Appendix 2 Basin Characteristics

Budd Inlet East Bay Basin

Budd Inlet Peninsula Basin

Budd Inlet West Bay Basin

Capitol Lake Basin

Chambers Creek Basin

Deschutes Basin

Eld Inlet Basin

Ellis Creek Basin

Green Cove Creek Basin

Indian Creek Basin

LOTT Basin

Mission Creek Basin

Moxlie Creek Basin

Percival Creek Basin

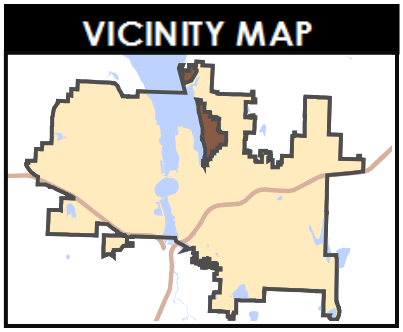
Schneider Creek Basin

Ward Lake Basin

Woodard Basin

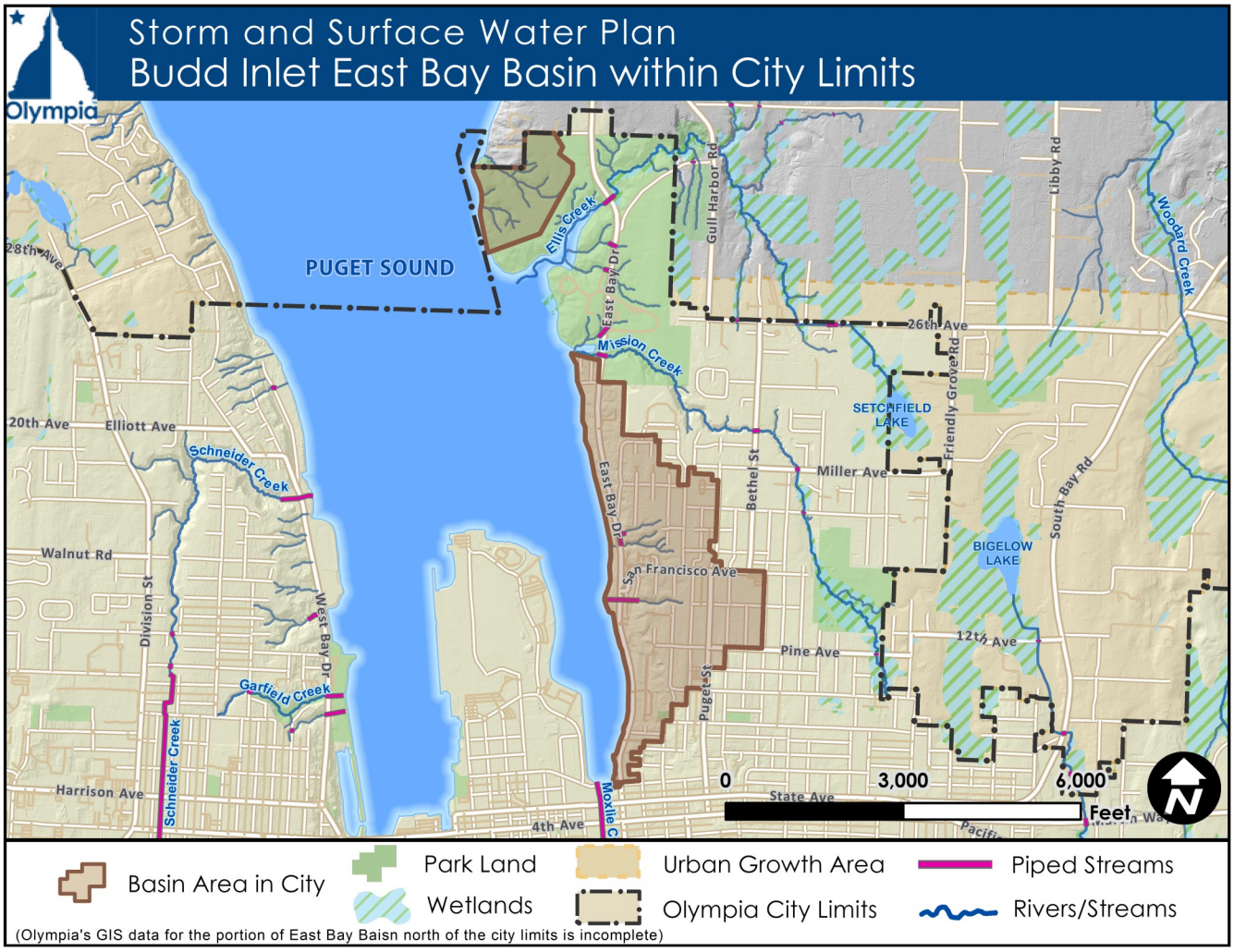
Woodland Creek Basin

Budd Inlet East Bay Basin



Physical Characteristics

The Budd Inlet East Bay Basin is 274 acres inside the city limits. The basin includes 46 acres within Priest Point Park and 229 acres of residential land south of the park. The basin also includes 1.7 miles of marine shoreline. Elevations in the basin extend from sea level to 190 feet. Several small seasonal streams located in ravines along East Bay Drive drain the basin into Budd Inlet.



Basin Concerns

Portions of Budd Inlet do not meet water quality standards for dissolved oxygen due to numerous sources of nitrogen. Low dissolved oxygen in East Bay is exacerbated by poor circulation. Urban residential, commercial, recreational, and industrial uses also contribute to the East Bay basin's water quality issues.

(Department of Ecology website: http://www.ecy.wa.gov/programs/wq/tmdl/deschutes/BudiInletTMDL.html, 2017).

Key Basin Elements

Total Basin = 2,442 acres

Basin in City = 274 acres

Marine Shoreline in City = 1.7 miles

Wetlands in City* = 0.02 acres

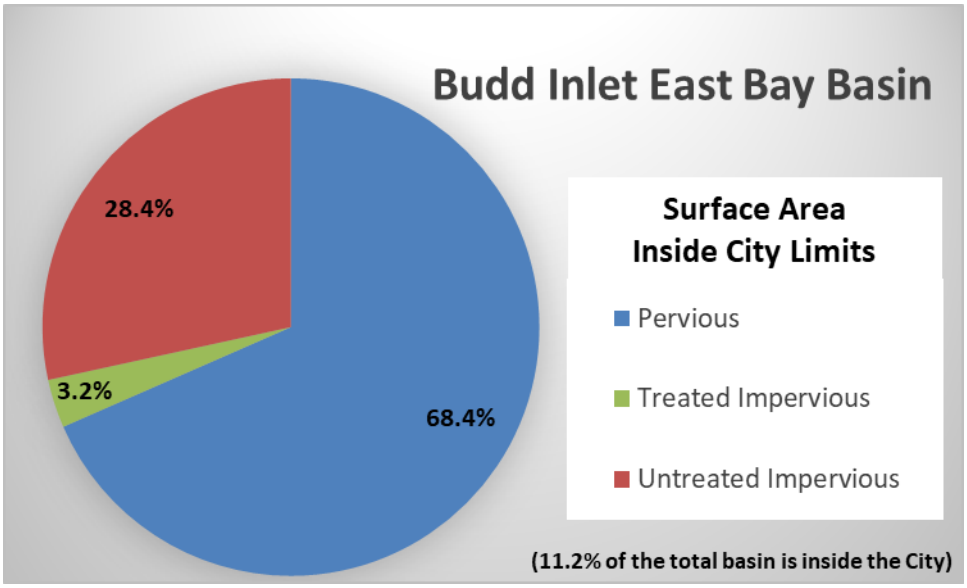
Pervious in City = 188 acres

Impervious in City = 86 acres

Treated Impervious in City = 9 acres

Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data.

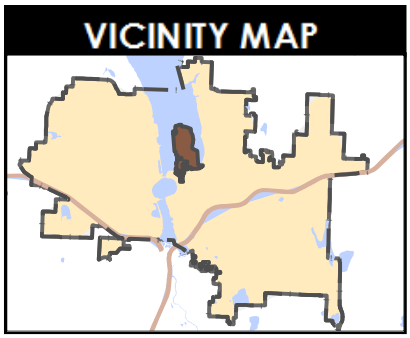
*National Wetlands Inventory Mapping, 2017



Source: Olympia_basemap.DBO.Topo_HardSurface, 2015, City of Olympia GIS data.

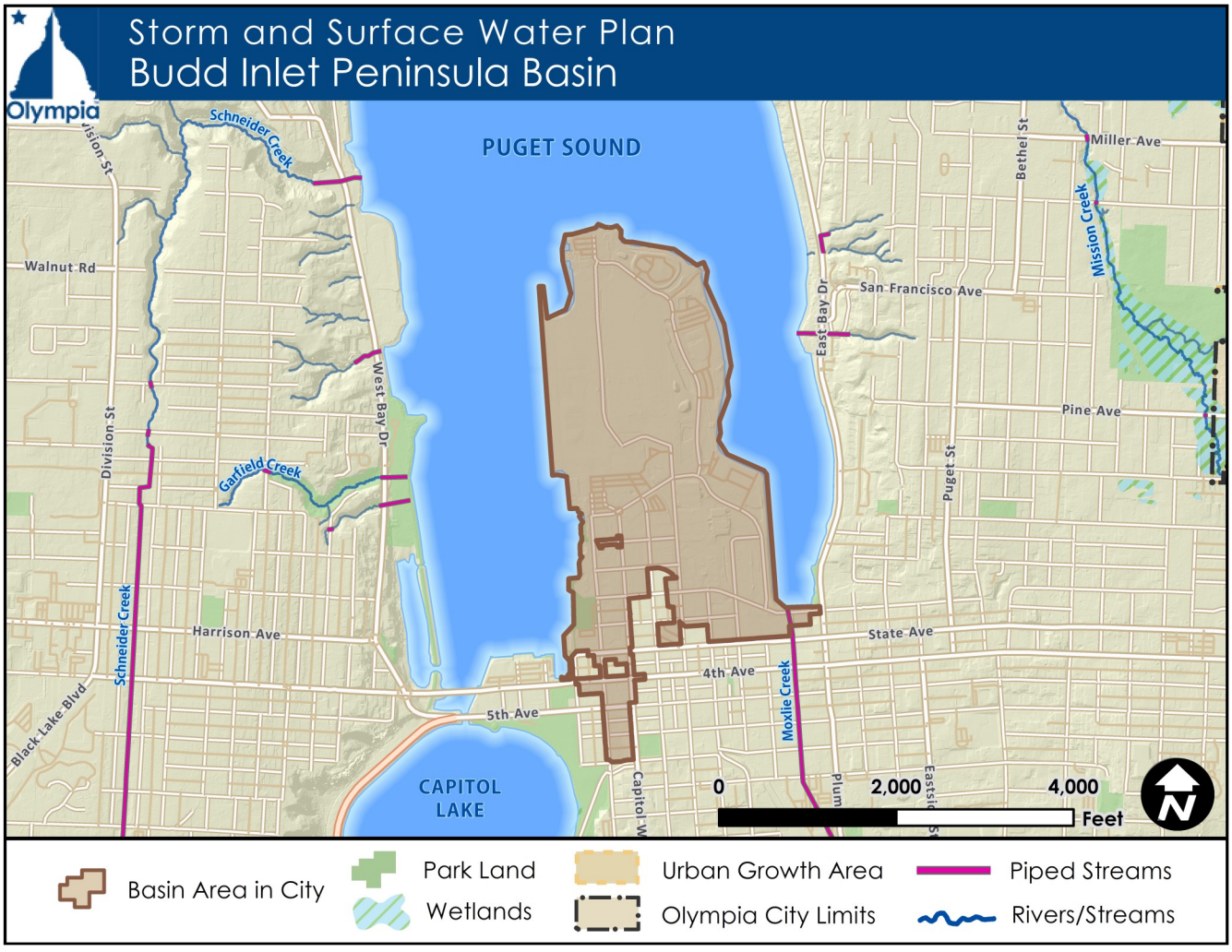
Because no specific stream is associated with the Budd Inlet Peninsula Basin, there are no WQI or BIBI charts.

Budd Inlet Peninsula Basin



Physical Characteristics

Budd Inlet is the southernmost section of Puget Sound. Olympia's Budd Inlet Peninsula Basin is 214 acres. Its area consists of the Port of Olympia, the LOTT Clean Water Alliance Budd Inlet treatment plant, Port Plaza, Olympia Farmers Market, Percival Landing, Swantown Marina, and a small part of downtown Olympia. The majority of the upland was created by historic filling of tidal mudflats. Elevations range from sea level to 20 feet. The basin is zoned Industrial and Urban Watershed. Twenty-five stormwater pipes outfall to Budd Inlet from this basin.



Basin Concerns

Budd inlet is on the 303(d) list of impaired water bodies due to certain portions that do not meet water quality standards for dissolved oxygen. Urban residential, commercial, recreational, and industrial uses contribute to Budd Inlet's water quality issues.

(Source: Thurston County Water Resources Monitoring report, 2016 and Department of Ecology, "Assessed Waters/Sediment." **Map Water Quality Data**. 2016).

Key Basin Elements

Total Basin = 214 acres

Basin in City = 214 acres

Wetlands in City* = 0 acres

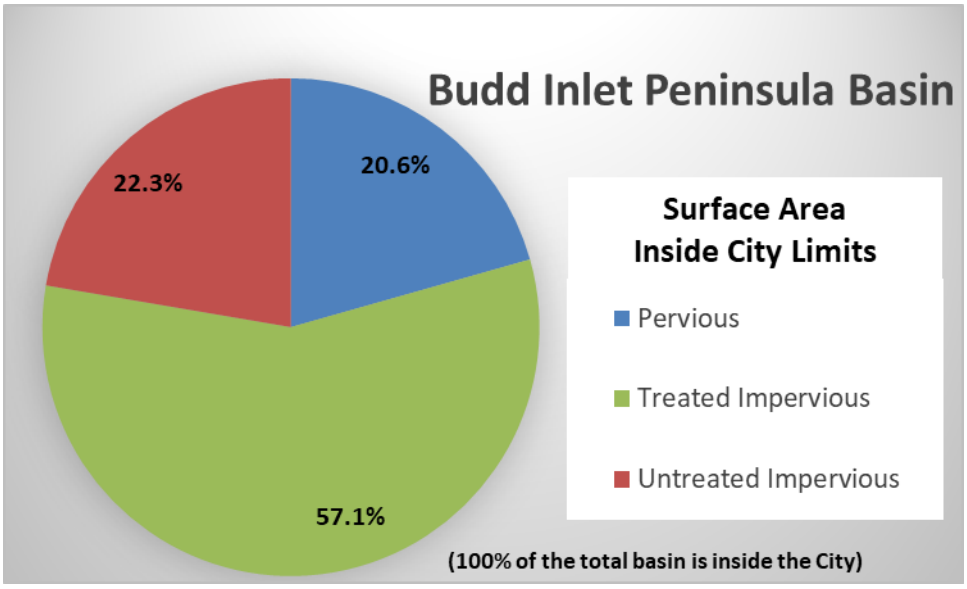
Pervious in City = 44 acres

Impervious in City = 170 acres

Treated Impervious in City = 122 acres

Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data.

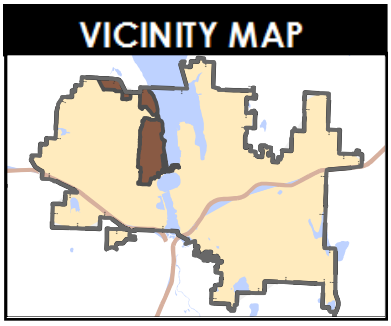
*National Wetlands Inventory Mapping, 2017



Source: Olympia_basemap.DBO.Topo_HardSurface, 2015., City of Olympia GIS data

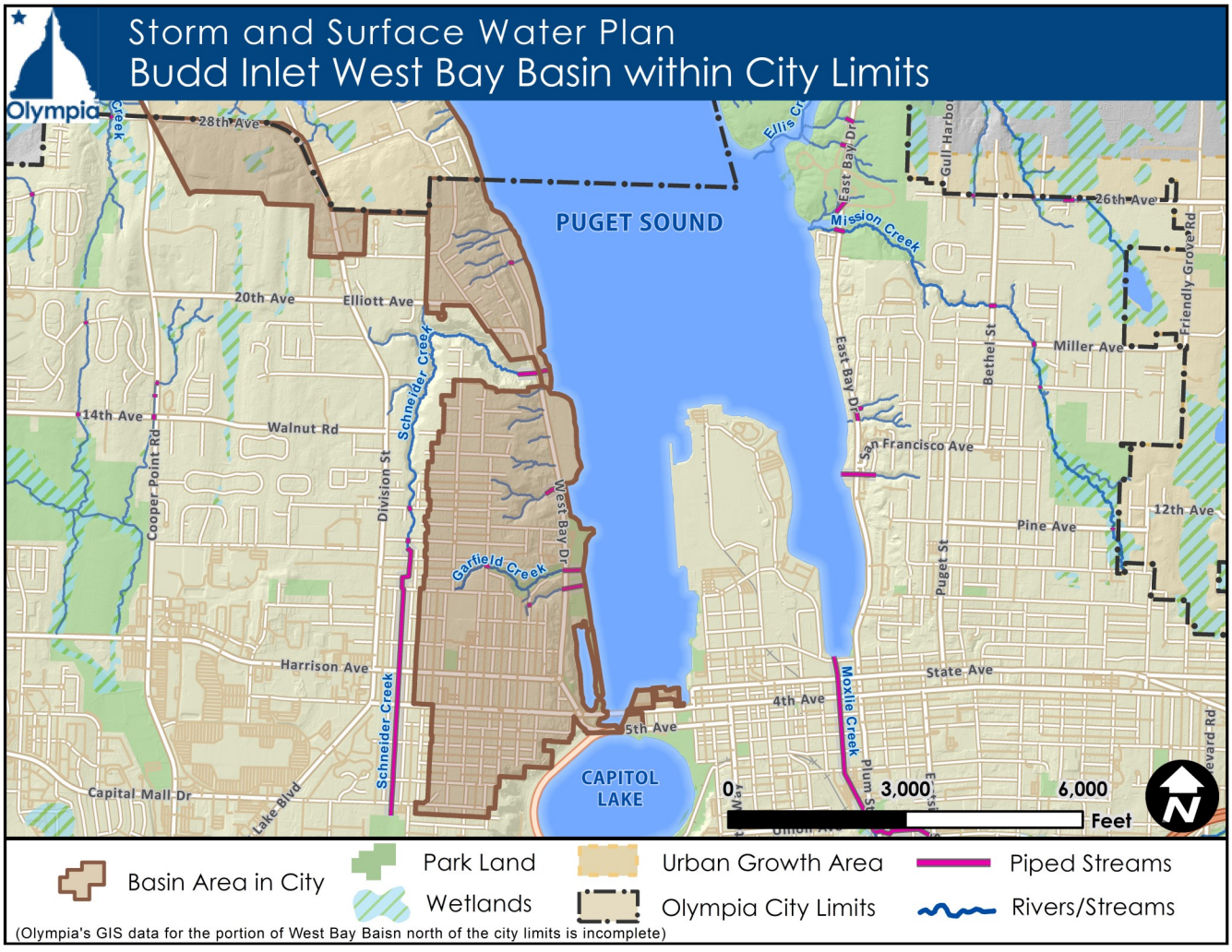
Because no specific stream is associated with the Budd Inlet Peninsula Basin, there are no WQI or BIBI charts.

Budd Inlet West Bay Basin



Physical Characteristics

The West Bay Basin is just over 2,000 acres and is split by the Schneider basin into two sub units. The basin includes approximately 3.1 miles of shoreline within the city limits. The western uplands of the basin slope gently to the east and then descend rapidly 100 plus feet to West Bay Drive. The basin includes Garfield Creek and several seasonal streams discharging directly to West Bay via piped outfalls. Land use is urban residential and professional offices.



