samples from many Olympia's streams and lakes on behalf of the Utility. This monitoring is limited to specific water quality parameters that are known to play a role and/or serve as indicators of water quality and biological health. These include nitrogen, phosphorus, fecal coliform, dissolved oxygen, pH, temperature, and turbidity. Diversity of benthic macroinvertebrates in streams, discussed in **Chapter 8**, is measured annually and is also considered an indicator of surface water quality.

Following is a summary of the findings from the analyses of water quality monitoring data local, regional and TMDL water quality monitoring efforts.

### Fecal Coliform

Fecal coliform indicator bacteria (referred to as "bacteria") are ubiquitous in Olympia's surface water bodies. Bacteria can get into surface waters from pets, domestic livestock, wildlife, and untreated or partially treated discharges from improperly functioning onsite sewage systems, cross-connections, and failing sewer lines, as well as improperly managed excrement from homeless encampments. Following are related findings:

- Fecal coliform pollution has been identified within many of Olympia's water bodies. The Utility's ambient monitoring indicates that some streams (Indian, Mission, and Moxlie) have had chronic problems since monitoring began in the early 1990s. The Utility's testing has indicated that other streams had little or only limited problems with fecal coliform pollution.
- Specific sections (reaches) of most Olympia streams (except for the Black Lake Ditch) have been placed on the 303(d) list of impaired waters for failure of fecal coliform tests (see **Table 7.1**). The 303(d) list is based on data collected over a limited time.
- Over the past 20-plus years, numerous illicit connections between the City's wastewater system and the stormwater system have been identified and eliminated. This has resulted in fewer failures of fecal coliform tests.
- The Utility performed dry weather outfall monitoring on several streams (Mission, Indian, Ellis, Percival, and Moxlie) in 2010 - 2012. This monitoring was performed specifically to identify possible illicit connections with the wastewater system. No dry weather flows were identified, indicating that continued fecal coliform problems in these streams are most likely not caused by illicit connections to the wastewater system.
- Earlier correlation analysis (2010 GIS Basin Analysis) failed to demonstrate a correlation between onsite sewage system density and the water quality problems indicated by a low Water Quality Index. The lack of correlation does not necessarily indicate that failing onsite systems aren't causing problems, since it may only take one failing onsite system nearby to cause a stream to fail fecal coliform monitoring tests.
- The Henderson TMDL requires that Olympia:
  - Monitor fecal coliform levels from stormwater discharging from the Taylor Wetlands stormwater treatment facility just south of Interstate 5.
  - Maintain a Stop and Scoop station on Woodard Creek, to include signs, pet waste collection baggies, and an information rack.
- The Deschutes TMDL recommends that Olympia:
  - Develop a plan to reduce bacteria and sediment loading with a schedule of prioritized projects.
  - Conduct source identification of potential bacteria pollutants and fix potential bacteria pollutant sources such as cross-connected infrastructure, recreational users, and homeless

populations. These actions apply in the Black Lake Ditch, Ellis, Indian, Mission, Moxlie, Percival, Schneider, and Woodard basins.

- Continue to develop and implement pet waste reduction programs through existing education and outreach efforts. These actions apply in Ellis, Indian, Mission, Moxlie, and Schneider Creek basins.
- In coordination with regional partners, develop and implement a strategy for converting onsite sewage systems in high priority/high density neighborhoods within the urban area to sewer. Chambers Lake and Chambers Creek are sensitive areas that are high priority for this action. This action is being led by the Olympia Wastewater Utility.

