

**UPPER HOOD CANAL RESTORATION PROJECT**  
**FINAL REPORT**

**1.0 INTRODUCTION**

Washington State Department of Ecology monitoring stations in Hood Canal show that hypoxic conditions may persist year-round in the southern portion, and the monitoring station in the north (Bangor) shows that hypoxia may be spreading north with conditions of biological stress for up to six months of the year (<http://www.prism.washington.edu/hcdop/index.html>. 2005).

Oxygen demand from failing onsite sewage systems (OSS), inadequate animal waste management and stormwater flowing into Hood Canal may contribute to the low oxygen conditions. The "Preliminary Assessment and Corrective Action Plan" (PSAT, May 2004) identifies nutrient contamination as the most likely cause because it stimulates algal growth, which demands oxygen as the algae break down.

The presence of fecal pollution is associated with oxygen demand because fecal pollution sources are typically failing OSS, inadequate animal waste management and stormwater. Oxygen demand can be reduced in Hood Canal by correcting these fecal pollution sources.

Kitsap County Health District (Health District) conducted a pollution identification and correction (PIC) project during 2005 in the Upper Hood Canal watershed from Warrentville (Ioka Way, Silverdale) south to the Kitsap-Mason County line. All work was conducted pursuant to the Health District's "Manual of Protocol: Fecal Coliform Bacteria Pollution Identification and Correction Projects, November 2003" and the EPA approved "Hood Canal Shoreline Survey Quality Assurance Project Plan, January 24, 2005". Funding sources included Puget Sound Action Team (Contract HC04-10), the United States Environmental Protection Agency, and Kitsap County Surface and Stormwater Management Program (SSWM).

The following report will discuss the project and present recommendations for future work that will be needed to protect water quality in Upper Hood Canal. Nutrient work conducted for this project is reported in "Kitsap County Health District Water Quality Analysis of Hood Canal Shoreline Discharges - Part 1" located in **Appendix A.**

**2.0 PROJECT AREA DESCRIPTION**

Kitsap County borders the Hood Canal on the east, Jefferson County to the west and Mason County to the south. The northern project area boundary is north of Seabeck in Warrentville at Ioka Way in Silverdale, and the southern boundary is the Kitsap/Mason county border, south of Holly. **Figure 1** shows a map of the Upper Hood Canal watershed and project area.

**Figure 1. Kitsap County Health District Hood Canal Project Area**



Washington State Department of Ecology (Ecology) established surface water quality standards in Chapter 173-201A of the Washington Administrative Code (WAC). Marine water quality in the project area is excellent. According to the Health District's Draft "2004-2005 Water Quality Monitoring Report", all eleven marine water stations meet Washington state's fecal coliform standard (FC, FC standard) for Extraordinary Primary Contact waters (Chapter 173-201A WAC).

From 1999 to 2004 Washington state Department of Health (WSDOH) performed shoreline surveys of the study area in order to classify the area for commercial shellfish harvesting (WSDOH, 2005). Their surveys resulted in a shellfish closure zone in Holly and identified seventeen properties as "potential FC sources of concern." The Big Anderson Creek drainage experienced a water quality decline in 2003 at the mouth of the creek. However, in 2004 Big Anderson Creek met both parts of the FC standard.

### **3.0 GOALS AND OBJECTIVES**

The goals of the Upper Hood Canal Restoration Project are to:

- Protect public health and the environment by identifying and correcting sources of FC contamination from failing OSS and inadequate animal waste management.
- Provide water quality data to determine if there is a correlation between FC levels and nutrients in freshwater discharges to the marine shoreline.
- Provide water quality data to determine if correction of FC sources also nets reductions in nutrients.
- Educate Upper Hood Canal residents about the low dissolved oxygen problem and actions they can take to reduce bacterial and nutrient contributions to Hood Canal.

