

KITSAP COUNTY HEALTH DISTRICT
ENVIRONMENTAL HEALTH DIVISION
POLLUTION IDENTIFICATION AND CORRECTION PROGRAM

HORSESHOE LAKE WATER QUALITY IMPROVEMENT PROJECT FINAL REPORT



By
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Environmental Health Specialist
January 28, 2011
Funded through Kitsap County Surface and Stormwater Management Program



Horseshoe Lake Water Quality Improvement Project Final Report January 28, 2011

Project Summary

Horseshoe Lake is a small lake located in the Burley Creek watershed in southern Kitsap County. It is about 40 acres in size and has a maximum depth of about 20 feet in the center. The lake has no inlet or outlet, but is fed by many large wetlands on the north side of the lake. Less than 50 properties are adjacent to the lake, but the majority of these properties are developed and most of the residents live at the lake year-round.

There are three public access areas on Horseshoe Lake: Horseshoe Lake County Park, the state public fishing access, and Miracle Ranch, a private camp. Health District trophic monitoring data indicates meso-eutrophic conditions, which indicates moderate to high levels of nutrients, poor visibility in the water column at times, and some aquatic plants and fish. The lake also has a history of blue-green algae blooms. The public fishing access was closed for seven days during the summer of 2008 due to high levels of *E. coli* bacteria. The lake has a history of closures due to bacterial contamination during the summer months. These factors led to the lake being listed first on the Kitsap County Health District Pollution Identification and Correct Program's 2009 Priority List.

Introduction and Background

The purpose of the Horseshoe Lake Water Quality Improvement Project was to identify and correct sources of bacterial and nutrient contamination in the watershed, while educating property owners on ways to maintain beneficial uses of the lake.

Approximately 132 properties drain to Horseshoe Lake and the surrounding wetlands. All property owners were mailed a postcard inviting them to the public meeting held February 24, 2009 at Miracle Ranch. Seventeen property owners attended.

The monitoring portion of the project consisted of pollution identification sampling of the lake at four stations for *E. coli* bacteria and phosphorus, trophic monitoring during the summer of 2009, and weekly swimming beach samples from May to September 2009. Water quality monitoring was conducted pursuant to the "Horseshoe Lake Water Quality Monitoring Plan" (**Appendix A**). Door-to-door Pollution Identification and Correction (PIC) surveys were also conducted. Property surveys were conducted pursuant to the Health District's "Manual of Protocol: Fecal Coliform Bacteria Pollution Identification and Correction, Version 9, November 2003."

Pollution Identification Monitoring

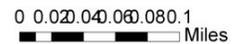
The Health District selected monitoring stations in Horseshoe Lake to determine priority areas within the lake. **Table 1** and **Figure 1** describe the four Horseshoe Lake monitoring locations.

Table 1: Horseshoe Lake Monitoring Stations

Station	GPS Coordinates
HL01-Northwest Station	N47.41086, W122.66536
HL02-Northeast Station	N47.40960, W122.66061
HL03-Center Station	N47.40708, W122.66253
HL04-South Station	N47.40660, W122.66632

Figure 1: Map of Horseshoe Lake Monitoring Stations

Horseshoe Lake Sampling Stations



Total phosphorus and *E. coli* samples were taken from each station four times. The sampling dates were March 18, 2009, April 29, 2009, September 22, 2009, and January 6, 2010. These dates were chosen in order to assess conditions during spring, summer, fall, and winter conditions.

E. coli Bacteria Results

The bacteria samples met the water quality criteria during each sampling event. The summer sampling event showed high levels of bacteria, likely due to higher use and lower water levels during the dry summer months. The bacteria data is shown in **Table 2** below.

Table 2: Results (Colonies of *E. coli*/100 milliliters)*

Date	Station HL01- Northwest Station	Station HL02- Northeast Station	Station HL03- Center Station	Station HL04- South Station
3/18/2009	<1	16.1	1	<1
4/29/2009	<1	1	1	<1
9/22/2009	83.9	61.3	57.3	20.1
1/6/2010	5.2	4.1	11.9	13.4

**E. coli* samples were compared to the Environmental Protection Agency's standard-no single sample may exceed 235 colonies of *E. coli*/100 milliliters and the geomean of samples may not exceed 126 colonies of *E. coli*/100 milliliters.