Basin Concerns

Portions of Budd Inlet do not meet water quality standards for dissolved oxygen due to numerous sources of nitrogen. Urban residential, commercial, recreational, and industrial uses contribute to the West Bay Basin's water quality issues.

None of the small streams along West Bay that discharge directly into Budd Inlet are monitored. Increasing development in the basin has the potential to impact flood volumes.

(Source: Thurston County Water Resources Monitoring report, 2016 and Department of Ecology, "Assessed Waters/Sediment." **Map Water Quality Data**. 2016).

Key Basin Elements

Total Basin = 2,005 acres

Basin in City = 591 acres

Marine Shoreline in City = 3.1 miles

Wetlands in City* = 3 acres

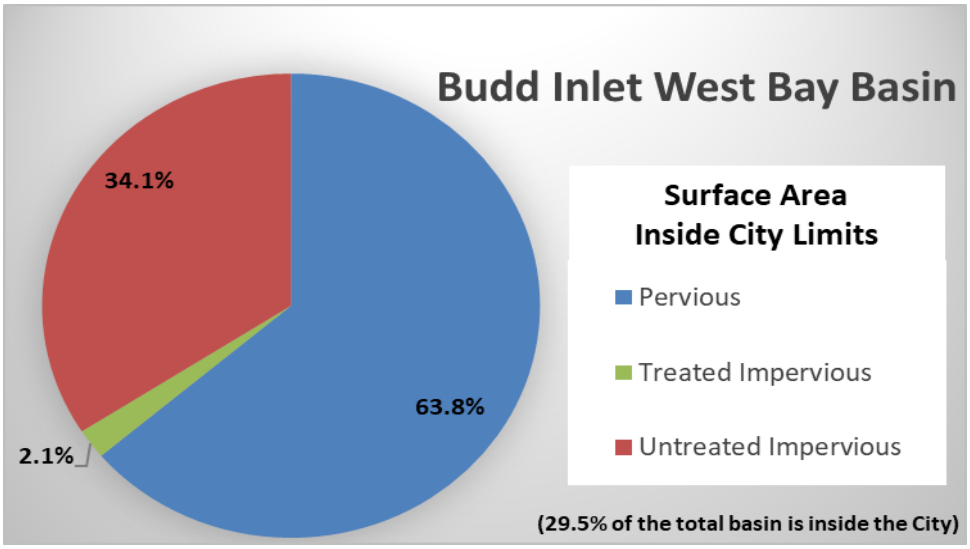
Pervious in City = 377 acres

City Impervious = 214 acres

City Treated Impervious = 12 acres

Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data.

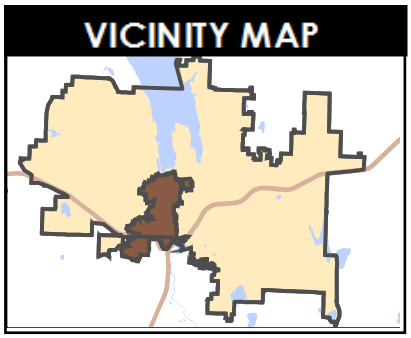
*National Wetlands Inventory Mapping, 2017



Source: Olympia_basemap.DBO.Topo_HardSurface, 2015, City of Olympia GIS data.

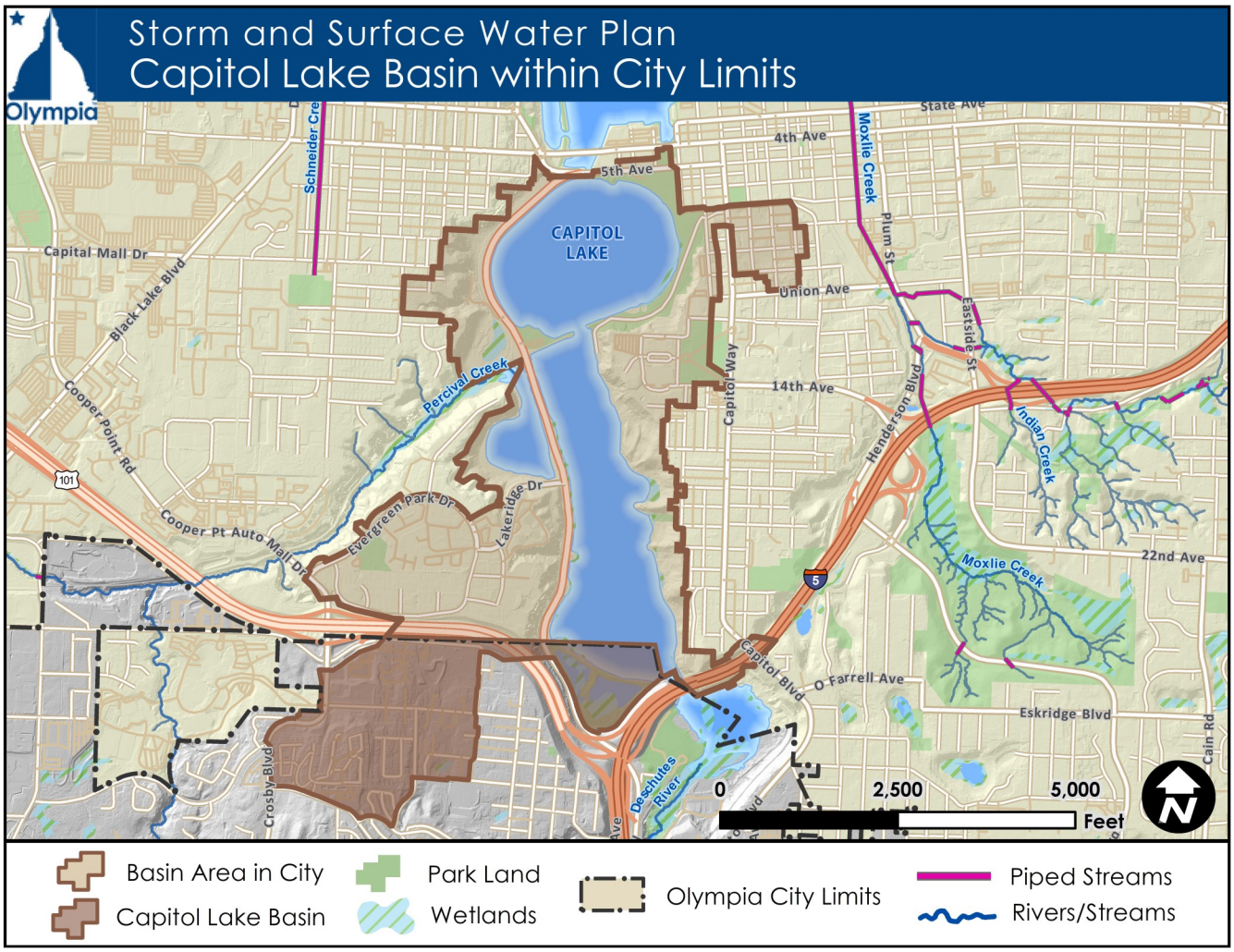
Because no specific stream is associated with the Budd Inlet West Bay Basin, there are no WQI or BIBI charts.

Capitol Lake Basin



Physical Characteristics

Capitol Lake was formed in 1951 as an impoundment of the Deschutes Estuary to create a reflecting pool for the State Capitol building. The Capitol Lake Basin is 519 acres and receives water from Percival Creek and the Deschutes River. Capitol Lake itself is 270 acres in size. 157 acres of the basin are within Tumwater. More than 50 stormwater pipes (41 owned by the State of Washington) outfall to Capitol Lake. Elevations in the basin range from sea level to 400 feet. The basin includes portions of the Capitol Campus and downtown, Courthouse Hill, Heritage Park and very limited residential areas.



Basin Concerns

Capitol Lake is on the 303(d) list of impaired water bodies and does not meet water quality standards for dissolved oxygen and bacteria. Urban residential, commercial, recreational, and industrial uses contribute to its water quality issues. The Washington State Department of Enterprise Services is heading a separate process for long-term planning and management of Capitol Lake.

(Source: Thurston County Water Resources Monitoring report, 2016 and Department of Ecology, "Assessed Waters/Sediment." **Map Water Quality Data**. 2016).

Key Basin Elements

Total Basin = 519 acres

Basin in City = 378 acres

Capitol Lake in City = 270 acres

Wetlands in City* = 7 acres

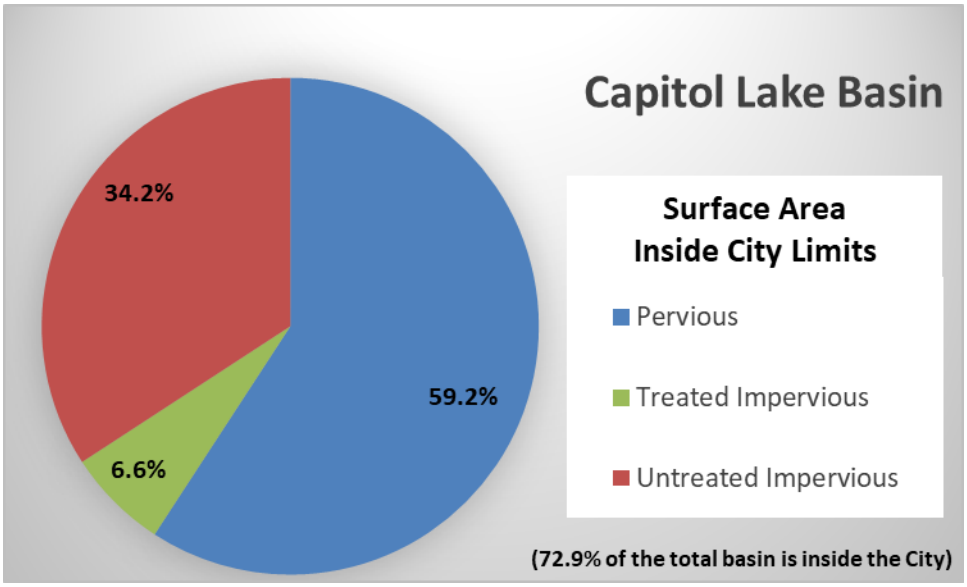
Pervious in City = 224

City Impervious = 154 acres

City Treated Impervious = 25 acres

Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data.

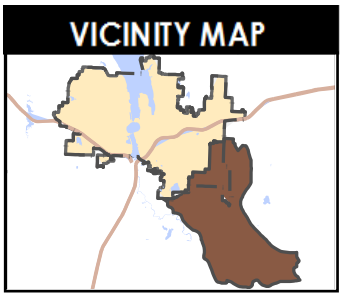
*National Wetlands Inventory Mapping, 2017



Source: Olympia_basemap.DBO.Topo_HardSurface, 2015., City of Olympia GIS data

Because no specific stream is associated with the Capitol Basin, there are no WQI or BIBI charts.

Chambers Creek Basin

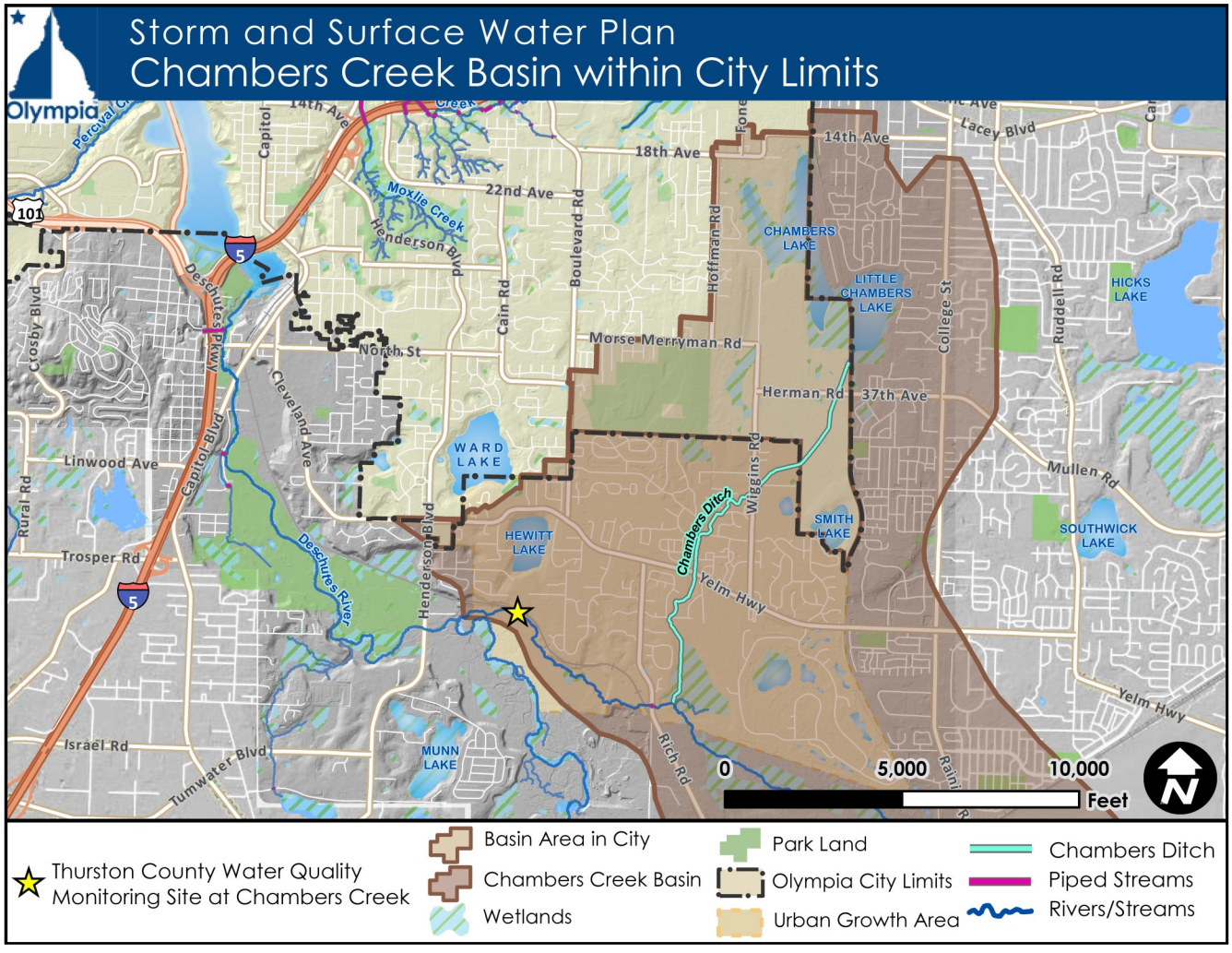


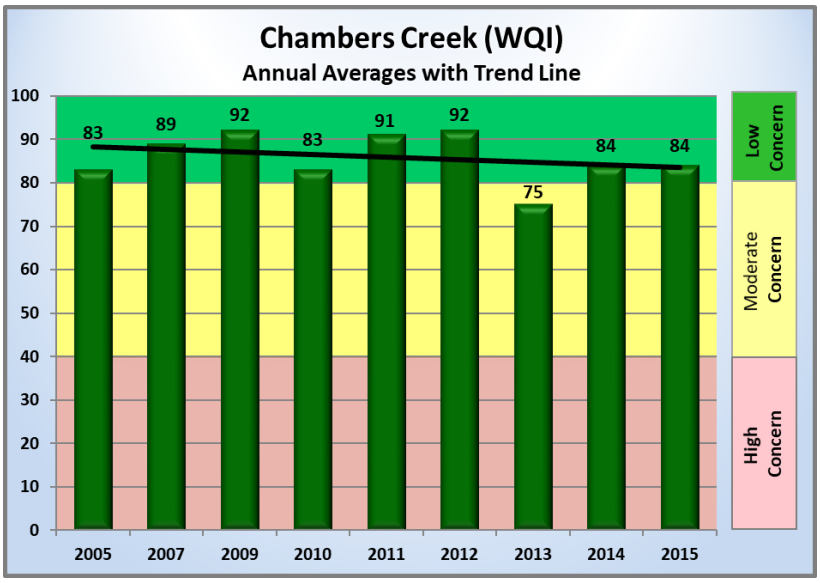
Physical Characteristics

The Chambers Basin is located in southeast Olympia. The basin covers 7,559 acres, ranging in elevation from 110' to 320' above sea level, and spans from the north end of Chambers Lake to Chambers Creek at the basin's southern end. The basin is primarily level prairies. Slopes generally range from 0 to 3 percent. Several kettles located in the basin contain lakes that are groundwater fed with no natural inlets or outlets.

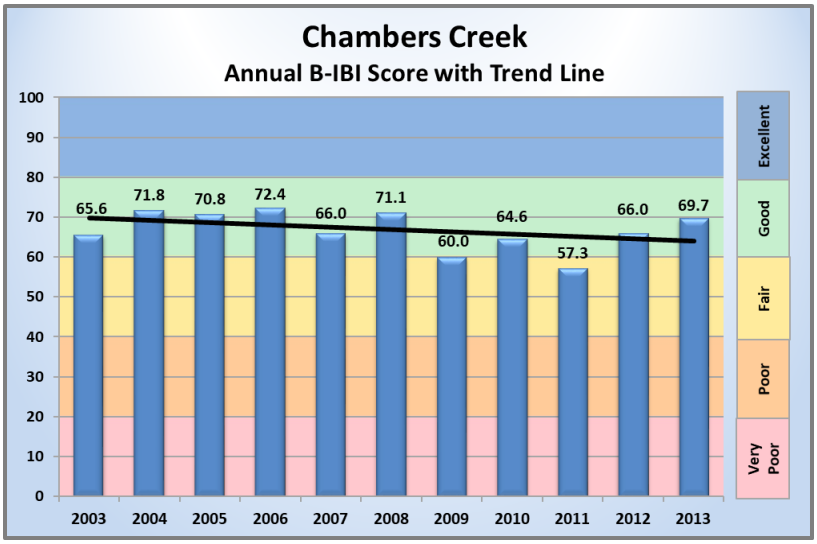
The Chambers/Little Chambers Lake complex is 121 acres making it the largest waterbody in the Basin. The construction of the Chehalis-Western railroad, completed in 1927, divided Chambers Lake into two lakes separated by a narrow 500' long channel. The western side of Chambers Lake is mostly within the City limits and is approximately 63 acres with a maximum depth of 5 feet. Little Chambers Lake is not within the City limits. Shallow aquifers lie underneath and surround the lakes. Portions of the basin are located in Lacey, Thurston County and Tumwater. The basin is almost exclusively zoned residential.

Chambers Ditch flows south through the northern Chambers basin for approximately 2.5 miles starting from the southern end of Little Chambers Lake to Chambers Creek's south tributary near Rich Rd. With the exception of the first 200 ft. at Little Chambers Lake, the ditch's initial 0.6 miles are within the City limits. The remainder of the ditch is inside the Urban Growth Area. Eventually, Chambers Creek drains into the Deschutes River south of Hewitt Lake.

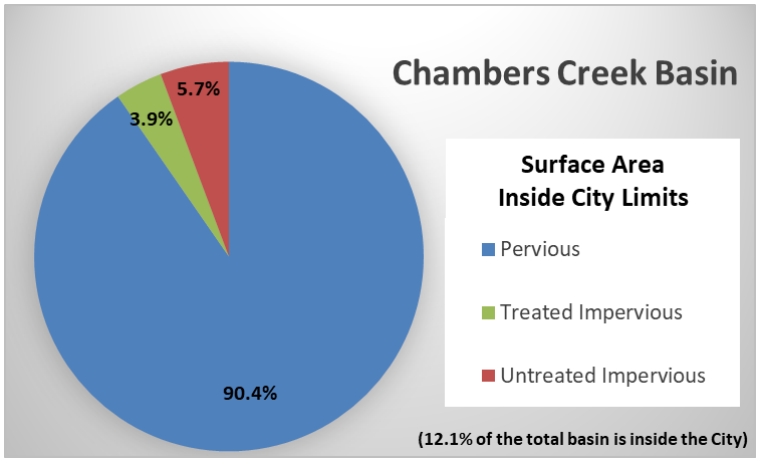




Source: Department of Ecology, "The Water Quality Index Spreadsheet (Version 6)," **A Water Quality Index for Washington State Streams (Version 6: 2014.06.11),** 2016.



