2017 Ward Lake Water Quality Report
Prepared by Thurston County Environmental Health

PART OF DESCHUTES RIVERWATERSHED
LENGTH OF LAKE: Approximately 1/3 mile
SHORELINE LENGTH: 1.4 miles
LAKE SIZE: 65 acres
BASIN SIZE: 0.95 square miles
MEAN DEPTH: 33 feet
MAXIMUM DEPTH: 67 feet
VOLUME: 2,100 acre-feet

PUBLIC ACCESS:
Washington Department of Fish and Wildlife public boat launch, four private community accesses.

PRIMARY LAKE USE:
Fishing, boating, and swimming.

GENERAL TOPOGRAPHY:
The lake is located at an altitude of 126 feet. The topography of the basin is lowlands and rolling hills with occasional glacial depressions. The lake is located in a deep glacial depression called a kettle. It is fed by groundwater and has no surface water inlet or outlet channel.

PRIMARY LAND USES:
The majority of the basin is suburban with moderate to high density residential housing. Historically there was a large plant nursery on the west side, but the area is now urban housing.
GENERAL WATER QUALITY: (Excellent, Good, Fair, Poor)

Good – After an abnormally high nutrient spike and consequent algae bloom in 2012, total phosphorous (TP) & total nitrogen (TN) concentrations have remained relatively steady. Average annual surface TP concentrations have decreased since the 2012 spike 0.015 mg/L to 0.008 mg/L in 2017. During 2017, all monthly surface TP concentrations were in compliance with the 0.020 milligrams per liter (mg/L) regulatory standard.

Recent average TN concentrations have also decreased since the 2012 spike of 0.877 mg/L to 0.313 mg/L in 2017.

Average chlorophyll-a concentrations are steady, with recent average annual concentrations ranging from 15.98 micrograms per liter (µg/L) in 2012 to 4.15 µg/L in 2017.

The mean 2017 Trophic State Index (TSI) is 38, placing the Ward Lake in the mesotrophic to oligotrophic classification, with no uses impaired.

OTHER AVAILABLE DATA:

Water Quality data since 1992 - Thurston County Environmental Health Division, www.co.thurston.wa.us/health/ehswat/swater.html (360) 867-2626

Thurston County Stormwater Program http://www.thurstoncountywa.gov/sw/Pages/monitoring.aspx

GENERAL DISCUSSION:

Ward Lake is a deep spring-fed glacial depression, or kettle lake. It has no surface inlet or outlet, and is groundwater fed. Nutrient levels are historically low, with the exception of the nutrient spike in 2012. The lake supports a light growth of aquatic plants along the lake perimeter, limited in large part by the depth of the lake.

Thurston County Environmental Health conducted monthly 2017 ambient monitoring for Ward Lake. Sampling occurred during 6 sampling events from June through October, at one site located in the deepest basin of the lake. Field parameters included temperature, dissolved oxygen, pH, conductivity, color, and secchi disk readings (water clarity). Additionally, Thurston County collected total phosphorus (TP) and total nitrogen (TN) water samples near the lake surface (surface) and near the lake bottom (benthic). Composite samples from the epilimnion (warm surface layer) were also collected and analyzed for chlorophyll-a and pheophytin. All water samples were submitted to IEH Analytical Laboratories in Seattle, WA. IEH Analytical Laboratories analyzed the samples for TP, TN, chlorophyll-a and pheophytin. The data is located at the end of this report.

**Field Parameters**

Monthly temperature, dissolved oxygen, pH, and conductivity profile graphs are included towards the end of this report. The term *thermal stratification* refers to a condition in the lake when there are two distinct layers in the water column, a warm upper layer and a cold bottom layer. In 2017, Ward Lake was stratified during the entire sampling season. Surface temperatures fluctuated between approximately 13.9 ºC in October to 24.4 ºC in August.