Total Phosphorus Results (Surface Sampling)

Excess phosphorus is a food source for algae and aquatic plants. Horseshoe Lake has experienced blue-green algae blooms in the past and has moderate levels of white water lily along the northwestern and eastern shorelines. The Washington Department of Ecology action level for phosphorus is 20 ppb. Phosphorus samples were taken at the surface from the four sampling stations during four sampling events. Results are shown in **Table 3** below. Only one sample exceeded the action level (HL02 on 9/22/09).

Table 3: Results (milligrams/Liter)

Date	Station HL01- Northwest Station	Station HL02- Northeast Station	Station HL03- Center Station	Station HL04- South Station
3/18/2009	0.01	<0.01	0.01	<0.01
4/29/2009	0.02	0.02	0.02	0.02
9/22/2009	0.01	0.03	0.01	0.02
1/6/2010	0.01	0.01	0.01	0.02

Shoreline Survey Results

Two shoreline surveys of the Horseshoe Lake shoreline were performed using a small boat. One survey was performed on September 22, 2009 during dry weather conditions and the other on January 6, 2010 during wet weather conditions. No samples were collected from beach discharges during either survey. Several pipes were visible during dry weather conditions when the lake level was several feet lower, but none of the pipes were flowing.

Trophic Monitoring

Nutrient monitoring in lakes takes place in order to determine the “age,” or eutrophication, of a lake. Eutrophication is a natural process driven by sedimentation in the lake and nutrient enrichment from various sources. As nutrients collect in the lake, plant material increases. Lakes are classified as oligotrophic (low nutrients, clear water, few aquatic plants and fish), mesotrophic (moderate amounts of nutrients, mostly clear water, some aquatic plants and fish), or eutrophic (high levels of nutrients, poor visibility in the water column, with many plants and fish). All trophic monitoring was conducted in accordance with Kitsap County Health District’s “Lake Trophic Assessment Monitoring Plan.”

Per Health District data, Horseshoe Lake continues to meet the criteria for meso-eutrophic conditions, which means that it is judged to be between the mesotrophic and eutrophic stages. Eutrophication can be accelerated by certain human activities, such as failing onsite sewage systems, improper use of fertilizers, sedimentation caused by uncontrolled runoff from development, and improper agricultural and pet waste management.

Swimming Beach Monitoring

The Health District’s swimming beach monitoring program is intended to determine the potential health risk of swimming at a given location at a certain point in time, not to establish water quality trends or to identify specific pollution sources. Water quality at Horseshoe Lake met the *E. coli* standard throughout most of the 2009 season. However, between July 25 and July 31, extremely hot temperatures and heavy beach use caused 33 reported cases of water-borne illness. Norovirus was isolated from infected persons who swam at the Horseshoe Lake County Park during that time. The 2009 swimming beach data from Horseshoe Lake is summarized in **Table 4** below.

Table 4: *E. coli* Bacteria-Swimming Beaches-2009

Sampling Location	Number of Samples	<i>E. Coli</i> Range	<i>E. Coli</i> Geomean	Swimming Beach Health Advisories
County Park	64	<2 – 1986.3	14	0
Miracle Ranch	45	<2 – 166.9	7	0

During the summer of 2010, the swimming beach was closed due to budget cuts, but samples were still taken at Miracle Ranch and the County Park. The data is shown in **Table 5** below.

Table 5: *E. coli* Bacteria-Swimming Beaches 2010

Sampling Location	Number of Samples	<i>E. Coli</i> Range	<i>E. Coli</i> Geomean	Swimming Beach Health Advisories
County Park	40	<2 – 146.7	6	0
Miracle Ranch	33	<2 – 130	4	0

Sanitary Survey Results

Ninety-one property inspections were completed during this project. For onsite sewage system rating criteria, see **Appendix B**. Three (3) residences were vacant. Thirty-six (36) property owners did not participate in the survey. Of the 91 property inspections completed: one had an onsite sewage system failure, 41 systems were non-conforming with regulations in place at the time of installation, eight systems had no records and 41 systems had no apparent problems. The failure was not a shoreline property and has been repaired.

Discussion

The primary focus of this project was property owner/occupant education. All property owners in the watershed were invited to the public meeting in February 2009. The postcard invitation and news release for the meeting are available in **Appendix C**. The focus of the meeting was to inform property owners and residents of the water quality problems in Horseshoe Lake, as well as provide information on how to protect the lake and how to get the most life out of onsite septic systems.