### ***Nutrients (Nitrogen and Phosphorous)***

Nitrogen and phosphorus are common constituents of fertilizers, animal waste, and sewage. Both are essential for plant life. Excess nitrogen can cause eutrophication (a reduction in dissolved oxygen) in marine water bodies. Excess phosphorus can cause eutrophication in fresh water bodies. The following findings are related to nutrients in Olympia's water bodies:

- Nitrogen concentrations in many Olympia streams are high enough to indicate that they are caused by human sources, such as onsite sewage systems, lawn fertilizers, and agriculture operations.
- Nitrogen concentrations above water quality standards do not contribute to surface water quality problems in freshwater systems (lakes, streams, wetlands), since nitrogen is not the limiting nutrient.
- Nitrogen can contribute to water quality problems in saltwater systems such as Puget Sound. Excess nitrogen in saltwater systems causes algae blooms, which then can lead to low dissolved oxygen levels.
- Nitrogen from numerous sources have contributed to low dissolved oxygen levels in portions of Budd Inlet. Modeling has indicated the worst problems are found in East Bay, where low dissolved oxygen levels are exacerbated by poor circulation.
- Ecology's modeling demonstrates that loading from outside the South Sound (1,500 kg/day), the Deschutes River (672 kg/day), and the LOTT Clean Water Alliance wastewater management service area (167 kg/day) each have a greater impact than the total nitrogen loads from all of Olympia's streams combined (145 kg/day).
- The cost effectiveness of identifying and eliminating appreciable sources of nitrogen from the smaller streams in Olympia suggests that eliminating comparable amounts of nitrogen from the other known sources would be a more effective strategy.
- Phosphorus concentrations have at times been identified as a cause of localized water quality problems primarily in freshwater lake systems in Olympia. Phosphorus has also been a limiting factor to water quality in Moxlie and Mission Creeks. Recent regulations that have reduced or eliminated phosphorus from household detergents and lawn fertilizers throughout Puget Sound are expected to greatly reduce water quality problems associated with excess phosphorus.
- The Henderson TMDL required that Olympia control phosphorus sources to protect or improve dissolved oxygen levels in Woodard Creek.
- The Deschutes TMDL recommends that Olympia:
  - Work with commercial businesses to identify pollution sources and best management practices needed to prevent discharge of TMDL pollutants of concern (including nutrients) to the municipal stormwater system (MS4).

- Quantify nutrient sources in Chambers Creek, a tributary to the Deschutes River with elevated nitrogen.
- In appropriate areas, require low impact development (LID) for future development, with particular attention to reducing nutrient contributions below current levels.

### *Acidity/Alkalinity (pH)*

The acidity or alkalinity of a water body is measured by pH. The range goes from 0-14, with 7 being neutral. The pH of water determines the solubility (amount that can be dissolved in the water) and biological availability (amount that can be utilized by aquatic life) of chemical constituents such as nutrients (phosphorus, nitrogen, and carbon) and heavy metals (lead, copper, cadmium, etc.). Fish and other aquatic species thrive in water with pH values between 6.5 and 8.5. When pH values are outside this range, other contaminants in the water may become more harmful to aquatic life.

- Monitoring results indicate only Black Lake Ditch requires actions be taken to address pH. Ellis, Indian, Moxlie and Woodard Creeks have also been listed as waters where there is some evidence of a pH water quality problem.

### *Total Suspended Solids*

High levels of total suspended solids are a common, but typically short-term problem associated with land disturbing activities. Particles in stormwater runoff can carry harmful chemicals such as nutrients, pesticides, heavy metal precipitates, biological solids, and other toxins into surface water bodies. Cloudy or muddy water can keep fish from finding food; the tiny particles in the water irritates their gills, limiting their ability to absorb oxygen.

- No water bodies are listed for total suspended solids. Problems with total suspended solids are addressed through enforcement of Olympia's erosion and sediment control program, street sweeping, and removal of sediment from catch basins, ponds, and treatment facilities.
- The Deschutes TMDL recommends that the City work with commercial businesses to identify pollution sources and best management practices needed to prevent discharge of TMDL pollutants of concern (including total suspended solids) to the municipal stormwater system (MS4).