When a lake is thermally stratified, there is no exchange of oxygen from the atmosphere into the bottom waters. During that time, bacterial decomposition of material in the lake sediment, such as aquatic plants, algae, and other organic matter, depletes the available dissolved oxygen in the bottom water. This condition is called *anoxic*. Benthic *anoxic* conditions existed throughout the 2017 sampling season. Low oxygen conditions near the lake bottom promote the release of phosphorus from the benthic sediment into the water in a form easily utilized by algae. When the lake mixes, sometime in winter or early spring, the nutrient-rich water brought up from the bottom can stimulate algae growth resulting in visible algae blooms. This phenomenon has been observed more frequently in recent years on Ward Lake, but not in 2017.

**Secchi Disk Water Clarity**

Water clarity in a lake is measured with a device called a secchi disk. In 2017, the water clarity ranged from 4 meters (13.12 feet) in September to 8.2 meters (26.90 feet) in October. The average water clarity for the 2017 sampling season was 5.5 meters (18.04 feet), up from the 2016 average water clarity of 3.94 meters (12.93 feet). The graph below shows the annual average secchi disk results for the period of record.
Water clarity was declining since 2014, but increased again in 2017. The above graph illustrates annual fluctuations in water clarity, revealing a cyclical pattern over the period of record. The average seasonal water clarity has varied up to 2.25 meters between 2011 & 2012, where the average water clarity decreased from 5.27 meters in 2011 to 2.55 meters in 2012. In 2013, the average water clarity improved to 5.15 meters and has slowly decreased in 2014 (5.00 meters), 2015 (4.66 meters), and 2016 (3.94 meters). In 2017, water clarity has increased again to 5.55 meters.

This cyclical trend is more clearly illustrated on the graph below entitled ‘Water Clarity Trend’. The trend graph shows the difference between each annual average secchi reading and the average secchi reading for the entire period of record (1992 to 2017). Graphing the water clarity data in this way helps to show true trends in water quality versus normal annual fluctuations. Excluding 2012, water clarity has typically oscillated no more than 1.5 meters above or below the annual average over the period of record (5.09 meters or 16.70 feet).
Nutrient Levels

Generally, lakes in the Puget Sound region with summer average surface total phosphorus (TP) concentrations greater than 0.030 mg/L experience undesirable algae growth which interferes with recreational uses of the lake (USGS Water Supply Paper 2240). The action level established in WAC 173-201A, “Water Quality Standards for Surface Water of the State of Washington” is 0.020 mg/L.

In 2017, the average surface TP concentration in Ward Lake was 0.008 mg/L. The individual monthly results were all below the above-referenced action level. As is the case in most Thurston County lakes, the TP concentration at the bottom is typically higher than at the surface, especially during periods of stratification. This is due to the accumulation of TP in the lake benthic sediments. The average benthic TP concentration was 0.286, significantly higher than the 2016 average benthic TP concentration of 0.088 mg/L.

The graph below illustrates the average annual benthic and surface TP concentrations over the period of record. Note the sharp increase in benthic TP concentrations in 2017 in comparison to the mean 2016 data. Surface mean TP appears to remain relatively consistent, with annual averages not exceeding the regulatory standard of 0.020 mg/L.
In most lakes, including Ward Lake, the algae growth is limited by the amount of available phosphorus. The two graphs above depict the annual average total phosphorus and total nitrogen (TN) concentrations.

In comparison with 2016, surface TN levels slightly decreased in 2017 and benthic TN concentrations increased.
The graph above depicts the 2017 monthly surface TN & TP data. Although TP increased August to September, TP values decreased overall throughout the sampling season, while TN concentrations increased in early summer, then dropped again in early fall. This is likely attributed to rapid growth of plant and algae matter during the warmer summer months, then the aging and death of vegetation as temperatures cooled.

**Trophic State Indices**

The Carlson Trophic State Indices (TSI) are used to express the degree of productivity of a lake. Average summer TP concentration, chlorophyll-\(a\) concentration, and secchi disk transparency are each used to calculate a TSI. A TSI of 0 to 40 indicates an oligotrophic, or low productivity lake. A TSI of 41 to 50 indicates a mesotrophic, or moderately productive lake. A TSI of greater than 50 indicates a eutrophic, or highly productive lake. For reference, eutrophic lakes have high nutrient levels, high plant and algae growth, low clarity, and are generally considered to have poor water quality.

