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Penn Cove Marine Water Quality

Status and Improvement Opportunities

June 2, 2010

Report for: Island County Marine Resources Committee

Report by: Gabriela Carvalho, Master of Public Administration Candidate
Melisa Snoeberger, Master of Public Administration Candidate
University of Washington, Program on the Environment
also Natalie Jones, Bachelor of Science in Chemistry Candidate, for contributions to Part B of this report

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Executive Summary

Penn Cove is a marine water body in the heart of Puget Sound's Whidbey Basin that is highly valued for the goods and services it provides, such as world-class shellfisheries, opportunities for recreation and tourism, and natural beauty.

Island County Marine Resources Committee works with public, private and nonprofit partners to improve the water quality of Penn Cove through various restoration, research, and water quality protection initiatives. This report compiles information about Penn Cove and recommends actions for the Marine Resources Committee to take to further progress towards water quality improvement.

This report contains three parts:

- **Part A** describes the regulatory history and current regulatory status of Penn Cove as defined by the Washington State Departments of Ecology and Health. Penn Cove is classified by Washington State Department of Ecology as a 303d water body due to low dissolved oxygen. This classification requires the Department of Ecology to conduct further assessments, expected to begin in 2012, to inform water pollution permitting affecting Penn Cove. Commercial shellfish harvesting is regulated by the Washington State Department of Health which prohibits commercial harvesting of shellfish in the central portion of Penn Cove due to the presence of wastewater treatment plant effluent outfalls. Department of Health would evaluate opening prohibited area upon request if the threat of a release of untreated wastewater were eliminated.

- **Part B** describes the water quality condition of Penn Cove based on monitoring data collected from the Washington State Departments of Ecology and Health, local wastewater treatment plants, and Island County Department of Public Health. Seven water quality variables were assessed to describe the condition of Penn Cove: dissolved oxygen, nitrogen, phosphorus, fecal coliform bacteria, temperature, chlorophyll, and salinity/conductivity. Although a degree of variability is evident, Penn Cove's condition has not shown evidence of substantial change in water quality since the mid-1990s. Penn Cove does show consistently low levels of dissolved oxygen.

- **Part C** compiles the findings from stakeholder interviews conducted to identify obstacles to the implementation of water quality improvement initiatives. Findings are summarized into the strengths, weaknesses, opportunities, and threats facing Penn Cove stakeholders in the areas of political, economical, social and technological aspects of their work. Four main obstacles were identified: funding, lack of scientific information, political will, and coordination. Specific recommendations are made to mitigate these obstacles.

PART A: Penn Cove Status as Defined by Regulatory Agencies

Introduction

We describe the current condition of Penn Cove from a regulatory and water quality perspective. We focus our analysis on the Washington State Department of Ecology (Ecology) and the Washington State Department of Health (DOH) because these agencies have primary authority over regulating the water quality of Penn Cove. We present the recent regulatory history of the water body, review the current impacts of human use on water quality, and set the stage for further assessment of opportunities to improve the condition and expand the use of Penn Cove for greater public value.

WA Department of Ecology

The Washington State Department of Ecology's (Ecology) water quality program protects and restores Washington's waters through prevention point sources of pollution, reducing nonpoint sources of pollution, controlling stormwater pollution, providing financial assistance, and cleaning up polluted waters. Ecology has jurisdiction over Penn Cove water quality and its activities are authorized by the US Clean Water Act.[1]

Clean Water Act Section 303(d)

Section 303 of the Clean Water Act authorizes the delegation of authority to conduct water body assessments from the US Environmental Protection Agency (EPA) to the states. Under 303(d), states are required to identify waters that do not meet water quality standards and to prioritize water bodies for Total Maximum Daily Load (TMDL) assessment.[2] A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards.[3]

In the State of Washington, Ecology is responsible for conducting water quality assessments and 303(d) listing processes for all waters within the state every two years. Ecology has established five categories of water quality described in Table A-1 below. A water body that falls under water quality Category 5 is defined as a polluted water body that requires a TMDL[4] (Ecology's Category 5 is equivalent to the EPAs303(d) classification).[5] Placement in this category indicates that Ecology has data showing that the water quality standards have been violated for one or more pollutants and there is no TMDL or pollution control plan in place. TMDLs are required for all water bodies in Category 5.[6]

Table A-1: Department of Ecology's Water Quality Assessment Categories[7]

Classification	Classification Description
Category 1	**Meets tested standards for clean waters:** placement in this category does not necessarily mean that a water body is free of all pollutants. A water body in this category met standards for all the pollutants for which it was tested.

Classification	Classification Description
Category 2	**Waters of concern:** waters where there is some evidence of a water quality problem, but not enough to require production of a water quality improvement project (also known as a TMDL) at this time. A water body in this category might have pollution levels that are not quite high enough to violate the water quality standards, or there may not have been enough violations to categorize it as impaired according to Ecology's listing policy. There might be data showing water quality violations, but the data were not collected using proper scientific methods.
Category 3	**Insufficient data:** this category will be largely empty. Water bodies that have not been tested will not be individually listed, but if they do not appear in one of the other categories, they are assumed to belong here.
Category 4	**Polluted waters that do not require a TMDL**: waters that have pollution problems that are being solved in one of three ways: **Category 4a** - has a TMDL**:** water bodies that have an approved TMDL in place and are actively being implemented. **Category 4b -** has a pollution control program**:** water bodies that have a program in place that is expected to solve the pollution problems. **Category 4c -** is impaired by a non-pollutant: water bodies impaired by causes that cannot be addressed through a TMDL. These impairments include low water flow, stream channelization, and dams.
Category 5	**Polluted waters that require a TMDL**: waters in which the water quality standards have been violated for one or more pollutants, and there is no TMDL or pollution control plan. TMDLs are required for the water bodies in this category.

According to Ecology's Water Quality Assessment for Washington database, Penn Cove is categorized as a Category 5 water body due to low dissolved oxygen. The assignment of Category 5 status is based on samples collected between 1993 and 2000 that show excursions beyond the standards for dissolved oxygen in 24 of 28 samples.[8]

There are three ways to change status of a water body from a Category 5 water body to another category. First, Ecology may conduct a TMDL assessment and submit it for approval to EPA. Once approved by EPA, the water body would change to a Category 4a (polluted water body that has a TMDL). Second, if Ecology makes a determination of Natural Conditions, meaning that Ecology finds that the water body conditions are naturally occurring, the category would change to a Category 1 (meets tested standards for clean waters). Third, additional monitoring may provide evidence that the category should be lowered in accordance with the listing policy.[9]

Penn Cove is currently not prioritized by Ecology for TMDL development.[10] Ecology is currently refining its marine modeling tools through the development of the South Puget Sound Dissolved Oxygen Study.[11] Once this study is completed, Ecology will widen the study area to include North Puget Sound. Ecology expects to evaluate Penn Cove and a number of other marine impairments starting in 2012 based upon the results of the South Puget Sound work. It is expected that the Penn Cove assessment will take a few years to complete. Although Ecology will have a Puget Sound-wide model developed before 2012, the outputs

of the model will be on a coarse scale and are not expected address dissolved oxygen level concerns in the Penn Cove area.[12]

Clean Water Act NPDES Permit Program

The Clean Water Act section 402 authorizes the EPA to develop the National Pollutant Discharge Elimination System (NPDES) permit program. NPDES permits are required by industrial, municipal and other facilities that discharge directly into surface waters. NPDES permits define the actions that a permit holder must take in order to control the pollution that is discharged into US waters.[13] In the State of Washington, Ecology is responsible for administering the NPDES permit program.[14]

There are two types of discharges regulated under the NPDES program, individual wastewater discharges and municipal stormwater discharges.

Individual Wastewater Discharge Permits

Ecology issues an individual permit to a facility for a specific discharge at a specific location. Individual permits are highly tailored to regulate the pollutants in effluent. Two facilities currently hold active NPDES permits to discharge into Penn Cove: Coupeville Wastewater Treatment Plant (Coupeville WWTP) and Penn Cove Wastewater Treatment Plant (Penn Cove WWTP).[15] These permits require these facilities to monitor and report on levels of biological oxygen demand, pH, total suspended solids, total residual chlorine, fecal coliform, and flow to Ecology monthly.

Municipal Stormwater Permits

Under the Clean Water Act, urban areas with stormwater infrastructure separate from wastewater infrastructure are required to have a permit in order to discharge into surface waters.[16] Ecology issues two types of the municipal stormwater permits based on municipal population and density. The first type, Phase I Municipal Stormwater Permits, regulate discharges from large municipalities (with populations greater than 10,000 and densities greater than 1000 people per square mile) including those owned or operated in Clark, King, Pierce and Snohomish Counties, and the cities of Seattle and Tacoma. The second type, Phase II Municipal Stormwater Permits, extends to certain small municipal separate stormwater sewer systems (MS4s). These cities have populations greater than 10,000, but densities less than 1,000 people per square mile. [17]

Currently there are no urban areas around Penn Cove required to obtain a municipal stormwater permit. The City of Oak Harbor has a Phase II permit and it is the only municipal stormwater permit in Island County.

Options to Address Penn Cove's Classification under the Clean Water Act

Ecology will address the low levels of dissolved oxygen in north Puget Sound once the South Puget Sound Dissolved Oxygen Study is complete. While local entities can engage in activities to improve Penn Cove's water quality, there is little the Island County Marine Resources Committee (MRC) can do to alter Penn Cove's classification status. Penn Cove's classification as a Category 5 water body keeps it on Ecology's queue for a thorough TMDL assessment. When Ecology conducts a TMDL assessment of Penn Cove in the future, it will identify the limitations on effluent and other inputs needed to restore dissolved oxygen to a level that meets water quality standards. Ecology will use information on

limitations to inform NPDES permits and other sources of inputs to Penn Cove. Any activity the MRC engages in to further study or improve levels of dissolved oxygen will benefit Ecology's efforts and ultimately the condition of Penn Cove.

WA Department of Health

The WA State Department of Health's (DOH) Office of Shellfish and Water Protection works to improve the health of people in Washington State by ensuring shellfish are safe to eat, beaches are safe for swimming and on-site sewage and reclaimed water systems are properly managed. DOH has regulatory jurisdiction over shellfish harvesting in Penn Cove.[18]

Washington State Shellfish Protection Program19

The National Shellfish Sanitation Program (NSSP) is a federal/state cooperative program to protect consumers from eating contaminated shellfish. It was created in 1925 when public health officials noted a large number of illnesses associated with consuming raw oysters, clams, and mussels.[20] Shellfish can be contaminated in the growing area before harvest, during activities involved in harvesting, processing, distribution, or during shipping. The NSSP is dependent on the cooperation of states to assist in the regulation of the shellfish industry.[21] In Washington State, DOH's Office of Shellfish and Water Protection regulates the shellfish industry in the state of Washington.

One of DOH's responsibilities is to determine whether shellfish beds are suitable for commercial growing areas. Shellfish are filter feeders and have the ability to concentrate microorganisms from water as much as 100 times higher than is present in the water column.[22] A key measure to determine if shellfish are safe to eat is the quality of water where shellfish are grown. DOH determines whether a shellfish bed is suitable by conducting a shoreline survey, a marine water quality evaluation and a meteorological and hydrographic study.

A shoreline survey consists of an evaluation of all actual and potential sources of pollution that could affect the growing area including:

- a determination of the distance from the pollution sources to the growing area and the impact of each source on the growing area.
- an assessment of the reliability and effectiveness of sewage or other waste treatment systems.
- a determination of any other poisonous, toxic, or harmful substances that may adversely affect the growing area.

When evaluating the marine water quality data, DOH applies the following NSSP criteria:

- The concentration of fecal coliform bacteria cannot exceed a geometric mean of 14 organisms per 100 milliliters (ml) in water (applied in all cases).
- The estimated 90th percentile cannot exceed 43 organisms per 100 ml of water (applied to areas where only nonpoint sources are present). NSSP specifies that a minimum of 30 prior results are needed to calculate the statistics.

A meteorological and hydrographic evaluation consists of analysis into a water body's:

- Tidal information
- Precipitation quantities
- Wind
- River discharges

Once DOH analyzes data from the shoreline survey, the marine water quality, and the hydrographic and meteorological evaluations, it makes a determination of the appropriate growing area classification for each commercially harvested growing area. Growing classifications are defined in Table A-2 below.

Table A-2: Office of Shellfish and Water Protection; 2008 Annual Report: Commercial Shellfish Areas in Washington State; June 2009[23]

Classification	Classification Description
Approved	A growing area where harvest for direct marketing is allowed. Pollution source evaluations and the bacteriological water quality data show that fecal material, pathogenic microorganisms, and poisonous or otherwise harmful substances are not present in dangerous concentrations.
Conditionally Approved	A growing area which meets the criteria for the approved criteria only during predictable periods of time. The growing area will be closed for a period of several days following an event that pollutes the water.
Restricted	A growing area where the bacteriological water quality does not meet the standard for an approved classification, but the sanitary survey indicates only a limited degree of pollution. Shellfish from a restricted growing area cannot be marketed directly. They must be moved to an approved growing area for a few weeks to several months to naturally purge themselves of the contaminates
Prohibited	A growing area where the fecal material, pathogenic microorganisms, or otherwise harmful substances may be present in dangerous concentrations. Marine waters adjacent to sewage treatment plant outfalls, marinas, and other persistent or unpredictable pollution sources must be classified as prohibited. *Under the NSSP if a sanitary survey has not been completed on a growing area, that area must be classified as prohibited.

A Sanitary Survey is the final written report of all the evaluations and the determination of a growing area by DOH. If DOH has not completed a sanitary survey of an area, they must classify it as prohibited. Commercial harvests of shellfish are not allowed in prohibited areas.[24]

DOH conducts monthly sampling of water quality an annual review of all water bodies that have been classified to assure that data are current and that conditions have not changed. Every three years, DOH conducts a detailed reevaluation updates a water body's classification as necessary. At least once every twelve years, DOH is required to conduct a sanitary survey of each growing area.

History of Penn Cove's Shellfish Growing Area

DOH originally classified the southwestern portion of Penn Cove as conditionally approved for shellfish harvest in 1975. The remaining portions of the cove were classified as prohibited due to the two sewage treatment plant outfalls and agricultural practices on the north side of the cove[25](Figure 1[26]).

1980 Report[27]

In September of 1980, DOH conducted a brief study of Penn Cove water quality. DOH collected samples from Penn Cove two times daily from 14 locations throughout the cove. The data revealed one station that did not meet the established water quality standards. Station 4, west of Coupeville, had fecal coliform densities in the range of <1.8 to 170/100ml with 12.5 percent of the samples collected over 43/100 ml.

Samples taken the Coupeville sewage treatment plant outfall location were lower in fecal coliform than the sample taken at Station 4. DOH offered several explanations why the numbers may not have reflected the actual fecal coliform numbers at the outfall. First, it was difficult for DOH to access the location of the outfall because it was in shallow water and they could not get the boat close enough to sample the major plume from the outfall. Second, the outfall was in poor condition and that could allow the effluent to disperse before it reached the sampling location. DOH also explained that flood tides and possible direct discharges from businesses along the waterfront could have caused the higher numbers obtained at Station 4.

The 1980 report concluded that although more studies were needed to determine effluent flow patterns from the Coupeville sewage treatment plant, it did not appear that discharge from the treatment plant was impacting the commercial mussel operations at that time. Tidal currents in the cove were not strong and it would probably take several tidal cycles to carry effluent from the outfall area to the west end of the cove where the commercial operations were located. DOH did recommend further investigation into the possible direct discharges of sewage from businesses in Coupeville.

1983 Report[28]

DOH closed Penn Cove to the commercial harvest of shellfish on September 9, 1983, when laboratory tests of mussels showed fecal coliform levels above the market standard. The market standard is no more than 230 organisms per 100 grams of tissue. Mussels from several locations in the Cove had fecal coliform counts in the thousands.

A water quality study began on September 12, 1983. DOH collected samples from September 12-15 and from September 19-22 from 15 locations around the Cove and they conducted a dye study on September 20. DOH determined that the water quality in Penn Cove is highly variable and can become seriously degraded within a very short period. DOH determined the treatment plants did not have an adequate notification system in the event of an upset, and they needed to make improvements in their reliability. DOH determined the northern portion of the cove would remain closed until both issues were addressed. (Figure A-1)

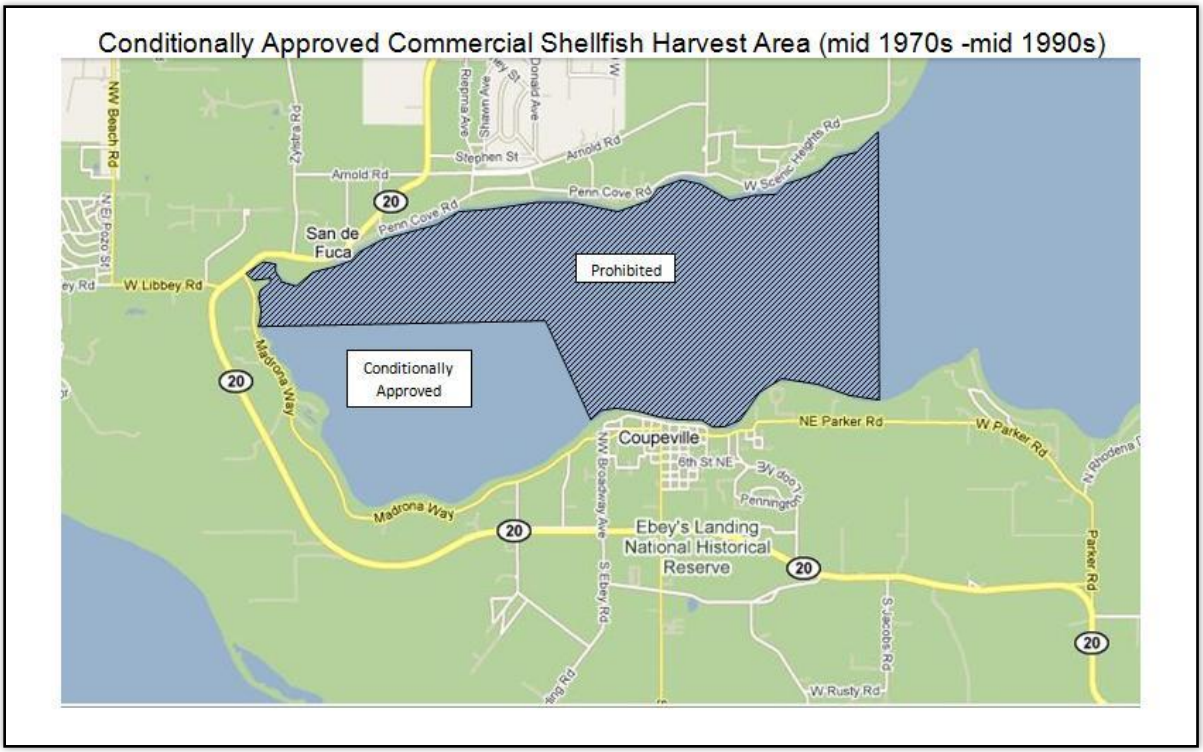

Figure A-1: Penn Cove Classification mid 1970s to mid 1990s[29]

1994 Report[30]

The northern portion of Cove remained prohibited until the mid-1990s when DOH recommended upgrading it to conditionally approved. The 1994 shoreline survey did not show any failures of on-site sewage treatment systems (septic tanks) and DOH noted significant improvements in dairy farming practices and physical upgrades to both wastewater treatment plants. The conditionally approved shellfish growing area was expanded in January 1995[31] (Figure A-2).