Source: Puget Sound Stream Benthos, "Plotting Biotic Integrity." **Analysis: Benthic Index of Biotic Integrity.** 2017.



Source: Olympia_basemap.DBO.Topo_HardSurface, 2015, City of Olympia GIS data.

Basin Concerns

Chambers Basin is not on Ecology's 303 (d) list of impaired water bodies. However, there are concerns due to high nitrate and total phosphorus concentrations. These high concentrations are likely due to impacted groundwater.

(Source: Thurston County Water Resources Monitoring report, 2016 and Department of Ecology, "Assessed Waters/Sediment." **Map Water Quality Data**. 2016).

Key Basin Elements

Total Basin = 7,559 acres

Basin in City = 917 acres

Chambers Lake = 75 acres

Chambers Lake in City = 59 acres

Chambers Creek (Ditch) in City = 0.6 miles

Wetlands in City* = 177 acres

Pervious in City = 828 acres

Impervious in City = 89 acres

Treated Impervious in City = 36 acres

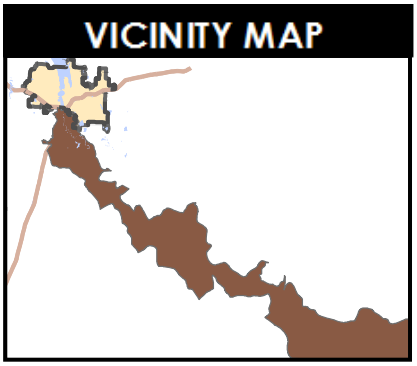
Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data.

*National Wetlands Inventory Mapping, 2017

The water quality sampling and B-IBI sampling locations for Chambers Creek are located in Thurston County.

Olympia

Deschutes Basin

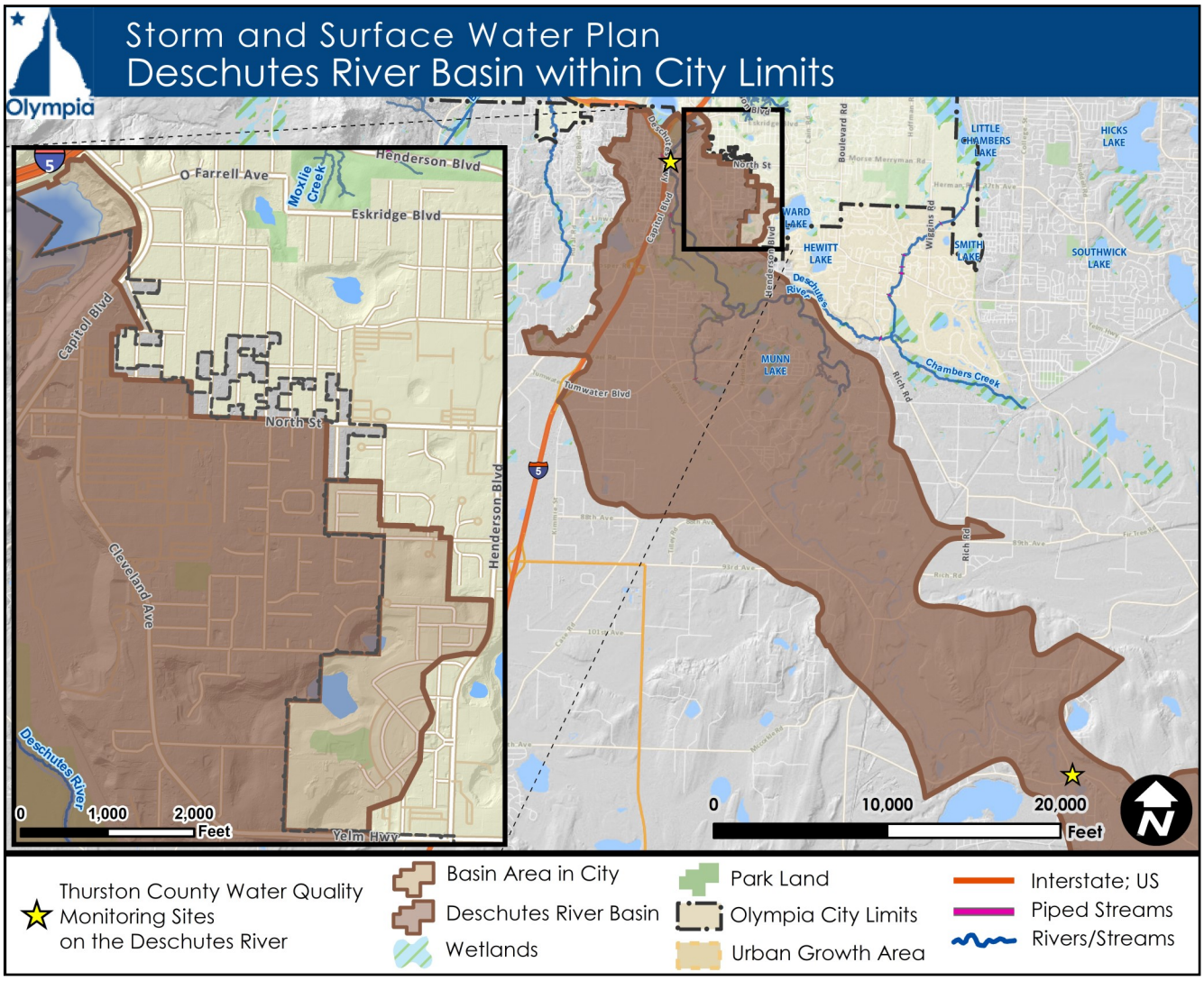


Physical Characteristics

The Deschutes Basin is 162 square miles. Only 112 acres of the basin are located within Olympia's city limits. Within the city limits, the majority of the runoff is captured in kettles connected to the river only by groundwater. The Briggs Village area, for example, is an area that drains into one of these kettles.

The upper Deschutes Basin is forested and has elevations close to 3,800 feet. The Deschutes River flows over 57 miles from its headwaters southeast of the City of Rainier to Capitol Lake then into Budd Inlet. Some slopes at the Deschutes River headwaters are as much as 70 percent.

The mid and lower basin areas include agricultural, rural, residential, and urban lands with slopes between 5 and 30 percent.



Basin Concerns

Parts of the Deschutes River are on Ecology's 303 (d) list of impaired water bodies due to violations for temperature, fecal coliform bacteria, dissolved oxygen, pH, and fine sediment levels. Growth and rural land uses contribute to non-point pollution sources. Summer low-flow causes high temperatures.

(Source: Thurston County Water Resources Monitoring report, 2016 and Department of Ecology, "Assessed Waters/ Sediment." **Map Water Quality Data**. 2016).

Key Basin Elements

Total Basin* = 162 square miles

Basin in City = 112 acres

Deschutes River = 57 miles

Deschutes River in City = 0 miles

Wetlands in City** = 8 acres

Pervious in City = 88 acres

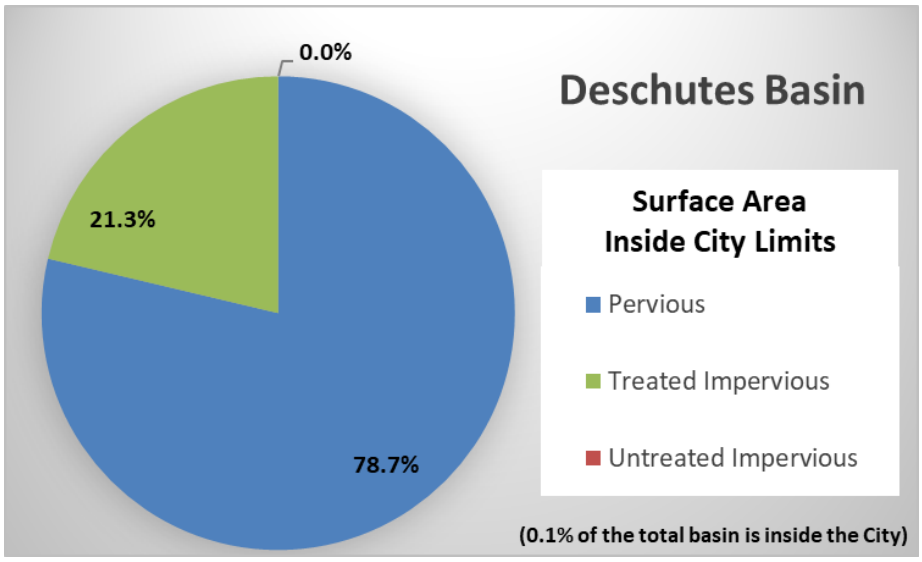
Impervious in City = 24 acres

Treated Impervious in City = 24 acres

Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data.

*Thurston County Water Resources Monitoring report, 2016

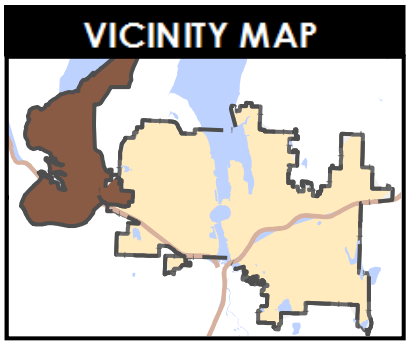
**National Wetlands Inventory Mapping, 2017



Source: Olympia_basemap.DBO.Topo_HardSurface, 2015., City of Olympia GIS data

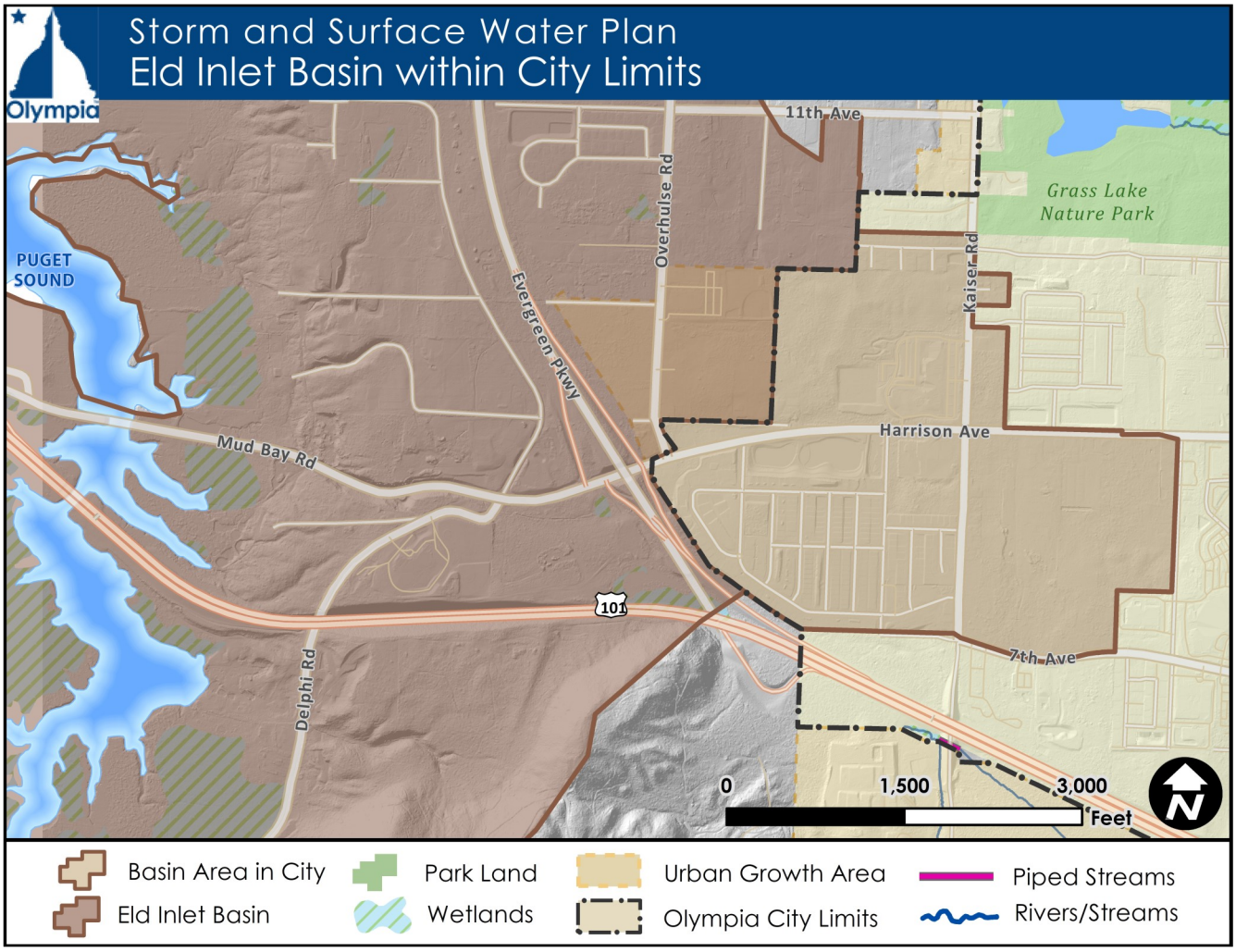
Because no specific stream is associated with the Deschutes Basin, here are no WQI or BIBI charts.

Eld Inlet Basin



Physical Characteristics

The Eld Inlet Basin is located at the western edge of the city limits and extends up the Cooper Point and Steamboat Peninsulas to the inlets mouth. The basin is approximately 23,000 acres. Only 242 acres of the basin are located within the city limits. Stormwater runoff from the area within the city limits is actually captured in a closed depression on the south side of the 4800 block of Harrison Avenue. The closed depression only discharges to Eld Inlet via groundwater. Land use in the basin is forest, agriculture and rural residential.



Basin Concerns

Bacteria is the main concern in the Eld Inlet Basin. However, the basin generally meets the standards for water quality.

(Source: Thurston County Water Resources Monitoring report, 2016 and Department of Ecology, "Assessed Waters/Sediment." **Map Water Quality Data**. 2016).

Key Basin Elements

Total Basin * = 22,912 acres

Basin in City = 243 acres

Wetlands in City** = 0 acres

Pervious in City = 172 acres

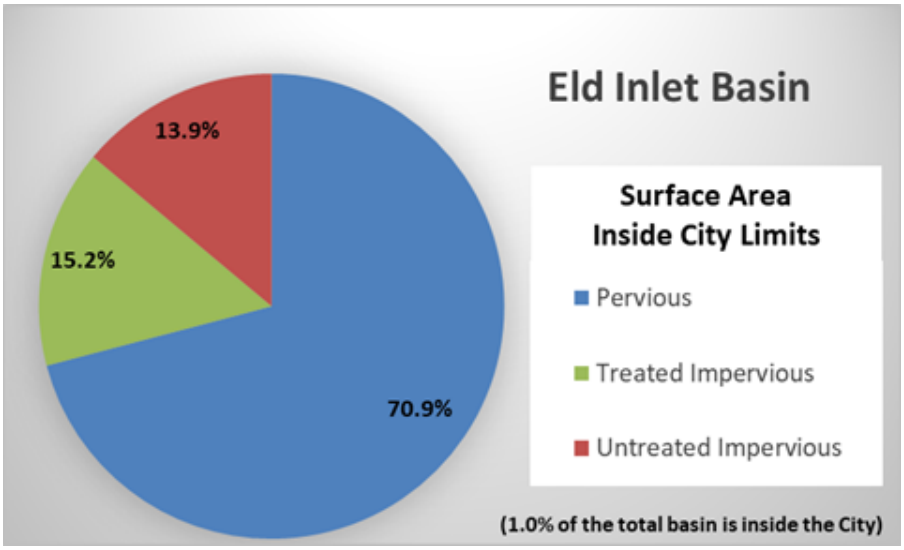
Impervious in City = 71 acres

Treated Impervious in City = 37 acres

Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data.

*Department of Ecology, Water Quality Study Findings (2006).

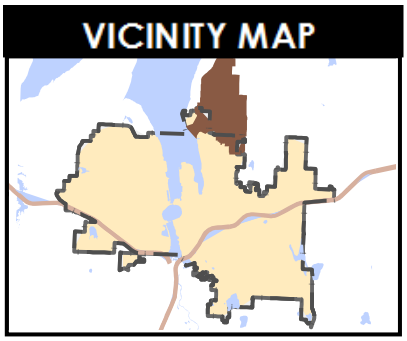
**National Wetlands Inventory Mapping, 2017



Source: Olympia_basemap.DBO.Topo_HardSurface, 2015, City of Olympia GIS data.

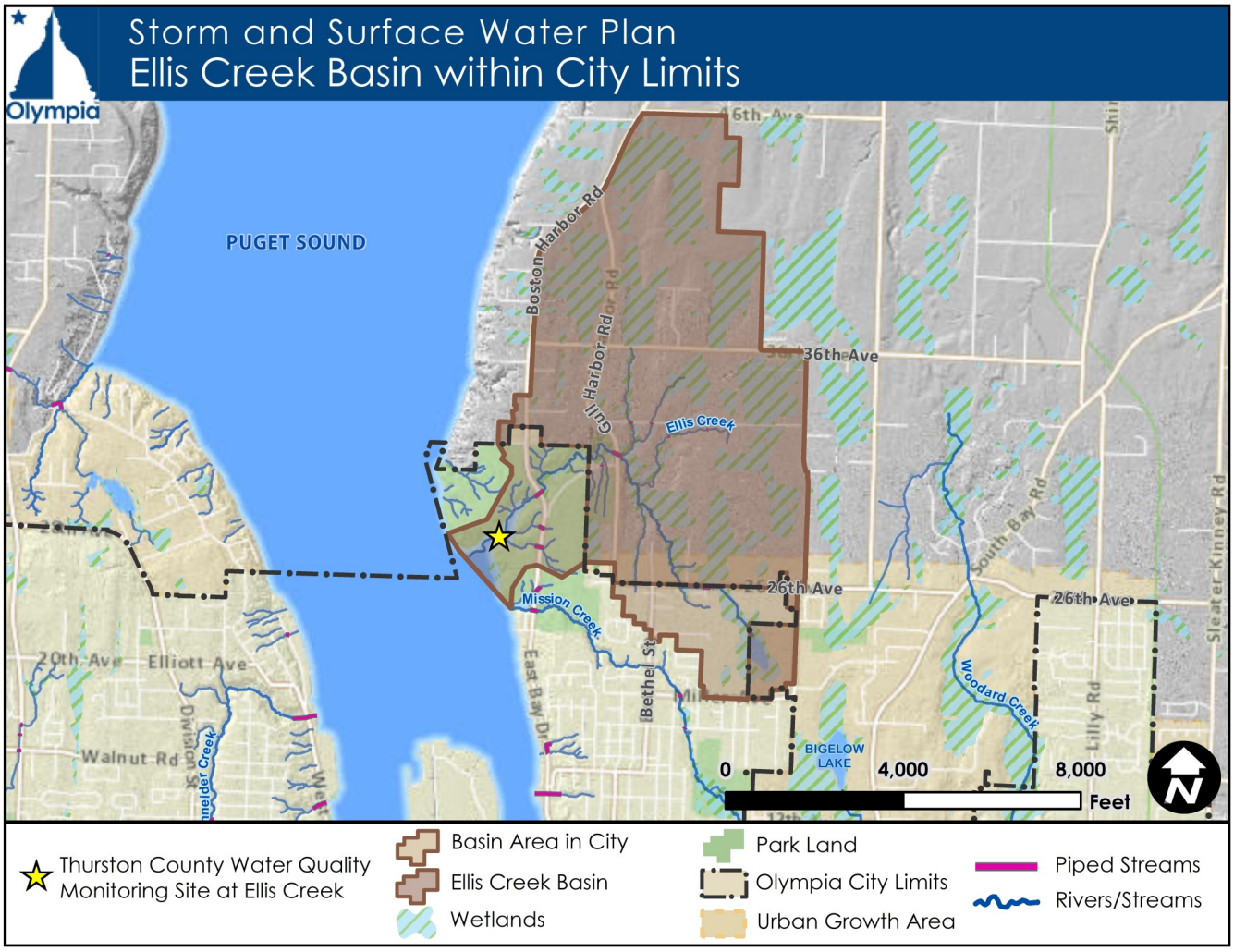
Because no specific stream is associated with the Eld Inlet Basin, there are no WQI or BIBI charts.