The 2017, TSIs were 34 for TP, 45 for chlorophyll-\(a\), and 35 for secchi disk transparency. The 2017 TSIs for phosphorus and secchi disk were in the oligotrophic range, or low productivity. The chlorophyll TSI was in the mesotrophic, or moderately productive range.

The graph below shows annual TSIs since 1995. 2012 was the first time that TSIs for phosphorus and secchi disk reached the mesotrophic range. The TSI graph below shows that the chlorophyll-\(a\) TSI index has consistently been in or near the mesotrophic range since 2003, but the index jumped well into the eutrophic range in 2012. The TSIs for Ward Lake during 2012...
were the highest on record. The 2014, 2015, 2016 and 2017 results show that the lake has gone back to more normal measurements for all three TSI indexes, with the chlorophyll TSI into the *mesotrophic* range, and the secchi and phosphorus TSIs within the *oligotrophic* range.

### Ward Lake - Annual Trophic State Indices

![Ward Lake - Annual Trophic State Indices](image)

**Algae**

Some species of blue-green algae can produce toxins that can cause illness in people, pets, and wildlife if ingested. Pets are particularly vulnerable to poisoning from toxic algae blooms due to their smaller body mass and their tendency to ingest higher doses by drinking lake water, etc. In recent years there has been an increase in documented toxic blue-green algae blooms occurring in lakes throughout Washington.

Because toxicity cannot be determined through visual observations, samples are sent to a laboratory to quantify the amount of toxin present in micrograms per liter (µg/L). The laboratory services are a statewide program sponsored by Washington Department of Ecology. Although toxin testing is now possible, lake residents and users should always observe lake conditions and avoid contact with lake water where an algae bloom is occurring.

In May, 2017 Thurston County responded to an algae bloom, and toxin results were negative.

More information about blue-green algae and swimming safety information is available through the Thurston County website: [www.co.thurston.wa.us/health/ehadm/swimming/swimming_index.html](http://www.co.thurston.wa.us/health/ehadm/swimming/swimming_index.html)

And the Washington State Toxic Algae website: [https://www.nwtoxicalgae.org/Data.aspx](https://www.nwtoxicalgae.org/Data.aspx)
Major Issues:

- Monthly 2017 TP concentrations met the water quality criteria of 0.020 mg/L in all months in the 2017 sampling season.
- Urban land uses, storm water discharges, and other non-point pollution sources have the potential to degrade water quality.

Recommendations:

- Investigate and promote best management practices (BMPs) and shoreline habitat enhancement on shoreline properties, to decrease external nutrient deposition/loading into the lake.
- Perform phosphorus and nitrogen analysis for specific species (i.e. orthophosphate, kjedahl nitrogen, etc.).
- Educate lake residents on the proper application (agronomic rates) of fertilizers.
- Conduct and inspect on-site septic systems to assure they are operational, and not contributing nutrients or pathogens into the lake.
- Identify all outfalls and stormwater conveyances discharging to the lake. Conduct dry weather outfall screening and identification. Sample outfalls that are actively discharging to the lake for nutrients.

Funding Sources:

County funds will continue to support monitoring in 2018.
### Table 1: Ward Lake Ambient Data

**Thurston County Water Resources Annual Report - 2017**

**Ward Lake**

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**Summary for 'Site Description' = Ward Lake (6 detail records)**

**Averages:**
- Sur TP: 0.008 mg/L
- Secchi: 5.548 meters
- Chl-a: 4.150 µg/L
## Ward Lake: 2017 Toxic Algae Results

<table>
<thead>
<tr>
<th>Site</th>
<th>Collect Date</th>
<th>Parameter</th>
<th>Toxin Conc. (µg/L)</th>
<th>MDL* (µg/L)</th>
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*MDL: Method detection limit