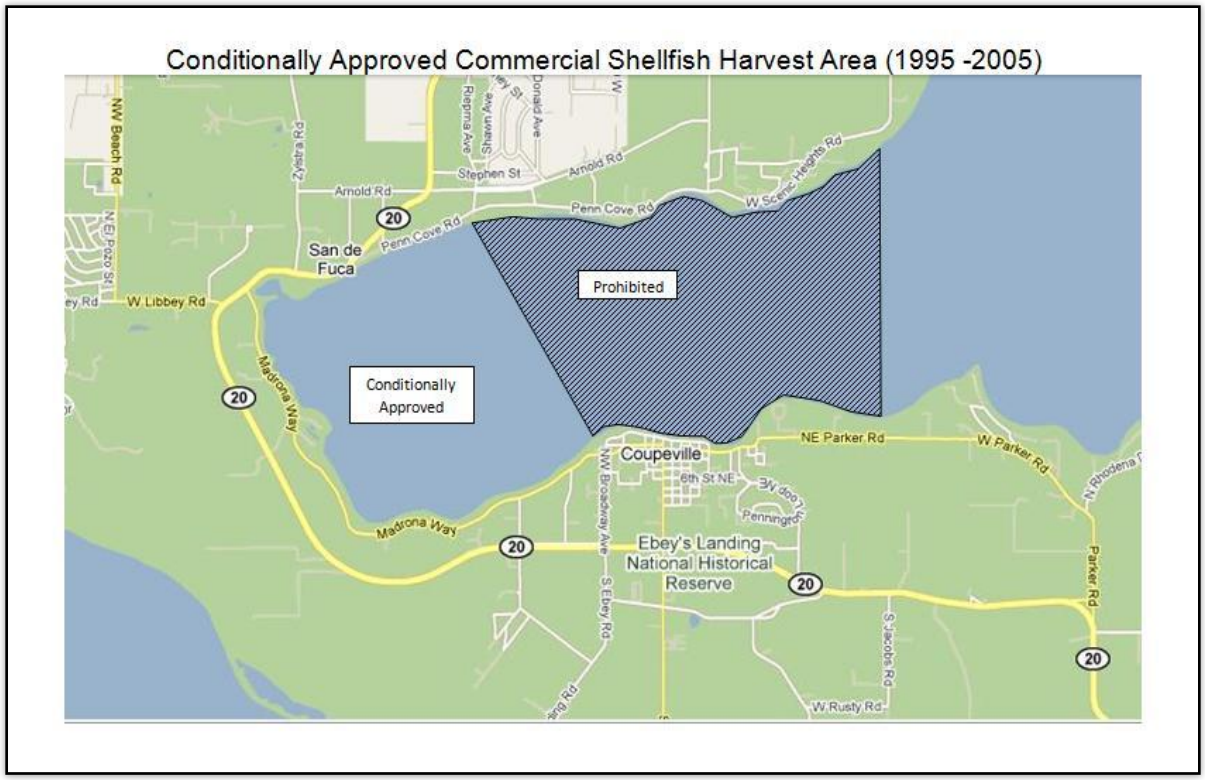

Figure A-2: Penn Cove classification following 1994 DOH water quality study[32]

2005 Report

While Kennedys Lagoon historically had been included in the conditionally approved area of Penn Cove, DOH recommended that the lagoon be unclassified in 2005. Since commercial shellfish growing areas were not present in the lagoon, and classification had never been requested for the area, DOH determined the lagoon should not have been included in past classifications of Penn Cove. Additionally, since local sanitary surveys had not included the lagoon, the water quality condition of the lagoon and impacts from upland activities were unknown. Similarly, since tidal flow exists between Kennedys Lagoon and Penn Cove, the impacts to Penn Cove resulting from water quality in Kennedys Lagoon were unknown. DOH unclassified the lagoon and established a monitoring station (number 321) to monitor the water quality in the cove near the mouth of the Kennedys Lagoon. DOH will not conduct surveys or monitor the water quality in the lagoon unless a request is made to classify it as a commercial shellfish growing area.[33] (Figure A-3)

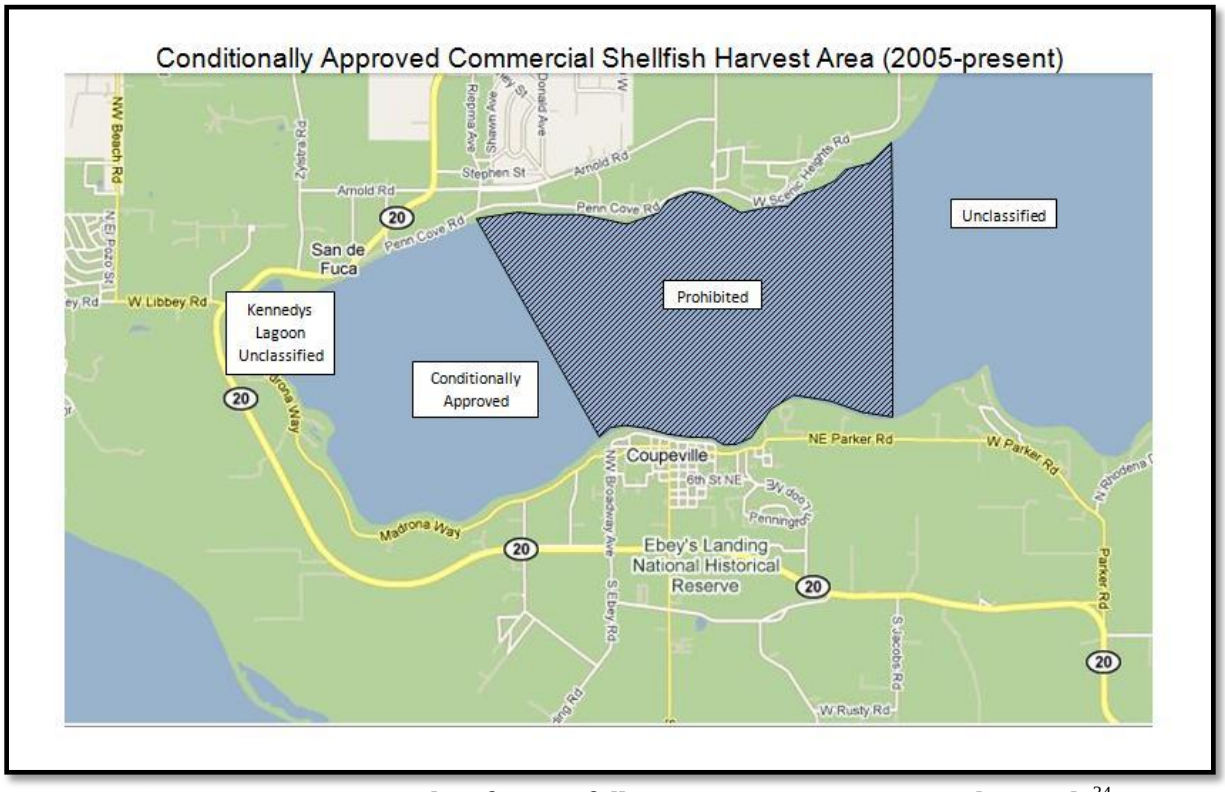

Figure A-3: Penn Cove classification following 2005 DOH water quality study[34]

Emergency Closures

Emergency closures of shellfish growing areas are intended to protect consumers from eating contaminated shellfish. An approved or conditionally approved growing area may be closed on a temporary basis if the water body becomes contaminated. The area will remain closed until the water quality is restored to safe conditions. Incidents that could affect a growing area include:

- oil or hazardous substance spill
- discharge from a wastewater treatment plant
- natural disasters
- heavy rainfall
- flooding[35]

DOH has written guidelines for determining when shellfish growing areas should be closed following an incident. For example, the guideline for Penn Cove states that when the Skagit River reaches a flood level of ≥ 30.3 feet at the gauge (in Mt. Vernon), Penn Cove will be closed and will remained closed for 14 days after reaching the flood level.[36]

Penn Cove also has a Conditionally Approved Area Management Plan (CAAMP). This plan outlines steps that must be taken in the event of a failure at one of the wastewater treatment plants. If discharge of non-disinfected sewage or untreated wastewater enters Penn Cove, the CAAMP plan provides details of

the notification procedure and the time limits for re-opening the conditionally approved area after an upset.[37]

Options to Expand the Approved Shellfish Growing Area

Penn Cove contains conditionally approved, prohibited, and unclassified areas. Options to expand the shellfish growing area include upgrading the prohibited area to an approved classification and classifying the unclassified areas.

Upgrading the Prohibited Area to an Approved Classification

The NSSP standards prohibit commercial harvests of shellfish around sewage treatment plant outfalls. Equipment failure, human error, heavy rainfall, or other unpredictable events could potentially release untreated fecal material, pathogenic microoganisms, or otherwise harmful substances into a water body and contaminate a shellfish growing area. The potential of an upset (a loss of disinfection and the release of untreated wastewater) requires the establishment of a prohibited area around the outfall even if sampling around an outfall shows that bacteriological levels are within approved limits.

The size of the prohibited area around an outfall is site-specific based on meteorological and hydrographic conditions. The center portion of the Penn Cove is prohibited because a wastewater treatment plant has the possibility for an upset to occur. DOH may reduce the size of the prohibited area, if one or both treatment plants eliminated the threat of an upset. Options could include eliminating or reducing discharge by reclaiming wastewater or removing bacteria with a bio-membrane or filter prior to disinfection. DOH will only approve the expansion of the growing area if the threat of discharge of fecal coliform bacteria is reduced. If the threat of harmful discharges is reduced, DOH would also assess reclassifying the west side of the cove from conditionally approved to approved.

Classifying the Unclassified Areas

DOH conducts sanitary surveys only in locations in which a shellfish grower expresses interest in classifying a shellfish growing area. DOH unclassified Kennedys Lagoon in 2005 upon realizing that a request for classification had not occurred and there were no shellfish growers in the area. Also, DOH has never received a request to conduct a sanitary survey in the area to the east of the prohibited line. To expand the shellfish growing area in Penn Cove, shellfish growers can make a request to DOH to classify Kennedys Lagoon or the area east of the prohibited line. Once DOH receives a request for classification, the DOH's timeline for performing a sanitary survey depends on DOH's staff and resource availability.

Summary

This overview of Ecology and DOH's regulatory authority over the water quality of Penn Cove describes how Penn Cove's classification evolved over time and provides useful background information that will inform future decisions related to Penn Cove water quality improvement.

PART B: Penn Cove Marine Water Quality Condition

Introduction

This section of the report describes the water quality condition of Penn Cove and the inputs that contribute to the overall quality of water. Data were collected from four key sources: Island County Department of Public Health, Washington State Department of Health (DOH), Washington State Department of Ecology (Ecology), and Coupeville and Penn Cove wastewater treatment plants. Each entity collects water quality data for its unique needs, so the variables monitored by each entity vary. Similarly, as each entity's policies, resources or priorities changed over time, each data set shows variability in monitoring frequency, monitoring intervals, and at times monitoring locations as sites were added or eliminated.

Part B of this report presents current Washington State water quality standards, a description of the water quality monitoring programs in Penn Cove, and a summary of Penn Cove's water quality condition through seven key water quality variables. The seven variables and reasons for selection are:

1. Dissolved oxygen – indicator for shellfish habitat health and WA Department of Ecology 303d water body determination
2. Nitrogen – nutrient that promotes algal growth
3. Phosphorus – nutrient that promotes algal growth
4. Fecal coliform bacteria – indicator for human health risks
5. Temperature – indicator for changes in the water body
6. Chlorophyll – indicator of eutrophication
7. Salinity/conductivity – indicator for water body stratification

The information presented here will support Island County Marine Resources Committee's (MRC) efforts to target future water quality improvement work.

Water Quality Standards

The State of Washington established water quality standards for dissolved oxygen, temperature and fecal coliform bacteria. Standards for nitrogen, phosphorus, chlorophyll and salinity/conductivity are generally established on a site specific basis once a study has been conducted to determine the level of nutrients and other inputs that a water body can process. An assessment by Ecology to identify Penn Cove specific limits for these parameters has not yet occurred.

Table B-1 below presents the water quality standards for aquatic life uses defined in Washington State Administrative Code WAC 173-201A-210. It uses the following four categories for aquatic life uses:

- Extraordinary Quality: salmonid and other fish migration, rearing and spawning; clam, oyster and mussel rearing and spawning; crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing and spawning
- Excellent Quality: salmonid and other fish migration, rearing, and spawning; clam, oyster, and mussel rearing and spawning; crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing and spawning

- Good Quality: salmonid migration and rearing; other fish migration, rearing, and spawning; clam, oyster, and mussel rearing and spawning; crustaceans and other shellfish (crab, shrimp, crayfish scallops, etc.) rearing and spawning
- Fair Quality: salmonid and other fish migration

Table B-1: Water quality standards defined in Washington Administrative Code (WAC) 173-201A-210

	Extraordinary	Excellent	Good	Fair
Dissolved Oxygen (Lowest 1-Day Minimum)	7.0 mg/L	6.0 mg/L	5.0 mg/L	4.0 mg/L
Temperature (Highest 1-Day Maximum)	13°C (55.4°F)	16°C (60.8°F)	19°C (66.2°F)	22°C (71.6°F)

WAC 173-201A-210 defines the following standards for fecal coliform bacteria for shellfish harvesting:

- The concentration of fecal coliform bacteria cannot exceed a geometric mean of 14 colonies/100 mL in water (applied in all cases)
- The estimated 90th percentile cannot exceed 43 organisms per 100 ml of water (applied to areas where only nonpoint sources are present)

Water Quality Monitoring Programs

Penn Cove water quality is monitored by several agencies. Ecology and DOH monitor the condition of Penn Cove from samples taken within the waterbody. The wastewater treatment plants and Island County's Surface Water Monitoring Program monitor the quality of the water entering Penn Cove. Table B-2 below presents the entities, monitoring stations, how to access data, variables monitored, dates in which data are available and a brief description of each program. All the raw data that was collected for this report is catalogued in an excel file and its contents were given to the Marine Resources Committee on the date listed on this report.

Table B-2: Summary of water quality data used in this report

Entity/ Program	Stations	How to Access Data	Variables	Dates	Description/Notes
WA Dept. of Ecology Long-Term Marine Water Quality Monitoring	1 station: PNN001	Ecology's Environmental Information Management online database: http://www.ecy.wa.gov/eim/ Ecology's Environmental Assessment Program. Marine Water Quality Monitoring: http://www.ecy.wa.gov/apps/eap/marinewq/mwdataset.asp	Ammonia, Chlorophyll, Conductivity, Density, Dissolved Oxygen, Fecal Coliform, Light Transmission, Nitrate. Ortho-Phosphate, pH, Pheopigments, Salinity, Silicate, Temerature, Total Phosphorus, Turbidity, Water transparency	Aug 1973 to Nov 2003 in EIM database and to Oct 2008 in EAP database	One station monitored by Ecology; located in the center of the cove near the two WWTP outfalls. Samples taken between 1973 and 2008 with a few years missing in between (no data between 88 and 92, or 99 and 02, or 03 and 07).
WA Dept. of Health National Shellfish Sanitation Study	22 monitoring stations throughout Penn Cove: 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 279, 321	Monitoring station data are not available online. Contact the DOH Office of Shellfish and Water Protection for data.	Fecal Coliform bacteria, Temperature, Salinity	Jan 1995 to Dec 2009	Twenty two monitoring stations throughout Penn Cove. Between 46 and 180 samples taken at each station between 1995 and 2009. Monitoring was conducted prior to 1995 but data prior to 1995 not reviewed in this report because in the early to mid 1990s, upgrades to the wastewater treatment plants and improvements in land use practices decreased the pollutant levels entering Penn Cove.

Entity/ Program	Stations	How to Access Data	Variables	Dates	Description/Notes
Island County Public Health Surface Water Monitoring Program	3 stations on the North side of Penn Cove: IC30A, IC37B, and IC39A 5 stations in Coupeville: C1, C2, C3, C4 and C5	Some data stored in Ecology's Environmental Information Management online database: http://www.ecy.wa.gov/eim/ Other data is available through Island County Public Health's Resource Enhancement Program staff.	Temperature, pH, Conductivity, DO%, DO mg/L, Turbidity, Gauge, Fecal, Nitrates, O-Phos, Hardness, Mercury, Beryllium, Chromium, Nickel, Copper, Zinc, Arsenic, Selenium, Silver, Cadmium, Antimony, Thallium, Lead	Oct 2006 to Aug 2008 for stations on north side of Penn Cove Nov 2008 to Sept 2009 for Coupeville stations	Eight monitoring stations to monitor water flowing into Penn Cove. Between 3 and 8 samples were taken at each of the Coupeville stations. Up to 28 samples were taken at the stations on the north side of Penn Cove.
Coupeville WWTP Penn Cove WWTP NPDES permit monitoring	Coupeville WWTP NPDES permit Number WA-002937-8 Penn Cove WWTP NPDES permit Number WA-002938-6	Ecology's online database: http://www.ecy.wa.gov/programs/wq/permits/paris/index.html As of May 2010, Ecology is upgrading its online database. This website site provides information on upgrade status and a link to current data.	Biological Oxygen Demand, Total Suspended Solids, pH, Fecal Coliform bacteria, Chlorine, NH_3, Temperature	Coupeville WWTP: Feb 1994 to Oct 2009 Penn Cove WWTP: Jan 1992 to Dec 2009	Samples taken monthly at facilities. Coupeville WWTP: Effluent discharged from a 1,450-foot outfall pipe that discharges at approximately 20 feet below Mean Lower Low Water Penn Cove WWTP: Effluent discharged form a 865-foot long outfall, discharges directly south of the treatment plant at 50 feet Mean Lower Low Water

Department of Ecology Station PNN001

Ecology takes samples at one monitoring station located in Penn Cove, station number PNN001. Data collected from Ecology's PNN001 exhibit the widest range of water quality variables out of any of the other Penn Cove monitoring stations and is the only station in which dissolved oxygen data is measured in Penn Cove. PNN001 is located in the eastern portion of the center of Penn Cove in close proximity to the two wastewater treatment plant effluent outfalls. Water quality monitoring data collected since 1973 at PNN001 are available on Ecology's website (website link provided in Table B-2).

Department of Health Shellfish Program

DOH currently monitors 19 stations in Penn Cove and collects monthly samples to measure fecal coliform bacteria, temperature and salinity. DOH's water quality monitoring in Penn Cove began in the mid 1970s when the agency initially classified the area for commercial production of shellfish. Sampling station number 213 was discontinued in 2001 followed by stations 203, and 214 in 2002. Station 279 was added in 2002 followed by the addition of station 321 in 2006. This report presents all DOH data collected from the 22 stations between 1995 and 2009.

Wastewater Treatment Plant Effluent Data

The two water treatment plants that discharge effluent into Penn Cove are regulated by National Pollutant Discharge Elimination System (NPDES) permits granted by Ecology. The treatment plants are required by their NPDES permits to monitor effluent and report monitoring data to Ecology monthly. The variables reported to Ecology include: biological oxygen demand, total suspended solids, pH, fecal coliform bacteria, chlorine, ammonia, and temperature.

The two facilities that discharge into Penn Cove are in compliance with their NPDES permits. Point-source monitoring performed in accordance with these permits describes the treatment plant effluents as they enter Penn Cove, but they do not characterize water body condition within the cove. Data from Ecology's PNN001 station, located in close proximity to the two treatment plant outfalls are better descriptors of the influence of the wastewater effluents on water body condition. Consequently, wastewater treatment plant data are not included in the analysis contained in this report.

Island County Surface Water Monitoring Project

Island County Public Health's Surface Water Monitoring Program is a five-year initiative to develop a baseline water quality assessment for three watersheds. Data from this program will inform Island County's efforts to update its Critical Area Ordinance regulations. Penn Cove is not one of the areas that is included in the baseline study; however each year, Island County samples 10-15 additional watersheds. The three stations on the north side of Penn Cove and five stations in Coupeville were sampled when water flow was present (water flow at these stations is intermittent). Table B-3 below describes the monitoring stations. The data for Coupeville were given to the Town of Coupeville for Town initiatives as Island County's jurisdiction does not include Coupeville's outfalls. The data collected from the three points on the north shore of Penn Cove did not meet the County's criteria for prioritizing the water body for further monitoring work. Monitoring was conducted sporadically and was not associated with storm events.

Table B-3: Island Co. Surface Water Monitoring Program monitoring stations around Penn Cove

Station Number	Description of Monitoring Station	Date Range
IC30A	Sample point is a culvert downstream of Arnold Road, east of junction with Riepma Road	Samples taken between October 2006 and Aug 2008
IC37B	Sample point is a wetland on private property on Penn Cove Road near Monroe Landing	Samples taken between Jan and July 2008
IC39A	Sample point is at outlet of stream on the upstream side of Highway 20, just south of intersection with Zylstra Road	Samples taken between November 2006 and April 2007
C1	Coupeville Wharf. Outfall located just west of the Coupeville Wharf	November 2008 to September 2009
C2	Front and Main. Outfall located just west of the Kneed and Feed store	Jan-March 2009. Aug and Sept 2009
C3	Boat Launch. Outfall located just north of the wastewater treatment plant	Nov 2008 to March 2009 and May 2009
C4	Perkins and 9th. The storm grate at the intersection of 9th and Perkins	Dec 08 and Mar, Sept 09 only
C5	Perkins Bluff. The trail to the elevated outfall is located just north of the intersection of Perkins and 9th	Nov 08 to March 09 and May, Sept 09

Other Penn Cove Water Quality Data Sources

Additional water quality monitoring activities have occurred in Penn Cove. Researchers at Western Washington University have collected data in Penn Cove. At the time this report was published, these data had not yet been analyzed or made publicly available. Penn Cove Shellfish collects water quality samples weekly to monitor harmful algal blooms.

Map of Penn Cove Water Quality Monitoring Stations

Figure B-1 illustrates the water quality monitoring station locations and the entities that monitor each station.

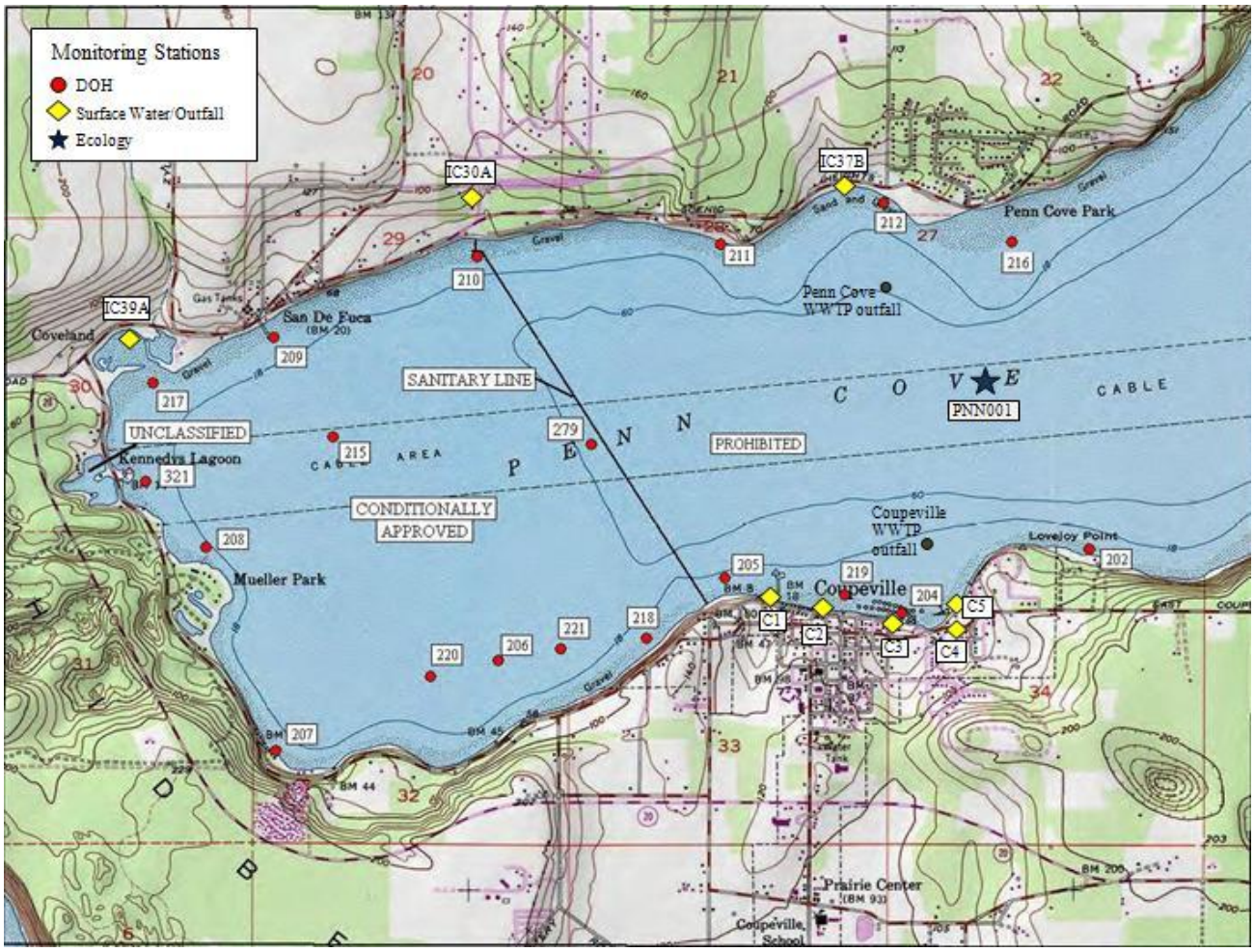

Figure B-1: Location of water quality monitoring stations by station number

Water Quality Condition

Each of the seven water quality variables assessed in this report are presented in this section. Data are presented that describe the condition of the water within the water column and the inputs to Penn Cove. When standards exist, the condition of Penn Cove is compared to Washington State standards. In cases in which Washington State has not established statewide standards, each variable is compared to conditions in Holmes Harbor, Hood Canal, or both

Dissolved Oxygen

Marine plants and animals require sufficient levels of dissolved oxygen for growth, reproduction, and survival. Low levels of dissolved oxygen (DO) can negatively influence physiological performance and can cause mortality. Hypoxia occurs when levels of DO drop to a point where fish or other aquatic life is negatively affected. WAC 173-201A-210 defines this level at 4 mg/L. Anoxia occurs when DO levels are too low to sustain living organisms.