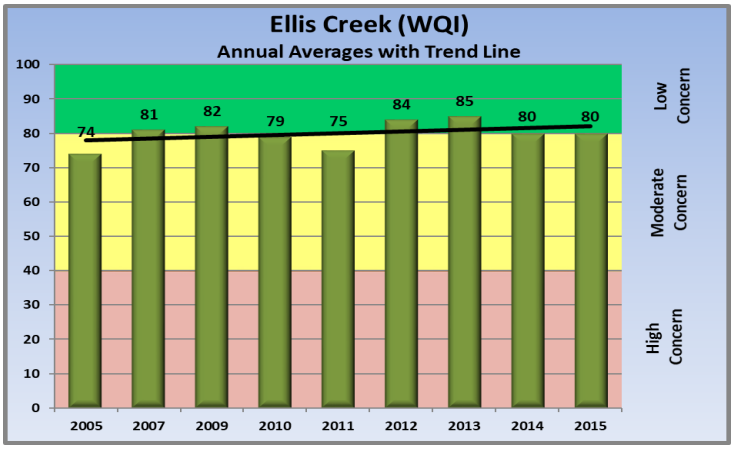
Ellis Creek Basin



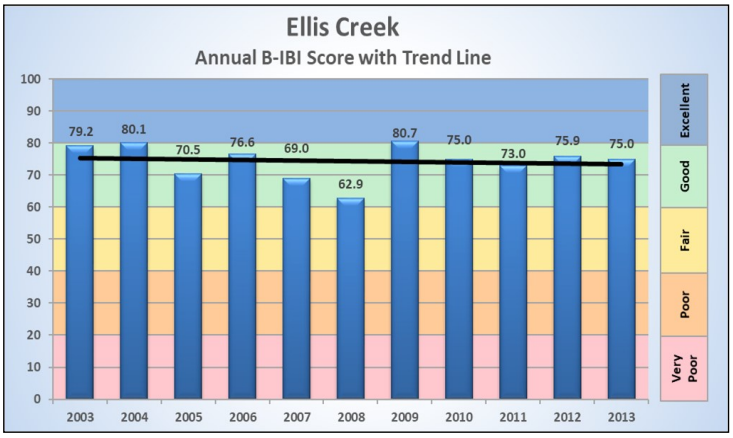
Physical Characteristics

The Ellis Creek Basin is located in north Olympia east of Budd Inlet. The basin is approximately 1,441 acres with 272 acres located within the city limits. The area consists of rolling hills and frequent wetlands. Ellis Creek is 1.2 miles long. The creek starts at Setchfield Lake at an elevation of 170 feet, gradually slopes east to west and discharges to Budd Inlet. Portions of the creek are within a steep ravine with the last reach flowing through intact native forest in Priest Point Park into Ellis Cove. Land use is primarily rural and suburban residential. The creek does support populations of native fish including salmon. Two fish passage barriers exist at East Bay Drive and Gull Harbor Road.

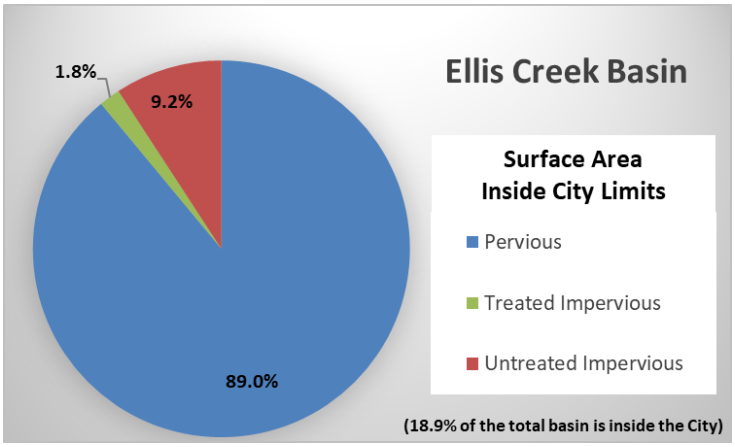




Source: Thurston County Public Health and Social Services, 2016. http://www.co.thurston.wa.us/health/ehrp/annualreport.html



Source: Puget Sound Stream Benthos, "Plotting Biotic Integrity." **Analysis: Benthic Index of Biotic Integrity.** 2017.



Source: Olympia_basemap.DBO.Topo_HardSurface, 2015, City of Olympia GIS data.

Basin Concerns

Ellis Creek is on the 303(d) list of impaired water bodies for bacteria. The source is unknown. Nitrate and total phosphorus concentrations are occasionally higher than the regional reference condition for Puget Sound Lowland ecoregion.

New development in the basin has the potential to impact flood volumes. Erosion from high stream flows and nonpoint source pollution are water quality concerns.

A partial fish passage barrier under Boston Harbor Road is a priority for retrofit. A full barrier exists approximately 1/2 mile upstream under Gull Harbor Road (Thurston County). Both impact anadromous fish use in this stream.

(Source: Thurston County Water Resources Monitoring report, 2016 and Department of Ecology, "Assessed Waters/ Sediment." **Map Water Quality Data**. 2016).

Key Basin Elements

Total Basin = 1,441 acres

Basin in City = 272 acres

Wetlands in City* = 37 acres

Ellis Creek in City = .9 miles

Pervious in City = 242 acres

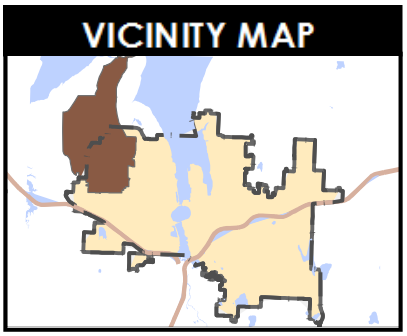
Impervious in City = 30 acres

Treated Impervious in City = 5 acres

Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data.

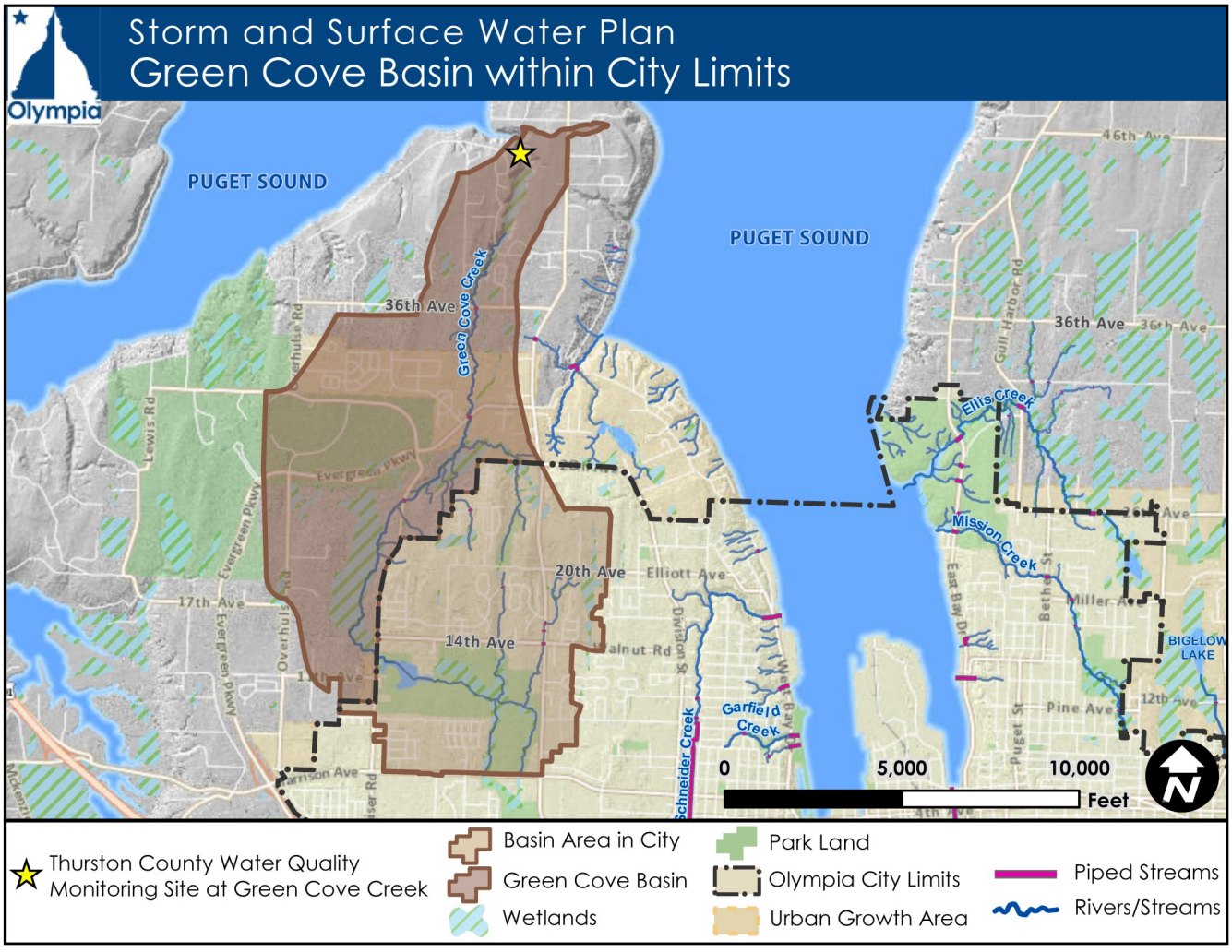
*National Wetlands Inventory Mapping, 2017

Green Cove Creek Basin



Physical Characteristics

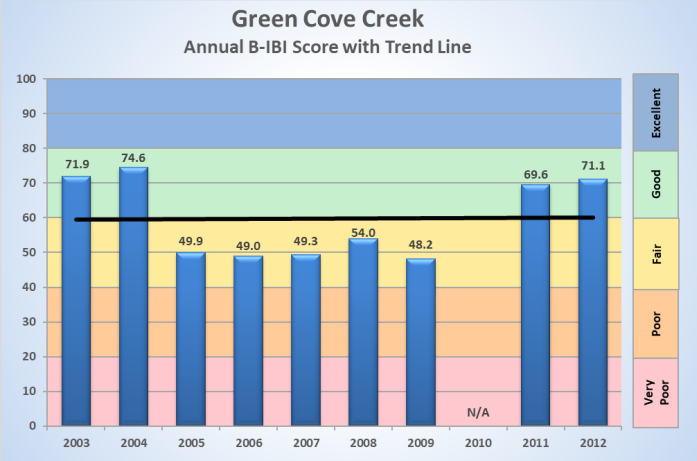
The Green Cove Creek basin is located in northwest Olympia roughly west of Cooper Point Road and north of Harrison Avenue. The basin is approximately 2,530 acres with 1,042 acres within the city limits. Elevations within the basin vary approximately 300 feet. Green Cove Creek is approximately 5.7 miles long and originates from Louise Lake. The creek collects water from several large wetland complexes including at Grass Lake Park before it empties into Eld Inlet at Green Cove. The creek is one of the healthiest in the city supporting a number of native salmon populations. Primary land use is agriculture and rural and low-impact residential.



Basin Concerns

Water quality standards are generally met. Nutrient concentrations occasionally rise above the regional reference conditions.

(Thurston County Water Resources Monitoring report, 2016).



Source: Puget Sound Stream Benthos, "Plotting Biotic Integrity." **Analysis: Benthic Index of Biotic Integrity.** 2017.

Key Basin Elements

Total Basin = 2,530 acres

Basin in City = 1,042 acres

Wetlands in City* = 89 acres

Louise Lake = 12 acres

Green Cove Creek in City = 1.6 miles

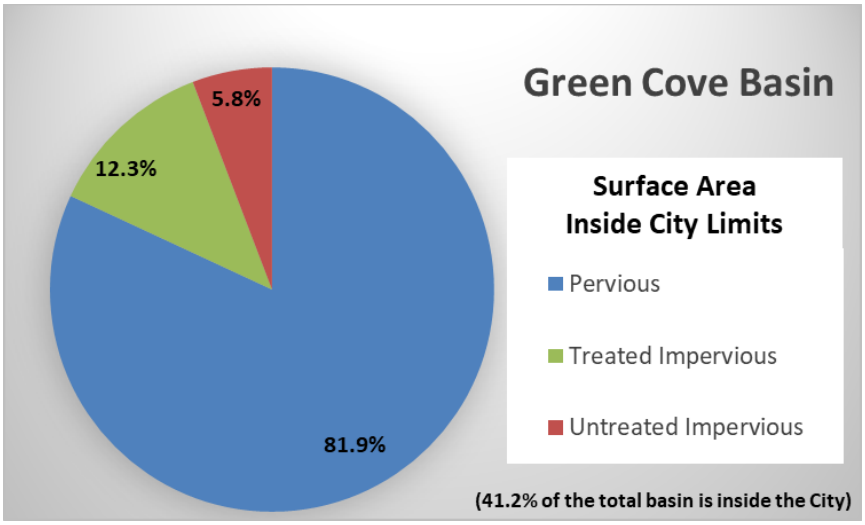
Pervious in City = 853 acres

Impervious in City = 189 acres

Treated Impervious in City = 128 acres

Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data.

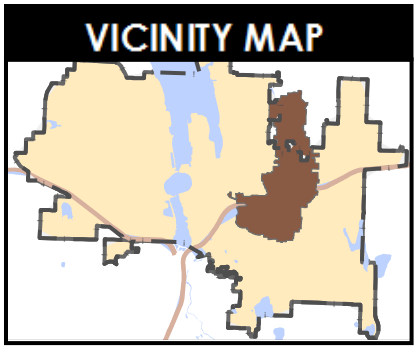
*National Wetlands Inventory Mapping, 2017



Source: Olympia_basemap.DBO.Topo_HardSurface, 2015, City of Olympia GIS data.

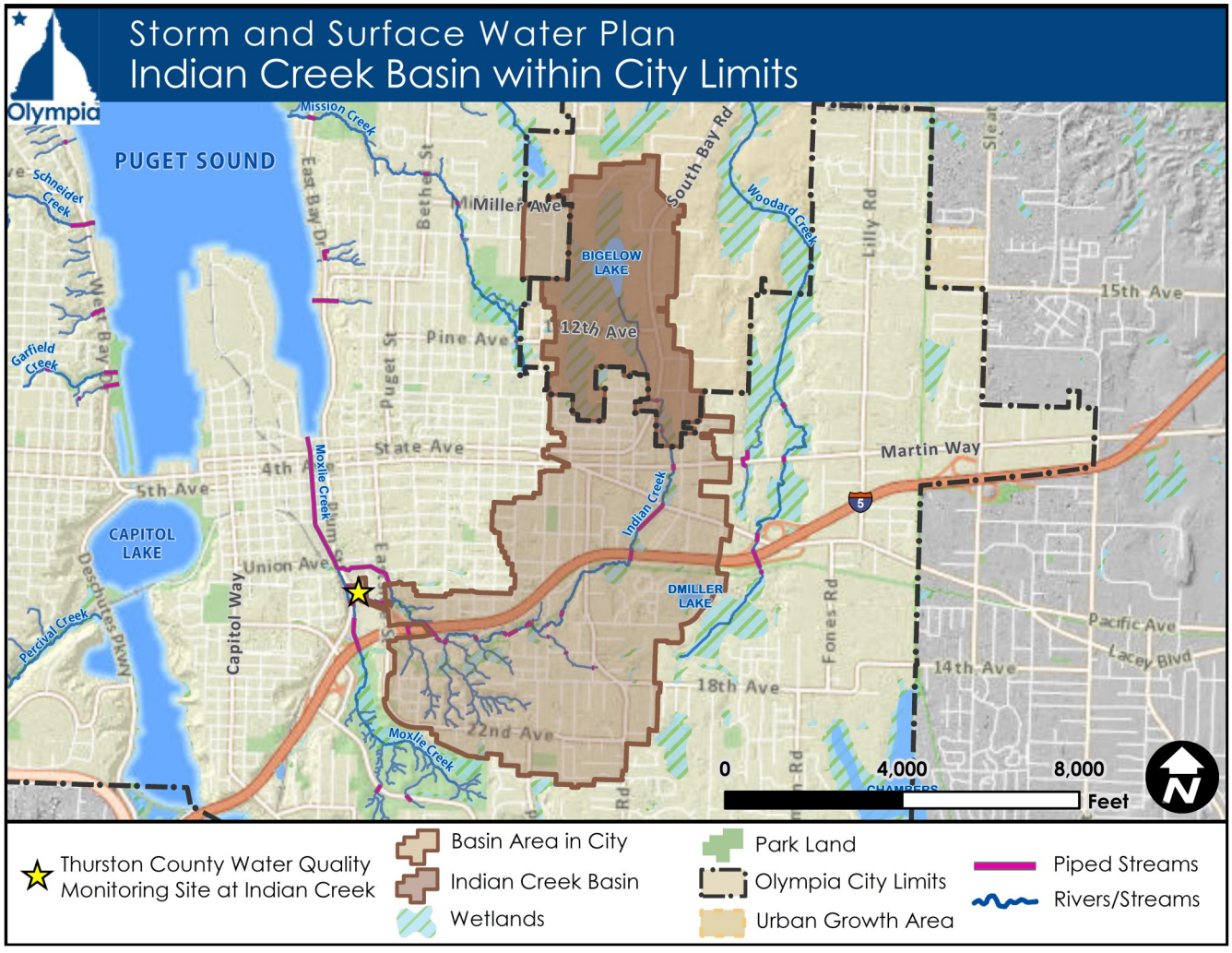
There is no WQI Chart for Green Cove

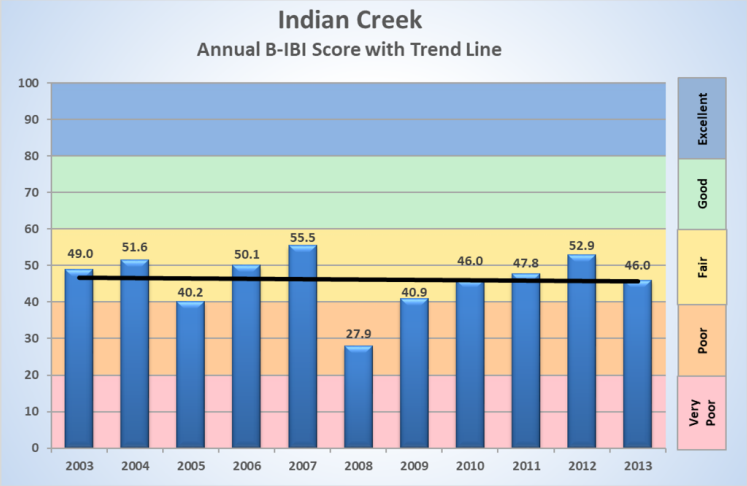
Indian Creek Basin



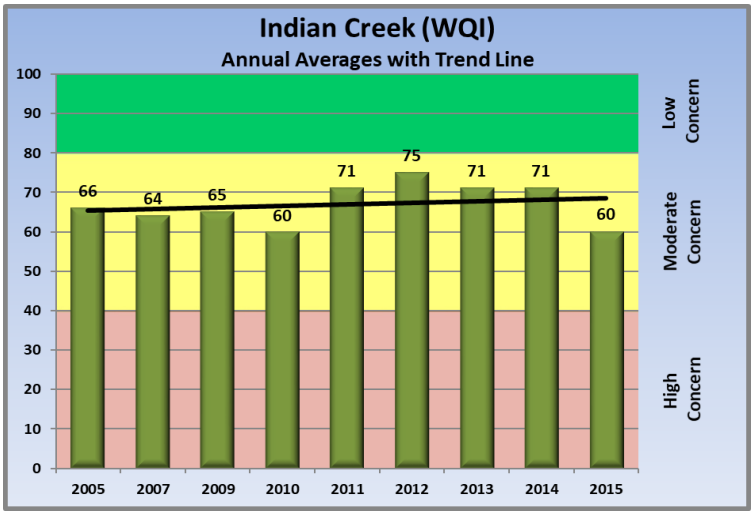
Physical Characteristics

The Indian Creek Basin is located in central northwest Olympia. The basin is approximately 1,322 acres with 1,001 acres located within the city limits. Indian Creek is 3.5 miles and begins at the southern end of Bigelow Lake. The northern section and headwaters of the basin is a fairly flat bog that surrounds Bigelow Lake in the urban growth area. The upper creek channel has a low to medium grade. Downstream the channel has steeper upper banks. Several wetlands border the creek on its path to Moxlie Creek. Approximately 1.2 miles of the creek is in culverts or pipes. The Olympia Woodland Trail follows a portion of the creek along a historic railroad grade. The creek merges with Moxlie near Plum Street and Union Avenue and enters Budd Inlet via the piped section of Moxlie to East Bay. Land uses within the City consist of moderate urban to high density residential and commercial. Urban growth area land uses are rural to moderate residential with a few businesses intermixed. The culvert under Interstate 5 and a culvert near Boulevard Road totally block the passage of fish.

