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DRAFT PETITION TO DESIGNATE THE WATERS OF PUGET SOUND AS A NO DISCHARGE ZONE

Prepared for
Washington State Department of Ecology

Prepared by
Herrera Environmental Consultants, Inc.

HERRERA

Note:
Some pages in this document have been purposely skipped or blank pages inserted so that this document will copy correctly when duplexed.

DRAFT PETITION TO DESIGNATE THE WATERS OF PUGET SOUND AS A NO DISCHARGE ZONE

Prepared for
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1. INTRODUCTION

Puget Sound is a natural resource of incredible value to Washington State and the nation. It is estimated that Puget Sound drives $20 billion in economic activities in Washington State that result from commercial and recreational fishing, shellfish aquaculture, tourism, boating, and international trade (Ecology 2008). Bounded by the Olympic Mountains and Vancouver Island to the West, and the Cascade Mountains to the East, it is place of unparalleled beauty. The nutrient-rich waters brought in by tidal currents from the Pacific Ocean provide nourishment for a vast diversity of life, from microscopic invertebrates to the salmon and orca whales vital to the region's cultural history and identity. Its 2,500 miles of shoreline provide critical habitat for fish, mammals, and birds, and provide shellfish harvesting and swimming opportunities for the region's residents and visitors. Sadly, deteriorating water quality is placing many of Puget Sound's valuable resources at risk.

Over the past several decades, human-caused sources of nutrients, pathogens, and toxic contaminants are thought to have degraded the water quality of Puget Sound and are putting many of its beneficial functions at risk. Large areas of Puget Sound have been designated as impaired waters under the Clean Water Act (CWA) due to persistent low dissolved oxygen (DO) concentrations and high concentrations of fecal indicator bacteria. Numerous public swimming beaches have been closed due to bacterial contamination concerns, and approximately 36,000 acres of commercial shellfish growing areas have been closed due to bacterial contamination.

Untreated vessel sewage discharges, less than 3 miles from shore, are currently prohibited within Puget Sound. Sewage that has been treated by a United States Coast Guard (USCG) approved marine sanitation device (MSD), however, may be discharged anywhere. Treated vessel sewage discharges often contain high concentrations of nutrients and pathogens, may contribute to decreased DO, and may contain toxic disinfection chemicals, and excreted pharmaceuticals. As such, even treated vessel sewage discharges can degrade water quality and contribute to water quality impairments.

The Washington State Department of Ecology (Ecology) is requesting that the United States Environmental Protection Agency (US EPA) designate the marine inland waters of Puget Sound, and waters of Lake Washington, Lake Union the Lake Union Ship Canal and connecting water bodies a No Discharge Zone (NDZ) pursuant to CWA Section 312(f)(3). In a NDZ the discharge of sewage (also known as blackwater) from vessels is prohibited. The NDZ does not apply to other vessel discharges such as graywater, bilge, or ballast discharges unless they are combined with sewage prior to discharge. The following report addresses the seven elements (listed below) required to designate a NDZ under CWA Section 312 (f)(3):

- A certification that the waters included in the petition require greater environmental protection than the applicable federal standard
- A map showing locations of pumpout facilities

- A description of the location of pumpout facilities
- A schedule of operating hours for the pumpout facilities
- Vessel size limits or draught limits for the pumpout facilities
- Information on treatment of wastes from pumpouts and verification that treatment conforms with federal law
- Information on area vessel population and usage

2. EVALUATION PROCESS

Over the past 2 years, Ecology and Herrera Environmental Consultants (Herrera) have been gathering data for evaluating the appropriateness and feasibility of establishing a NDZ for Puget Sound. This was a multifaceted effort that involved: reviewing and summarizing existing water quality data; compiling an accurate database of pumpout facilities available to Puget Sound boaters and commercial vessel operators; and several outreach efforts aimed at learning about existing vessel sewage management practices and attitudes, and ways to improve access to pumpout facilities so that NDZ compliance is straightforward for boaters and commercial vessel operators alike. The results of these research efforts are detailed in a series of seven informational memorandums available at Ecology's NDZ website: http://www.ecy.wa.gov/programs/wq/nonpoint/CleanBoating/nodischargezone.html.

The water quality data review focused primarily on identifying known water quality impairments and problems that could be worsened by vessel sewage discharges. While a number of studies and reports were reviewed, the primary data sources were the most recent 303(d) list of impaired waters and Washington State Department of Health (WDOH) data on shellfish harvesting area and beach closures.