Water Column

Generally, higher DO concentrations are present close to the surface of the water and concentrations decrease at greater water column depths. Station PNN001 is the only location in Penn Cove in which DO is measured. Figures B-2 to B-13 below show concentrations of DO at station PNN001. Data are grouped by month for years in which data were taken. The x-axis shows concentration of DO in the water column and the y-axis shows depth from surface level to 35 meters.

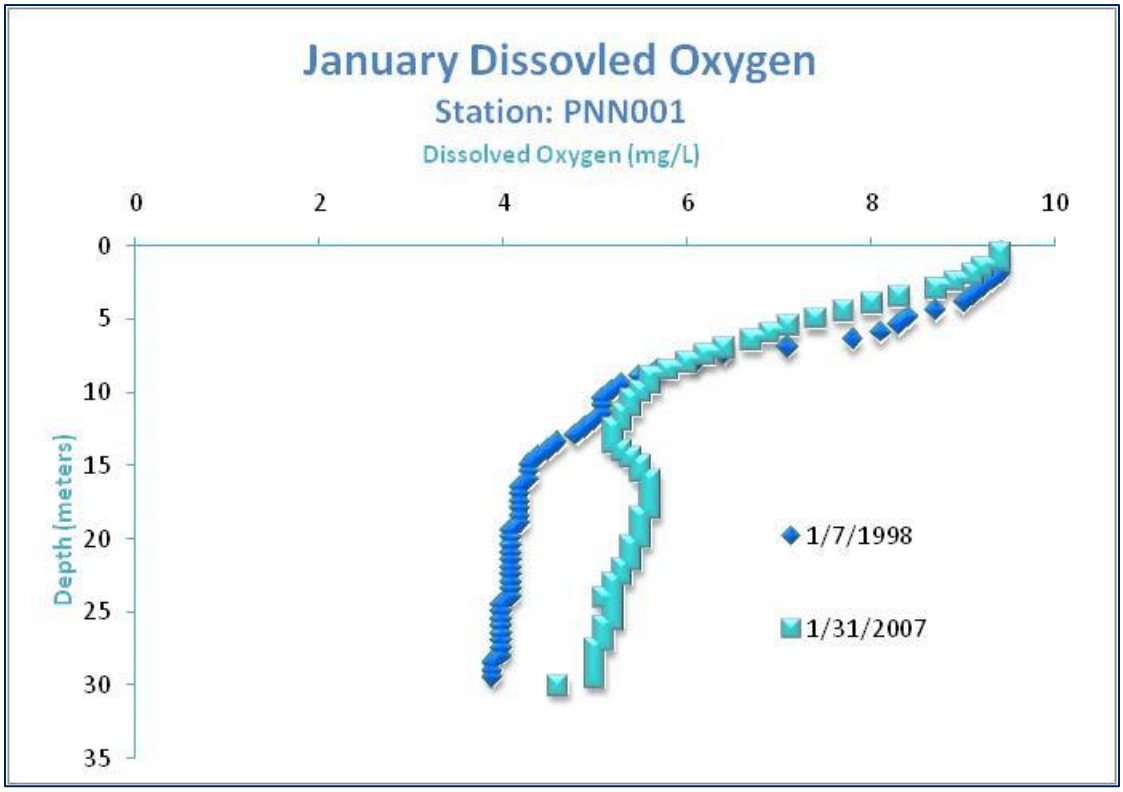

Figure B-2: Dissolved oxygen concentrations at PNN001 in January months

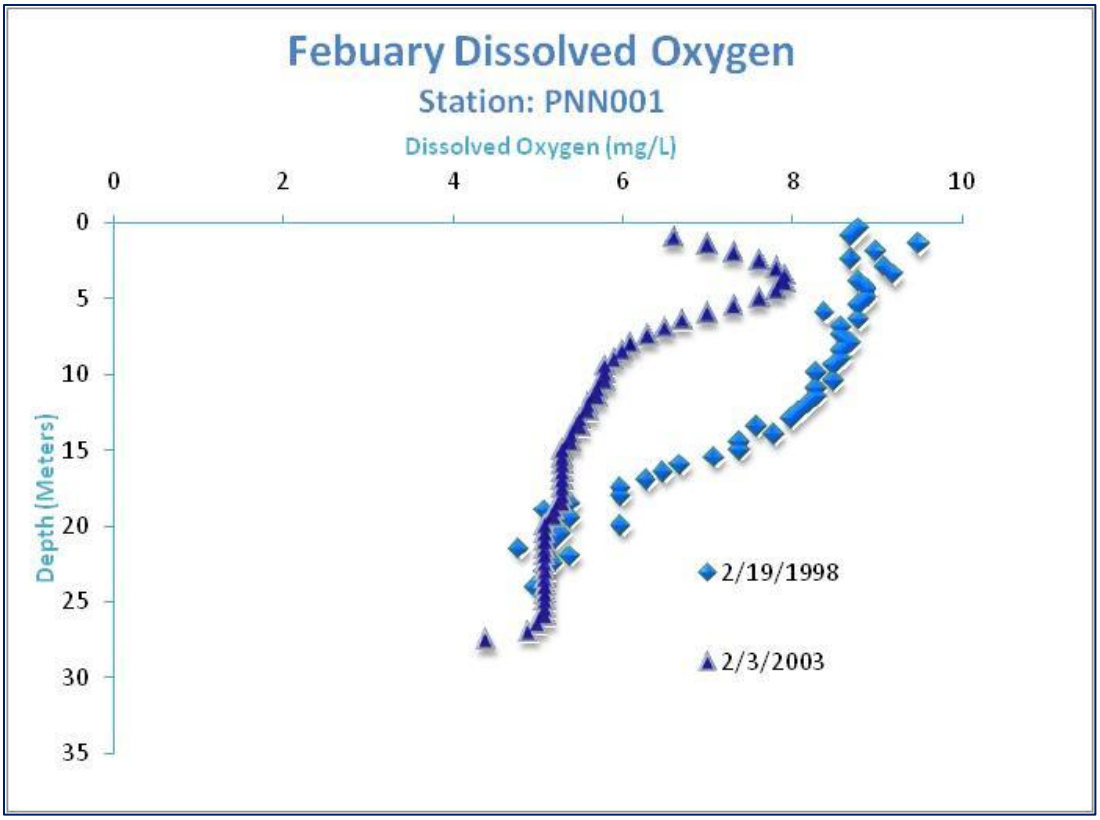

Figure B-3: Dissolved oxygen concentrations at PNN001 in February months

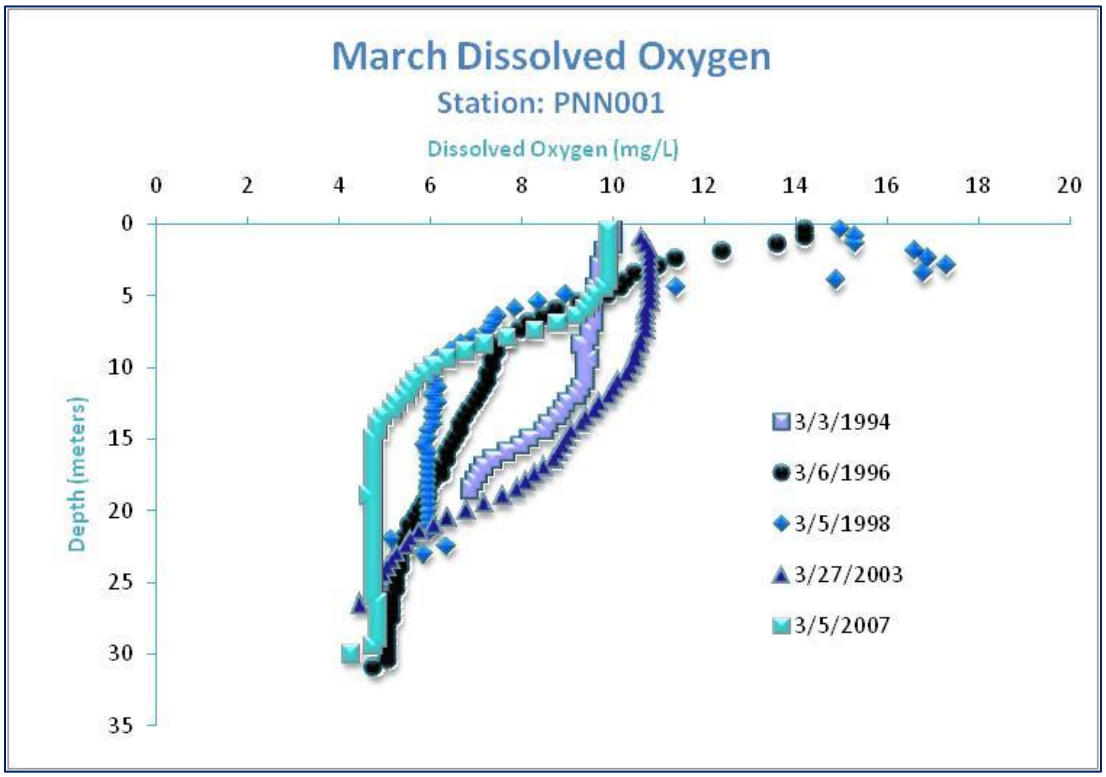

Figure B-4: Dissolved oxygen concentrations at PNN001 in March months

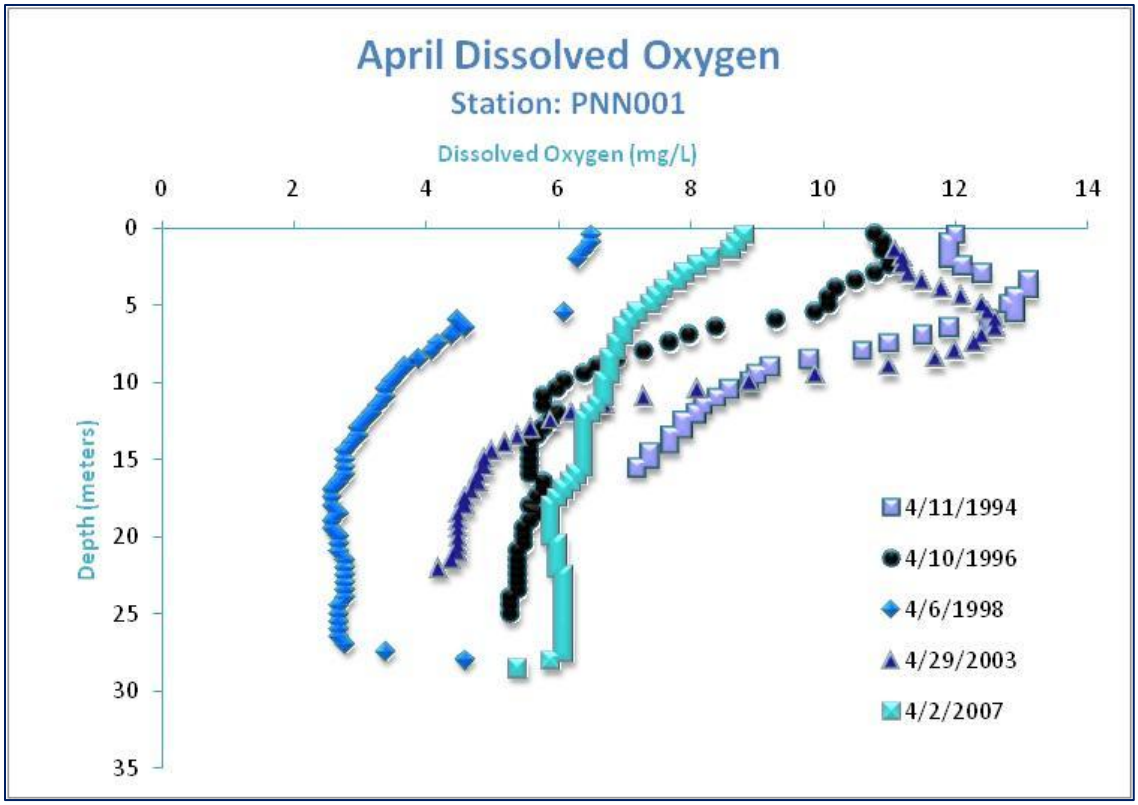

Figure B-5: Dissolved oxygen concentrations at PNN001 in April months

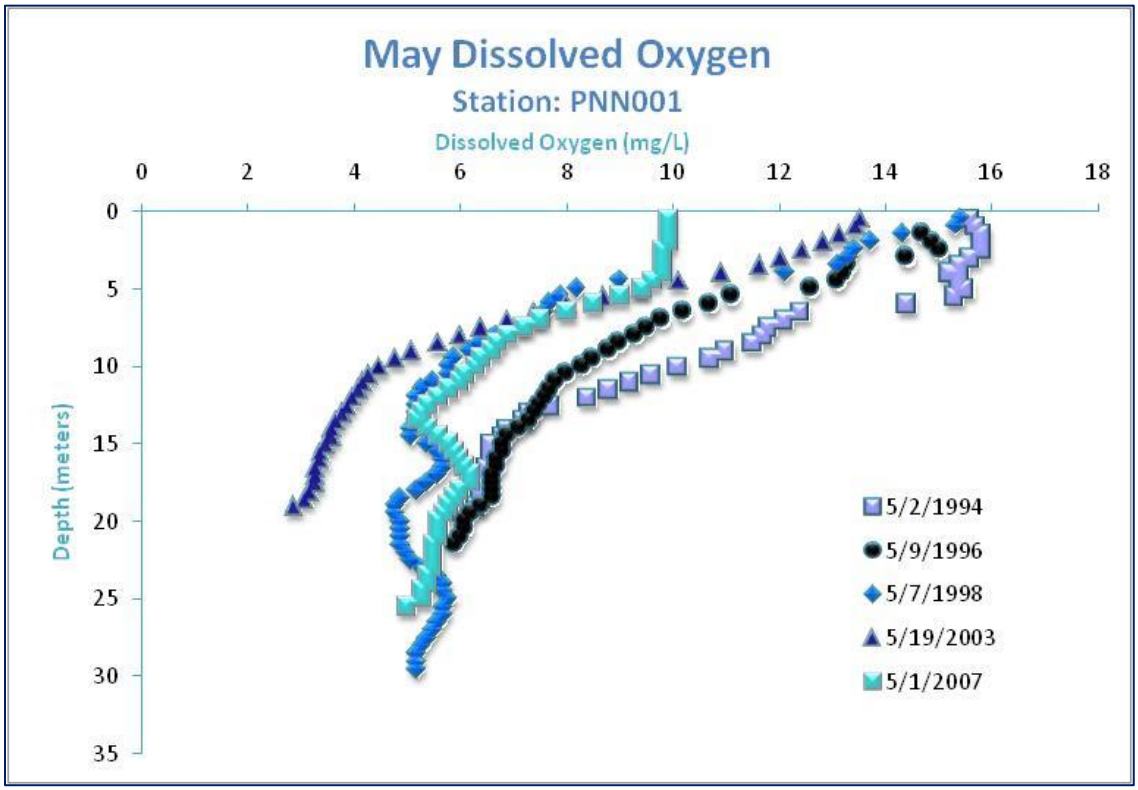

Figure B-6: Dissolved oxygen concentrations at PNN001 in May months

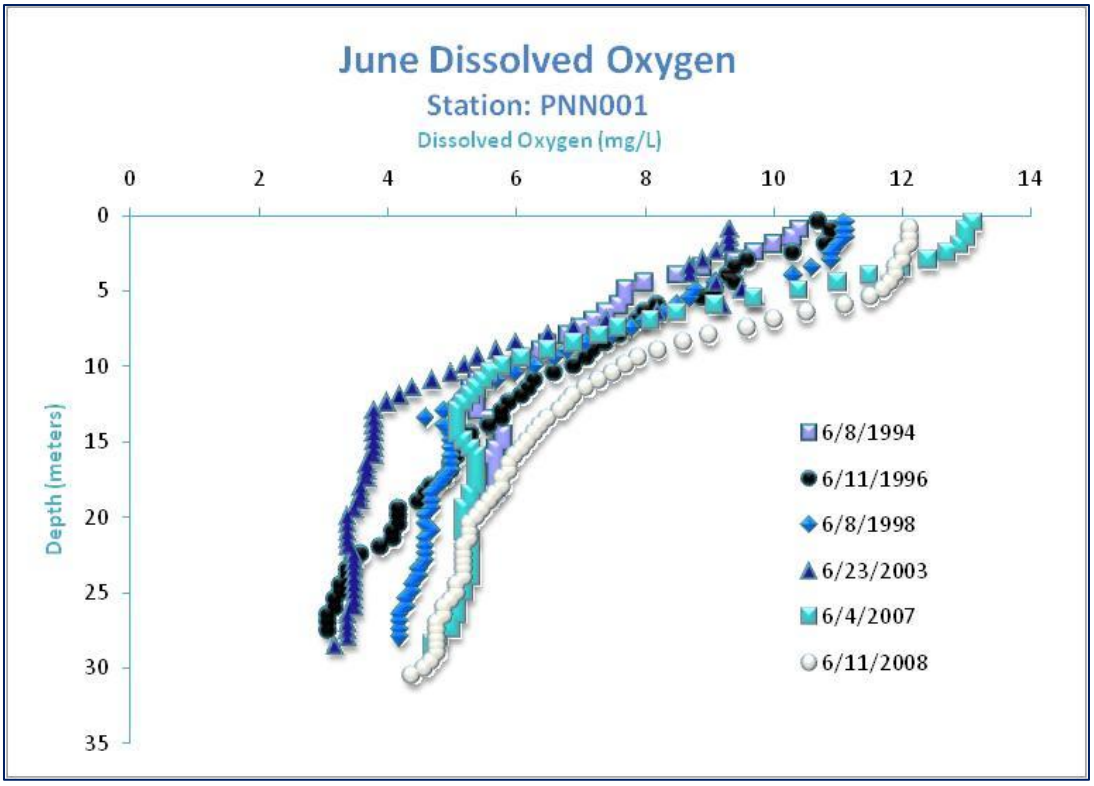

Figure B-7: Dissolved oxygen concentrations at PNN001 in June months

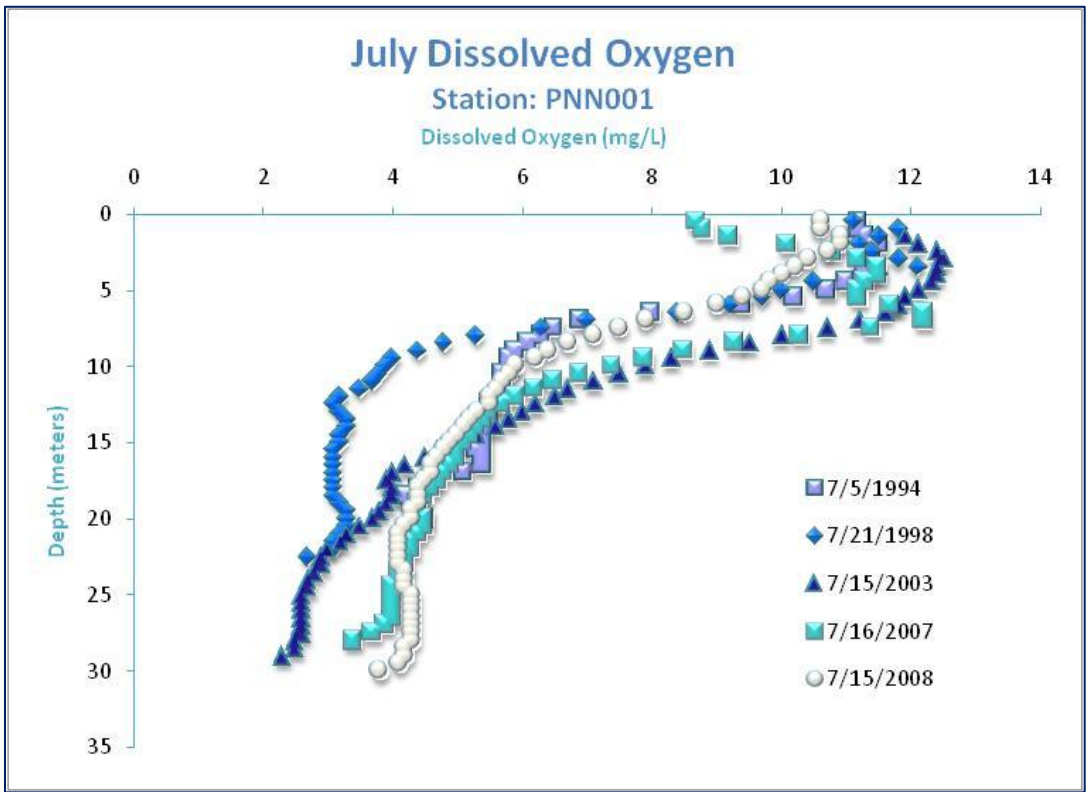

Figure B-8: Dissolved oxygen concentrations at PNN001 in July months

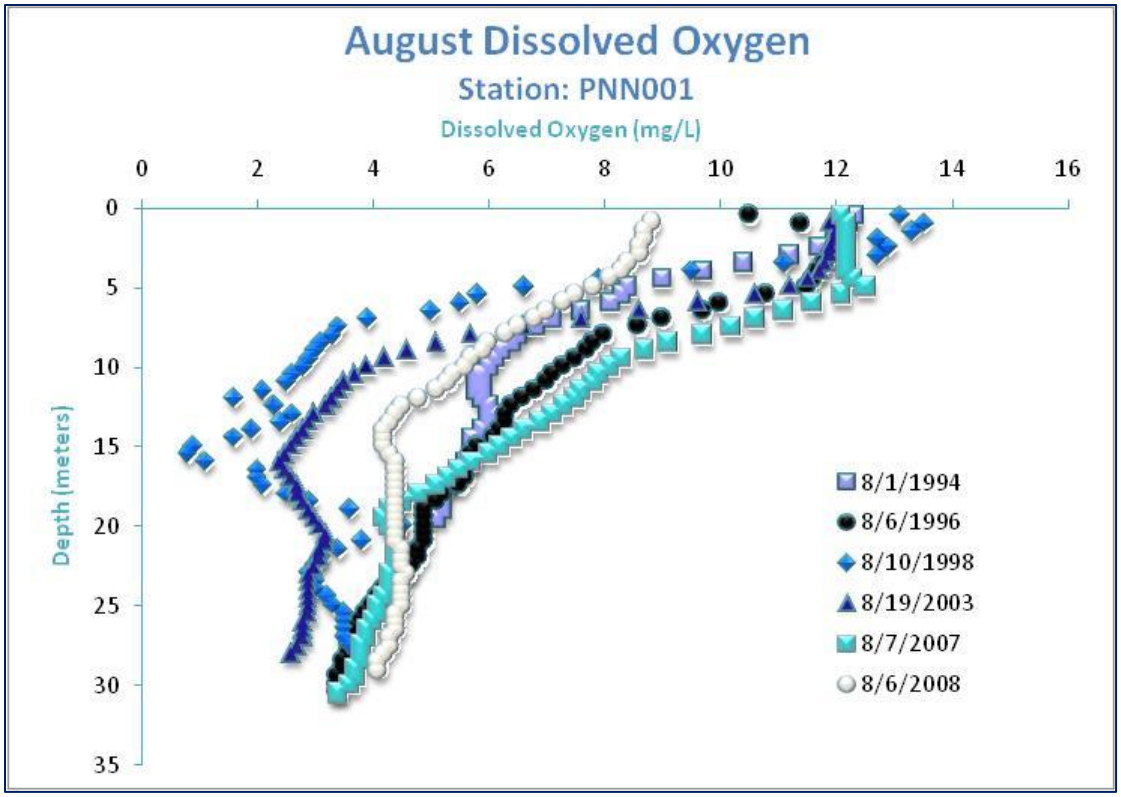

Figure B-9: Dissolved oxygen concentrations at PNN001 in August months

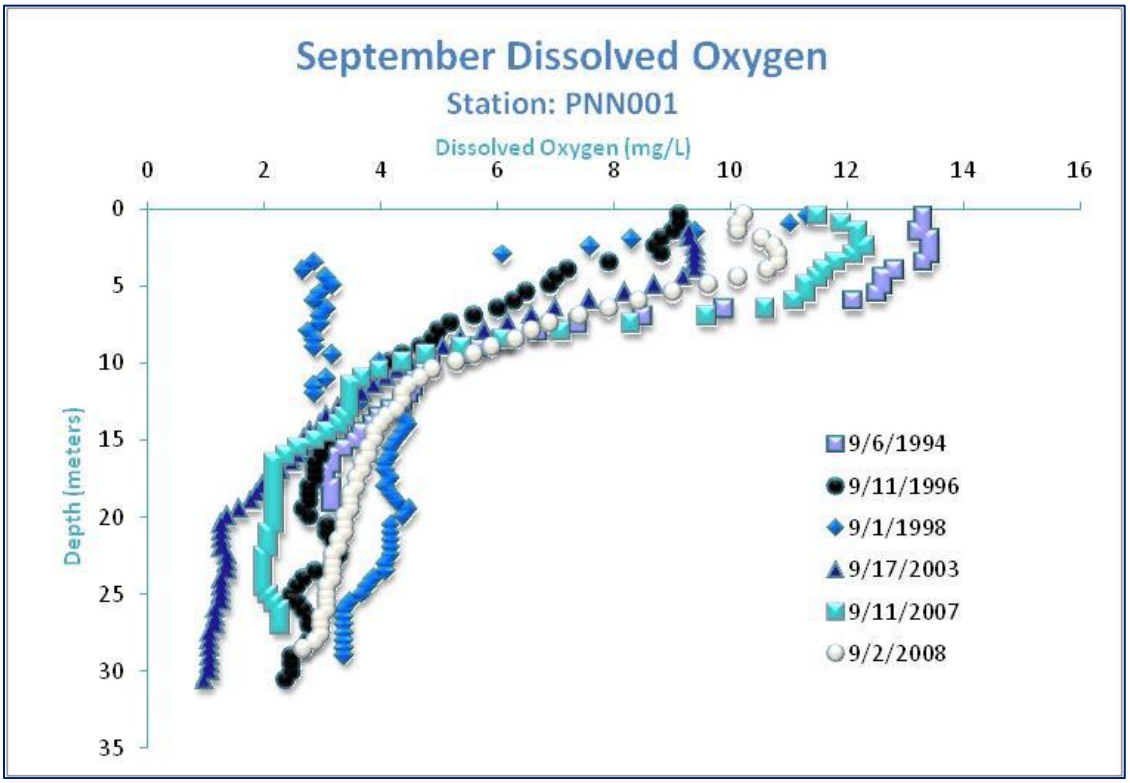

Figure B-10: Dissolved oxygen concentrations at PNN001 in September months

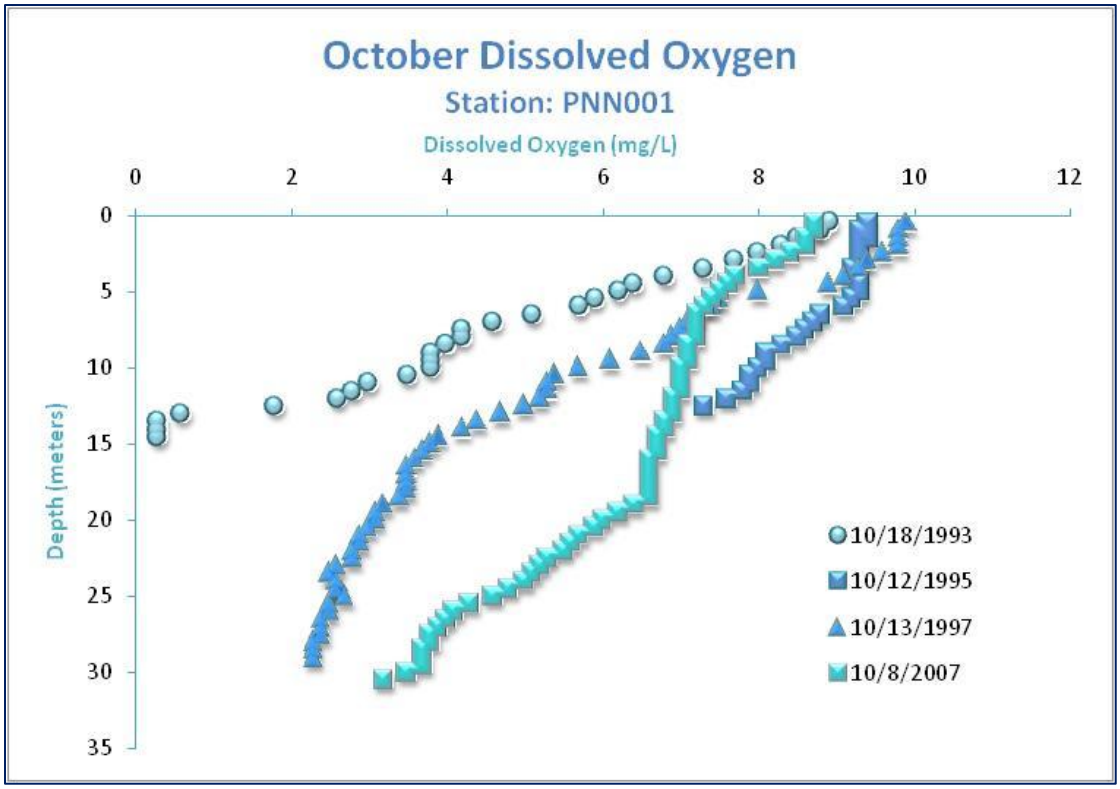

Figure B-11: Dissolved oxygen concentrations at PNN001 in October months

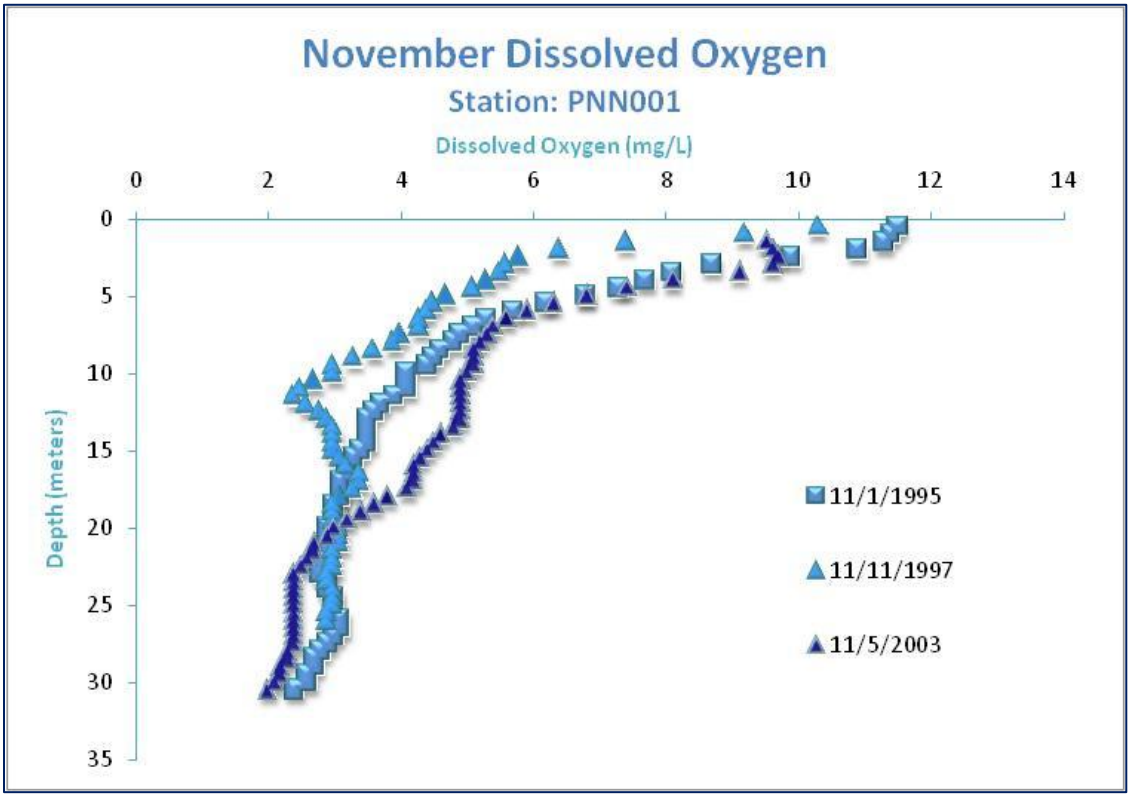

Figure B-12: Dissolved oxygen concentrations at PNN001 in November months

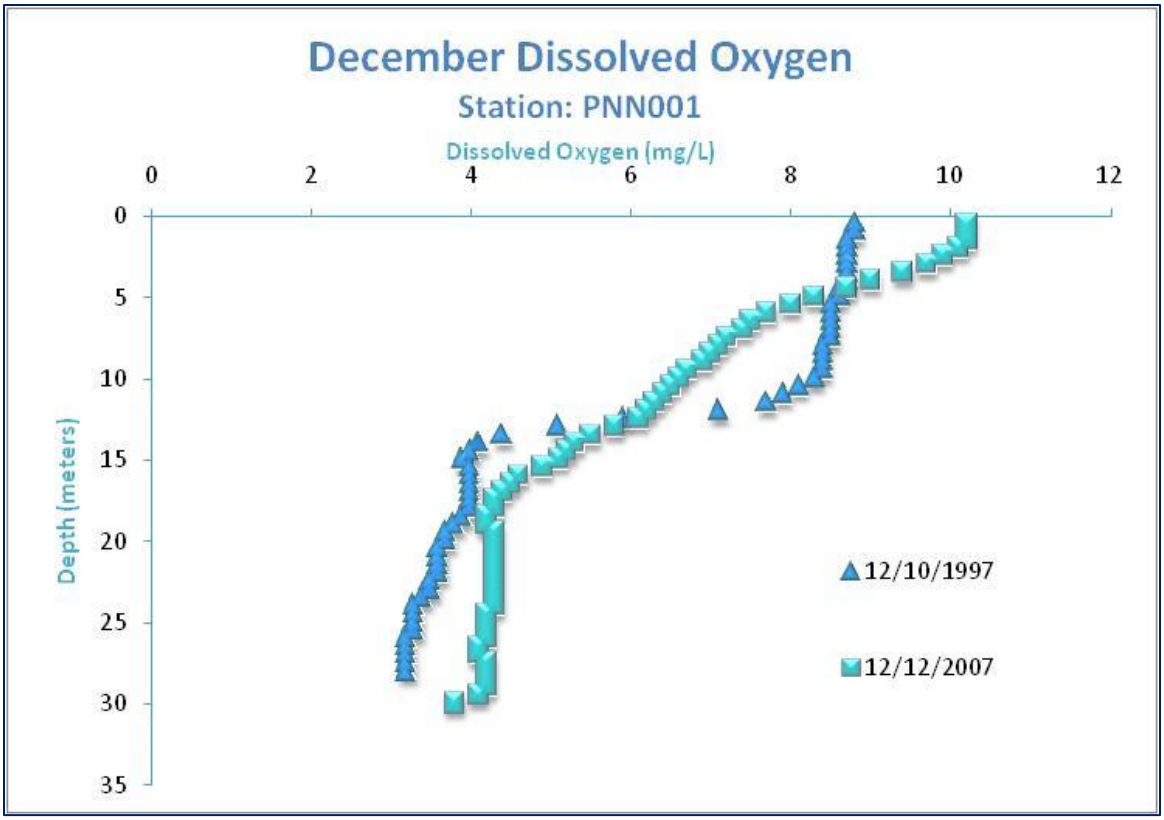

Figure B-13: Dissolved oxygen concentrations at PNN001 in December months

DO concentrations less than 4 mg/L indicate poor water quality and define the threshold for hypoxia according to WAC 173-201A-210. The data indicate frequent hypoxic events at station PNN001. Hypoxia is especially evident in the summer and occurs at shallower depths relative to winter months. Notably, hypoxic waters extended nearly to the surface in September 1998.

Tables B-4 to B-7 below compare Penn Cove DO conditions to the conditions in Holmes Harbor and Hood Canal. Data for these tables were obtained from Ecology's Environmental Information Management database described in Table B-2

Table B-4: Comparison of DO (mg/L) in Penn Cove, Hood Canal and Holmes Harbor at 0.5 m

	Start Date	End Date	Depth (m)	Total Number of Samples	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)
Holmes Harbor	8/8/1973	8/6/1996	0.5	91	5.60	16.00	10.14	10.00
Hood Canal	11/11/1975	12/19/2000	0.5	186	6.10	15.90	9.81	9.60
Penn Cove	8/8/1973	9/1/1998	0.5	111	5.60	15.60	10.71	10.70

Table B-5: Comparison of DO (mg/L) in Penn Cove, Hood Canal and Holmes Harbor at 10 m

	Start Date	End Date	Depth (m)	Total Number of Samples	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)
Holmes Harbor	8/8/1973	8/6/1996	10	92	4.50	13.60	8.31	8.10
Hood Canal	11/11/1975	12/19/2000	10	189	1.00	12.90	5.83	5.60
Penn Cove	8/8/1973	9/1/1998	10	111	1.80	12.80	6.94	7.10