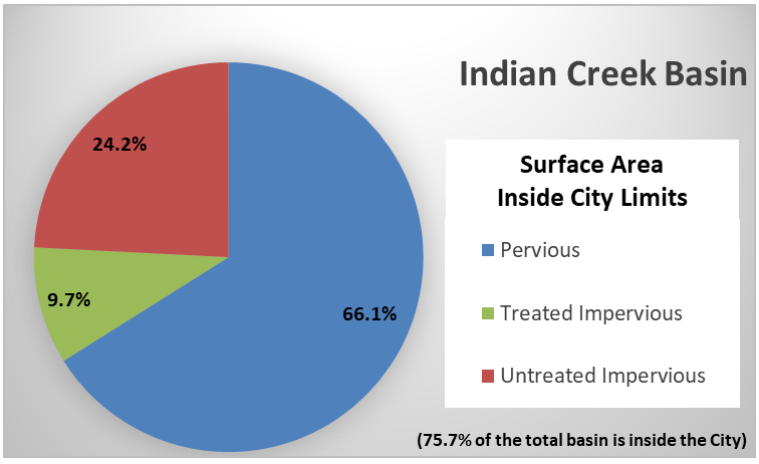




Source: Puget Sound Stream Benthos, "Plotting Biotic Integrity." **Analysis: Benthic Index of Biotic Integrity.** 2017.



Source: Department of Ecology, "The Water Quality Index Spreadsheet (Version 6)," **A Water Quality Index for Washington State Streams (Version 6: 2014.06.11),** 2016.



Source: Olympia_basemap.DBO.Topo_HardSurface, 2015, City of Olympia GIS data.

Basin Concerns

Indian Creek is on the 303(d) list of impaired water bodies for bacteria. Fecal coliform concentrations are consistently high and nitrate concentrations are also high. Past studies have found elevated metals and organics in creek sediments.

(Source: Thurston County Water Resources Monitoring report, 2016 and Department of Ecology, "Assessed Waters/ Sediment." **Map Water Quality Data**. 2016).

(Thurston County Water Resources Monitoring report, 2016).

Key Basin Elements

Total Basin = 1,322 acres

Basin in City = 1,001 acres

Wetlands in City* = 55 acres

Indian Creek in City = 2.8 miles

Indian Creek tributaries in City = 4.4 miles

Pervious in City = 661 acres

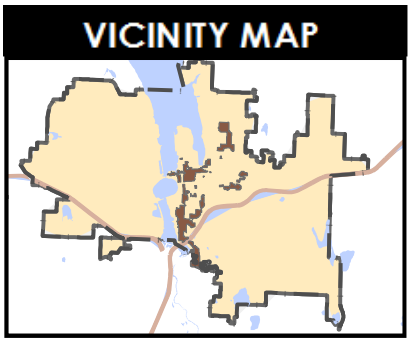
Impervious in City = 340 acres

Treated Impervious in City = 97 acres

Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data.

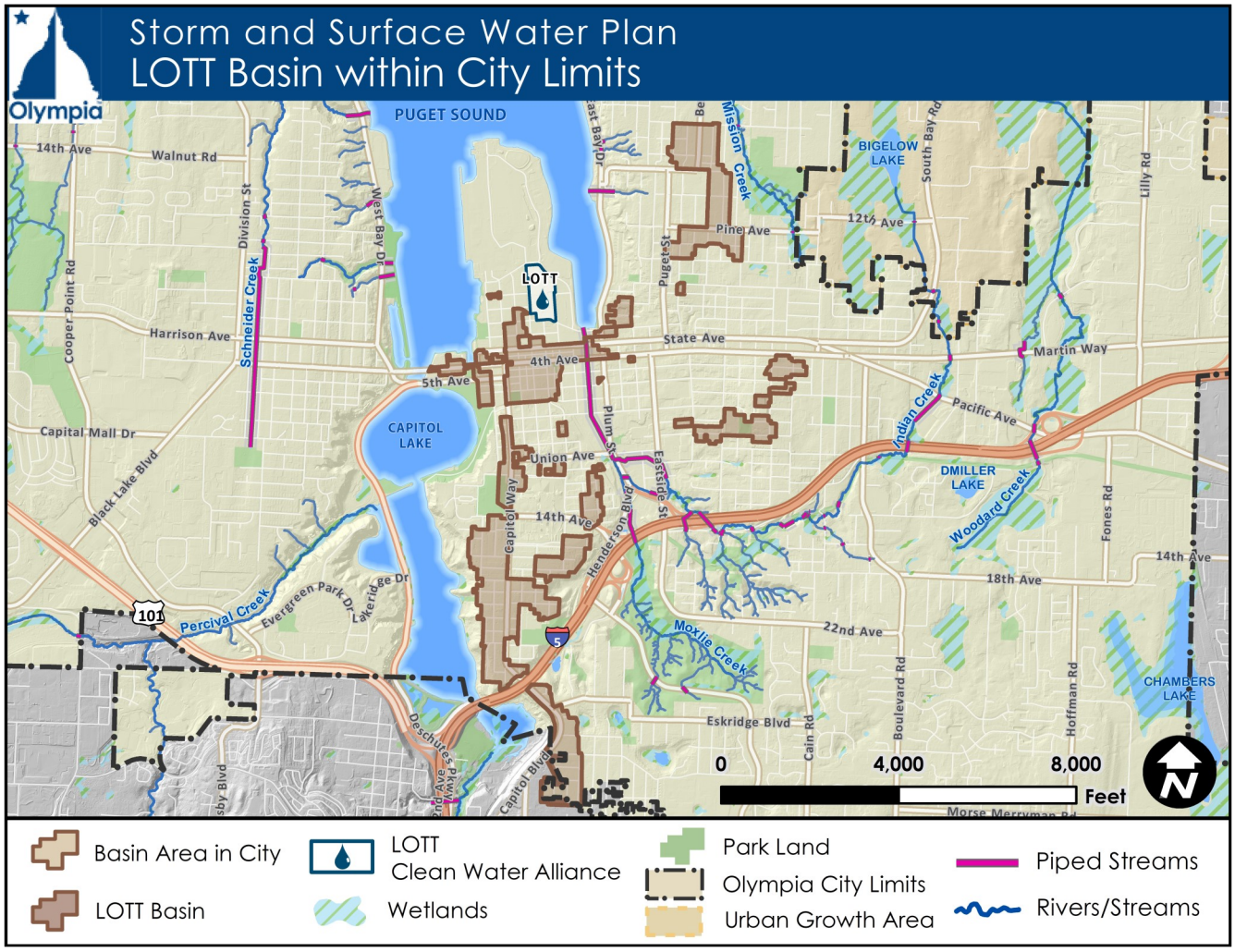
*National Wetlands Inventory Mapping, 2017

LOTT Basin



Physical Characteristics

The LOTT Clean Water Alliance treats wastewater from homes and businesses in Lacey, Olympia, and Tumwater and also treats stormwater that enters the combined storm-sewer system. The LOTT Basin area in Olympia is approximately 332 acres primarily located downtown and in the South Capitol Neighborhood. The basin also includes part of the Northeast, Bigelow, Eastside, Governor Stevens, and Carlyon North neighborhoods. All stormwater runoff from the LOTT Basin is treated at the Budd Inlet Treatment Plant.



Basin Concerns

Combined storm-sewer systems have the potential to overflow into surface waters during big storm events. Combined sewer overflows are rare in Olympia but any increase in stormwater would be a concern.

(Source: Thurston County Water Resources Monitoring report, 2016 and Department of Ecology, "Assessed Waters/ Sediment." **Map Water Quality Data**. 2016).

Key Basin Elements

Total Basin = 332 acres

Basin in City = 325 acres

Wetlands in City* = 0 acres

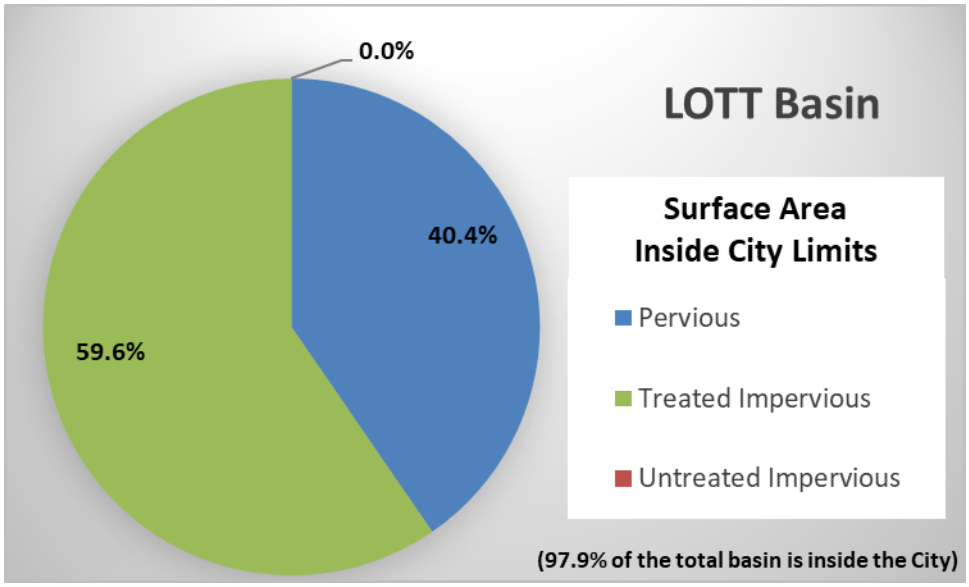
Pervious in City = 131

City Impervious = 194 acres

City Treated Impervious = 194 acres

Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data.

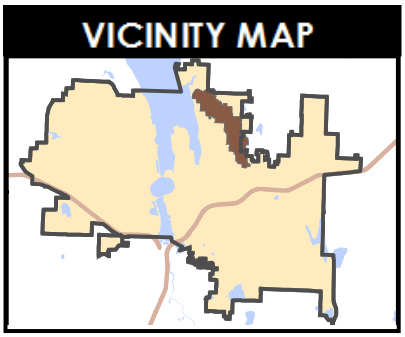
*National Wetlands Inventory Mapping, 2017



Source: Olympia_basemap.DBO.Topo_HardSurface, 2015, City of Olympia GIS data.

Because no specific stream is associated with the LOTT Basin, There are no WQI or BIBI charts.

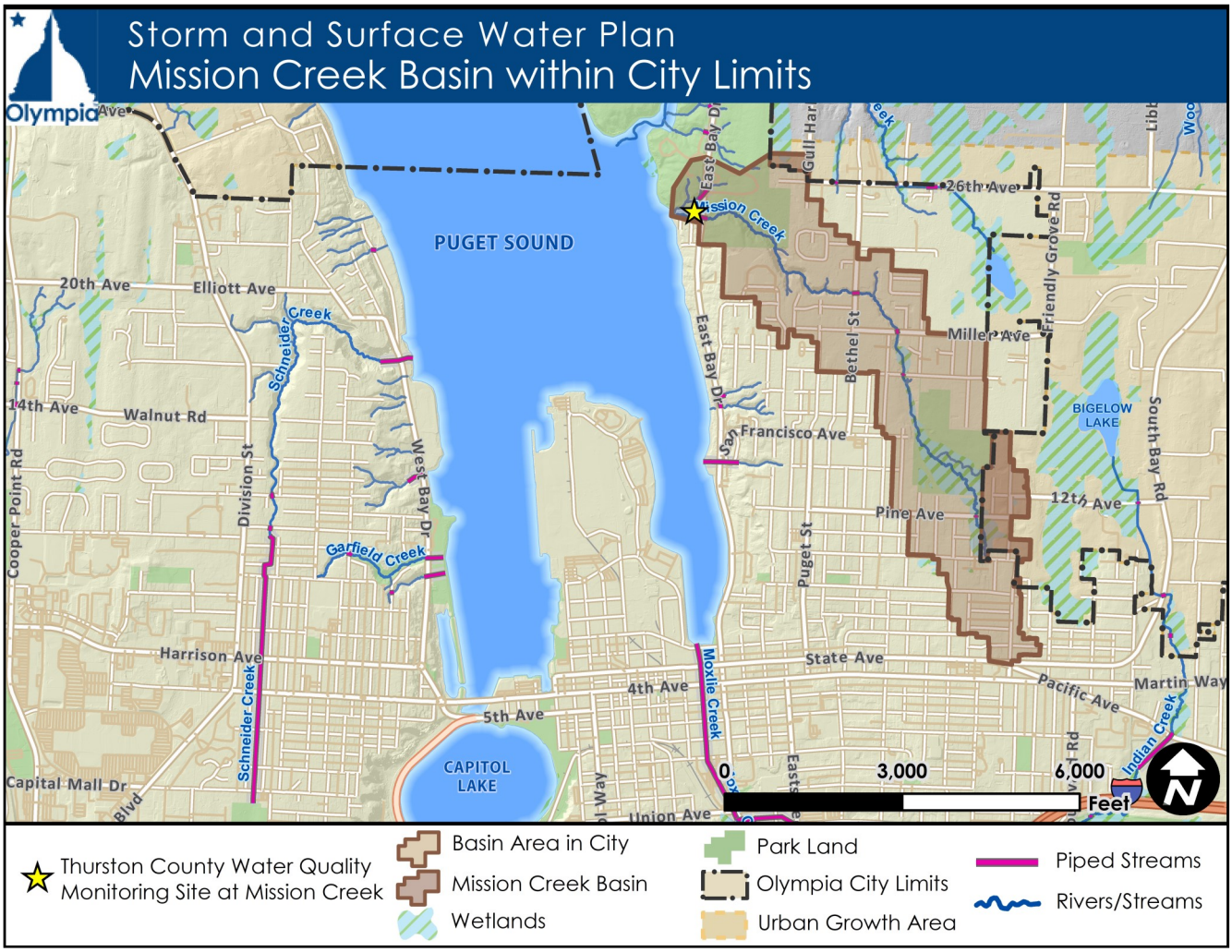
Mission Creek Basin

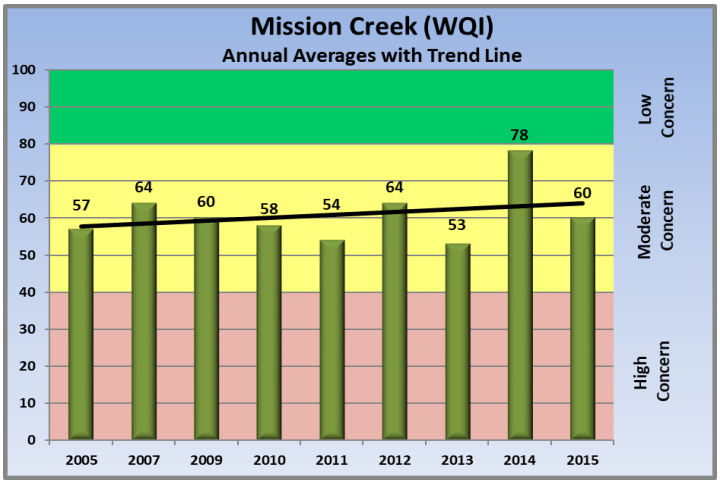


Physical Characteristics

The Mission Creek basin is located in north-central Olympia, east of Budd Inlet. The basin is approximately 406 acres with 374 acres within the city limits. The creek is 2.1 miles long that originates in the wetlands at an elevation of 170 feet just south of Mission Creek Nature Park and flows through a relatively flat basin. The headwaters is a wetland complex that becomes a defined channel as it leaves Mission Creek Nature Park. It continues flowing northwest in a deep ravine to the south end of Priest Point Park. The creek enters Budd Inlet at the site of a 2013 estuary restoration project. Land use in the basin is predominately suburban residential. A number of culverts along the creek are full or partial fish passage barriers (WDFW data).

Land use includes residential, forest cover and public parks.





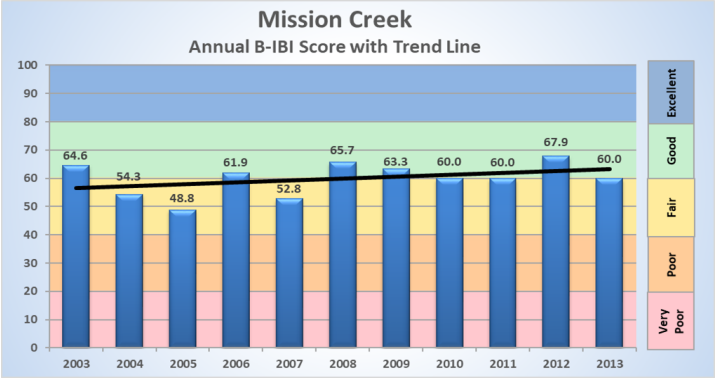
Source: Department of Ecology, "The Water Quality Index Spreadsheet (Version 6)," **A Water Quality Index for Washington State Streams (Version 6: 2014.06.11),** 2016.

Basin Concerns

Mission Creek is on the 303(d) list of impaired water bodies for bacteria. High levels of fecal coliform bacterial contamination has been a chronic problem since monitoring began in the early 1990s. Total phosphorus and nitrate concentrations have often exceeded their respective regional reference concentrations.

Future development has the potential to negatively impact Mission Basin.

(Source: Thurston County Water Resources Monitoring report, 2016 and Department of Ecology, "Assessed Waters/Sediment." **Map Water Quality Data**. 2016).



Source: Puget Sound Stream Benthos, "Plotting Biotic Integrity." **Analysis: Benthic Index of Biotic Integrity.** 2017.

Key Basin Elements

Total Basin = 406 acres

Basin in City = 374 acres

Wetlands in City* = 29 acres

Mission Creek in City = 2.0 miles

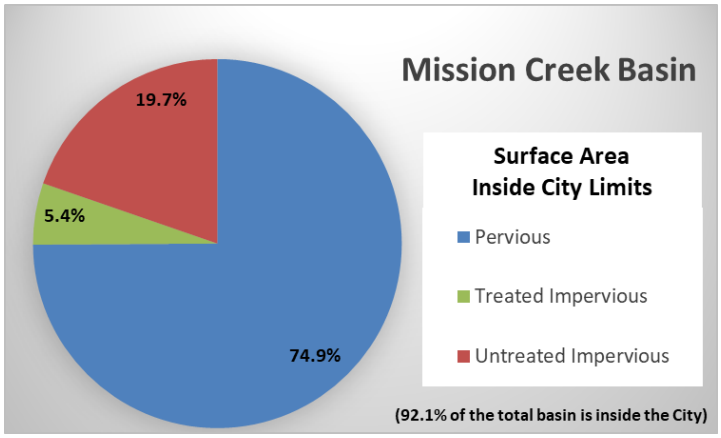
Pervious in City = 280 acres

City Impervious = 94 acres

City Treated Impervious = 20 acres

Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data.