Information on public pumpout facilities for recreational vessels was obtained via the Washington State Parks Department (WSPD) pumpout facility data base. The number, location, and operation of pumpout facilities changes regularly, so every pumpout facility was contacted to verify its operation. The operators of mobile pumpout boats were also contacted to verify their vessel capacity, areas of operation, and ability to take on additional business.

A survey of over 300 Puget Sound boaters was conducted in the summer of 2012. The information gathered via this effort helped determine the percentage of Washington boaters that already use pumpout facilities and how many more might require access to pumpout facilities if Puget Sound were designated a NDZ. It also helped assess whether boaters were satisfied with the number and locations of existing pumpout facilities, and where additional pumpout facilities are desired.

Commercial vessel owners and operators from several industries were contacted to learn about sewage management practices on their vessels. Information gathered during this effort helped catalog existing pumpout options capable of serving commercial vessels. This information-gathering campaign also helped determine what modifications to their vessels and routines many commercial vessel operators would have to make to be able to comply with NDZ regulations.

Outreach for the Puget Sound NDZ began in 2011 by contacting recreational and commercial boating organizations, environmental groups, shellfish growers, and ports, in addition to other state agencies and tribal entities. Ecology launched an informational website outlining the NDZ development process which includes technical reports developed during the process and links

to pertinent information. Ecology also identified more than 300 stakeholder groups and individuals and requested input from them throughout the NDZ evaluation process.

An advisory committee of stakeholders was assembled to guide decision making for the NDZ. The committee was comprised of representatives from state agencies, recreational boating and liveaboard advocacy groups, environmental interest groups, commercial vessel owners associations, tribal representatives, and ports. Two advisory committee meetings were held in June and July of 2013. Most of the first meeting was devoted to providing an overview of the information collected during to support the NDZ decision making process. At the second meeting the advisory committee provided direct input to; defining the geographic boundaries of the NDZ, infrastructure capacity and needs, and implementation needs (e.g., outreach, enforcement, and evaluation measures.

Based on the information gathered over the past 2 years and the outcomes of the advisory committee meetings, Ecology has concluded that there is sufficient need for establishing an NDZ in Puget Sound to protect water quality. Ecology has also determined that there are a sufficient number of pumpout facilities available to recreational boaters and methods to prevent vessel sewage discharges from the vast majority of commercial vessels, with certain commercial vessels being allowed additional time to retrofit vessels.

3. Proposed No Discharge Zone and Boundaries

The proposed NDZ includes all inland waters of Puget Sound and applies to all recreational and commercial vessels. The western boundary of the NDZ would be the exit of the Strait of Juan de Fuca near the entrance of Admiralty Inlet. This boundary is known and visible to vessel operators as it is the line between New Dungeness lighthouse and Discovery Island lighthouse. The northern boundary would include all Washington State waters of the San Juan Islands. The proposed NDZ includes all areas to the south of the San Juan Islands including South Puget Sound, Hood Canal, and the fresh waters of Lake Washington, Lake Union, the Lake Union Ship Canal, and the connecting water bodies. The specific boundaries of the proposed NDZ are clearly delineated on Figure 1.

The geographical boundaries were determined by reviewing the vessel counts, and pumpout availability and distribution data, as well as the information collected on water quality concerns and locations of sensitive resources and public health protection. Ecology reviewed all of the data collected during the 2-year evaluation process on the number of vessels, locations of vessels, types of vessels, and the number and distribution of stationary and mobile pumpout facilities. Ecology evaluated mapped data such as sensitive water bodies, shellfish growing areas, and locations of known water quality problems. And Ecology conducted numerous stakeholder meetings including two Advisory Group meetings in which the pros and cons of the various geographic boundary options were analyzed. The analysis concluded that all of the inland marine waters of Puget Sound as well as the fresh waters of Lake Washington, Lake Union and the ship canal should be designated to adequately protect water quality and public health and that the infrastructure to prevent vessel sewage discharges was adequate.

The NDZ would immediately apply to all vessels with the exception of small and mid-sized commercial vessels that operate almost exclusively within the NDZ that do not already have a Type III MSD. Examples of vessels that might fit these criteria would be tug boats, resident commercial fishing vessels, and NOAA research vessels. The exception is included because there are some unique challenges associated with retrofitting these types of vessels, such as requiring engineered designs with extra safety considerations. These vessels would have a temporary exemption from the new NDZ regulations, but would still be required to comply with existing state and federal discharge regulations. The exemption would only apply until each boat's next dry dock maintenance event or for no more than 3 years from the effective date of the NDZ.