Table B-6: Comparison of DO (%) in Penn Cove, Hood Canal and Holmes Harbor at 0.5 m

	Start Date	End Date	Depth (m)	Total Number of Samples	Minimum (%)	Maximum (%)	Mean (%)	Median (%)
Holmes Harbor	8/8/1973	8/6/1996	0.5	91	63	168	113	114
Hood Canal	11/11/1975	12/19/2000	0.5	195	63	164	109	109
Penn Cove	8/8/1973	9/1/1998	0.5	111	63	171	117	117

Table B-7: Comparison of DO (%) in Penn Cove, Hood Canal and Holmes Harbor at 10 m

	Start Date	End Date	Depth (m)	Total Number of Samples	Minimum (%)	Maximum (%)	Mean (%)	Median (%)
Holmes Harbor	8/8/1973	8/6/1996	10	91	50	151	90	88
Hood Canal	11/11/1975	12/19/2000	10	198	11	144	63	59
Penn Cove	8/8/1973	9/1/1998	10	111	20	131	75	76

These data indicate that minimum and mean values for DO in Penn Cove approximate levels in Hood Canal.

Inputs

Tables B-8 and B-9 below present DO data collected by Island County Public Health for eight monitoring stations used to measure the quality of water entering Penn Cove. In all but one case, minimum values are above hypoxic levels.

Table B-8: Summary of dissolved oxygen (mg/L) sampling at Island County monitoring stations

Station Number	Start Date	End Date	Number of Samples	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)
IC30A	11/30/2006	7/3/2008	24	8.39	15.3	12.38	12.17
IC37B	1/3/2008	7/3/2008	28	2.53	13.02	7.00	7.5
IC39A	11/13/2006	4/10/2007	8	5.9	13.6	10.00	10.4
C1	10/16/2008	9/30/2009	8	9.77	15.04	13.21	13.5
C2	10/16/2008	9/30/2009	5	9.68	14.6	12.87	14.27

Station Number	Start Date	End Date	Number of Samples	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)
C3	10/16/2008	9/30/2009	6	11.46	15.04	13.65	13.895
C4	11/13/2008	9/30/2009	3	11.4	14.46	13.24	13.85
C5	10/16/2008	9/30/2009	7	11.35	14.76	13.49	14.38

Table B-9: Summary of dissolved oxygen (%) sampling at Island County monitoring stations

Station Number	Start Date	End Date	Number of Samples	Minimum (%)	Maximum (%)	Mean (%)	Median (%)
IC30A	11/30/2006	7/3/2008	24	84.60	123.20	104.98	104.90
IC37B	1/3/2008	7/3/2008	28	24.40	124.20	61.63	61.20
IC39A	11/13/2006	4/10/2007	8	50.90	99.10	80.40	84.60
C1	10/16/2008	9/30/2009	8	99.30	123.20	115.38	118.15
C2	10/16/2008	9/30/2009	5	100.60	120.30	110.96	113.20
C3	10/16/2008	9/30/2009	6	103.70	120.00	114.45	115.50
C4	11/13/2008	9/30/2009	3	105.10	118.50	113.93	118.20
C5	10/16/2008	9/30/2009	7	107.50	120.30	114.74	115.40

Nitrogen

Excess nitrogen in the marine environment can accelerate algal growth and affect other water quality variables, such as dissolved oxygen.

Water Column

Ecology's reporting methods for nitrogen changed over time. Table B-10 below describes these reporting changes.

Table B-10: Variation in nitrogen reporting from station PNNOO1 over time

Variable	Date Range
Nitrite-Nitrate as N (mg/L)	measured between 1973 and 1987 and between 1993 and 1998
Nitrate (measured in µM)	measured between Feb and Nov 2003

The following figures and tables below illustrate nitrogen data collected by Ecology at two depths: 0.5 and 10 meters. In the figures, the y-axis represents the concentrations of nitrogen in either µM (micromoles) or mg/L in the water. The x-axis represents the year and month the sample was taken. The tables present a comparison of conditions in Penn Cove to Holmes Harbor and Hood Canal.