Also, inspectors attempted to meet with property owners on an individual basis for property inspections/site visits. Health District staff provided homeowners with educational brochures describing proper use and maintenance for onsite septic systems, as well as a copy of the sewage disposal permit/as-built on file at the Health District for their property. Inspectors emphasized to homeowners that proper operation and maintenance is crucial to prevent future sewage system failures and protect water quality in Horseshoe Lake. In addition, information regarding landscaping, proper use of fertilizers, pet/livestock waste, and yard waste was discussed and distributed. "The Washington Lake Book" written by the Washington State Lake Protection Association, was distributed to property owners, and gives tips for protecting the lake and their lakeside property.

Pet owners were very aware of the need to pick up pet waste on a regular basis and pet waste was not determined to be a source of nutrients and bacteria. Many property owners had concerns regarding geese and ducks frequenting the lake. Inspectors reminded residents that feeding wildlife is not an acceptable practice and gave tips on methods to keep wildlife off their beaches, such as decoys and landscaping. During the summer months, geese and duck densities appear to be much higher than during the winter months, which is likely affecting nutrient and bacteria levels.

During the property inspections, most residents were very aware of the need to be careful on their properties in order to protect the lake. Health District inspectors used a standard form, available in **Appendix D**, to go through a checklist with each property owner and discuss any concerns the property owner might have. Inspectors also inspected the onsite septic system visually by walking over the area and letting the property owner know of anything that could be stressing the system, such as parking or

driving over the components. Each system was rated according to the criteria in **Appendix B**.

Conclusions

Based on the project results, the Health District concludes the following with regard to the bacterial pollution and phosphorus loading in Horseshoe Lake:

- Maintaining the current conditions and phosphorus levels is the goal for the lake.
- Onsite septic systems do not seem to be contributing to nutrient loading or elevated *E. coli* levels in the lake.
- High levels of bacteria in the summer months are likely a result of high use at the county park and the lack of flushing in the lake system.

Recommendations

- Horseshoe Lake should be monitored regularly to track any changes to nutrient levels.
- Individual property owners should continue to take precautions to control runoff to ensure there is no increase in nutrient pollution.
- Swimming beach sampling at Horseshoe Lake County Park should occur more frequently during periods of high use, i.e. unusually hot weather.

Appendix A
HORSESHOE LAKE WATER QUALITY MONITORING PLAN
March 3, 2009

Introduction

The purpose of the Horseshoe Lake water quality monitoring effort is to identify sources of bacterial and nutrient contamination of the lake. The results of this monitoring effort will be used to prioritize pollution identification and correction work in the Horseshoe Lake watershed.

Additional monitoring may be conducted depending upon the results.

This monitoring is in addition to monitoring that will be conducted by Water Protection Program staff to fully assess the trophic state of the lake. The trophic monitoring will occur four times between June 2009 and September 2009. Sampling will occur in the deepest portion of the lake. Total phosphorus, chlorophyll A, and secchi disk readings will be taken to determine the trophic status of the lake.

Monitoring Schedule

The lake will be monitored four times at four stations between March 2009 and March 2010 for *E. coli* bacteria and total phosphorus. These sampling events will occur in March 2009, April 2009, September 2009, and December 2009. In addition, two shoreline surveys will be conducted during which all flowing discharges into the lake will be sampled. One will be a dry weather event conducted in September 2009 and the other will be a wet weather event conducted in December 2009. The monitoring team will carry out this plan and then determine if future sampling is necessary and beneficial to the health of the lake.

Monitoring Station Locations

A northwest station, a northeast station, a southwest station, and a southeast station will be chosen for the monitoring. GPS coordinates will be taken at each point in order to ensure that samples are taken at the same location for each of the four sampling events.

Monitoring Parameters

The analysis for *E. coli* bacteria is the Health District's primary public health indicator for surface waters. The sample is collected in a 100 milliliter sterile water bottle, stored at 4°C, and transported to the Twiss Analytical for analysis.

The analysis for total phosphorus will determine the potential for toxic algae blooms in the lake. The sample is collected in a 1,000 milliliter sterile water bottle, stored at 4°C, and transported to Twiss Analytical for analysis.

Monitoring Procedures

All monitoring activities will be performed in accordance with the applicable procedures and methodologies as discussed in the Health District's *Water Quality Trend Monitoring Plan, Streams and Marine Waters* (Trend Plan).

Data Assessment and Reporting

Copies of the laboratory analytical results will be provided to the project lead, Kimberly Jones. Results will be faxed to (360) 475-9223. Project lead will evaluate the monitoring results and prepare a report that details the Health District's conclusions and recommendations.