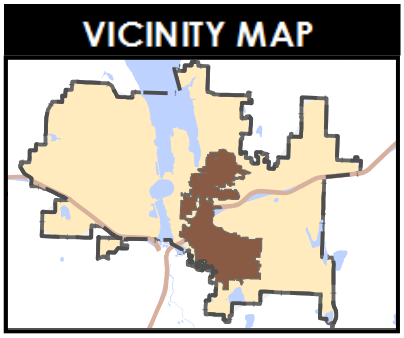
*National Wetlands Inventory Mapping, 2017



Source: Olympia_basemap.DBO.Topo_HardSurface, 2015, City of Olympia GIS data.

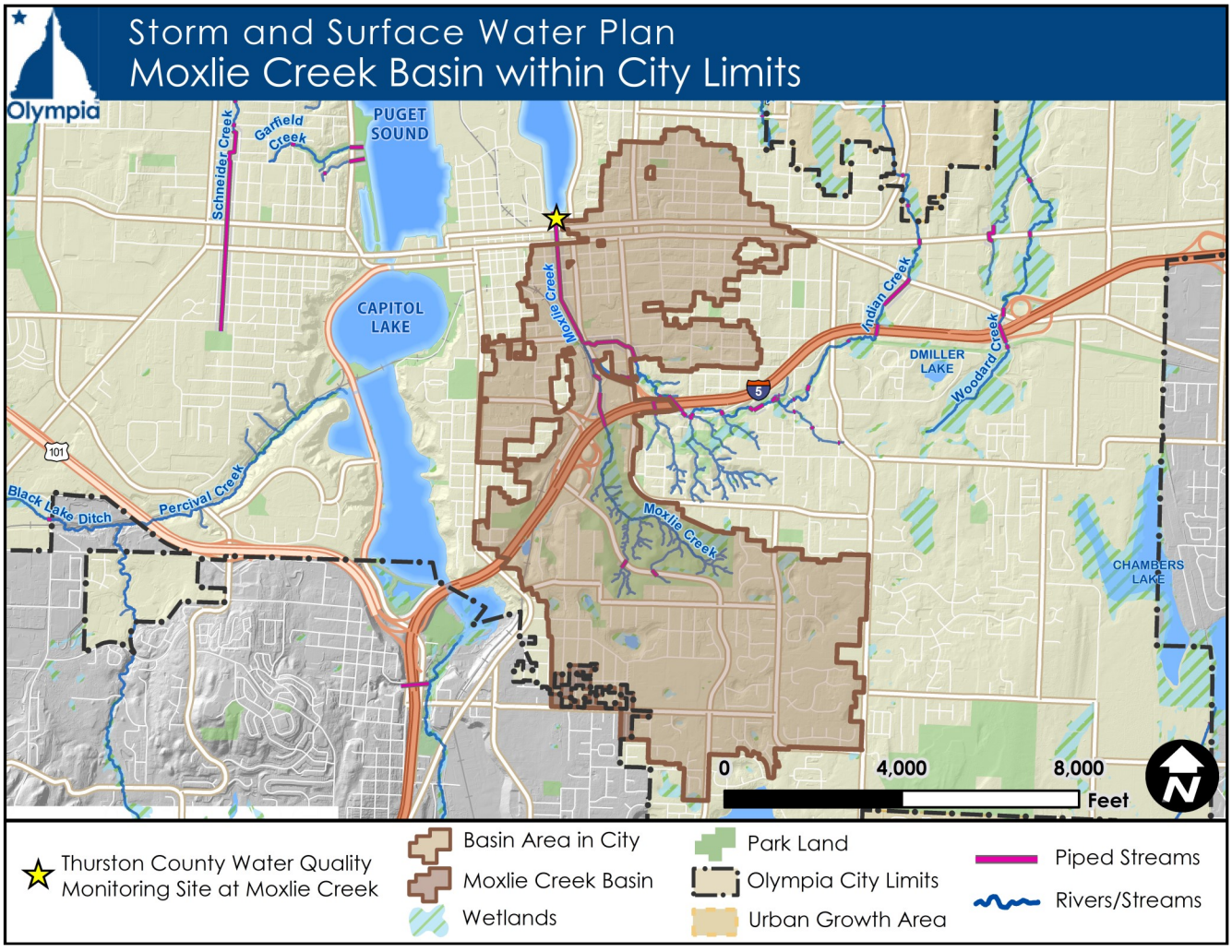
Olympia

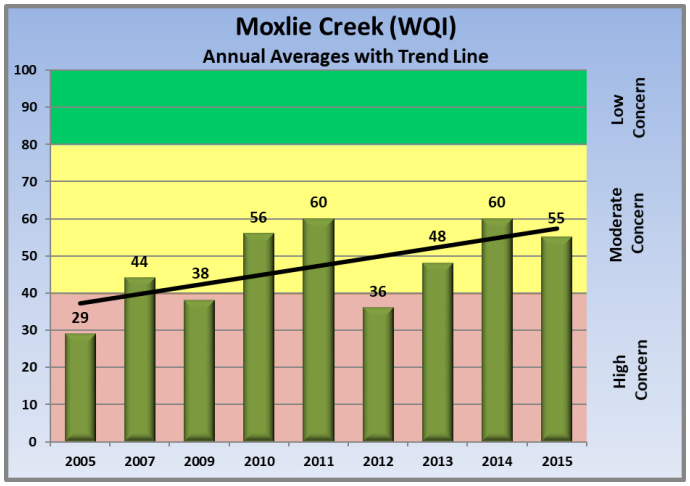
Moxlie Creek Basin



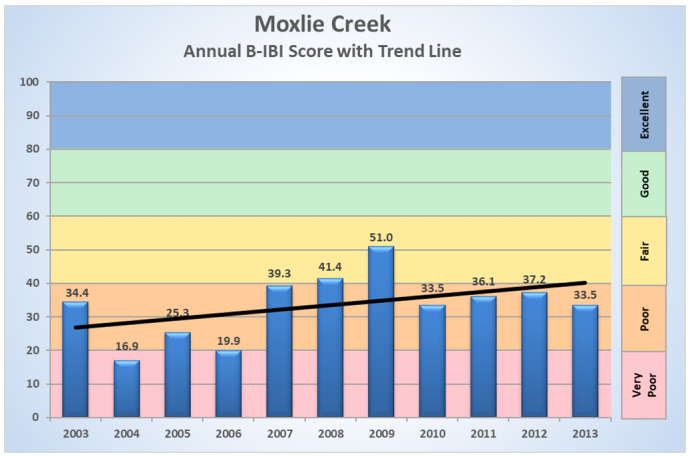
Physical Characteristics

The Moxlie Creek basin is located in south central Olympia. The basin is approximately 1,562 acres nearly fully contained within the city limits including an upland terrace dotted with kettles located in an area south of Watershed Park. The creek originates from a series of springs and wetlands at the southern end of Watershed Park. Upper bank slopes are often greater than 30% in the ravines above the creek headwater springs. Across the upland terrace extending south of the park surface water drains into kettles rather than into the creek. Water flowing to the kettles supplies groundwater that feed the springs and wetlands. Moxlie creek is approximately 2.1 miles long and is piped underground approximately 0.8 miles through downtown Olympia. Several small springs and tributaries enter Moxlie Creek throughout Watershed Park. Indian Creek flows into Moxlie Creek at Plum Street between Union Avenue and Henderson Boulevard . The creek enters a culvert at Union Avenue and is piped all the way to its discharge point into Budd Inlet at the southern end of East Bay. This culvert and the culvert under Interstate 5 are partial fish passage barriers. The natural substrate in the creek channel in the park is sandy and too small to be appropriate as salmonid spawning habitat. Primary land uses include urban commercial and urban residential, heavily forested public parks, and suburban residential.

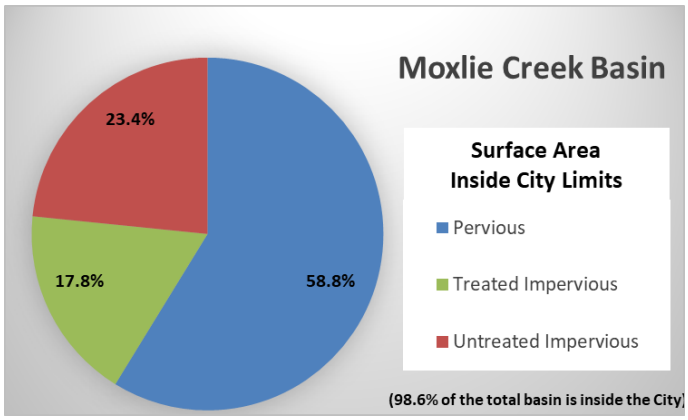




Source: Department of Ecology, "The Water Quality Index Spreadsheet (Version 6)," **A Water Quality Index for Washington State Streams (Version 6: 2014.06.11),** 2016.



Source: Puget Sound Stream Benthos, "Plotting Biotic Integrity." **Analysis: Benthic Index of Biotic Integrity.** 2017.



Source: Olympia_basemap.DBO.Topo_HardSurface, 2015, City of Olympia GIS data.

Basin Concerns

Moxlie Creek is on the 303(d) list of impaired water bodies for bacteria. Fecal coliform pollution has been a chronic problem since the execution of water quality monitoring in the 1990s. Nitrate+nitrite and total phosphorus concentrations are above the regional reference condition.

Stormwater discharges continue to alter the natural creek channel in the upper Moxlie watershed and degrade water quality throughout the length of the creek. The piped portion of the creek provides little to no habitat value.

(Source: Thurston County Water Resources Monitoring report, 2016 and Department of Ecology, "Assessed Waters/ Sediment." **Map Water Quality Data**. 2016).

Key Basin Elements

Total Basin = 1,562 acres

Basin in City = 1,541 acres

Wetlands in City* = 51 acres

Moxlie Creek in City = 2.1 miles

Pervious in City = 906 acres

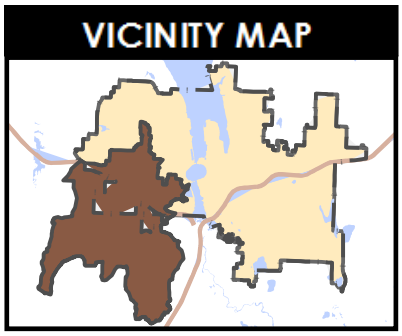
City Impervious = 635 acres

City Treated Impervious = 275 acres

Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data.

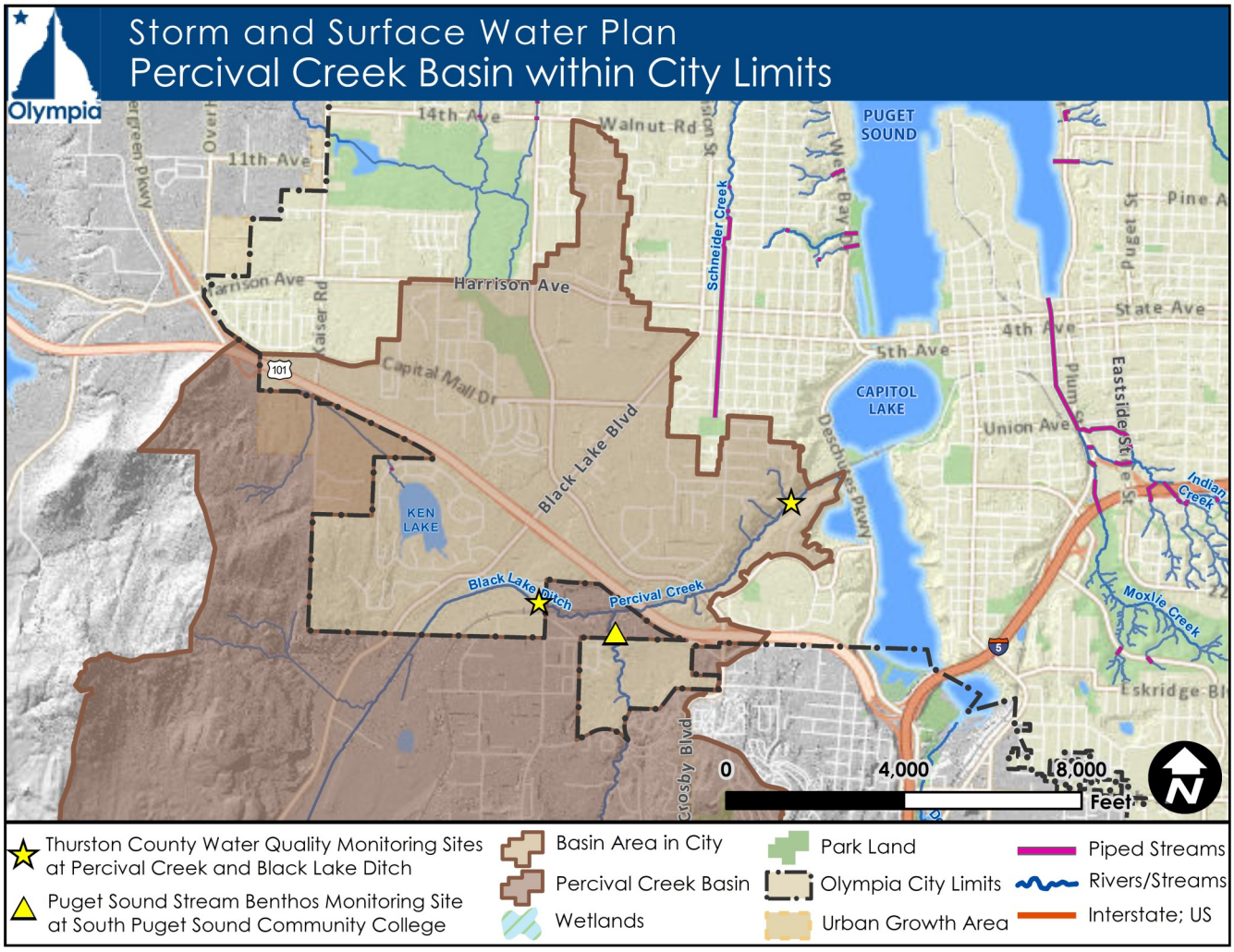
*National Wetlands Inventory Mapping, 2017

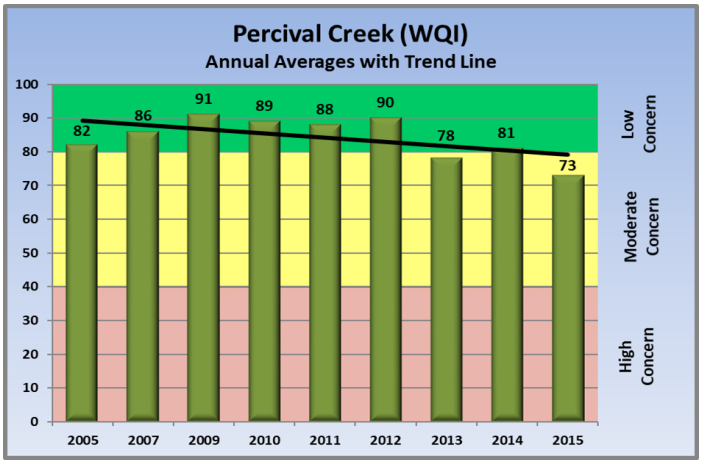
Percival Creek Basin



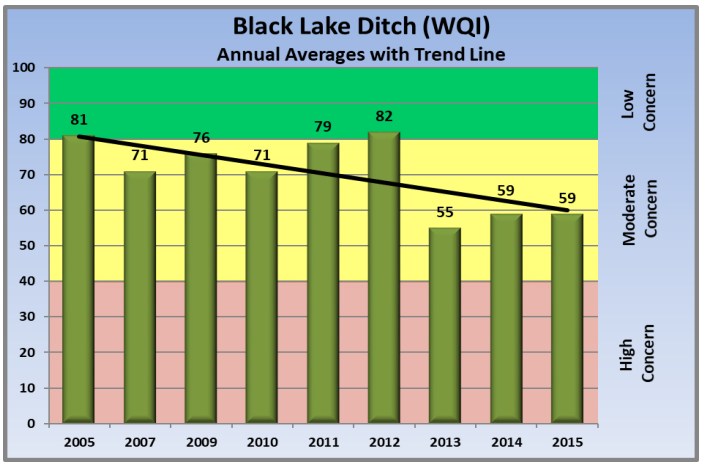
Physical Characteristics

The Percival Creek basin is located in southwest Olympia. It spans between Black Hills on the west and Interstate-5 on the east. The basin covers approximately 5,340 acres with approximately 1,713 acres located within the city-limits. Elevations within the basin range from sea level to 760 feet above Black Lake. Percival Creek is 4.1 miles starting at the north end of Trosper Lake in Tumwater and discharging to Capitol Lake. Ken Lake and Black Lake are tributary to Percival Creek via human-made ditches. Black Lake Ditch flows from Black Lake joining Percival Creek approximately 600 feet north of Mottman Road SW and 600 feet west of Highway 101. There are low gradients in the upper wetland segments of Black Lake Ditch and Percival Creek. Medium gradients are found in the forested Percival Creek Canyon. Several small tributaries, springs, and seeps enter the creek along its route to Capitol Lake. The portion of the basin within the city limits is predominately zoned commercial or multi-family. The Yauger Park and Black Lake Meadows Stormwater Facilities treat runoff from a large portion of West Olympia before releasing water to the ditch. Percival Creek is fishbearing, often having runs of Chinook and Coho salmon when the fish gates are opened at Capitol Lake.

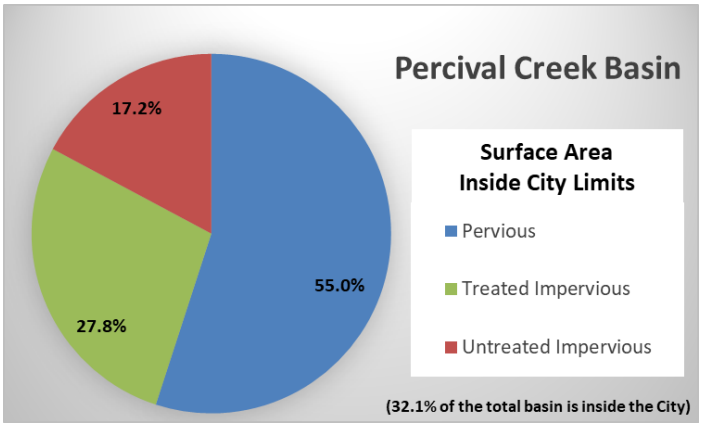




Source: Department of Ecology, "The Water Quality Index Spreadsheet (Version 6)," **A Water Quality Index for Washington State Streams (Version 6: 2014.06.11),** 2016.



Source: Department of Ecology, "The Water Quality Index Spreadsheet (Version 6)," **A Water Quality Index for Washington State Streams (Version 6: 2014.06.11),** 2016.



Source: Olympia_basemap.DBO.Topo_HardSurface, 2015, City of Olympia GIS data.

Key Basin Elements

Total Basin = 5,340 acres

Basin in City = 1,713 acres

Wetlands in City* = 61 acres

Percival Creek in City = 1.9 miles

Black Lake Ditch in City = .7 miles

Ken Lake = 27 acres

Pervious in City = 943 acres

City Impervious = 770 acres

City Treated Impervious = 476 acres

Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data.