### *Dissolved Oxygen*

Dissolved oxygen (DO) is a measure of how much oxygen is dissolved in water. Like terrestrial animals, fish and other aquatic species need oxygen to live. A certain minimum amount of oxygen must be present in water for aquatic life to survive. When the amount of dissolved oxygen drops below normal levels in water bodies, water quality is harmed and creatures begin to die off, in a process called eutrophication. Dissolved oxygen issues in freshwater are typically related to elevated water temperatures, since cold water can hold more dissolved oxygen than warm water. In winter and early spring, when the water temperature is low, the dissolved oxygen concentration is high. In summer and fall, when the water temperature is high, the concentration is low.

- Black Lake Ditch, Percival Creek, Woodard Creek, Woodland Creek, and Budd Inlet have all been listed for DO.
- DO problems in Black Lake Ditch and Percival Creek are assumed to be associated with temperature. Refer to the following section regarding temperature for actions to be taken.
- To correct DO in Woodard Creek, the Henderson TMDL requires Olympia to:
  - Monitor, and if necessary source trace, fecal coliform discharging from Taylor Wetlands.
  - Maintain a Stop and Scoop station to include signs, pet waste collection baggies, and an information rack.
  - Require phosphorus control water quality treatment for development within the Woodard Creek basin.

## Temperature

Fish of the salmon family (salmonids) depend on cool, oxygenated water to survive. If a stream is too warm it cannot hold as much dissolved oxygen, and low dissolved oxygen can stress or kill juvenile and adult fish. Ecology is required to protect salmonids listed as threatened or endangered under the Endangered Species Act (ESA) or identified as a beneficial use in State water quality standards.

- Monitoring results indicate actions need to be taken to reduce temperatures in Black Lake Ditch and Percival Creek. Fully established riparian vegetation could possibly lower the water temperature in these water bodies. Riparian vegetation currently provides good shade along Percival Creek within the City, and the Utility has made significant efforts to establish riparian vegetation along Black Lake Ditch. The temperature in Black Lake Ditch and to some extent Percival Creek is also highly affected by temperatures upstream in Black Lake.
- The Deschutes TMDL recommends that Olympia:
  - Condition future shoreline development permits to maintain or enhance riparian conditions along Percival Creek.
  - Prioritize and implement riparian and channel restoration projects on City-owned properties as funding is available.
  - Preserve existing riparian vegetation, and restore areas with young or no vegetation.
  - Reduce anthropogenic sources of heat through implementation of the City's Drainage Design and Erosion Control Manual. Where feasible, actions include: retaining runoff and encouraging infiltration, and increasing native vegetative cover in sensitive areas.

## Non-Monitored Stormwater Pollutants from Roadways

Many pollutants found in stormwater are not monitored, for example petroleum, metals, and PAHs (poly-aromatic hydrocarbons). Given the complexity and expense of monitoring for these substances, Ecology conducted a series of in-depth studies that measured these and other substances. The resulting data was then correlated to land use practices, such as road classification and traffic intensity. With this information, the Utility can target new infrastructure and programs to best manage for these pollutants.

Key findings are:

- Greater loading of stormwater pollutants are closely correlated with higher traffic counts (average daily trips or ADTs), area of "pollution generating impervious surfaces," and lack of stormwater controls.
- The greatest pollutant potential is from the high traffic routes (arterials and collectors) in the Moxlie, Woodard, West Bay, and Indian Creek Basins.
- The Deschutes TMDL recommends that Olympia work with commercial businesses to identify pollution sources and best management practices needed to prevent discharge of TMDL pollutants of concern to the municipal stormwater system (MS4).

## Special Studies

The Utility occasionally conducts short-term studies to explore a specific problem, such as potential pollution from stormwater outfalls, macroinvertebrates in freshwater, and phytoplankton in marine waters. These studies are described below, and in **Appendix 3**.

### Outfall Reconnaissance

Between 2010 and 2013, Utility staff inspected all known outfalls from the City's stormwater drainage system into Percival, Mission, Indian, Moxlie, and Ellis Creeks.

The intent of this monitoring work was to identify areas of obvious pollution or non-stormwater discharges. By performing dry weather outfall inspections in late summer, staff can identify potential "non-

stormwater” discharges without the need for laboratory analysis, under the assumption that flows from outfalls during dry weather are potentially from illicit connections.