To accomplish this, the following tasks were completed:

- Conducted shoreline survey (FC source identification sampling) of approximately nine miles of Hood Canal shoreline from Ioka Way in Silverdale south to the Kitsap-Mason county line.
- Identified fecal pollution sources and areas in need of investigation. Selected fifty (50) properties and conducted onsite sewage system (OSS) surveys in the project area.
- Enforced correction of failing OSS under Bremerton-Kitsap County Board of Health Ordinance No. 1996-8, "Rules and Regulations Governing On-Site Sewage Systems" (Health District, 1996). Hereinafter referred to as "OSS Regulations".
- Held three neighborhood water quality workshops "How to Keep Bacteria and Nutrients Out of Hood Canal".
- Developed "Pollution Solutions" brochure in partnership with SSWM.
- Developed Hood Canal Memo Board in partnership with WSU Mason County Extension.
- Conducted sampling of a subset of Kitsap Hood Canal shoreline discharges to determine whether there was a correlation between FC and nitrate+nitrite nitrogen levels. Results are reported in **Appendix A**.

- Sampled FC and nutrient concentrations in drainages with identified FC sources before correction. Results are reported in **Appendix A**.

#### **4.0 PROJECT DESIGN AND METHODS**

The project design consisted of the following components:

##### **4.1 SHORELINE SURVEY**

All work was conducted according to the methods contained in the “Manual of Protocol: Fecal Coliform Bacteria Pollution Identification and Correction” (Health District, 2003).

Shoreline areas with homes adjacent to the shoreline were identified using aerial photos and property parcel maps. Health District staff visually inspected approximately nine miles of developed shorelines comprising 340 homes. Due to the limited funding of this project, developed areas upland of undeveloped shorelines were considered a lesser priority and were not included in this study.

The shoreline survey was divided into nine segments. Development density ranged from 1.7 to 6.4 residences per .1 mile. Please refer to **Appendix B** for more detail about the shoreline segments. All discharges from curtain drains, bulkhead drains, drainage culverts, overland flows, and significant beach flows from the nearshore property were sampled for FC in each shoreline segment. Samples were collected at low tide to target the discharge of fresh groundwater versus the drainage of residual marine water. Detailed field notes, photographs and global positioning systems waypoints were collected in support of samples.

##### **4.2 PROPERTY SURVEYS**

All work was conducted according to the methods contained in the “Manual of Protocol: Fecal Coliform Bacteria Pollution Identification and Correction” (Health District, 2003).

A total of fifty (50) properties were selected for onsite sewage system (OSS) surveys in the project area: thirteen (13) were associated with high FC drainages and two (2) were greywater discharges found during the shoreline survey, eighteen (18) were identified by WSDOH shoreline surveys, six (6) were located in the Big Anderson Creek drainage, three (3) were public sewage complaints, one (1) was an OSS repair plan submission, six (6) were properties with high nutrient discharges, and one (1) was a request during a neighborhood water quality workshop.

The PIC survey consisted of an OSS record search, homeowner/resident interview, field inspection, and water samples and dye test when necessary. The purpose of the survey was to identify all potential sources of FC contamination (including failing OSS and inadequate animal waste management), and sources of nutrient contamination (including yard waste and fertilizer). The survey included a strong educational component to proactively educate property owners about how to properly operate and maintain their OSS and to identify any non-conforming conditions that could cause premature OSS failure. Property owners were

given copies of OSS records and information about how to reduce bacterial and nutrient pollution sources to Hood Canal from their property.

Based upon the results of each survey, each OSS was categorized as Failing; Suspect; Non-Conforming; or No Apparent Problems (see **Appendix C** for rating category criteria.) Failing OSS were corrected pursuant to the Bremerton-Kitsap County Board of Health's Ordinance No. 1996-8, "Rules and Regulations Governing On-Site Sewage Systems".

#### **4.3 PUBLIC EDUCATION AND OUTREACH**

One focus of this project was to provide property owners and residents with information to recognize and reduce bacteria and nutrient contributions to Hood Canal from their properties. Recipients of the Hood Canal early action education projects were asked to coordinate educational messages. Washington State University (WSU) Extension - Mason County coordinated this effort, which has evolved into the Hood Canal Watershed Education Network (HCWEN). This group meets regularly with frequency ranging from monthly to quarterly, depending on the level of activity. Mason and Jefferson County Health departments established pollution correction projects in Hood Canal during 2005. Health District staff provided program and educational materials and field training.