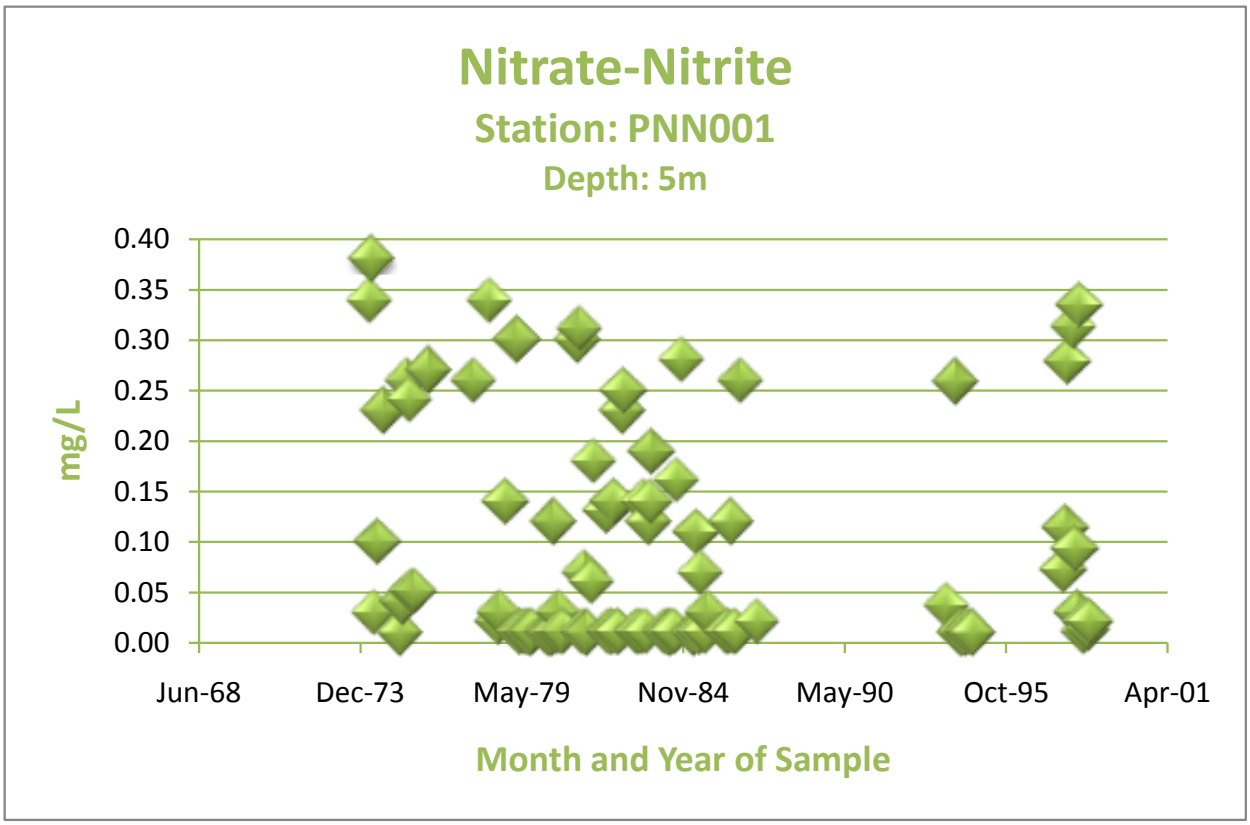

Figure B-14: Nitrate-Nitrite concentrations at PNN001 at depth of 0.5 meters

Table B-11: Comparison of nitrate-nitrite (mg/L) in Penn Cove, Hood Canal and Holmes Harbor at 0.5 m

	Start Date	End Date	Depth (m)	Total Number of Samples	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)
Holmes Harbor	8/8/1973	7/10/1996	0.5	91	0.01	5.20	0.16	0.01
Hood Canal	10/7/1975	9/14/1998	0.5	151	0.01	0.41	0.04	0.01
Penn Cove	10/9/1973	9/1/1998	0.5	103	0.01	0.38	0.09	0.03

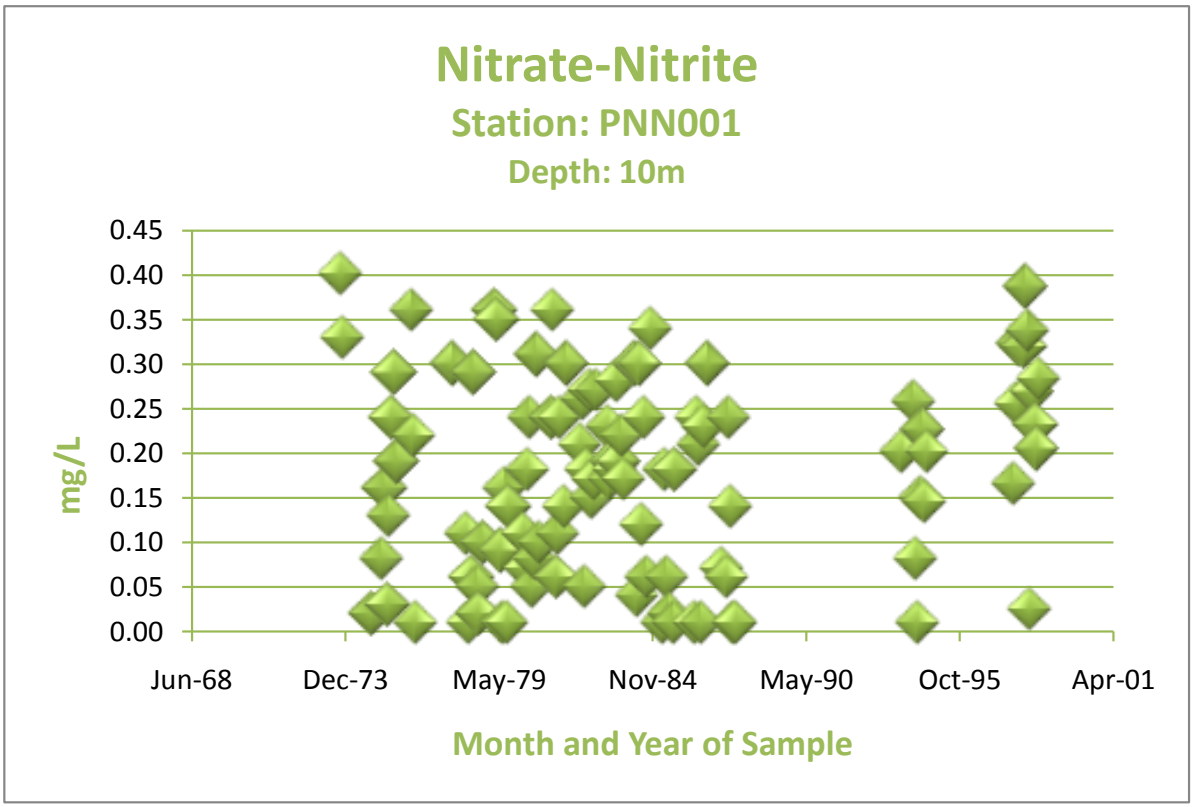

Figure B-15: Nitrate-Nitrite concentrations at PNN001 at depth of 10 meters

Table B-12: Comparison of nitrate-nitrite (mg/L) in Penn Cove, Hood Canal and Holmes Harbor at 10 m

	Start Date	End Date	Depth (m)	Total Number of Samples	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)
Holmes Harbor	8/8/1973	7/10/1996	10	95	0.01	0.50	0.19	0.18
Hood Canal	10/7/1975	9/14/1998	10	162	0.01	0.49	0.24	0.26
Penn Cove	10/9/1973	9/1/1998	10	107	0.01	3.40	0.21	0.18

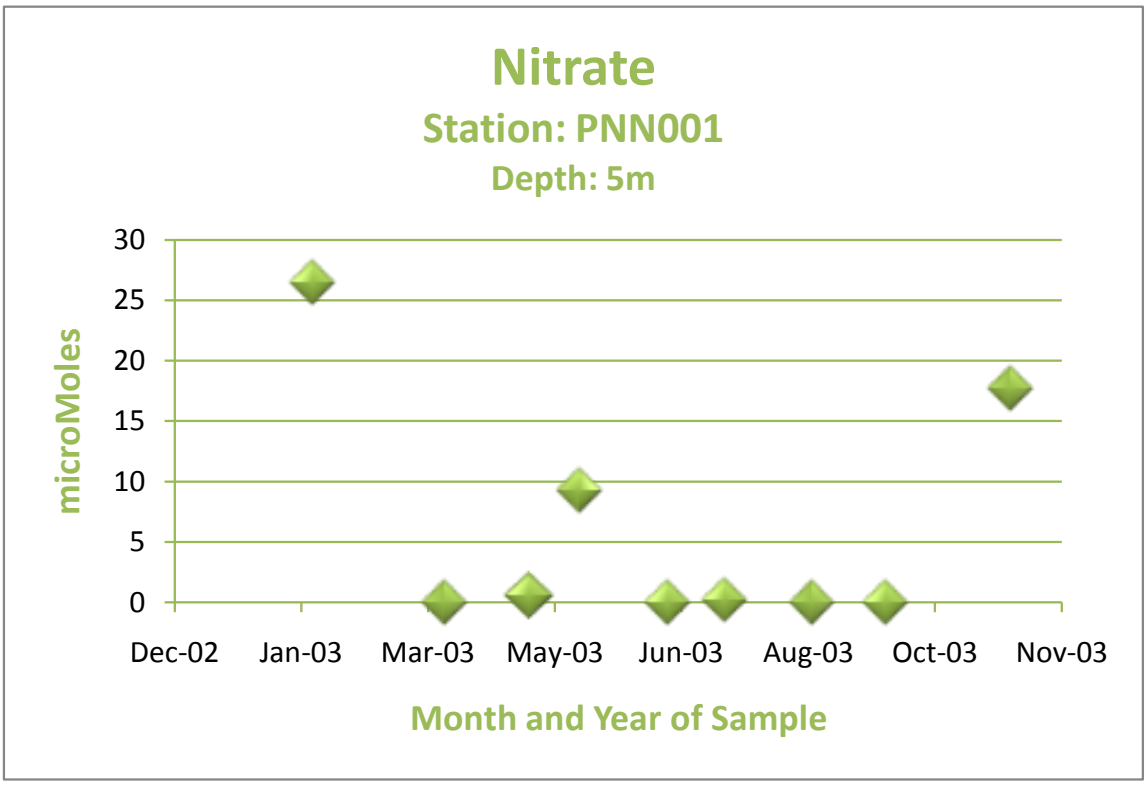

Figure B-16: Nitrate concentrations at PNN001 at depth of 0.5 meters

Table B-13: Comparison of nitrate (µM) in Penn Cove and Hood Canal at 0.5 m

	Start Date	End Date	Depth (m)	Total Number of Samples	Minimum (µM)	Maximum (µM)	Mean (µM)	Median (µM)
Hood Canal	3/11/1999	9/14/2004	0.5	54	0.00	24.46	3.38	0.46
Penn Cove	2/3/2003	11/5/2003	0.5	9	0.00	26.43	5.97	0.14

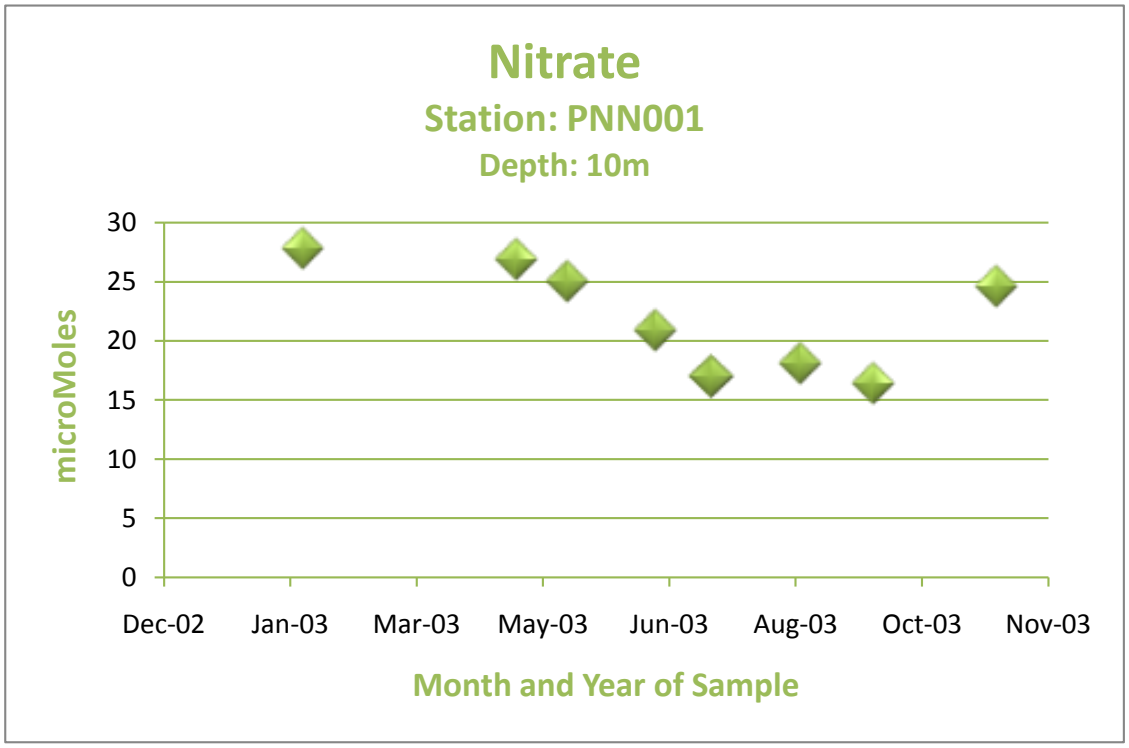

Figure B-17: Nitrate concentrations at PNN001 at depth of 10 meters

Table B-14: Comparison of nitrate (µM) in Penn Cove and Hood Canal at 10 m

	Start Date	End Date	Depth (m)	Total Number of Samples	Minimum (µM)	Maximum (µM)	Mean (µM)	Median (µM)
Hood Canal	3/11/1999	9/14/2004	10	47	0.10	31.53	19.62	20.96
Penn Cove	2/3/2003	11/5/2003	10	8	16.35	27.71	22.05	22.75

Inputs

Table B-15: Summary of nitrate (mg/L) sampling at Island County monitoring stations

Station Number	Start Date	End Date	Total Number of Samples	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)
IC30A	11/30/2006	7/3/2008	14	0.00	1.83	0.32	0.04
IC37B	1/3/2008	6/17/2008	16	0.00	0.20	0.03	0.00
IC39A	11/13/2006	4/10/2007	6	0.14	1.44	0.94	1.14
C1	10/16/2008	9/30/2009	7	0.13	2.88	0.88	0.47
C2	10/16/2008	9/30/2009	6	0.14	1.14	0.42	0.29
C3	10/16/2008	9/30/2009	6	0.17	2.08	0.68	0.42
C4	11/13/2008	9/30/2009	4	0.14	1.88	0.85	0.69
C5	10/16/2008	9/30/2009	8	0.26	0.95	0.53	0.53

Phosphate

Excess phosphate in marine waters can contribute to algal growth.

Water Column

Ecology's reporting methods for phosphorus changed over time. Table B-16 below describes these reporting changes.

Table B-16: Variation in phosphorus reporting from station PNNOO1 over time

Variable	Date Range
Total Phosphorus (mg/L)	measured between 1973 and 1987
Ortho-Phosphate (mg/L)	measured between 1973 and 1998
Ortho-Phosphate (µM)	measured in 2003

The following graphs illustrate ortho-phosphate and total phosphorus data collected by Ecology at station PNN001. The y-axes represent the concentrations of ortho-phosphate and total phosphorus in either µM (micromoles) or mg/L in the water column and the x-axes depict the year and month the sample was taken.

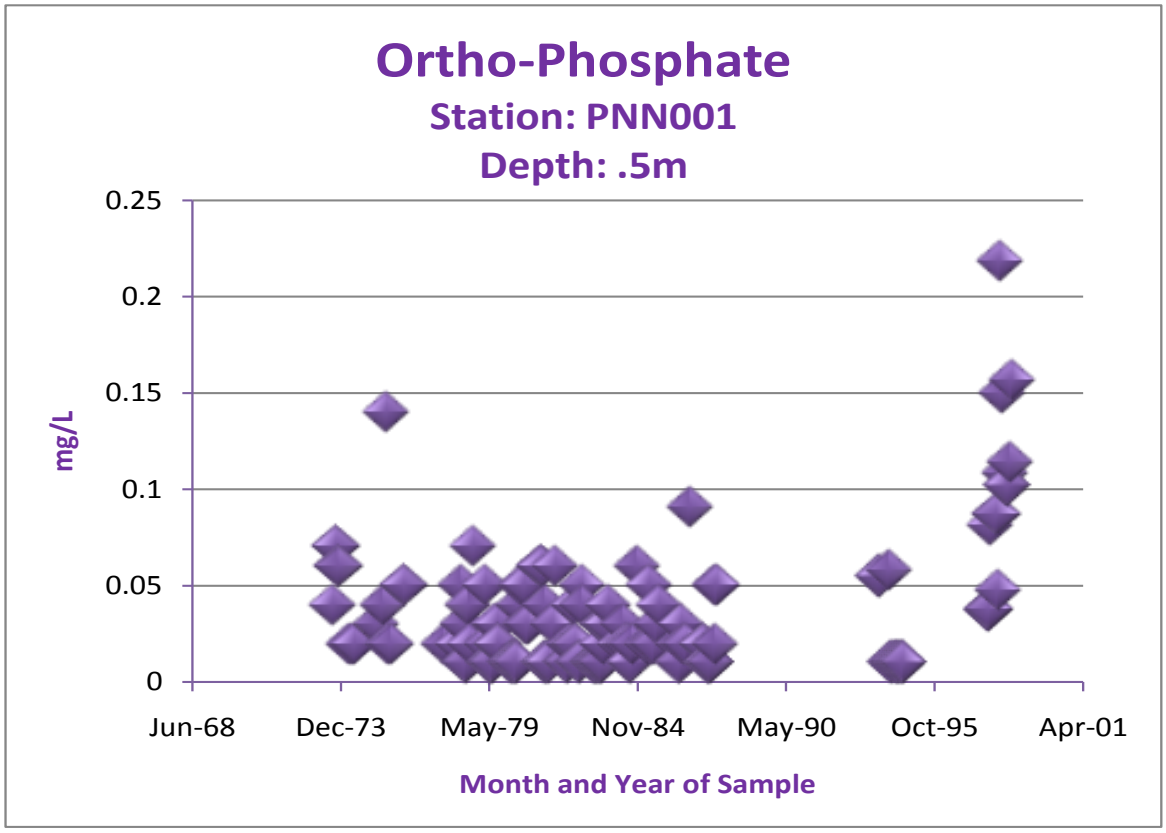

Figure B-18: Ortho-Phosphate concentrations at PNN001 at depth of 0.5 meters

Table B-17: Comparison of ortho-phosphate (mg/L) in Penn Cove, Hood Canal and Holmes Harbor at 0.5 m

	Start Date	End Date	Depth (m)	Total Number of Samples	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)
Holmes Harbor	8/8/1973	7/10/1996	0.5	89	0.01	0.11	0.03	0.02
Hood Canal	10/7/1975	9/14/1998	0.5	161	0.01	0.22	0.031	0.022
Penn Cove	8/8/1973	9/1/1998	0.5	102	0.01	0.218	0.038	0.03

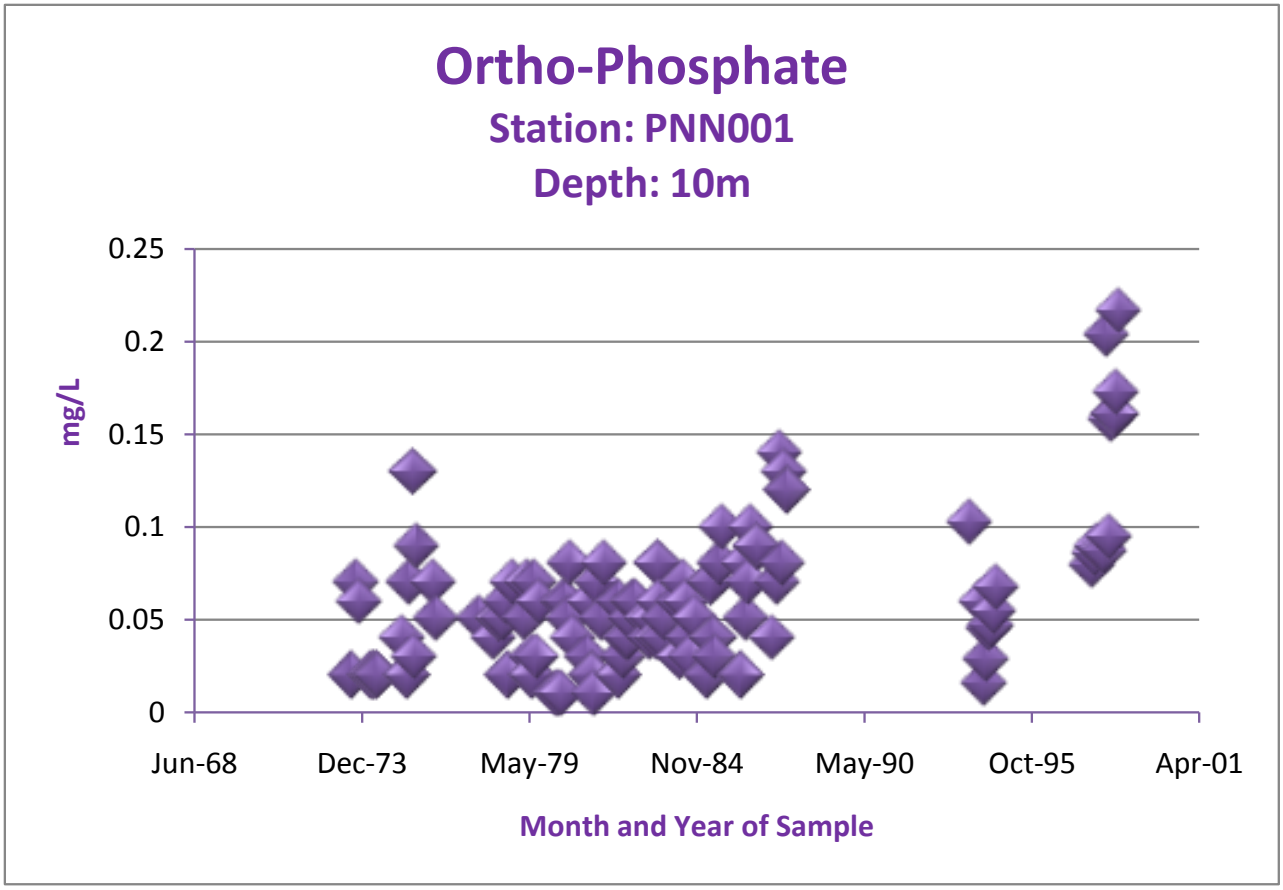

Figure B-19: Ortho-Phosphate concentrations at PNN001 at depth of 10 meters

Table B-18: Comparison of ortho-phosphate (mg/L) in Penn Cove, Hood Canal and Holmes Harbor at 10 m

	Start Date	End Date	Depth (m)	Total Number of Samples	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)
Holmes Harbor	8/8/1973	7/10/1996	10	92	0.01	0.09	0.04	0.04
Hood Canal	10/7/1975	9/14/1998	10	166	0.01	0.29	0.075	0.0735
Penn Cove	8/8/1973	9/1/1998	10	103	0.01	0.216	0.061	0.054

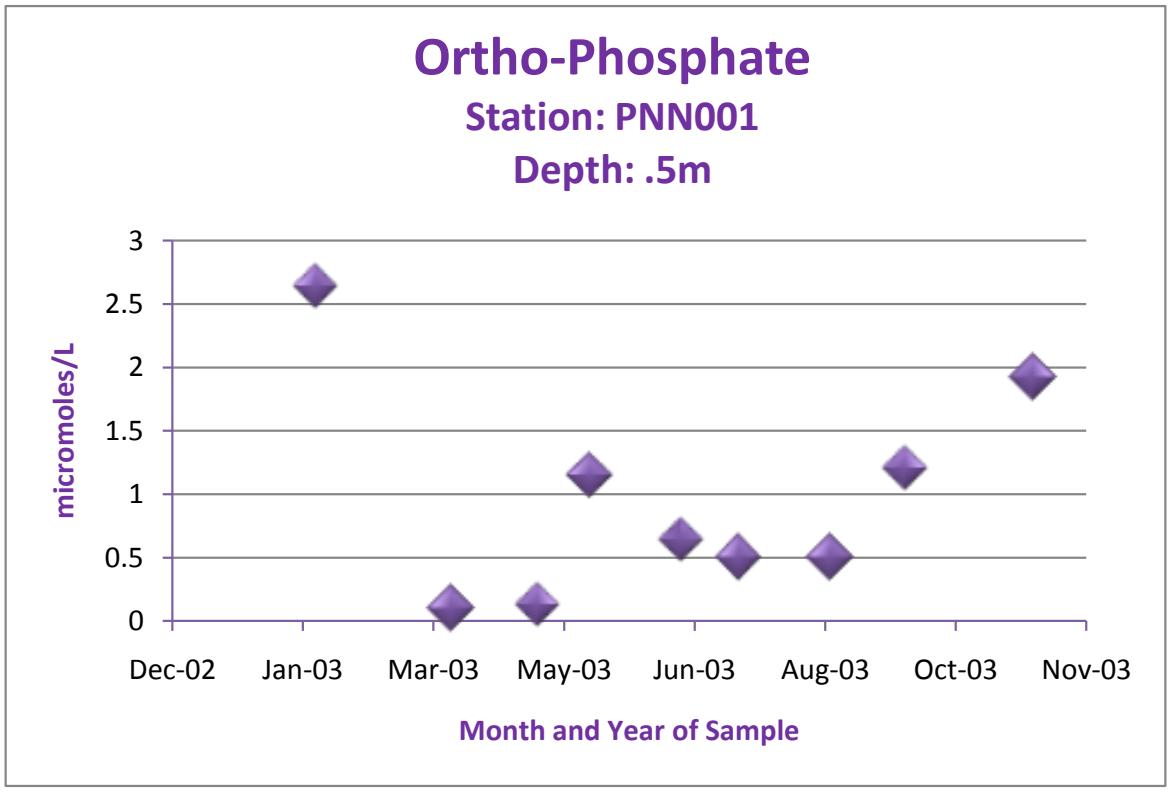

Figure B-20: Ortho-Phosphate concentrations at PNN001 at depth of 0.5 meters

Table B-19: Comparison of ortho-phosphate (µM) in Penn Cove and Hood Canal at 0.5 m