Appendix B OSS Rating Criteria

Rating Classification	Criteria for Meeting Classification ¹
No Apparent Problems	<ul style="list-style-type: none"> • Completed/signed Sewage Disposal Permit on file at Health District, or available from owner. • No illegal repairs or alterations have been performed on OSS. • All applicable setbacks and conditions in effect at the time of permitting are in place.
No Records	<ul style="list-style-type: none"> • No completed/signed Sewage Disposal Permit on file at the Health District, or in possession of the owner/occupant . • No Non-Conforming, Suspect or Failure criteria were observed .
Non-Conforming	<ul style="list-style-type: none"> • Repairs or alterations have been performed on OSS without a permit • Additional bedrooms have been added to the home (or business) without a permit. • Non-conforming conditions exist (such as insufficient setbacks from surface waters or wells, no reserve area, vehicular traffic on drainfield).
Suspect	<ul style="list-style-type: none"> • Drainfield area is saturated. • Collected water sample results from bulkhead drains, curtain drains, or other pipes or seeps, at or above 500 FC/100 ml. and negative dye-test. • Collected water sample results from bulkhead drains, curtain drains, or other pipes or seeps, less than 500 FC/100 ml. and positive dye-test.
Failure ²	<ul style="list-style-type: none"> • Sewage backing up into, or not draining out of a structure caused by slow soil absorption of septic tank effluent. <ul style="list-style-type: none"> • Sewage leaking from a septic tank, pump tank, holding tank, or collection system. • Surfacing sewage in a documented drainfield area. • Collected water sample result from bulkhead drains, curtain drains, or other pipes or seeps, at or above 500 FC/100 ml. and positive dye-test results. • Straight discharge (gray or blackwater) from any indoor plumbing is observed and documented.

¹Not all criteria in each rating classification must be met in order to rate a system; in some cases only meeting one of the criterion is required.

²As defined in the Bremerton-Kitsap County Board of Health Rules and Regulations Governing On-Site Sewage, 1996-8.

Appendix C

Horseshoe Lake Water Quality Improvement Project Postcard and News Release

A postcard with a background image of a lake and trees. The text is centered and reads: "Horseshoe Lake Water Quality Improvement Project". Below this, it says "Please join us for a public meeting on Tuesday, February 24, 2009 6:30 pm - 7:30 pm". The location is "Miracle Ranch-Circle K Room 15999 Sidney Road SW Port Orchard, WA 98367". At the bottom, it says "For questions and/or more information, please contact Kimberly Jones at (360) 337-5222". There are two logos: "KITSAP COUNTY HEALTH DISTRICT" on the left and "SOSUM" on the right.

**Horseshoe Lake Water Quality
Improvement Project**

**Please join us for a public meeting on
Tuesday, February 24, 2009
6:30 pm - 7:30 pm
Miracle Ranch-Circle K Room
15999 Sidney Road SW
Port Orchard, WA 98367**

**For questions and/or more information, please contact
Kimberly Jones at (360) 337-5222**



SCOTT W. LINDQUIST, MD, MPH, DIRECTOR
345 6TH STREET, SUITE 300
BREMERTON, WA 98337-1866
(360) 337-5235

News Release

FOR IMMEDIATE RELEASE
February 17, 2009

CONTACT: Kimberly Jones
(360) 337-5222
Stuart Whitford
(360) 337-5674

Health District Kicks Off Horseshoe Lake Water Quality Improvement Project

The Horseshoe Lake Water Quality Improvement Project will kick off with a public meeting on **Tuesday, February 24, 2009 from 6:30 p.m. to 7:30 p.m.** at Miracle Ranch's Circle K Room, 15999 Sidney Road SW, Port Orchard, WA 98367. A meeting invitation has been mailed to residents of the Horseshoe Lake watershed. Lake shoreline residents and the general public are invited to attend to learn how they can participate in cleaning up the lake.

The purpose of the project is to reduce nutrient pollution in Horseshoe Lake. Excess nutrients can be associated with toxic algae blooms and other problems. The project will investigate all freshwater drainages and properties draining to Horseshoe Lake, correcting problems and giving property owners useful information. Pollution sources may be one or more of the following: failing on-site sewage systems, pet waste, livestock waste, fertilizers, soil erosion runoff, waterfowl, or wildlife.

Horseshoe Lake is on the "2009 Priority Area Work List for the Pollution Identification and Correction Program, which is available at http://www.kitsapcountyhealth.com/environmental_health/water_quality/docs/pic_priority_list.pdf. Funding for this project is provided by the Kitsap County Surface and Storm Water Management Program.