The project included three neighborhood educational workshops: one in Seabeck, one in Olympic View, and one in Lofall. A "Pollution Solutions" brochure was designed in partnership with SSWM to visually represent water quality recommendations. An attractive "Hood Canal Memo Board" was designed to remind property owners and residents about ways they can keep bacteria and nutrients out of Hood Canal.

#### **4.4 NUTRIENT STUDY**

The shoreline segment south of Big Beef Creek and north of the Seabeck Marina has the highest concentration of homes and smallest lot sizes. This section was selected for a pilot FC/Nutrient correlation study. A special study of FC and nutrient concentrations in FC contaminated drainages was also conducted.

Nutrient work conducted for this project is reported in **Appendix A**.

### **5.0 RESULTS AND DISCUSSION**

#### **5.1 SHORELINE SURVEY**

Shoreline discharge samples were collected on six different days between January 30, 2005 and February 14, 2005. A total of 228 identified drainages were sampled. Eleven (11) discharges exceeded the 200 FC/100 ml. investigation threshold. Two greywater direct discharges were identified during the shoreline survey by observing laundry discharges. Both were corrected. Confirmation samples were collected from the eleven drainages. Nine of the eleven drainages were classified as High Priority with FC results that were at the upper test detection limit of 1600 FC/100ml. The nine drainages were investigated and eight were tracked back to six

failing OSS. Investigation of the ninth drainage resulted in two negative dye tests. This site will be reinvestigated in 2006.

## 5.2 PROPERTY SURVEYS

OSS surveys were conducted from April through September 2005. All fifty (50) of the properties (100%) were reviewed. Forty-five (45) surveys were completed, and three properties were vacant. Two properties did not participate as property owners and/or occupant never responded to Health District attempts to contact them. These two properties were investigated and no FC contamination was found.

Table 1 summarizes the project OSS survey results.

**Table 1**  
**Upper Hood Canal Restoration Project**  
**Summary of Pollution Identification and Correction Results**  
**2005**

	Properties Surveyed	Failing	Suspect	Non-Conforming	No Records	No Problems
<b>Shoreline</b>	14	2	1	6	1	4
<b>Upland</b>	31	10	6	2	2	11
<b>Total</b>	45	12	7	8	3	15

- Fifty (50) of the 340 (15%) residences in the project area were reviewed. Forty-five (45) properties (90%) were surveyed, three (3) were vacant (6%), two (2) did not participate (4%), and none (0) denied access for inspection.
- A project total of twelve (12) OSS failures were found. This is 24% of the properties reviewed, and 4% of the 340 residences in the project area. The overall failure rate of 4% is on the low end of the range of failure rates (3% to 16%) found in other areas of Kitsap County surveyed over the past twelve years.
- A project total of seven (7) suspect OSS were found. This is 14% of those reviewed and 2% of the residences in the project area.
- A project total of eight (8) non-conforming OSS were found. This is 16% of those reviewed and 2% of those residences in the project area.
- A project total of three (3) OSS with no records were found. This is 6% of those reviewed and 1% of the residences in the project area.
- A project total of fifteen (15) OSS were rated as no apparent problems. This is 30% of those reviewed and 4% of the residences in the project area.

### 5.2.1 Analysis of Failures

Ten (10) of twelve (83%) of the failing OSS were located adjacent to surface waters (<100 feet) and two (2) of twelve (17%) were located 100 feet or more from surface waters. Eight (8) of the failing OSS (67%) discharged directly to Hood Canal. Three (3) of these were greywater direct

discharges that were tied into the septic tanks. One (1) of these OSS subsequently failed and was replaced.

The following factors have been related to OSS failure in previous surveys. Of these, age of the OSS and homeowner maintenance of the OSS have been the most prevalent causes of failure:

- Age of the OSS;
- Close proximity of the OSS to surface water;
- Poor soil types and shallow depth to water table/impervious layer;
- Inadequate or lack of maintenance of the OSS;
- Number of previous repairs (failure history); and
- Grey water discharge.