No “non-stormwater” discharges were discovered in Percival, Mission, Indian, nor Ellis. This finding confirms the results of previous outfall reconnaissance.

Since large portions of Moxlie Creek are within a pipe, the reconnaissance was largely performed with televising equipment. During this assessment staff did identify dry-weather discharges. Follow up source tracing in suspect upstream manholes and sampling did not result in the discovery of evidence of illicit connections. It is assumed the flow was associated with artesian flows.

### ***Aquatic Species Studies***

The Utility also uses biological indicators to assess water quality. Stream Team volunteers often participate in these studies. For details, see **Chapter 8, Section 8.1**.

- **Benthic Macroinvertebrates in Streams.** One indicator of stream health is the quantity and diversity of benthic macroinvertebrates like insects, crustaceans, worms, snails and clams, found in or near the stream bed. Macroinvertebrate samples are collected and sent to a laboratory where they are identified and counted, and the resulting data is converted into an index score called a Benthic Index of Biotic Integrity (B-IBI).
- **Phytoplankton in Budd Inlet.** The microscopic plants that form the base of the aquatic food web are also important indicators of water quality. The Utility has worked with the Pacific Shellfish Institute to monitor phytoplankton in Budd Inlet since 2013. Each year, approximately 15 sampling events have been conducted from mid-June through September. The resulting data is compiled and shared with the NOAA/Sea Grant’s Sound Toxins volunteer monitoring program.

## **7.5 Challenges**

The Utility faces many challenges when it comes to maintaining and improving water quality. The greatest challenges include a legacy of development without adequate water quality treatment, increasing urbanization, increasing regulatory requirements, a society built around motor vehicles, widespread use of chemicals, and a public with limited knowledge of water quality.

### **Legacy Developments**

Most of Olympia’s stormwater infrastructure was constructed prior to the current rigorous storm drainage design regulations. Before 1991, both public and private land was typically constructed with little or no water quality treatment. As a result, infrastructure serving much of the City will eventually need to be retrofitted to meet current standards. This will be a slow and expensive endeavor.

The Utility is slowly retrofitting drainage facilities along high-traffic corridors, and private property owners are required to meet current standards during re-development. Providing water quality treatment through a retrofit is more difficult than with original construction. The Utility projects that providing enhanced water quality treatment will cost over \$50,000 per acre and approximately \$500 per acre per year to maintain. Low Impact Development (LID) holds promise for retrofitting, but poorly drained soils like glacial till and shallow groundwater underlying much of the City will pose challenges.

### **Land Development Pressure**

To protect agriculture and natural resources, including habitat, Washington’s Growth Management Act (GMA) requires population growth to be focused in urban growth areas like Olympia. In addition to conserving rural areas, the GMA requires cities to protect critical areas within their boundaries. Increasing population density creates challenges for water quality; it also provides opportunities for additional water quality treatment, since new development and redevelopment are required to meet current standards.

### **Increasing Permit Requirements**

Management of stormwater is a relatively new concept. As further scientific research and TMDL studies are performed, the Utility can expect ever-tightening regulations and oversight intended to solve water quality problems. Currently, approximately half of what the Utility does and spends is driven by the City's NPDES Municipal Stormwater Permit. This can only be expected to increase. It is difficult to know what new ideas will compel changes to permit requirements. To prepare for and embrace change as it comes, the Utility closely monitors and participates in the development of water quality regulations.

### **Reliance on Individual Choices**

Modern society is dependent on motor vehicles and chemicals, which are major sources of nonpoint pollution. Whether water quality improves or declines depends largely on how individual citizens manage daily activities like driving habits, vehicle maintenance, lawn care, pet care, onsite sewage system maintenance, and use and handling of toxic chemicals. The Utility's ability to influence such individual choices is limited, although education and outreach efforts can help citizens understand the implications of their actions and make proper decisions.