For more information, contact Kimberly Jones at (360) 337-5222 or jonesk@health.co.kitsap.wa.us.

**Appendix D
 Survey Form**



**KITSAP COUNTY HEALTH DISTRICT
 WATER QUALITY PROGRAM
 Horseshoe Lake-PIC Survey Form**

Address:

Tax ID:

<p><u>PROPERTY INFORMATION:</u> Address: _____ _____ Phone: _____ Number of Occupants _____ Previous Owner: _____</p>	<p>OCCUPANT: Owner (if different) _____ Address : _____ _____ Phone: _____ Water supply : Public: _____ Private : _____ Number of Bedrooms _____ Water Meter? _____ County/ City _____</p>
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<p><u>SEPTIC SYSTEM INFORMATION:</u> System type : _____ System altered: Yes __ No __ Repair __ Date: _____ Date of last septic tank pumping _____ Effluent filter ? _____ Washer filter? _____ Install Date : _____ Records: BSA <input type="checkbox"/> Permit <input type="checkbox"/> As-built <input type="checkbox"/> Complaint <input type="checkbox"/></p>	<p>OSS Check List :</p> <table style="width: 100%;"> <tr> <td>Additives</td> <td><input type="checkbox"/></td> <td>Water softener</td> <td><input type="checkbox"/></td> </tr> <tr> <td>Plumbing leaks or back-ups</td> <td><input type="checkbox"/></td> <td></td> <td></td> </tr> <tr> <td>Clotheswasher use</td> <td><input type="checkbox"/></td> <td>Max # loads/day) _____</td> <td></td> </tr> <tr> <td>Medications (Antibiotics chemo, kidney dialysis)</td> <td><input type="checkbox"/></td> <td>Garbage grinder used</td> <td><input type="checkbox"/></td> </tr> <tr> <td></td> <td></td> <td>Fabric softener used</td> <td><input type="checkbox"/></td> </tr> </table> <p>Nutrients Check List :</p> <p>Fertilizers <input type="checkbox"/> Yard Waste <input type="checkbox"/> Pet Waste <input type="checkbox"/> Ag Waste <input type="checkbox"/></p>	Additives	<input type="checkbox"/>	Water softener	<input type="checkbox"/>	Plumbing leaks or back-ups	<input type="checkbox"/>			Clotheswasher use	<input type="checkbox"/>	Max # loads/day) _____		Medications (Antibiotics chemo, kidney dialysis)	<input type="checkbox"/>	Garbage grinder used	<input type="checkbox"/>			Fabric softener used	<input type="checkbox"/>
Additives	<input type="checkbox"/>	Water softener	<input type="checkbox"/>																		
Plumbing leaks or back-ups	<input type="checkbox"/>																				
Clotheswasher use	<input type="checkbox"/>	Max # loads/day) _____																			
Medications (Antibiotics chemo, kidney dialysis)	<input type="checkbox"/>	Garbage grinder used	<input type="checkbox"/>																		
		Fabric softener used	<input type="checkbox"/>																		

<p><u>FIELD INSPECTION INFORMATION:</u> Inspector: _____ Date of site visits : _____ _____ OSS condition : _____ Reserve condition: _____ Roof drains: _____ _____ Curtain drains: _____ _____ Bulkhead drains: _____ _____</p>	<p>Surface Waters Nearby: Yes __ No __ Type: _____ Distance From Drainfield _____ Animals, Domestic or Livestock (Type and Number): _____ _____ Site concerns: (Ponds, Topography) _____ _____ Approx. distance to sewer service _____ _____</p>
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<p><u>FINAL RATING OSS:</u> <input type="checkbox"/> NAP <input type="checkbox"/> NO RECORDS <input type="checkbox"/> NON-CONFORMING <input type="checkbox"/> SUSPECT <input type="checkbox"/> FAILURE</p> <p>Reasons for final rating: _____ _____ _____</p>
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<p>Public ed information: <input type="checkbox"/> OSS Facts <input type="checkbox"/> OSS Manual <input type="checkbox"/> OSS Repair <input type="checkbox"/> Nutrients Brochure <input type="checkbox"/> Natural Yard Care <input type="checkbox"/> Additives <input type="checkbox"/> Pet Waste <input type="checkbox"/> Leak Guide <input type="checkbox"/> PIC <input type="checkbox"/> Lake Guide <input type="checkbox"/> Shorebank Other: _____</p>

Notes: _____