	Start Date	End Date	Depth (m)	Total Number of Samples	Minimum (µM)	Maximum (µM)	Mean (µM)	Median (µM)
Hood Canal	3/11/1999	9/14/2004	0.5	54	0.01	3.1	0.959	0.895
Penn Cove	2/3/2003	11/5/2003	0.5	9	0.1	2.64	0.973	0.63

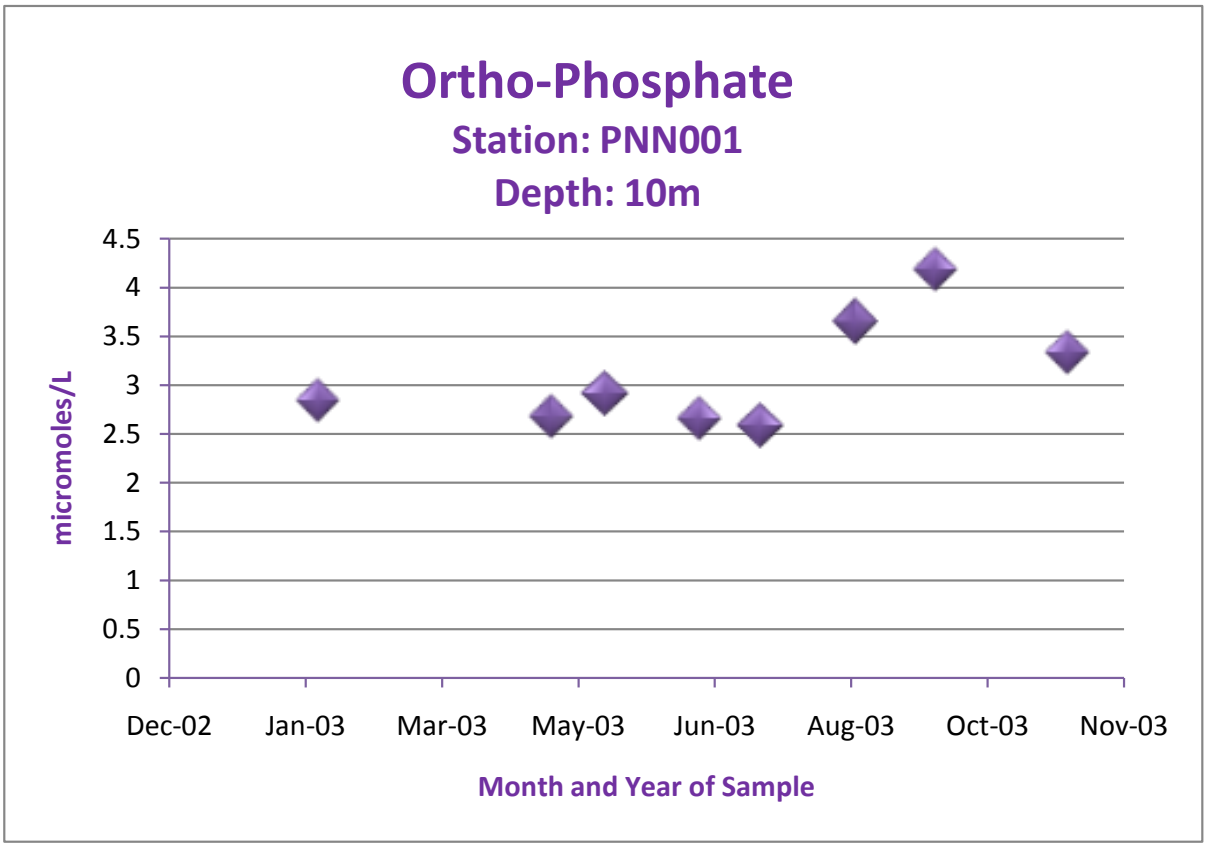

Figure B-21: Ortho-Phosphate concentrations at PNN001 at depth of 10 meters

Table B-20: Comparison of ortho-phosphate (µM) in Penn Cove and Hood Canal at 10 m

	Start Date	End Date	Depth (m)	Total Number of Samples	Minimum (µM)	Maximum (µM)	Mean (µM)	Median (µM)
Hood Canal	3/11/1999	9/14/2004	10	47	0.75	4.06	2.8	2.8
Penn Cove	2/3/2003	11/5/2003	10	8	2.58	4.17	3.099	2.865

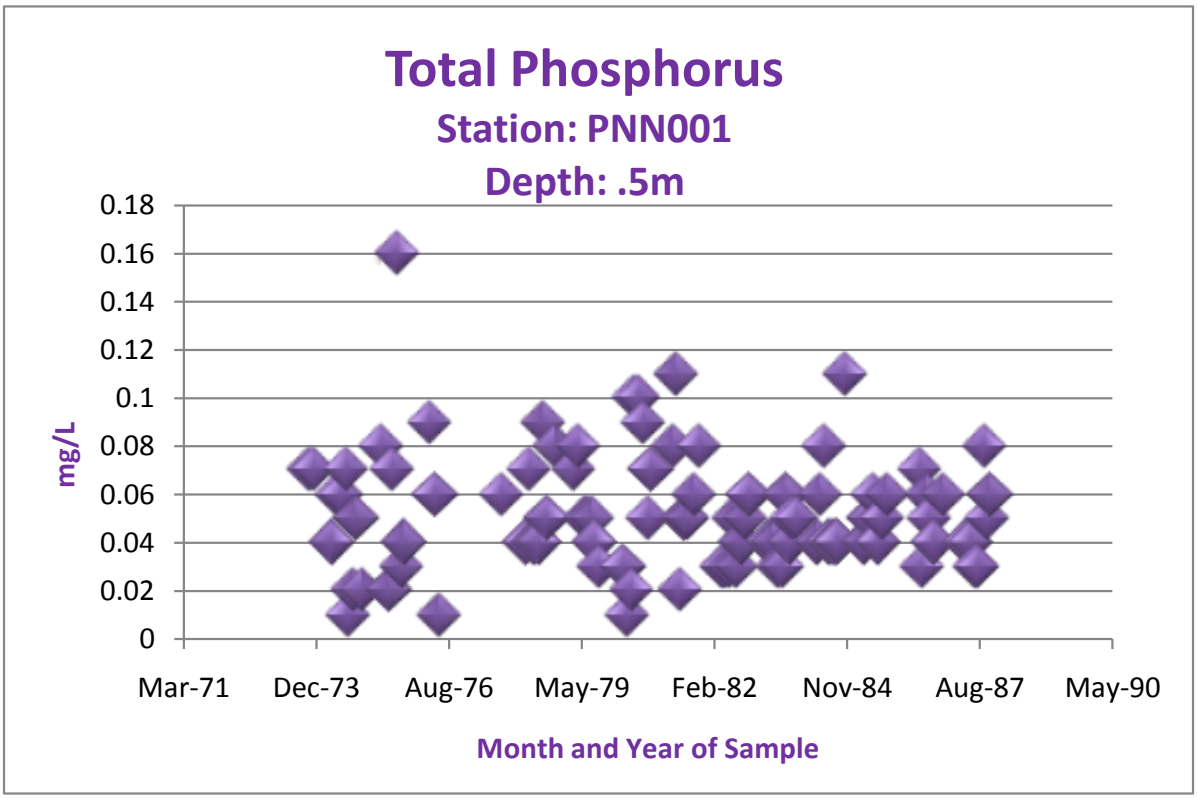

Figure B-22: Total Phosphorus concentrations at PNN001 at depth of 0.5 meters

Table B-21: Comparison of total phosphorus (mg/L) in Penn Cove, Hood Canal and Holmes Harbor at 0.5 m

	Start Date	End Date	Depth (m)	Total Number of Samples	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)
Holmes Harbor	8/8/1973	11/3/1987	0.5	89	0.01	0.18	0.05	0.04
Hood Canal	10/7/1975	11/9/1987	0.5	81	0.01	0.14	0.05	0.04
Penn Cove	8/8/1973	11/3/1987	0.5	92	0.01	0.16	0.05	0.05

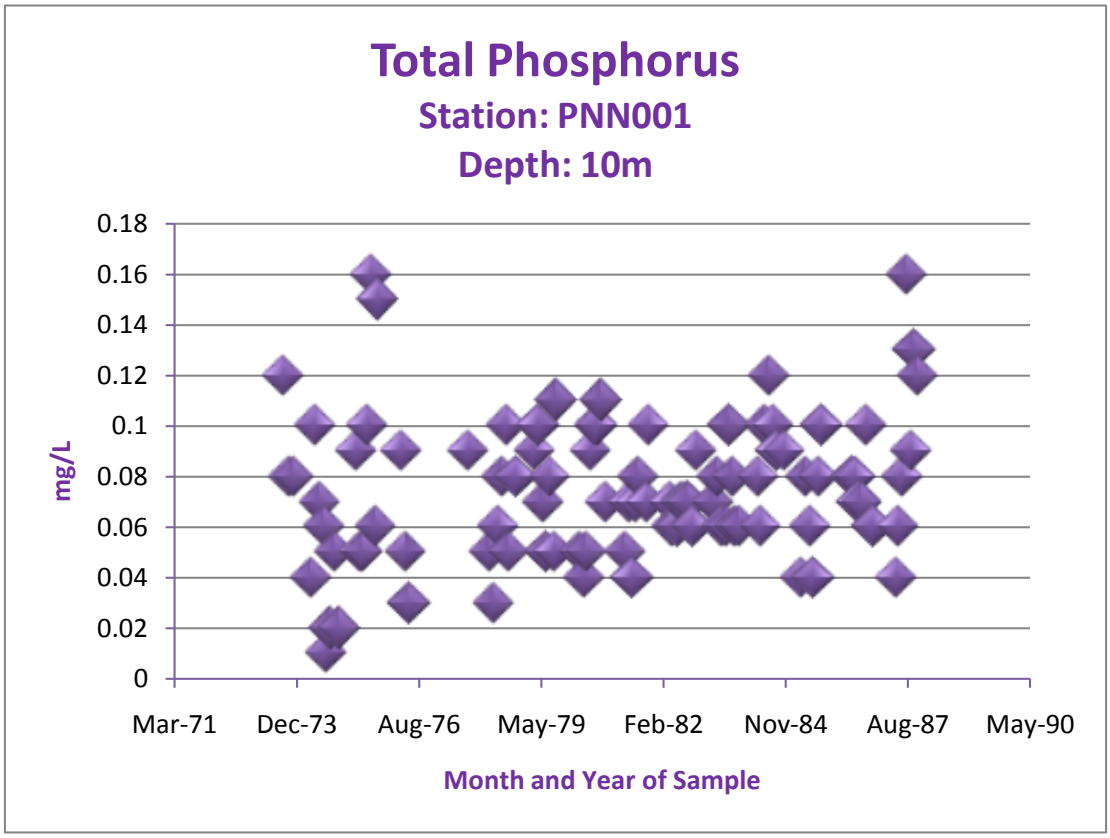

Figure B-23: Total Phosphorus concentrations at PNN001 at depth of 10 meters

Table B-22: Comparison of total phosphorus (mg/L) in Penn Cove, Hood Canal and Holmes Harbor at 10 m

	Start Date	End Date	Depth (m)	Total Number of Samples	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)
Holmes Harbor	8/8/1973	11/3/1987	10	89	0.01	0.15	0.06	0.06
Hood Canal	10/7/1975	11/9/1987	10	81	0.01	0.25	0.10	0.09
Penn Cove	8/8/1973	11/3/1987	10	93	0.01	0.16	0.07	0.07

Inputs

Table B-23: Summary of phosphate (mg/L) sampling at Island County monitoring stations

Station Number	Start Date	End Date	Total Number of Samples	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)
IC30A	11/30/2006	7/3/2008	14	0.09	0.56	0.34	0.33
IC37B	1/3/2008	6/17/2008	16	0.50	6.30	1.60	1.00
IC39A	11/13/2006	4/10/2007	6	0.20	0.30	0.20	0.20
C1	10/16/2008	9/30/2009	8	0.00	0.14	0.06	0.06
C2	10/16/2008	9/30/2009	6	0.07	0.07	0.07	0.07
C3	10/16/2008	9/30/2009	7	0.10	0.17	0.13	0.13
C4	11/13/2008	9/30/2009	4	0.14	0.33	0.25	0.26
C5	10/16/2008	9/30/2009	9	0.12	0.35	0.21	0.21

Table B-23 shows that phosphate concentrations in the water entering Penn Cove range from a minimum of 0 mg/L to a maximum of 6.3 mg/L.

Fecal Coliform Bacteria

High concentrations of fecal coliform bacteria can indicate inadequate treatment of wastewater or leaching of septic systems into a water body. The maximum concentration of fecal coliform bacteria that is considered safe according to WA State water quality standards for shellfish harvesting is 14 organisms per 100 ml of water.

Water Column

The following graph illustrates fecal coliform bacteria data collected by Ecology at station PNN001. The y-axis represents the concentration of the organisms in 100ml of water and the x-axis represents the month and year the sample was taken.

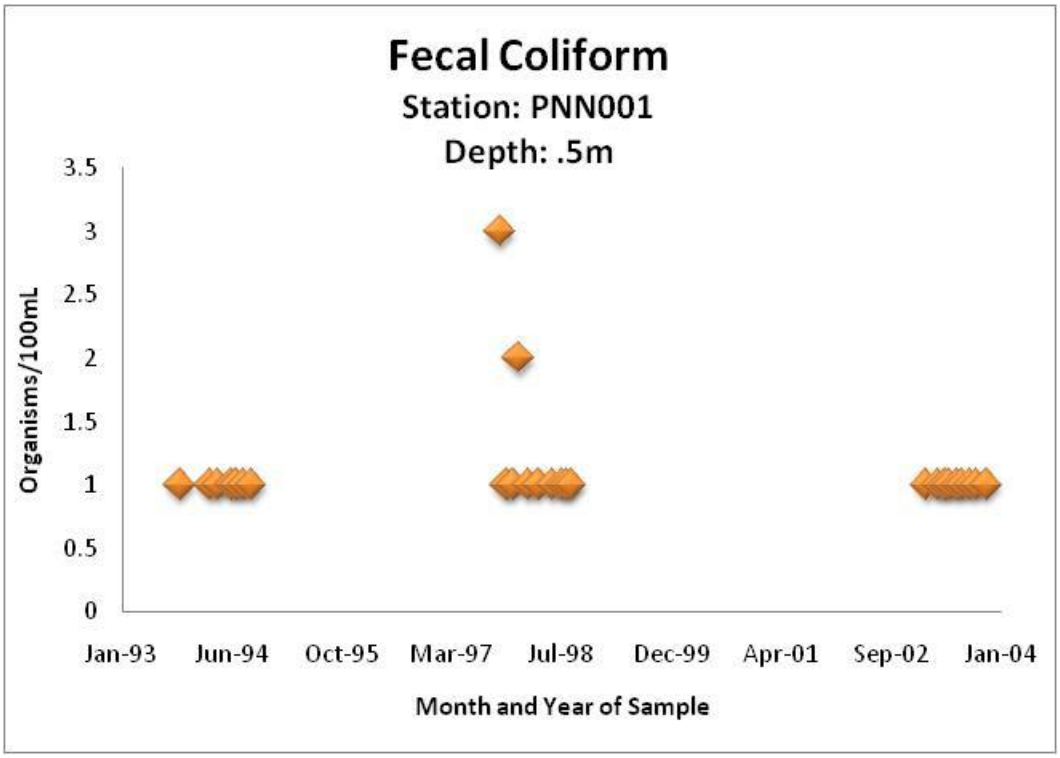

Figure B-24: Fecal coliform bacteria concentrations at PNN001 at depth of 0.5 meters

Figure B-24 shows that none of the samples taken at PNN001 between 1994 and 2003 failed to meet water quality standards. Ecology monitored fecal coliform bacteria beginning in 1973 and six out of 95 samples taken prior to 1990 exceeded current fecal coliform bacteria standards (with a maximum exceedance of 59 #/100mL). Given that during the mid-1990s, the wastewater treatment plants that discharge into Penn Cove were upgraded, data collected prior to the upgrades are not useful for comparison.

Tables B-24 below illustrates the fecal coliform bacteria data collected by DOH for all 22 stations in Penn Cove. Table B-25 and B-26 below describe fecal coliform bacteria conditions at ebb and flood tide at the same 22 stations.

Table B-24: Summary of fecal coliform bacteria (Fcoli/100ml) sampling at DOH monitoring stations

Station Number	Start Date	End Date	Total Number of Samples	Minimum (Fcoli/100ml)	Maximum (Fcoli/100ml)	Mean (Fcoli/100ml)	Median (Fcoli/100ml)
202	1/5/1995	12/7/2009	179	1.7	130	3.79	1.7
203	1/5/1995	12/16/2002	92	1.7	49	3.15	1.7
204	1/5/1995	12/7/2009	178	1.7	170	4.55	1.7
205	1/5/1995	12/7/2009	180	1.7	49	5.04	1.7
206	1/5/1995	12/7/2009	180	1.7	540	5.88	1.7
207	1/5/1995	12/7/2009	179	1.7	79	2.54	1.7

Station Number	Start Date	End Date	Total Number of Samples	Minimum (Fcoli/100ml)	Maximum (Fcoli/100ml)	Mean (Fcoli/100ml)	Median (Fcoli/100ml)
208	1/5/1995	12/7/2009	180	1.7	33	2.68	1.7
209	1/5/1995	12/7/2009	180	1.7	170	3.97	1.7
210	1/5/1995	12/7/2009	180	1.7	130	3.61	1.7
211	1/5/1995	12/7/2009	181	1.7	49	3.40	1.7
212	1/5/1995	12/7/2009	180	1.7	33	3.49	1.7
213	1/5/1995	11/6/2001	83	1.7	17	2.37	1.7
214	1/5/1995	1/7/2002	86	1.7	23	2.58	1.7
215	1/5/1995	12/7/2009	180	1.7	17	2.20	1.7
216	1/5/1995	12/7/2009	179	1.7	70	3.14	1.7
217	1/5/1995	12/7/2009	181	1.7	49	3.64	1.7
218	1/5/1995	12/7/2009	179	1.7	170	4.39	1.7
219	1/5/1995	12/7/2009	180	1.7	79	3.52	1.7
220	1/5/1995	12/7/2009	180	1.7	1600	12.27	1.7
221	1/5/1995	12/7/2009	179	1.7	220	4.72	1.7
279	5/20/2002	12/7/2009	91	1.7	17	2.00	1.7
321	2/27/2006	12/7/2009	46	1.7	17	2.67	1.7

Table B-25: Summary of fecal coliform bacteria (Fcoli/100ml) sampling at DOH monitoring stations at ebb tide

Station Number	Start Date	End Date	Total Number of Samples	Minimum (Fcoli/100ml)	Maximum (Fcoli/100ml)	Mean (Fcoli/100ml)	Median (Fcoli/100ml)
202	1/5/1995	12/7/2009	89	1.7	130.0	5.09	1.7
203	1/5/1995	12/16/2002	51	1.7	17.0	2.90	1.7
204	1/5/1995	12/7/2009	95	1.7	170.0	6.07	1.8
205	1/5/1995	12/7/2009	91	1.7	49.0	6.01	1.7
206	1/5/1995	12/7/2009	91	1.7	49.0	3.34	1.7
207	1/5/1995	12/7/2009	91	1.7	17.0	2.15	1.7
208	1/5/1995	12/7/2009	91	1.7	33.0	3.10	1.7
209	1/5/1995	12/7/2009	90	1.7	170.0	5.69	1.7
210	1/5/1995	12/7/2009	93	1.7	130.0	4.40	1.7
211	1/5/1995	12/7/2009	93	1.7	49.0	4.05	1.7
212	1/5/1995	12/7/2009	89	1.7	33.0	4.05	1.8
213	1/5/1995	11/6/2001	46	1.7	17.0	2.29	1.7
214	1/5/1995	1/7/2002	49	1.7	23.0	2.57	1.7
215	1/5/1995	12/7/2009	93	1.7	17.0	2.20	1.7
216	1/5/1995	12/7/2009	90	1.7	70.0	3.82	1.7
217	1/5/1995	12/7/2009	92	1.7	49.0	4.98	1.7
218	1/5/1995	12/7/2009	89	1.7	170.0	5.04	1.7
219	1/5/1995	12/7/2009	94	1.7	79.0	4.20	1.7
220	1/5/1995	12/7/2009	90	1.7	1600.0	21.12	1.7
221	1/5/1995	12/7/2009	90	1.7	220.0	5.86	1.7
279	5/20/2002	12/7/2009	43	1.7	17.0	2.19	1.7
321	2/27/2006	12/7/2009	19	1.7	17.0	3.89	1.7

Table B-26: Summary of fecal coliform bacteria (Fcoli/100ml) sampling at DOH monitoring stations at flood tide

Station Number	Start Date	End Date	Total Number of Samples	Minimum (Fcoli/100ml)	Maximum (Fcoli/100ml)	Mean (Fcoli/100ml)	Median (Fcoli/100ml)
202	1/5/1995	12/7/2009	90	1.7	13.0	2.51	1.7
203	1/5/1995	12/16/2002	41	1.7	49.0	3.47	1.7
204	1/5/1995	12/7/2009	83	1.7	17.0	2.80	1.7
205	1/5/1995	12/7/2009	89	1.7	33.0	4.05	1.7
206	1/5/1995	12/7/2009	89	1.7	540.0	8.47	1.7
207	1/5/1995	12/7/2009	88	1.7	79.0	2.95	1.7
208	1/5/1995	12/7/2009	89	1.7	89.0	2.26	1.7
209	1/5/1995	12/7/2009	90	1.7	13.0	2.25	1.7
210	1/5/1995	12/7/2009	87	1.7	33.0	2.76	1.7
211	1/5/1995	12/7/2009	88	1.7	33.0	2.72	1.7
212	1/5/1995	12/7/2009	91	1.7	23.0	2.94	1.7
213	1/5/1995	11/6/2001	37	1.7	17.0	2.46	1.7
214	1/5/1995	1/7/2002	37	1.7	17.0	2.60	1.7
215	1/5/1995	12/7/2009	87	1.7	13.0	2.21	1.7
216	1/5/1995	12/7/2009	89	1.7	17.0	2.47	1.7
217	1/5/1995	12/7/2009	89	1.7	13.0	2.26	1.7
218	1/5/1995	12/7/2009	90	1.7	79.0	3.76	1.7
219	1/5/1995	12/7/2009	86	1.7	11.0	2.78	1.7
220	1/5/1995	12/7/2009	90	1.7	79.0	3.43	1.7
221	1/5/1995	12/7/2009	89	1.7	110.0	3.58	1.7
279	5/20/2002	12/7/2009	48	1.7	4.5	1.84	1.7
321	2/27/2006	12/7/2009	27	1.7	4.8	1.81	1.7

DOH's data indicate that fecal coliform bacteria concentrations in Penn Cove range from 1.7 mg/L to 1600 mg/L. Table B-27 below illustrates the percent of time that each station exceeded Washington State fecal coliform bacteria standards for shellfish harvesting.