*National Wetlands Inventory Mapping, 2017

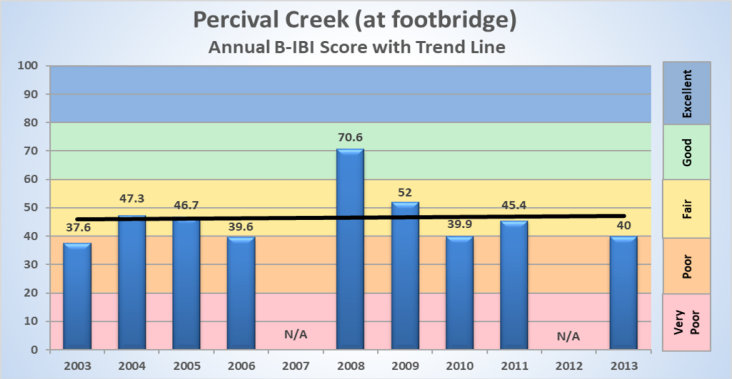
Basin Concerns

Percival Creek and Black Lake Ditch are on the 303(d) list of impaired water bodies. Both experience problems with dissolved oxygen and high temperatures.

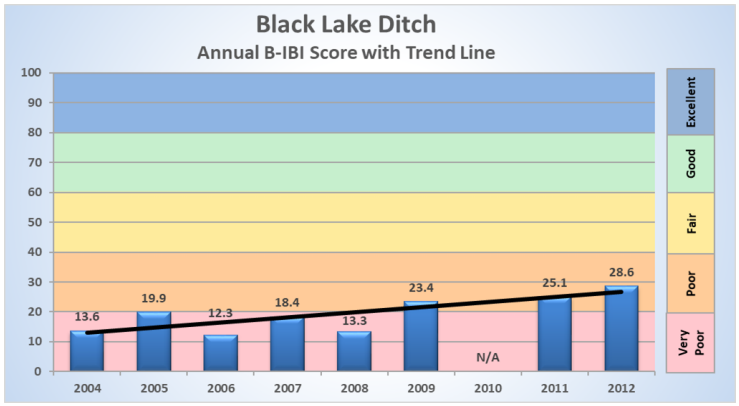
Percival Basin's rapid growth is increasing the impact of stormwater runoff.

Homeless encampments along the riparian corridor threaten water quality conditions.

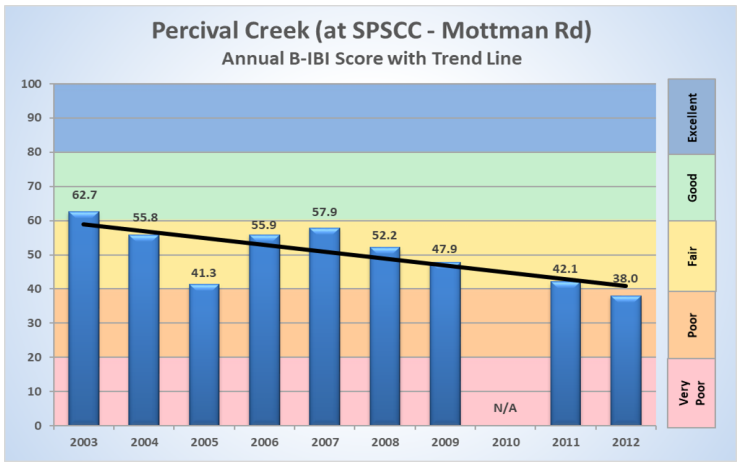
(Source: Thurston County Water Resources Monitoring report, 2016 and Department of Ecology, "Assessed Waters/Sediment." **Map Water Quality Data**. 2016).



Source: Puget Sound Stream Benthos, "Plotting Biotic Integrity."
Analysis: Benthic Index of Biotic Integrity. 2017.

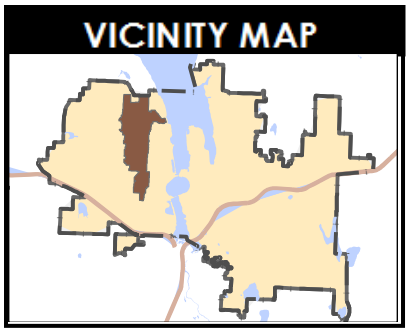


Source: Puget Sound Stream Benthos, "Plotting Biotic Integrity."
Analysis: Benthic Index of Biotic Integrity. 2017.



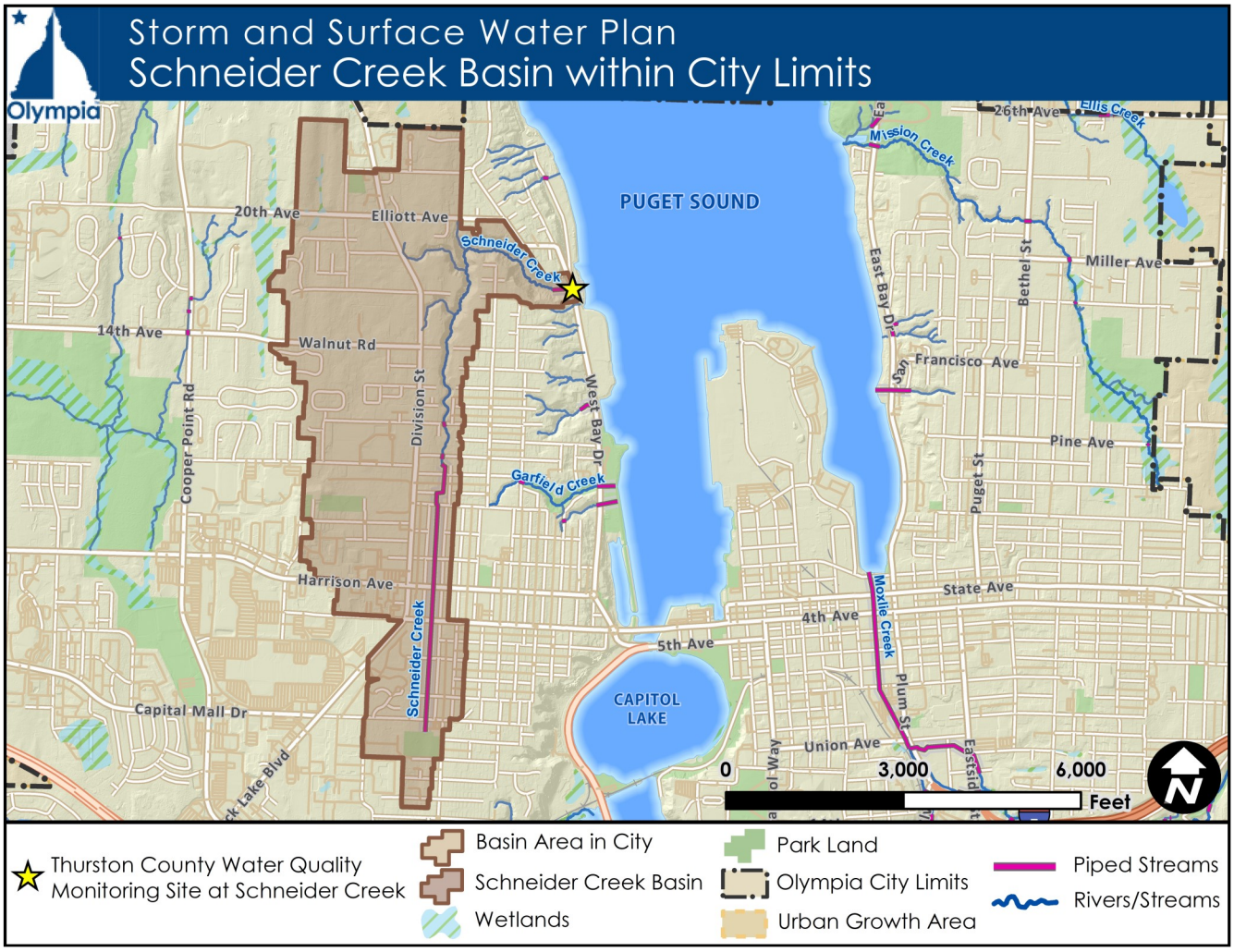
Source: Puget Sound Stream Benthos, "Plotting Biotic Integrity."
Analysis: Benthic Index of Biotic Integrity. 2017.

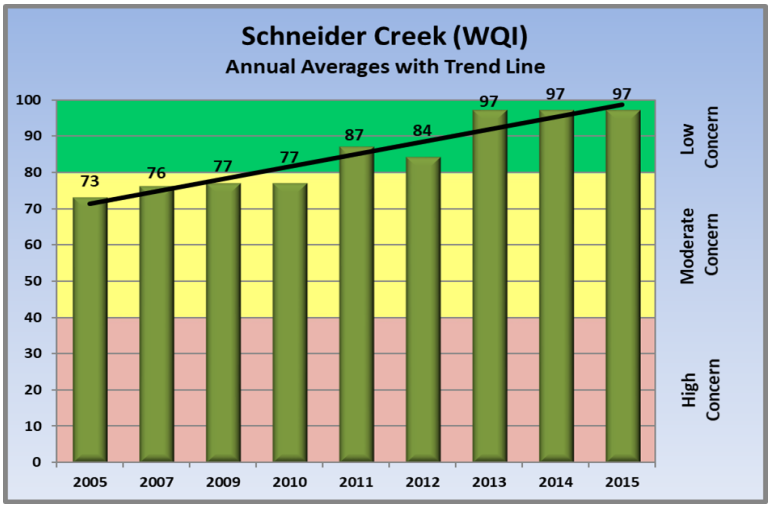
Schneider Creek Basin



Physical Characteristics

The Schneider Creek basin is located in northwest Olympia. The basin is completely contained within the city limits and covers. approximately 635 acres stretching north and south along the plateau above West Bay and Capitol Lake. The basin is generally flat except for the deep-cut ravine found at the lower segment of Schneider Creek. The creek is approximately 2.2 miles long, originating from a stormwater pond adjacent to Decatur Woods Park off of 9th Avenue SW. The first mile of Schneider Creek is piped underground. Historically, there was likely a wetland complex in this portion of the basin that was drained and filled early in the history of Olympia. A stormwater treatment facility at Giles Ave treats water before it flows from the piped section into the open channel through a forested ravine. The last 0.1 mile of the creek is piped under private property and West Bay Drive before discharging into Budd Inlet. This pipe is a partial fish passage barrier. Basin land use is primarily moderate density residential, commercial along the Harrison Ave corridor and West Bay Drive, and forested in the ravine down to West Bay below Giles.





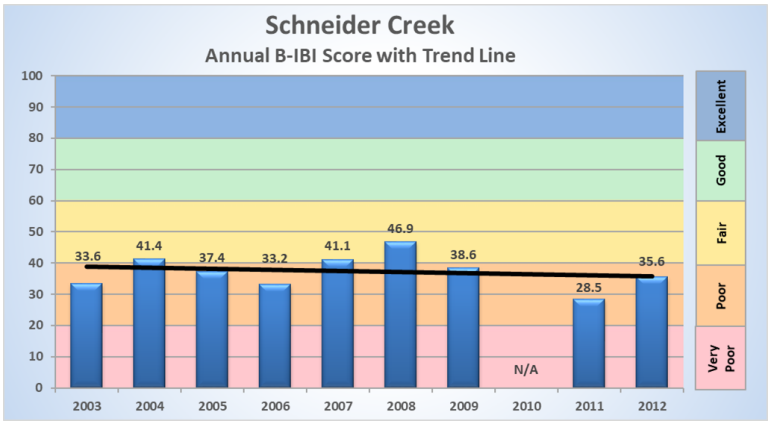
Source: Department of Ecology, "The Water Quality Index Spreadsheet (Version 6)," **A Water Quality Index for Washington State Streams (Version 6: 2014.06.11),** 2016.

Basin Concerns

Schneider is on the 303(d) list of impaired water bodies due to bacteria. One possibility causing this problem is the moderate number of homes within the basin that are connected to onsite sewage systems.

High volumes of stormwater discharging directly to the creek are causing bank failures, streambank erosion, flooding, stream channel scour, and water quality degradation.

(Source: Thurston County Water Resources Monitoring report, 2016 and Department of Ecology, "Assessed Waters/Sediment." **Map Water Quality Data**. 2016).



Source: Puget Sound Stream Benthos, "Plotting Biotic Integrity." **Analysis: Benthic Index of Biotic Integrity.** 2017.

Key Basin Elements

Total Basin = 635 acres

Basin in City = 635 acres

Wetlands in City* = 2.0 acres

Schneider Creek in City = 2.2 miles

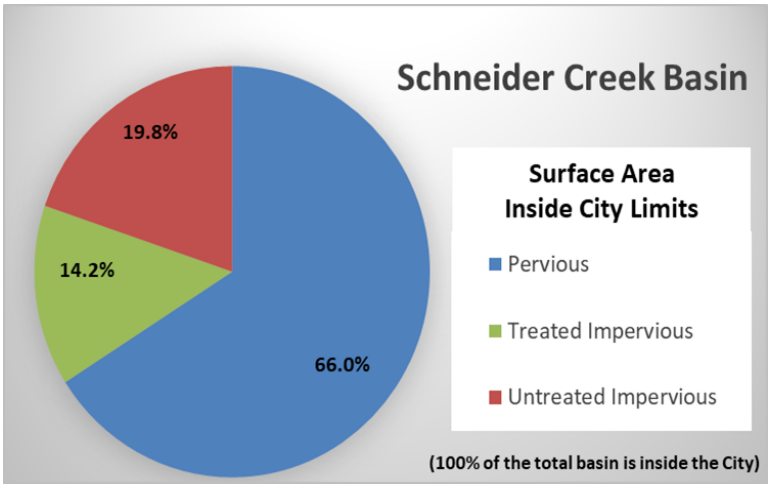
Pervious in City = 419 acres

City Impervious = 216 acres

City Treated Impervious = 90 acres

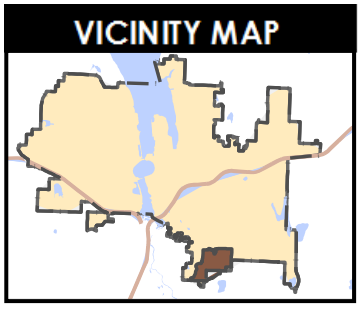
Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data.

*National Wetlands Inventory Mapping, 2017



Source: Olympia_basemap.DBO.Topo_HardSurface, 2015, City of Olympia GIS data.

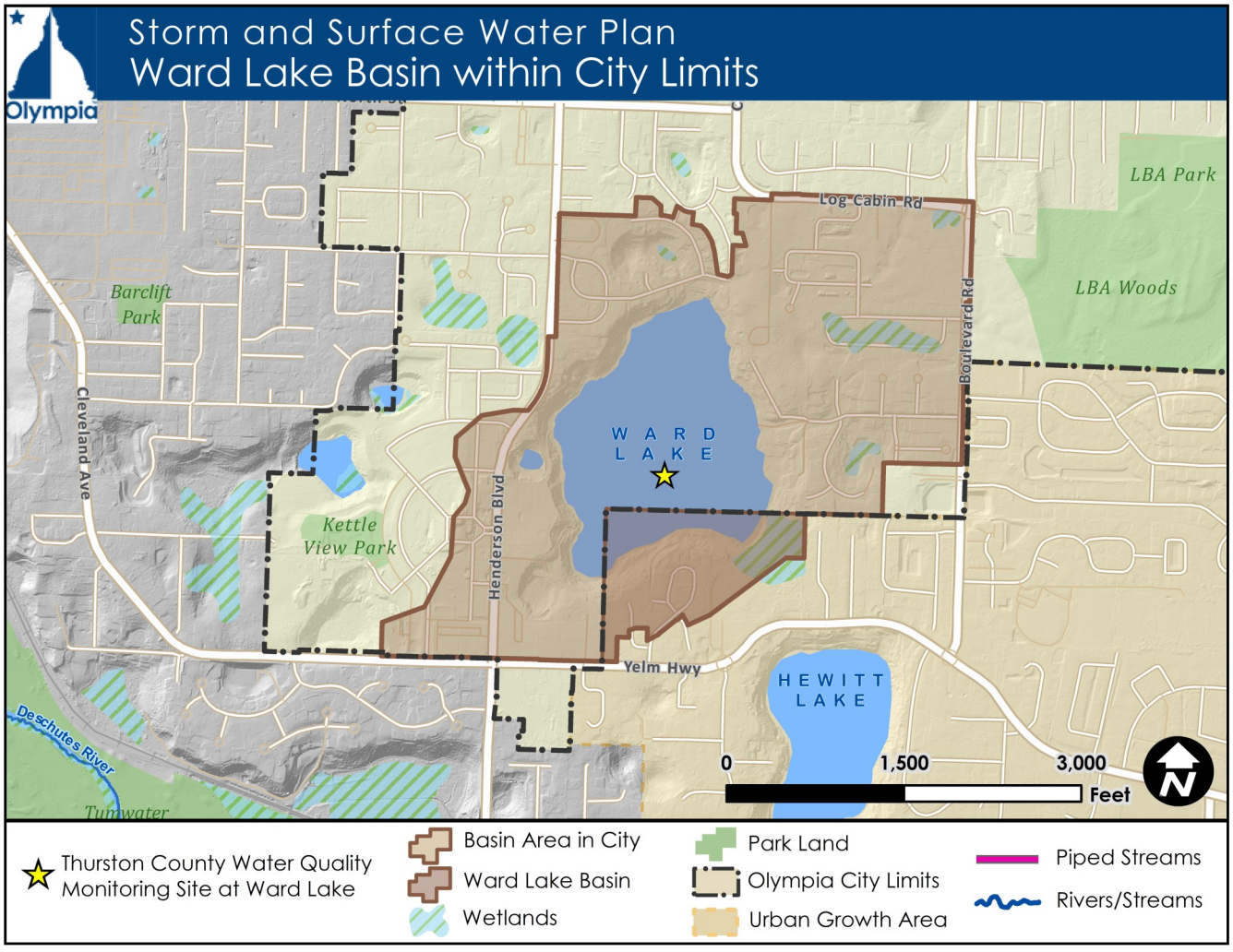
Ward Lake Basin



Physical Characteristics

Ward Lake is located in southeast Olympia The Ward Lake Basin covers 226 acres including the 66 acre lake. The basin is a combination of lowlands, rolling hills, and kettles. Ward Lake is a steep-sided kettle that is fed by ground water springs and has no surface water inlet or outlet channel. The lake elevation is 126 ft

Basin land use is suburban mixed with moderate to high density residential.



Basin Concerns

Ward Lake is on the 303(d) list of impaired water bodies due to Polychlorinated Biphenyls (PCBs)[2] that are possibly associated with discontinued land uses.

Rapid development in the basin may be contributing to late winter/early spring algae blooms and increases in nutrients and chlorophyll in Ward Lake.

Source: Thurston County Water Resources Monitoring report, 2016 and Department of Ecology, "Assessed Waters/Sediment." **Map Water Quality Data**. 2016).