Analysis of failing OSS found in the project area shows that:

- Nine (9) of twelve (75%) of the failing OSS were 20 years old or older;
- Five (5) of twelve (42%) of the failing OSS had failed and were repaired previously;
- Five (5) of twelve (42%) of the failing OSS were located less than 100 feet from surface waters, three (3) of these were located within the tidal zone.
- Three (3) of twelve (25%) of the failing OSS were grey water discharges; and
- Two (2) of twelve (17%) of the failing OSS was linked to system abuse through damage to the drainfield area.

As shown above, age of the system was the most common cause of failure.

### **5.2.2 Types of OSS Repairs and Maintenance Requirements**

Eight (8) of the failing OSS have been repaired and the other four (4) have accepted repair plans and are awaiting installation. Of the eight (8) repaired, three (3) repairs were accomplished by routing greywater into the septic tank, two (2) broken pipes were replaced, one (1) well overflow was routed out of the drainfield, and two (2) were repaired with alternative OSS. Of the four (4) properties awaiting installation, two (2) are pressure distribution, and two (2) are alternative OSS.

State and local regulations require that all OSS be properly maintained and operated. The requirements of Bremerton-Kitsap County Board of Health Ordinance 1995-14, "Regulations for Operation and Maintenance of On-Site Sewage Treatment Systems" are in place. Alternative and pressure distribution septic systems are required to have ongoing operation and maintenance and standard gravity systems require septic tank inspection every three years.

### **5.3 NEIGHBORHOOD WATER QUALITY WORKSHOPS**

Conducted three neighborhood water quality workshops "How to Keep Bacteria and Nutrient Out of Hood Canal". The locations, Seabeck Conference Center (March 10, 2005), Olympic View Community Club (March 16, 2005), and Edgewater Beach Community Club, were donated. A total of 43 people attended these workshops, which featured an overview of Hood Canal water quality and presented tools to prevent and reduce bacterial and nutrient pollution.

Developed a flyer that was posted at local businesses by community group representatives. Developed and mailed approximately 1,800 postcards to community group mailing lists with postage credit donated by Kitsap County Department of Natural Resources (KCDNR). Guest speakers from SSWM discussed watersheds, stormwater, and natural yard care, Health District staff presented OSS tips and John Cambalik of Puget Sound Action Team presented Low Impact Development techniques. WSU Extension Kitsap stood in for John at the first workshop.

#### **5.4 POLLUTION SOLUTIONS BROCHURE**

Coordinated with Kitsap County Surface and Stormwater (SSWM) program to develop a visually-oriented brochure about actions property owners can take to reduce oxygen demand and nutrient contributions to Hood Canal. SSWM purchased the artwork and pooled resources to allow the Health District to purchase 10,000 brochures for less than what we budgeted for 2,000. SSWM also ordered 8,000 pieces, making a total of 18,000 purchased. Brochures were distributed at the June water quality workshop and made available at all site visits from June through December 2005. The brochures are very popular and are available in the Health District main lobby and were distributed at the district's Kitsap County Fair booth. Staff plan to distribute the brochures with the Memo Board discussed below while conducting the activities planned for the next phase of Hood Canal work that will be funded by Washington state Department of Ecology's (Ecology) Centennial Clean Water Funds (CCWF).

#### **5.5 HOOD CANAL MEMO BOARD**

PSAT grant officer John Cambalik recommended producing a token to remind Hood Canal residents about how to reduce bacterial and nutrient pollution to the canal. Health District community educator and graphic artist produced an attractive dry erase memo board with tips and contact information. This was produced in association with Washington State University Extension Mason County. The Health District received 917 memo boards and WSU received 688 memo boards.

#### **5.6 ASSESSMENT**

A pre- and post-activity questionnaire was developed in partnership with a Health District epidemiologist experienced in water quality and project evaluation. Survey residents or owners and workshop attendees were asked to answer the questions before and after contact. Those contacted for surveys were determined to answer either survey questions or questionnaire questions – not both. Workshop attendees were similarly reluctant to fill out the questionnaire. Please refer to **Appendix D** for the questions and responses. Sixteen before and after responses were received at the first two workshops. Nine of the sixteen showed improved scores following the workshop. Although some answers changed after the workshop, the surveys had the same number of correct answers. At the last workshop, reading the questions and asking for a show of hands resulted in better participation. However, the attendees, mostly the board of Edgewater Beach Community Club, answered all of the before questions correctly.