Table B-27: Summary of fecal coliform bacteria (Fcoli/100ml) standard exceedances at DOH stations

Station Number	Number of Samples Taken at Station	Number of Samples that Exceeded Standard	Percent of Samples that Exceeded Standard
202	179	5	2.79%
203	92	2	2.17%
204	178	8	4.49%
205	180	19	10.56%
206	180	5	2.78%
207	179	2	1.12%
208	180	5	2.78%
209	180	5	2.78%
210	180	4	2.22%
211	181	9	4.97%
212	180	5	2.78%
213	83	1	1.20%

Station Number	Number of Samples Taken at Station	Number of Samples that Exceeded Standard	Percent of Samples that Exceeded Standard
214	86	2	2.33%
215	180	1	0.56%
216	179	5	2.79%
217	181	7	3.87%
218	179	6	3.35%
219	180	6	3.33%
220	180	5	2.78%
221	179	6	3.35%
279	91	1	1.10%
321	46	1	2.17%

On average, stations exceed fecal standards 3% of the time. Station 211 exceeded standards 5% of the time, station 205 exceeded standards 10.6% of the time. The percentage of time in which each station exceeded WA water quality standards is illustrated in Figure B-25 below.

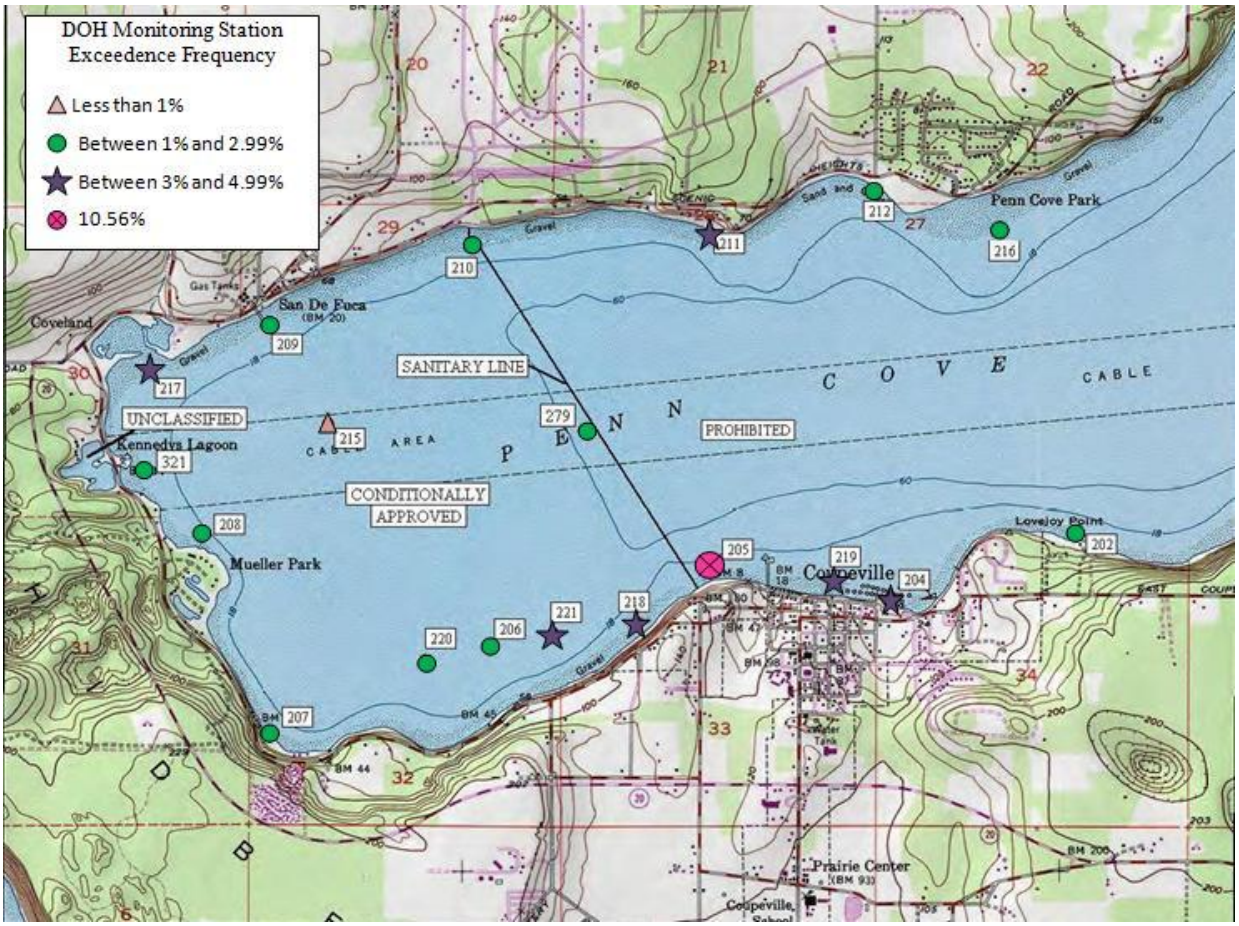

Figure B-25: Map of DOH monitoring stations showing frequency of fecal coliform bacteria water quality standard exceedence and DOH shellfish harvest area classification boundaries

Figure B-26 illustrates the magnitude of fecal coliform water quality standard exceedences in four DOH monitoring stations: 205, 210, 217and 221. Two outliers for station 221 not shown on in figure B-26: 110/100mL in Oct 1996 and 220/100mL in May 2002

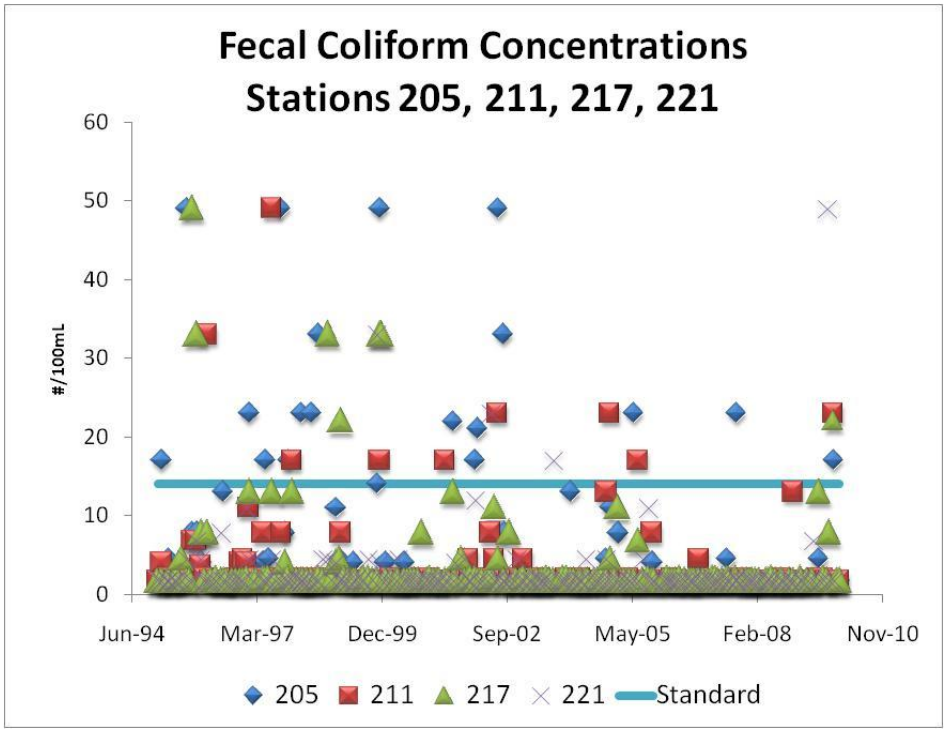

Figure B-26: Fecal coliform at four DOH monitoring stations compared to WAC standard

Inputs

Table B-28: Summary of fecal coliform bacteria (cfu/100mL) sampling at Island County monitoring stations

Station Number	Start Date	End Date	Total Number of Samples	Minimum (cfu/100mL)	Maximum (cfu/100mL)	Mean (cfu/100mL)	Median (cfu/100mL)
IC30A	11/30/2006	7/3/2008	24	2.00	1110.00	255.90	80.00
IC37B	1/3/2008	7/3/2008	30	1.00	268000.00	20300.80	22.00
IC39A	11/13/2006	4/10/2007	8	1.00	24.00	9.80	6.50
C1	10/16/2008	9/30/2009	8	5.16	16.51	9.43	7.88
C2	10/16/2008	9/30/2009	6	64.00	530.00	284.00	261.50
C3	10/16/2008	9/30/2009	6	600.00	15500.00	6503.33	5555.00
C4	11/13/2008	9/30/2009	4	263.00	1910.00	1215.75	1345.00
C5	10/16/2008	9/30/2009	9	46.00	2300.00	634.11	520.00

Table B-28 illustrates that the majority of the outfalls consistently contain high concentrations of fecal coliform bacteria.

Data from PNN001 indicate that in the center of Penn Cove, fecal coliform bacteria concentrations have consistently meet water quality standards since the mid-nineties. DOH data indicate that monitoring stations near the shoreline are more prone to fecal coliform bacteria standard exceedances. Island County's outfall monitoring data indicates that high concentrations of fecal coliform bacteria are entering the cove. It can be inferred by PNN001 data that Penn Cove water body is diffusing fecal coliform bacteria concentrations as the water flows away from the shore.

Temperature

The amount of dissolved oxygen held in solution is sensitive to temperature; capacity declines with increasing temperature. Algal growth is also temperature sensitive and generally increases with temperature.

Water Column

Table B-29: Summary of temperature (degrees C) sampling at DOH monitoring stations

Station Number	Start Date	End Date	Total Number of Samples	Minimum (degC)	Maximum (degC)	Mean (degC)	Median (degC)
202	1/5/1995	12/7/2009	178	4	20	11.17	11.0
203	1/5/1995	12/16/2002	92	4	20	11.25	11.0
204	1/5/1995	12/7/2009	177	4	20	11.22	11.0
205	1/5/1995	12/7/2009	179	3	20	11.08	11.0
206	1/5/1995	12/7/2009	179	3	20	11.03	11.0
207	1/5/1995	12/7/2009	178	3	20	11.07	11.0
208	1/5/1995	12/7/2009	179	3	19	11.01	11.0
209	1/5/1995	12/7/2009	179	4	18	11.03	11.0
210	1/5/1995	12/7/2009	179	4	18	11.09	11.0
211	1/5/1995	12/7/2009	180	4	18	11.07	11.0
212	1/5/1995	12/7/2009	179	4	20	11.13	11.0
213	1/5/1995	11/6/2001	83	4	20	11.31	11.0
214	1/5/1995	1/7/2002	86	4	18	11.12	11.0
215	1/5/1995	12/7/2009	179	3	18	11.04	11.0
216	1/5/1995	12/7/2009	178	4	19	11.16	11.0
217	1/5/1995	12/7/2009	180	4	19	11.03	11.0
218	1/5/1995	12/7/2009	178	3	20	11.06	11.0
219	1/5/1995	12/7/2009	179	4	20	11.20	11.0
220	1/5/1995	12/7/2009	179	3	20	11.04	11.0
221	1/5/1995	12/7/2009	178	3	19	11.07	11.0
279	5/20/2002	12/7/2009	90	4	18	11.04	12.0
321	2/27/2006	12/7/2009	46	4	19	10.76	11.0

Penn Cove water temperature at DOH monitoring stations ranged from 3 to 20 degrees Celsius during the sample period. Recall that the WA State water quality standards indicate that temperatures at or below 13^{o}C are considered Extraordinary, 16^{o}C is considered Excellent, 19^{o}C is considered Good, and at 22 ^{o}C the waterbody is at Fair condition. Table B-29 above illustrates that while 16 of the 22 monitoring stations measured a maximum temperature that registered between Good and Fair water quality, the mean temperature for all 22 stations fell below 13^{o}C indicating Extraordinary temperature.

Inputs

Table B-30: Summary of temperature (degrees C) sampling at Island County monitoring stations

Station Number	Start Date	End Date	Total Number of Samples	Minimum (degC)	Maximum (degC)	Mean (degC)	Median (degC)
IC30A	11/30/2006	7/3/2008	24	1.82	15.70	8.51	8.42
IC37B	1/3/2008	7/3/2008	28	4.00	14.50	9.70	9.09
IC39A	11/13/2006	4/10/2007	8	2.30	8.80	6.30	6.80
C1	10/16/2008	9/30/2009	8	5.16	16.51	9.43	7.88
C2	10/16/2008	9/30/2009	5	6.22	17.17	10.09	7.84
C3	10/16/2008	9/30/2009	6	7.01	10.79	8.03	7.63
C4	11/13/2008	9/30/2009	3	6.81	11.84	9.05	8.50
C5	10/16/2008	9/30/2009	7	6.51	12.88	8.42	7.82

The water entering Penn Cove ranges in temperature from 1.82 to 17.17 degrees Celsius.

Chlorophyll a

Chlorophyll is an indicator of algal growth in a water body. Algal growth and decay affects the amount of dissolved oxygen and nutrients in a water body. Generally, algal growth increases with increasing nitrogen concentration. Rapid algal growth followed by mortality can lead to low DO levels.

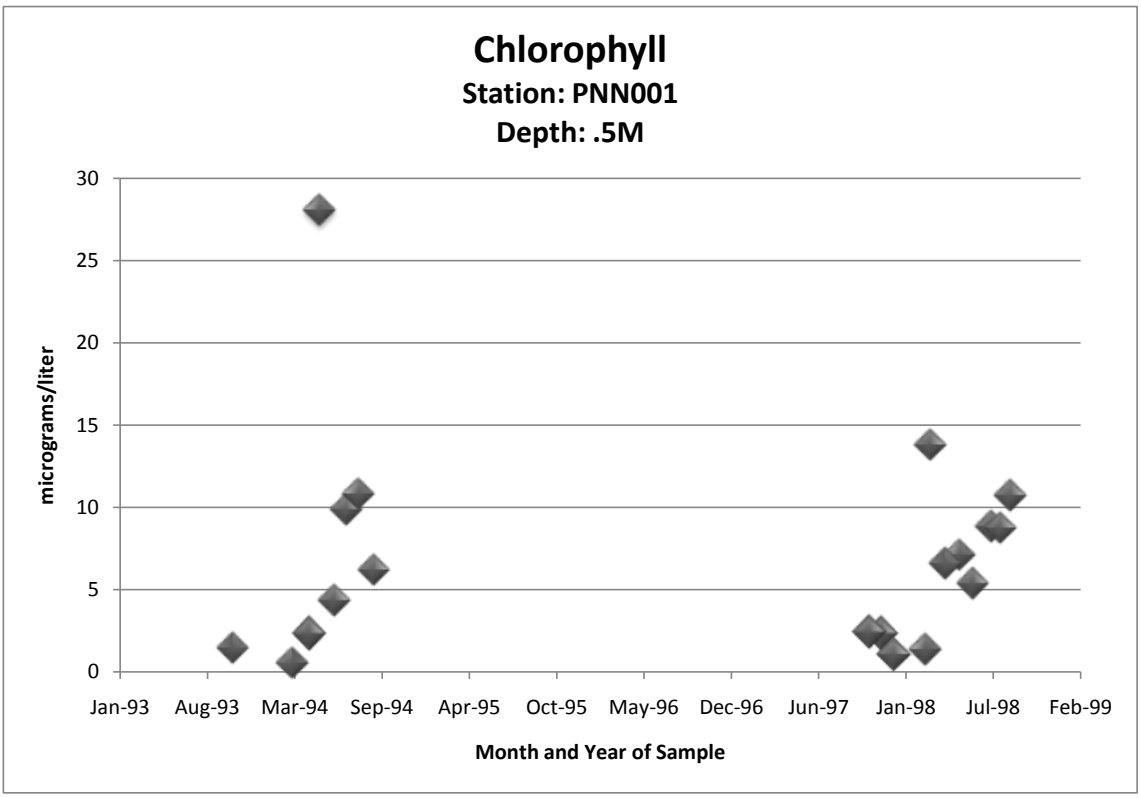

Figure B-27: Chlorophyll concentrations at PNN001 at depth of 0.5 meters

Table B-31: Comparison of chlorophyll in Penn Cove, Hood Canal and Holmes Harbor at 0.5 meters

	Start Date	End Date	Depth (m)	Total Number of Samples	Minimum (µg/L)	Maximum (µg/L)	Mean (µg/L)	Median (µg/L)
Holmes Harbor	10/12/1995	7/10/1996	0.5	9	0.85	45.50	11.25	4.10
Hood Canal	12/5/1990	12/19/2000	0.5	91	0.29	218.33	7.12	2.70
Penn Cove	10/18/1993	9/1/1998	0.5	19	0.52	28.10	6.92	6.20

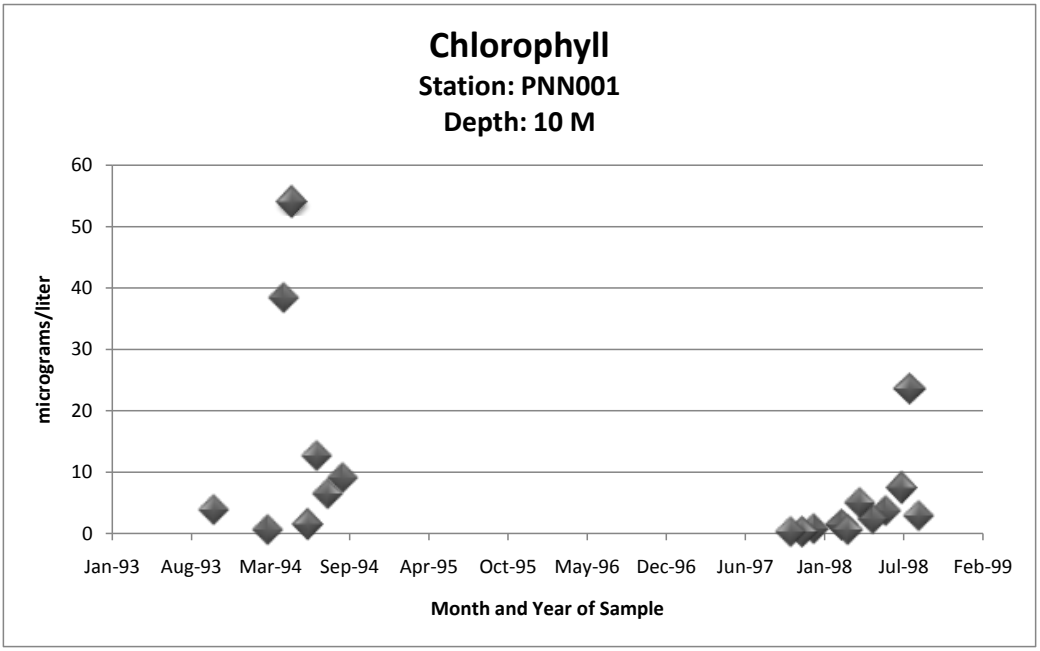

Figure B-28: Chlorophyll concentrations at PNN001 at depth of 10 meters

Table B-32: Comparison of chlorophyll in Penn Cove, Hood Canal and Holmes Harbor at 10 meters

	Start Date	End Date	Depth (m)	Total Number of Samples	Minimum (µg/L)	Maximum (µg/L)	Mean (µg/L)	Median (µg/L)
Holmes Harbor	10/12/1995	7/10/1996	10	9	0.07	19.80	6.83	6.90
Hood Canal	12/5/1990	12/19/2000	10	91	0.08	466.00	15.37	4.33
Penn Cove	10/18/1993	9/1/1998	10	19	0.16	54.00	9.13	3.70

Chlorophyll was measured by Ecology at PNN001 in 1993-1994 and 1997-1998. Out of 38 samples, 8 indicate values of Chlorophyll in the amounts of 10µg/L or above. Maximum average values of chlorophyll in Penn Cove are an order of magnitude lower than those reported for Hood Canal, but somewhat higher than those reported for Holmes Harbor.

Salinity/Conductivity

Salinity is a measure of dissolved salts in a water body and it affects oxygen levels, water clarity and habitats for aquatic species. Conductivity is a measure of salinity in seawater. Salinity and conductivity in Penn Cove are likely influenced by discharge from the Skagit River and to a smaller extent by local freshwater conditions.