Key Basin Elements

Total Basin = 226 acres

Basin in City = 201 acres

Ward Lake = 66 acres

Ward Lake in City = 56 acres

Wetlands in City* = 6 acres

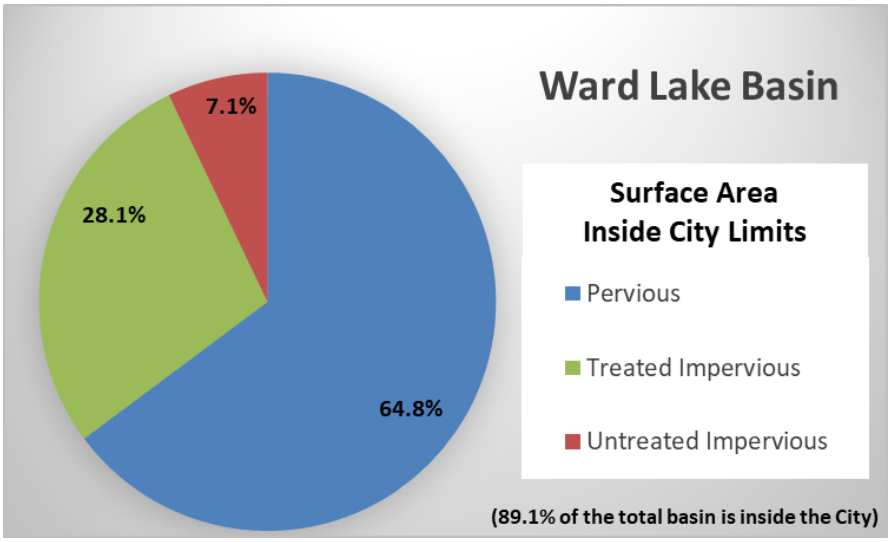
Pervious in City = 130 acres

City Impervious = 71 acres

City Treated Impervious = 57 acres

Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data.

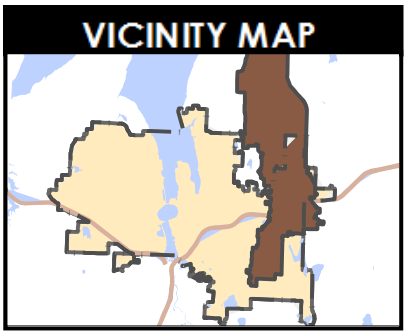
*National Wetlands Inventory Mapping, 2017



Source: Olympia_basemap.DBO.Topo_HardSurface, 2015, City of Olympia GIS data.

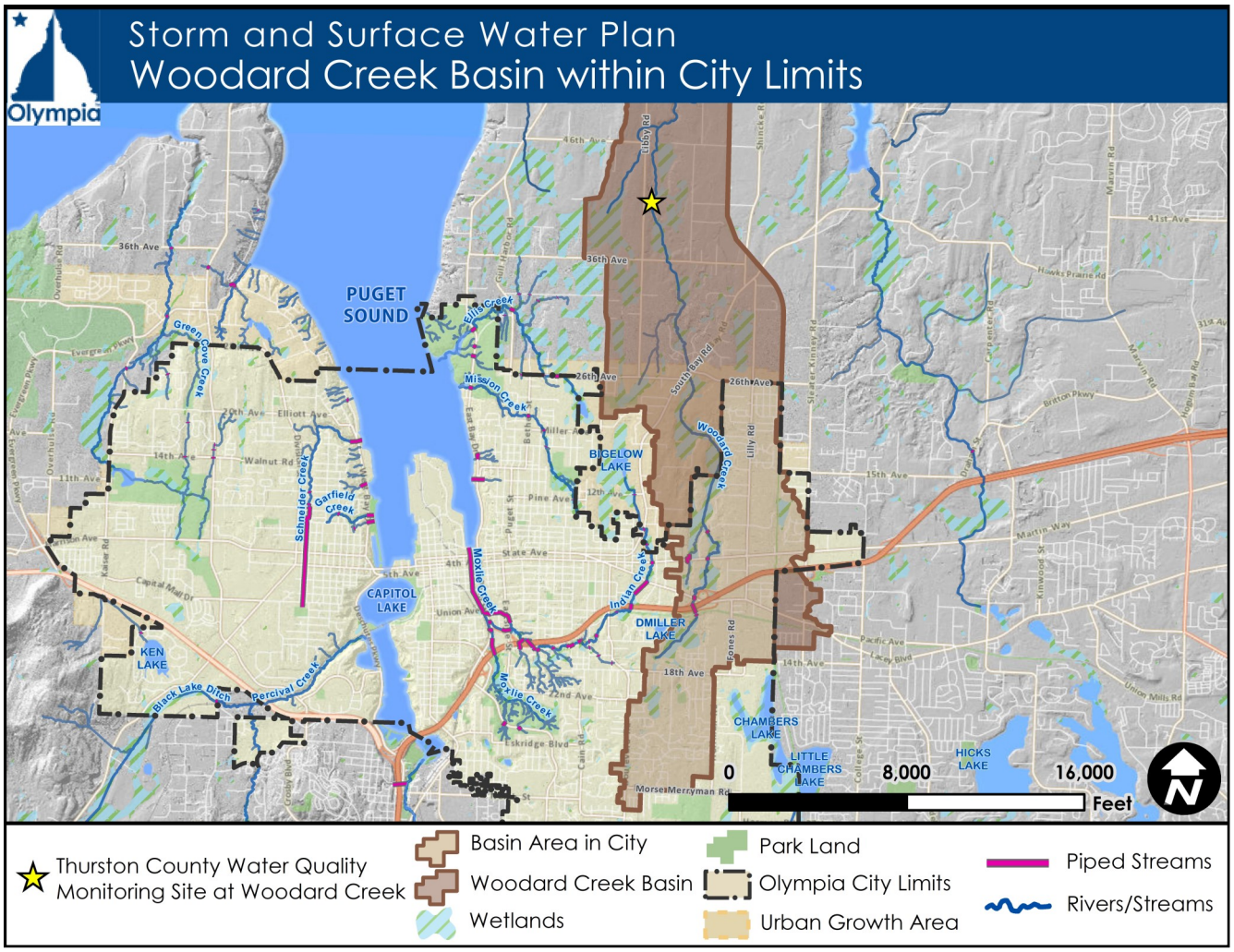
Because no specific stream is associated with the Ward Lake Basin, there are no WQI or BIBI charts.

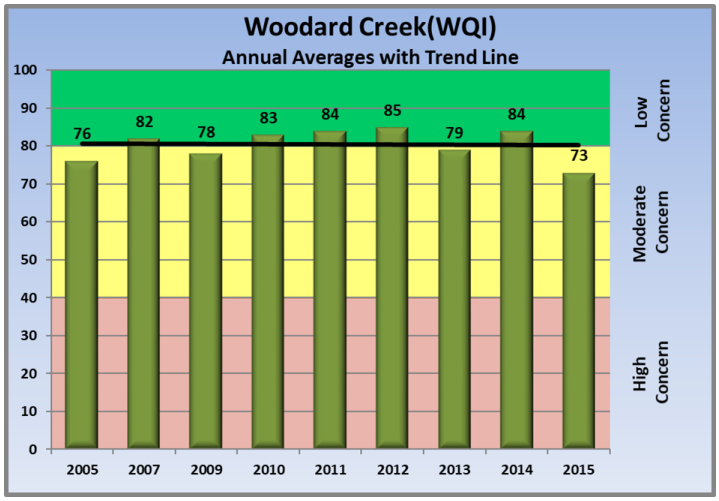
Woodard Basin



Physical Characteristics

The Woodard Creek Basin is located in northwest Olympia roughly with the Chehalis Western Trail on its east side from Woodard Bay Road to just south of Lacey Boulevard. The basin covers approximately 5,200 acres with approximately 1,733 acres located within the city limits. The creek's 7.8 miles originate at an elevation of approximately 280 feet near 30th Avenue SE and Hoffman Road. The creek then flows through a series of interconnected kettles, several large wetland complexes between 18th Avenue SE and 26th Avenue NE, and rural wooded terrain in the county before meeting Henderson Inlet at Woodard Bay Natural Resource Conservation Area. Land use in the basin is a mix of residential neighborhoods, commercial areas along Pacific and Martin Way, and rural low density residential and agricultural lands in the county. There are over 558 acres of wetlands dotted throughout the basin. Taylor Wetland stormwater facility provides treatment of runoff from commercial areas near South Sound Center and discharges into the wetlands south of Interstate 5. The piped sections of the creek are culverts under Ensign Road, Martin Way, Pacific Avenue, Interstate 5, and a few other minor streets for a total of 0.3 miles.





Source: Department of Ecology, "The Water Quality Index Spreadsheet (Version 6)," **A Water Quality Index for Washington State Streams (Version 6: 2014.06.11),** 2016.

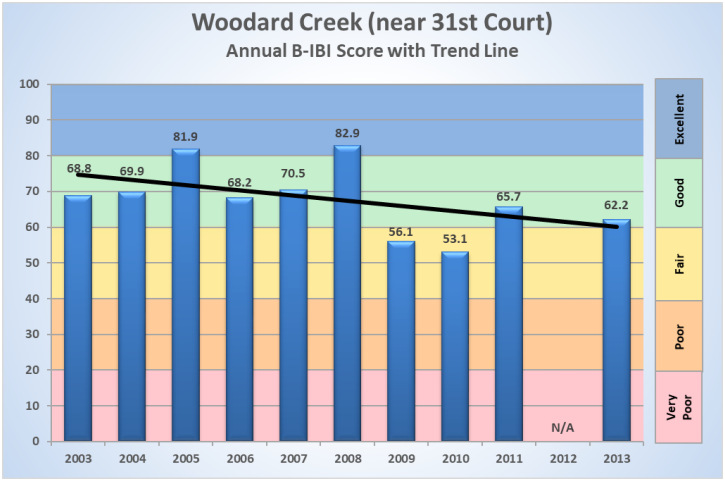
Basin Concerns

Development in the Urban Growth Area challenges stormwater runoff management.

Woodard Creek is part of the Henderson Inlet multi-parameter TMDL for dissolved oxygen, bacteria, pH, and temperature.

Agricultural practices and septic systems in rural areas are contributing to the problem.

(Source: Thurston County Water Resources Monitoring report, 2016).



Source: Puget Sound Stream Benthos, "Plotting Biotic Integrity." **Analysis: Benthic Index of Biotic Integrity.** 2017.

Key Basin Elements

Total Basin = 5,211 acres

Basin in City = 1,733 acres

Woodard Creek in City = 2.2 miles

Wetlands in City* = 172 acres

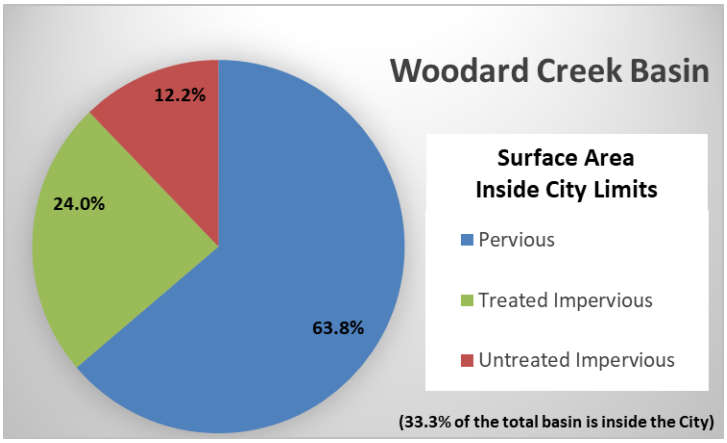
Pervious in City = 1,105 acres

City Impervious = 628 acres

City Treated Impervious = 283 acres

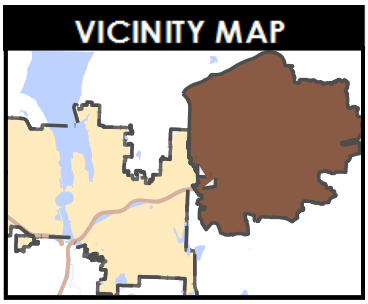
Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data.

*National Wetlands Inventory Mapping, 2017



Source: Olympia_basemap.DBO.Topo_HardSurface, 2015, City of Olympia GIS data.

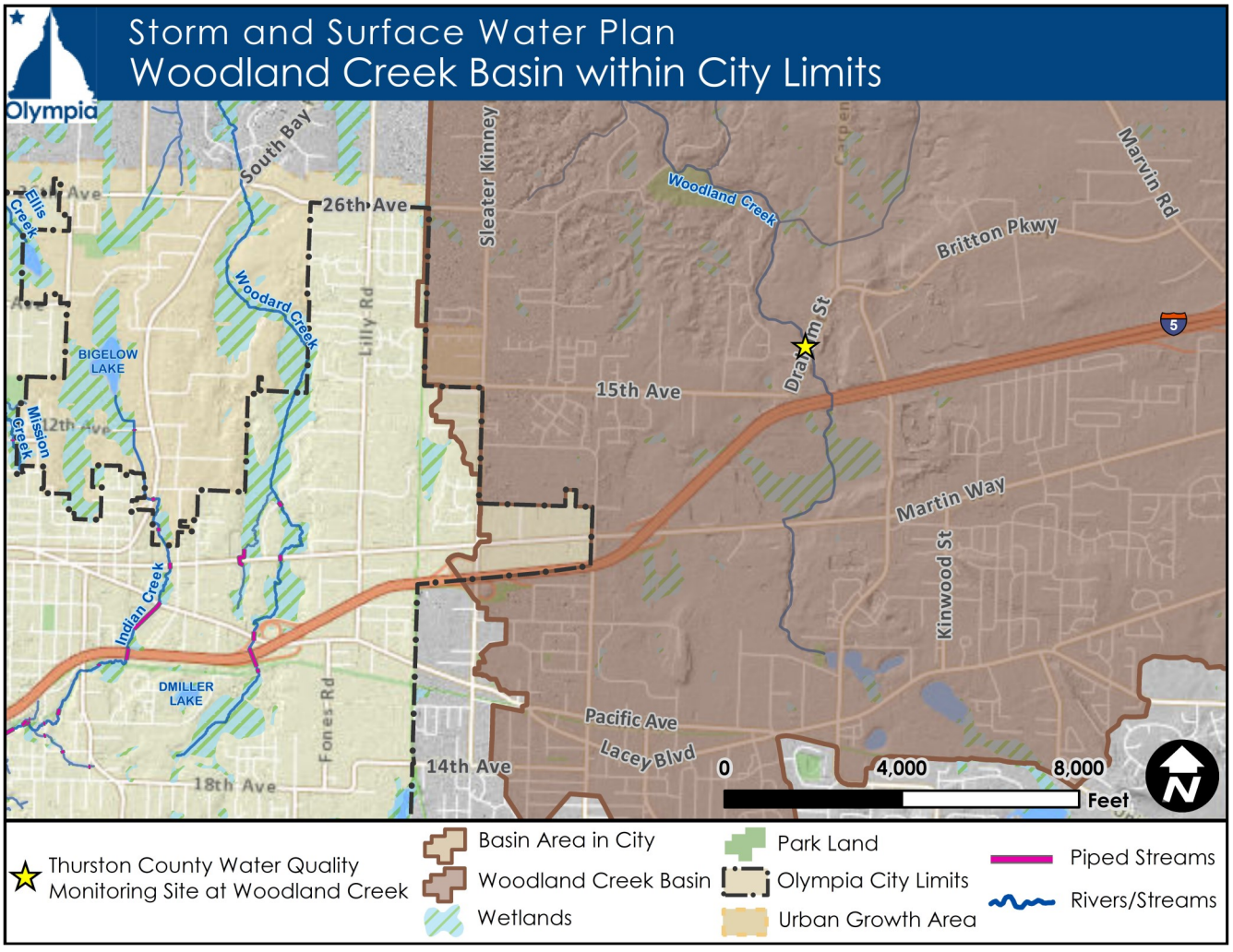
Woodland Creek Basin

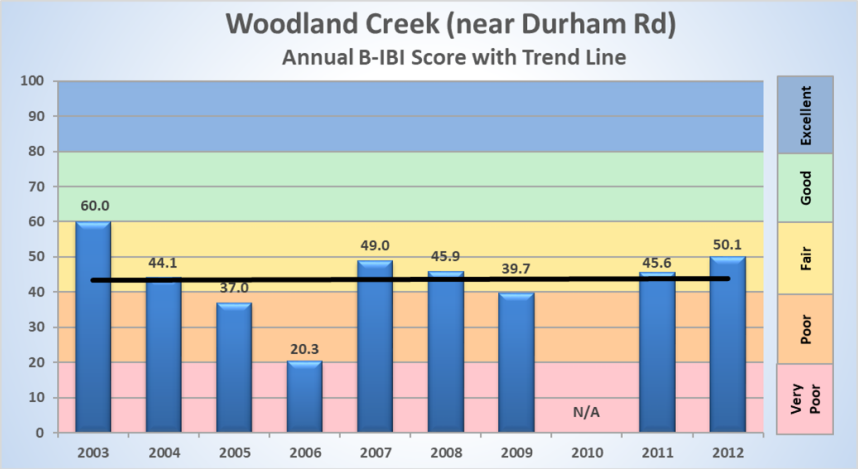


Physical Characteristics

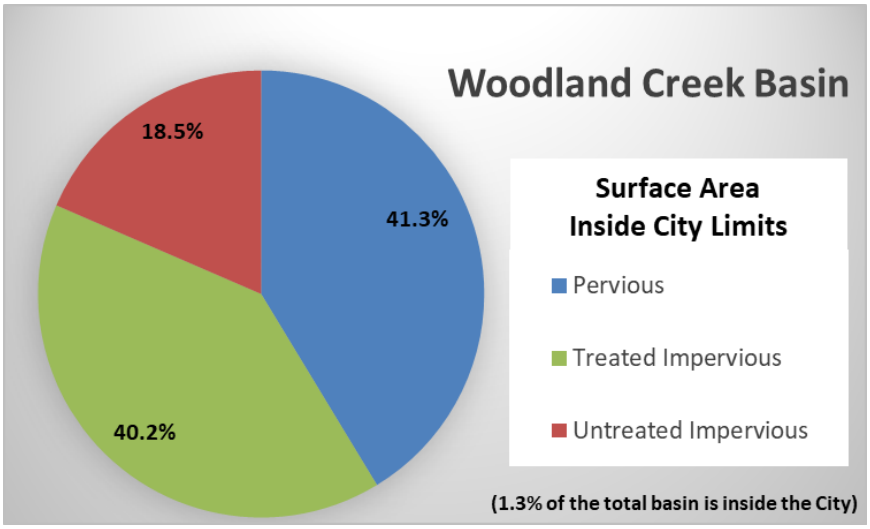
A small portion of the Woodland Creek Basin is located at the eastern-most edge of Olympia. The basin is over 10,000 acres with only approximately 135 acres located in the city limits. Woodland Creek does not enter the City.

Three lakes, Hicks, Pattison, and Long Lake, are connected by extensive wetlands and make up the headwaters of Woodland Creek. The creek is an 11 mile intermittent channel that often dries up during the summer. Downstream (north) of Martin Way, several springs provide perennial flow to lower Woodland Creek. The creek is piped under Martin Way and Interstate 5 and flows through rolling hills before discharging into Henderson Inlet. No portion of Woodland Creek flows through Olympia. Land use includes urban residential and commercial within the Lacey and Olympia city limits and agricultural and rural residential in the county.





Source: Puget Sound Stream Benthos, "Plotting Biotic Integrity."
Analysis: Benthic Index of Biotic Integrity. 2017.



Source: Olympia_basemap.DBO.Topo_HardSurface, 2015, City of Olympia GIS data.

Key Basin Elements

Total Basin = 10,460 acres

Basin in City = 135 acres

Wetlands in City* = 5 acres

Woodland Creek in City = 0 miles

Pervious in City = 56 acres

City Impervious = 79 acres

City Treated Impervious = 54 acres

Source: Olympia_Utility.DBO.swBasin, 2010, City of Olympia GIS data.

*National Wetlands Inventory Mapping, 2017

Basin Concerns

Woodland Creek is on the 303(d) list of impaired water bodies for temperature and dissolved oxygen. Stormwater discharged from the Tanglewilde stormwater outfall is a major source of bacteria and nutrient pollution to the creek.

Elevated nitrate+nitrite and total phosphorus are above the respective regional reference condition. Nitrate concentrations are very high in base flows due to shallow groundwater contamination. On-site septic systems and other urban activities contribute to the contamination of shallow ground water that infiltrates into the stormwater system.

(Source: Thurston County Water Resources Monitoring report, 2016 and Department of Ecology, "Assessed Waters/Sediment." **Map Water Quality Data**. 2016).

There is no WQI chart for Woodland Basin.