#### **6.0 CONCLUSIONS**

The findings of the Upper Hood Canal Restoration Project are that the goals of the project have been achieved:

- Sampled 228 distinct shoreline freshwater discharges for approximately nine miles of developed shoreline comprising 340 homes. Confirmed eight of the nine “high priority” drainages, or 4% of the total drainages, to be failing OSS located on six properties.
- Twelve (12) failing OSS were identified during the project. Eight (8) have been corrected and four (4) are awaiting installation. Age of the system, failure history and proximity to surface water were the primary reasons for OSS failure in the project area. Eight (8) of the failures (67%) directly discharged to Hood Canal, three (3) of these were greywater.
- Sampled 51 discharges, or 22% of the total drainages, located in the Big Beef and Seabeck area for three events for FC and nitrate+nitrite nitrogen; no correlation between FC and nitrate+nitrite nitrogen was found in all three sampling events;
- Estimated and extrapolated both natural and human nitrogen sources in shoreline discharges from 2 miles of developed shoreline. Nitrogen loading appears to be less than the PACA estimate for human sewage only;
- Concentrations of nitrate+nitrite nitrogen were significantly reduced during moderate and heavy rainfall events compared to a dry weather sampling event;
- Shoreline discharges from three selected failing OSS had elevated nitrate+nitrite nitrogen, ammonia nitrogen or ortho-phosphorus compared to shoreline discharges from properly working OSS; but no consistent correlation existed between FC and nitrate+nitrite nitrogen; FC and ammonia; or FC and ortho-phosphorus.
- Three (3) neighborhood water quality workshops were conducted “How to Keep Bacteria and Nutrient Out of Hood Canal”. A brochure and memo board were produced and distributed.
- Efforts to coordinate the educational water quality messages to Hood Canal residents resulted in better coordination and reduced costs. Project coordination meetings have evolved into the Hood Canal Water Educators Network (HCWEN).
- The Health District has been able to provide materials and training for Mason and Jefferson County Hood Canal project staff. This will allow a consistent canal-wide approach and shorter project lead time.

## **7.0 RECOMMENDATIONS**

Based upon the conclusions of the Upper Hood Canal Restoration Project, the Health District recommends the following:

- The Health District complete correction of the four (4) remaining OSS failures as weather permits.
- Follow up on the FC contaminated drainage for which a source was not found.
- Perform a summer shoreline survey of the project area to assess water quality during the summer recreation season.
- Conduct pollution identification and correction from the north project boundary to the Hood Canal Bridge and in Kinman Creek and Lofall Creek watersheds.
- Share project results with WSDOH’s shoreline survey program to remove closure zones from areas established around OSS failures in Seabeck and Holly.

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- Explore funding to conduct pollution identification and correction in Jump-Off Joe Creek watershed (approximately 81 properties)
- Determine the nitrate+nitrite nitrogen concentrations of shoreline discharges from undeveloped Kitsap shorelines for comparison of shoreline discharges in this study.
- Determine the nitrate+nitrite nitrogen concentrations in shallow groundwater sampling upslope and down slope of properly working OSS in the Hood Canal watershed on shorelines and upland areas.
- Perform site analysis of the nitrate+nitrite nitrogen study area; site analysis would include a review of OSS records, lot sizes, amount of native vegetation, setbacks from drainfield and components to shoreline, soil characteristics, and age of OSS; relate these characteristics with the nitrate+nitrite nitrogen results.
- The Health District continue to explore ways to work in partnership with other agencies to more effectively meet goals.
- Research assessment methods to find ways of encouraging public responses.

Ecology has made CCWF funding available to the Health District in the amount of \$70,000 to conduct further Hood Canal work. The draft scope of work includes: summer shoreline and hotspot work in the project area; winter shoreline and hotspot work from the project area northern boundary to the Hood Canal bridge; and nutrient sampling of undeveloped shorelines and source drainages.

## **8.0    REFERENCES**

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