Water Column

Table B-33: Summary of salinity (parts per thousand) sampling at DOH monitoring stations

Station Number	Start Date	End Date	Total Number of Samples	Minimum (ppt)	Maximum (ppt)	Mean (ppt)	Median (ppt)
202	1/5/1995	12/7/2009	178	5	30	21.68	22.0
203	1/5/1995	12/16/2002	92	5	30	21.41	22.0
204	1/5/1995	12/7/2009	176	4	30	21.63	22.0
205	1/5/1995	12/7/2009	179	2	30	21.55	22.0
206	1/5/1995	12/7/2009	179	4	30	21.94	22.0
207	1/5/1995	12/7/2009	178	4	30	21.87	22.0
208	1/5/1995	12/7/2009	179	4	30	21.99	22.0
209	1/5/1995	12/7/2009	179	2	30	21.83	22.0
210	1/5/1995	12/7/2009	179	4	30	21.64	22.0
211	1/5/1995	12/7/2009	180	4	30	21.49	22.0
212	1/5/1995	12/7/2009	179	4	30	21.37	22.0
213	1/5/1995	11/6/2001	83	5	30	20.94	22.0
214	1/5/1995	1/7/2002	86	4	30	21.38	22.0
215	1/5/1995	12/7/2009	179	4	30	21.80	22.0
216	1/5/1995	12/7/2009	178	2	30	21.01	21.0
217	1/5/1995	12/7/2009	180	2	30	22.07	22.0
218	1/5/1995	12/7/2009	178	2	30	21.67	22.0
219	1/5/1995	12/7/2009	179	4	30	21.72	22.0
220	1/5/1995	12/7/2009	179	4	30	22.08	22.0
221	1/5/1995	12/7/2009	178	2	30	21.86	22.0
279	5/20/2002	12/7/2009	90	9	30	21.78	22.0
321	2/27/2006	12/7/2009	46	10	30	21.72	22.0

Inputs

Table B-34: Summary of conductivity (µS/cm) sampling at Island County monitoring stations

Station Number	Start Date	End Date	Total Number of Samples	Minimum (µS/cm)	Maximum (µS/cm)	Mean (µS/cm)	Median (µS/cm)
IC30A	11/30/2006	7/3/2008	24	59.60	767.00	428.50	419.00
IC37B	1/3/2008	7/3/2008	28	415.00	34638.00	1237.10	1288.00
IC39A	11/13/2006	4/10/2007	8	353.00	470.00	410.80	417.00
C1	10/16/2008	9/30/2009	8	61.00	372.00	237.38	248.00
C2	10/16/2008	9/30/2009	5	4.70	543.00	218.34	144.00
C3	10/16/2008	9/30/2009	6	138.00	493.00	385.17	424.50
C4	11/13/2008	9/30/2009	3	392.00	1409.00	771.33	513.00
C5	10/16/2008	9/30/2009	7	107.00	1318.00	357.43	186.00

Summary of Findings

This report compiles water quality monitoring data that describe the water quality condition of Penn Cove and makes comparisons to Washington State water quality standards and to conditions in other local water bodies. In general, this report illustrates that although a degree of variability is evident, Penn Cove's condition has not shown evidence of substantial change in water quality since the mid-1990s, when the local wastewater treatment plants upgraded to secondary treatment facilities. Some distinctions can be drawn for the variables evaluated in this report:

1. Dissolved oxygen – At a depth of .5 meters, condition is consistent with that of Holmes Harbor and on average, DO concentrations are higher than in Hood Canal. At depths of 10 meters or deeper, Penn Cove consistently fails to meet water quality standards. At 10 meters, DO concentrations in Penn Cove are more similar to Hood Canal than DO concentrations in Holmes Harbor.

2. Nitrogen – New efforts could be made to sample nitrogen at various depths because recent data are not available. It appears that nitrogen inputs from Coupeville monitoring stations exhibit higher concentrations than from stations on the northern shore of Penn Cove. Higher concentrations seem to be found in Penn Cove at 10 meters deep over concentrations present in Holmes Harbor and Hood Canal.

3. Phosphorus – New efforts could be made to sample phosphorus at various depths because recent data are not available. Maximum values of ortho-phosphate samples taken in Penn Cove are more similar to those of Hood Canal than with Holmes Harbor. Total phosphorus measured at 0.5 meters is comparable among Penn Cove, Hood Canal, and Holmes Harbor. Hood Canal shows slightly higher concentrations of total phosphorus at depth of 10 meters. Phosphate concentrations at surface water station IC37B were higher than any of the other surface water and storm water monitoring stations.

4. Fecal coliform bacteria – Since the mid-1990s, fecal coliform bacteria concentrations at station PNN001 have not exceeded water quality standards; however the monitoring stations close to the shoreline have shown exceedances. Coupeville stormwater outfalls and surface water monitoring station IC37B show higher concentrations than others and these findings are consistent with the locations of the DOH monitoring stations that illustrate the highest proportion of water quality standard exceedences.

5. Temperature – Penn Cove's temperature generally meets or exceeds water quality standards for good quality; however annual maximum temperatures fall within the range between fair and good quality.

6. Chlorophyll – Further investigation could be conducted to sample chlorophyll at various depths because recent data are not available. Chlorophyll concentrations in Penn Cove are less than concentrations found in Hood Canal but greater than concentrations found in Holmes Harbor at depth; however Penn Cove shows lesser concentrations than Holmes Harbor and Hood Canal at shallower waters.

PART C: Penn Cove Stakeholder Interviews

Introduction and Methods

Part C presents the results of interviews with Penn Cove water quality stakeholders. Interviews were conducted to identify the obstacles stakeholders face as they work to attain greater progress on their water quality improvement efforts. In total, 14 Penn Cove stakeholders were interviewed in April and May of 2010. The people interviewed represented a range of interests including: five interviewees represented the MRC, two represented state agencies, three represented Island County, two represented local districts, and others represented the Town of Coupeville, local businesses, local tribes, regional partnerships and volunteer groups. We report findings in aggregate, without attribution to specific individuals.[1]

The information collected from interviews was summarized into Table C-1 as a compilation of strengths, weaknesses, opportunities, and threats facing the Island County Marine Resources Committee (MRC) and other local groups in political, economical, social, and technological areas. We identify the key obstacles common throughout the interviews and we recommend actions for the MRC to take to support the development of a strategic focus for future water quality improvement work. These recommendations can be found in the final section of this report.

Current Penn Cove Water Quality Initiatives

Every person interviewed commented on the breadth and depth of community engagement in Island County around water quality improvement. The following list is a compilation of the initiatives that were discussed during the interviews categorized by the entity that initiated or drives the work described. Please note that this list is by no means comprehensive, but it does portray the wide variety of entities engaged and initiatives underway.

Local Businesses / Districts

- Penn Cove Shellfish: Penn Cove is the home of Penn Cove Shellfish, America's oldest and largest mussel farm. Penn Cove Shellfish has been operating in Penn Cove since 1975 and with its 64 employees it distributes live shellfish all over the United States and in Asia. Penn Cove Shellfish monitors water quality weekly and collaborates with local entities to protect and improve water quality.
- Agriculture and the Whidbey Island Conservation District: The few farms that exist on the north side of Penn Cove grow forage crops and raise livestock. The Whidbey Island Conservation District provides technical assistance to land owners such as these farmers to support the adoption of best practices for water management.
- Penn Cove Water and Sewer District: Penn Cove Water and Sewer District conducted a study to assess the feasibility of reclaiming wastewater to both eliminate effluent discharged into Penn Cove and provide upland farmers with more irrigation water. A feasibility study found that the

[1] The Human Subjects Division at the University of Washington was consulted and it was determined that a Human Subjects Review was not required for the interviews conducted. Information from these interviews is reported in aggregate and not attributed to specific individuals. The findings in this report are interpretations of interview results made by the report authors.

project would require an up-front investment of $1.5 million for infrastructure and increase utility payer monthly bills from $5 to $20 depending on the level of water treatment attained. The District determined that these costs were too high at the present time.

Town of Coupeville

- Reclaimed Water Project: In conjunction with the wastewater treatment plant and other partners, the Town of Coupeville is assessing how to eliminate wastewater discharge into Penn Cove to protect Penn Cove water quality and produce reclaimed water for use in irrigation of farmlands and/or groundwater recharge.
- Stormwater Project: In partnership with a number of local, state and federal entities, the Town of Coupeville is in the process of assessing stormwater quality and creating a mitigation plan to protect Penn Cove.
- Phytoremediation Pilot Project: The Town of Coupeville is planning to use phytoremediation, a process of decontaminating soil or water by using the roots of trees to break down pollutants, to mitigate the containments in polluted stormwater.
- Coupeville Bio-Solid Management Study: This study will examine alternative sludge handling and disposal alternatives for the Town of Coupeville wastewater treatment facility. The Town currently hauls excess un-digested, un-thickened liquid sludge from the wastewater treatment plant to a septage facility or to a commercial agricultural land spreading site.
- Ebey's Aquifer Storage and Retrieval Study: This study will assess the feasibility a Coupeville Aquifer Storage and Recovery (ASR) system through hydrological and engineering studies and evaluate the feasibility of using stormwater, reclaimed water, or both, for groundwater recharge. The study is also intended to evaluate the feasibility of recovering the recharged water for beneficial use, such as irrigation.

Island County

- Marine Resources Committee: The MRC is an advisory committee to the Board of Island County Commissioners. The MRC is made up of 16 volunteer members and it is funded by the Northwest Straits Commission. The MRC's numerous programs work to protect and restore marine waters.
- Water Resources Advisory Committee: The WRAC is an advisory body to the Board of Island County Commissioners with a mission to ensure that the water resources of Island County are managed and protected in such a way as to ensure sustainable use, while protecting habitat, environmental and human health.
    - Non-Point Source Sub Committee: This WRAC subcommittee was initiated in early 2009 to determine the status of recommendations made in prior nonpoint source management plans for Whidbey and Camano islands. Once current status is determined, the subcommittee intends to update nonpoint source management plans for Island County.
    - Salmon Technical Advisory Group: The TAG recommends projects to protect existing salmon habitat and restore areas where habitat has been lost. The TAG makes recommendations to the WRAC and the Board of Island County Commissioners on how to award approximately $1M in Salmon Recovery Funding Board grants from the Recreational Conservation Office. The current salmon recovery plan does not directly impact Penn Cove; however, indirect activities related to outreach and education efforts do impact the broader Penn Cove community.
- Surface Water Quality Monitoring Program: Island County Health Department is engaged in a five-year surface water monitoring program. The results of monitoring activities will be used to develop baseline data for three watersheds, each with different land uses. Baseline data will be used to update critical areas regulations and inform future policy-making. Eight monitoring

stations on the Penn Cove shoreline were monitored, three on the north side of Penn Cove and five in Coupeville.

- Onsite Septic Management Plan; Island County's Onsite Septic Program provides education and outreach to homeowners and provides technical assistance for septic tank inspections and maintenance. Penn Cove is designated as a Category Risk II Area which requires that homeowners with septic systems around Penn Cove conduct more frequent septic tank inspections.

WA State Agencies

- Puget Sound Partnership: PSP has developed an Action Agenda for the Whidbey Basin which includes Penn Cove. This Action Agenda lays out plans for collaboration, funding, monitoring, and education that involve entities such as the MRC. PSP also provided low impact development (LID) technical assistance to Island County planning staff for the preparation and revision of local codes and standards related to stormwater management and development practices.
- WA Department of Ecology: Ecology is a regulator, source of grant funding, and conducts water quality monitoring. Ecology enforces the NPDES permits that allow discharges into Penn Cove. It has provided grant funding for numerous water quality initiatives, such as the Camano Island Nonpoint Source Pollution Prevention Plan. Ecology also monitors and assesses local water bodies. Penn Cove is classified as an impaired water body under the Washington State Water Quality Assessment for low dissolved oxygen which triggers a TMDL assessment. Ecology collects water quality data from one monitoring station in the center of Penn Cove.
- WA Department of Health: DOH regulates commercial shellfish growing beds under the Washington State Shellfish Protection Program. DOH monitors the water quality in Penn Cove monthly at 19 separate monitoring stations and makes determinations on the safety of shellfish harvesting in Penn Cove.
- Recreation Conservation Office: The RCO's Salmon Recovery Funding Board provides grants to protect and restore salmon habitat. Projects seeking funding through the Salmon Recovery Fund must go through the Island County WRAC's selection process.

Federal Agencies

- National Park Service: Penn Cove lies completely within Ebey's Landing National Historic Reserve. This Reserve was created to protect the rural working landscape and community on Whidbey Island. The Reserve is managed by a nine member Trust Board that works collaboratively with local, state and federal governments to ensure the reserve's resources are protected for future generations.

Universities

- Washington State University Beach Watchers: The Beach Waters program trains volunteers to collect data on marine plants and animals, measure shore topography, evaluate water quality, educate the public, and do hands on work such as invasive plant species removal.
- University of Washington, Bothell - Biogeochemical Study: UW Bothell, in partnership with the Northwest Straits Foundation, is seeking funding to conduct a study to investigate the processes and interplay of algae, bacteria, and biotoxins and their relationships to nutrient inputs and dissolved oxygen in Penn Cove. This study would refine the existing Puget Sound Water Quality Model in Penn Cove and assess the feasibility of reopening Penn Cove shellfish beds.
- Western Washington University Shannon Point Marine Center: Faculty from WWU collected water quality data from Penn Cove. At the time of this report, the data had not yet been analyzed.

Strengths, Weaknesses, Opportunities and Threats

Based on information obtained from interviews, the table below presents the strengths and weaknesses of local water quality improvement efforts, the opportunities the MRC can exploit, and the threats the MRC can work to mitigate. The information is categorized in terms of the political, economical, social, and technical aspects of water quality improvement work.

Table C-1: Penn Cove Stakeholder Interview Findings

	Strengths	Weaknesses	Opportunities	Threats
Political	• Board of Island County Commissioners receptive to MRC advice • Coupeville mayor receptive to partnerships • Strong partnerships with local and state entities • Local government supportive of piloting innovative projects • Grassroots approach attracts support from elected officials	• MRC has no regulatory authority, so it relies on Commission to take action based on recommendations • County has limited staff capacity to take on recommendations or new initiatives • MRC is lacking an overall plan that guides and integrates work with other efforts, which restricts effective partnership building and measuring success • Local officials limit engagement on initiatives based on perceptions of lack public support • Local jurisdictions do not have authority over regional Puget Sound water quality policy making • County not coordinated strongly with Puget Sound Partnership	• State agencies and elected officials responsive to community led initiatives. • County Commissioners likely receptive to beginning projects on County land • Stronger partnerships with local tribes	• Election cycle presents potentially short window to influence policy • Complexity of state laws and state agencies slows down innovative projects requiring that advocates for projects know more than the regulators. • Penn Cove work may result in pointing fingers at newly discovered pollution sources or groups of community members, potentially creating political friction.

	Strengths	Weaknesses	Opportunities	Threats
Economical	• MRC receives Northwest Straits Commission funding from federal source • Talented grant writers involved in MRC efforts • Local economy relies on healthy marine and freshwater resources	• Difficult to know where to best target scarce resources due to limited data, uncertain public support, and limited coordination and planning among groups • Local government financial resources insufficient to take on many needed projects • Local people impacted by economy and are less able to shoulder burden of increased contributions through taxes or other means	• Whidbey Island activities are ahead of the curve, making pilot projects attractive to funders • Board of Commissioners is currently evaluating a Clean Water District and MRC can be strategic in how it advises the process • Puget Sound Partnership and EPA funding opportunities could emerge in the future.	• Potential of worsening economy may hamper current water quality efforts • County or Town funding is scarce and at risk from one year to the next • Actions to deepen understanding of Penn Cove water quality may threaten current uses of Penn Cove
Social	• Broad range of interests and expertise on MRC • MRC has a flexible culture that allows members to take swift action on issues • MRC is effective at raising public support and awareness through community education and outreach • Majority of community is in tune with importance of water quality • Strong commitment among local groups to improve water quality	• Local groups are challenged to break out of traditional areas of focus and do not integrate or coordinate efforts on a broad scale • The County is limited in its ability to use volunteer groups for a wide variety of activities due to reduced accountability. • Limited usage of tribal partnership opportunities • Individual members of the community may not have strong understanding of the connections between individual actions and impact on water quality. • Planning efforts conducted by volunteers that rely on scarce County staff or funding have reduced chance of implementation due to resource constraints.	• WRAC's work underway to update Island County's nonpoint pollution prevention plans presents an opportunity to coordinate efforts	• Significant reliance on volunteer workforce risks loss of institutional knowledge with volunteer turnover

	Strengths	Weaknesses	Opportunities	Threats
Technological	• High technical and scientific expertise on MRC • Data and scientific studies exist to support decision making	• Lack of understanding about how the greater Puget Sound system influences water quality in Penn Cove • Local jurisdiction not capable of conducting studies on regional (Puget Sound–wide) scale • Nonpoint pollution sources are not clearly understood • Limited number of feasible options for treating wastewater effluent • Treatment plants unlikely to invest in new processes to remove pharmaceuticals or other expanded treatment until government requires such actions	• Available data could be analyzed further with volunteer resources • Nonpoint source pollution prevention plan recommendations to improve forest practices have not yet been fully implemented • New Conservation District funding source presents opportunities for further technical support program development and coordination • Funding for Oceanographic study may be awarded	• Pilot projects to reclaim water or aquifer storage and retrieval may present unforeseen consequences to water resources, organic agriculture, etc. • Use of volunteers for data collection and analysis could result in discrediting of findings

Recommendations to Overcome Obstacles

The interviewees identified a number of obstacles that constrain progress towards meeting water quality improvement goals. These obstacles are grouped into four key areas: funding, lack of scientific information, political will, and coordination. These are described in more detail below with specific recommendations for the MRC to consider.

Funding Obstacles

Interviews illustrated that progress is only possible with funding to both begin new projects and to sustain ongoing efforts. Grant funding through state and federal agencies is available for projects; however, grants are highly competitive and successful grant writing requires unique skills. Long-term operational funding generally relies on investment from local government and the local tax base consists of Island County residents facing tough economic times. Successful programs currently in place are at risk of loss of funding.

Recommendations to Overcome Funding Obstacles:

1. Develop water quality improvement plans that integrate the work of partner entities. Use these plans to illustrate the strategic position of each project to grant making agencies.
2. Participate in Clean Water District dialogue to ensure that new funding, if approved, is directed at best uses.
3. Explore options to expand uses of salmon recovery funding into comprehensive water quality improvement initiatives that address pollution sources.
4. Build up County grant acquisition skills through support from local organizations that have extensive grant experience.
5. Consult and collaborate with the Puget Sound Partnership when appropriate.

Lack of Scientific Information Obstacles

Policy makers rely on scientific information to inform decisions that impact their constituents. Measureable reductions in the impacts of nonpoint sources of pollution would require substantial changes in public behavior. The collection and analysis of water quality and hydrodynamic data is labor intensive and requires specialized skills. Local government agencies do not have a large staff of scientists to engage in water quality studies and the use of volunteers as citizen scientists is not widely used due to reduced accountability.

Recommendations to Overcome Lack of Scientific Information Obstacles:

1. Develop a scientific review process to support County decision making that utilizes scientific expertise on the MRC and mitigates the County's concerns.
2. Develop a training and certification program for volunteer water quality monitoring data collection that addresses data quality concerns that hinder more expansive use of volunteers. If a program is planning to use volunteers from the Beach Watchers program, consult with the Beach Watchers program early on in that planning phase.
3. Organize a conference of scientists with expertise on Penn Cove water quality issues and through conference activities identify areas of limited scientific understanding that can focus future research.

4. Develop a Penn Cove water quality monitoring program that includes monitoring during storm events and includes quality assurance protocols. Use this plan to justify grants for monitoring instrumentation.
5. Obtain Penn Cove water quality data from Western Washington University Shannon Point Marine Center that was collected prior to and including 2008. At the time this report was developed, those data were not available.

Political Will Obstacles

Short election cycles limit opportunities for change. Elected officials are appropriately attuned to the average constituent's wishes and thus they tend to support middle-of-the-road policies. Maintaining the status quo will not generally result in improved water quality. State agencies are bound by regulations and may be challenged to approve required permits for innovative projects. Thus, regulatory agencies may present implementation hurdles. Individual community members are generally resistant to change.

Recommendations to Overcome Political Will Obstacles:

1. Make the most of partnerships with State legislators to promote projects and reduce hurdles presented by state regulatory agencies.
2. Assess the value of water resources in dollar terms and use those dollar terms to communicate water quality benefits to elected officials and regulators.
3. Develop and implement strategies to grow public support, and in turn political support, for water quality improvement initiatives. Make sure that proponents are more vocal than opponents.
4. Develop plans in conjunction with the Puget Sound Action Agenda.
5. Draw connections in public outreach between water quality, which is a somewhat intangible term, and the effects on tangible things like fish and shellfish to increase support among local community. Develop community shellfish gardens and communicate the economic and ecological benefits of water quality.
6. Involve school districts in work to foster continued focus on issues and promote intergenerational work.

Coordination Obstacles

As financial resources become scarcer, coordination with partner organizations is not only more challenging, but also more important than ever. Many entities in the Penn Cove area are staffed by volunteers that require coordination. Reliance on volunteers presents risks to water quality improvement projects because volunteers may not be as reliable as a paid workforce. Layers of local, tribal, state and federal agencies are engaged in water quality improvement work where jurisdictional boundaries complicate integrating efforts.

Recommendations to Overcome Coordination Obstacles:

1. Develop a systematic approach to improving Penn Cove's water quality that includes data collection, restoration, source identification, education, outreach, and collaboration with tribes and other agencies. Take a leadership role in this effort.
2. Increase coordination of activities between Water Resources Advisory Committee and Marine Resources Committee on a project by project basis and continue to improve communication between groups.
3. Establish better communication channels between Island County and the Puget Sound Partnership and other WRIAs.

4. Connect with larger communities/cities that have greater regulatory requirements to learn from their experiences. It is likely that the same requirements will filter down to smaller communities in the near future.
5. Advocate for Island County to establish an environmental department staffed by scientists skilled in coordination of efforts.

Conclusion

The challenges facing Penn Cove water quality improvement work are not unique. The inherent challenges associated with preventing nonpoint source pollution and unraveling the scientific complexity of water system dynamics are shared by communities throughout Puget Sound and the rest of world. What does seem unique to Penn Cove is the level of engagement and dedication of local citizenry. The community involved in Penn Cove water quality improvement work is already addressing local water quality problems from all angles. The MRC has many strengths in its technical expertise, local knowledge, and what seems to be an unbridled passion for making Penn Cove better. By connecting more closely with federal, state, local, tribal, and academic partners, the MRC can use its leadership to overcome obstacles to progress.

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