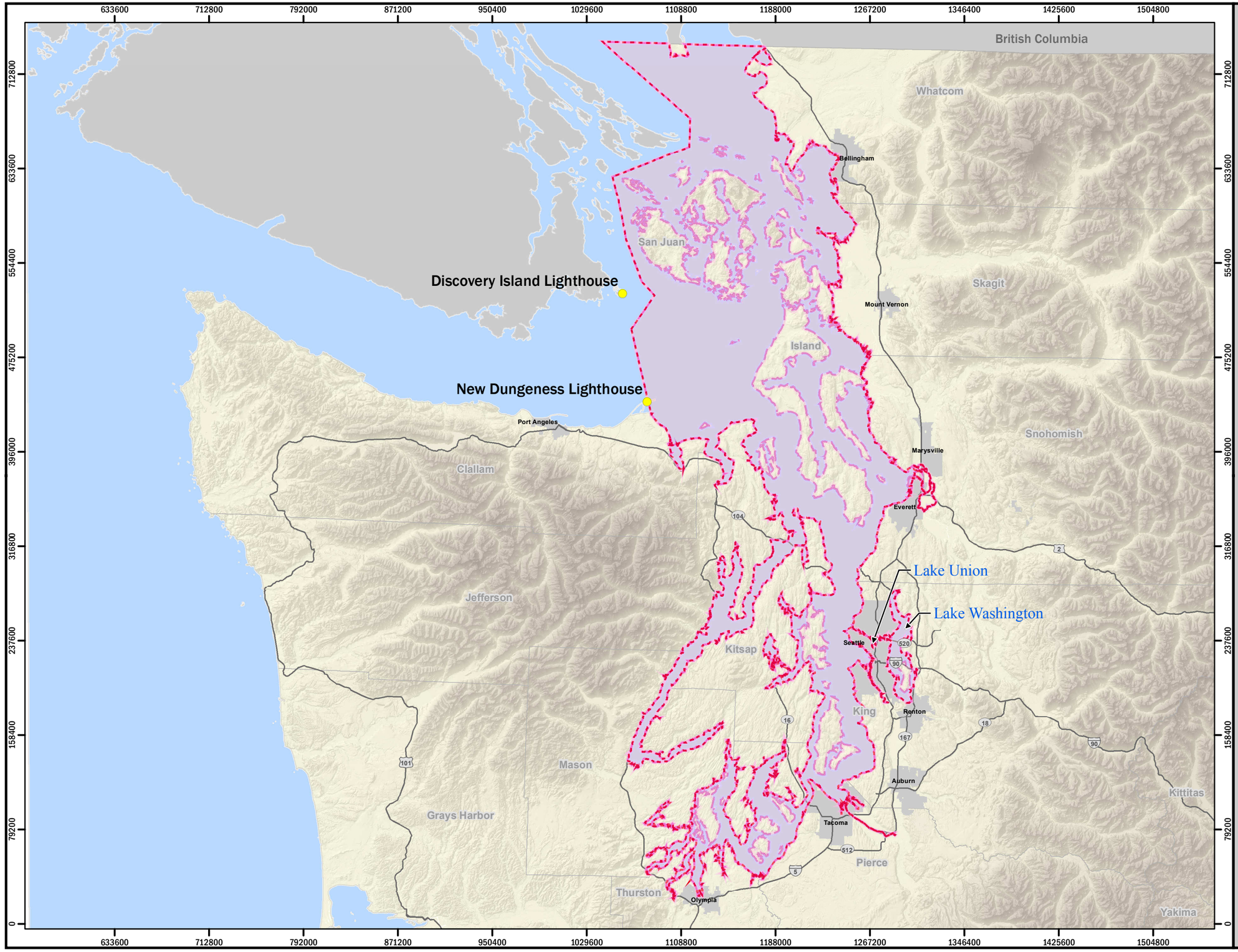

Figure 1.
Proposed NDZ Boundaries.

Legend

- Proposed NDZ boundary
- Lighthouse

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Miles

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Coordinates: NAD83 Wahington
State Plane North (feet)

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4. CERTIFICATION OF NEED

Water quality declines over the past several decades have put many of Puget Sound's economic, recreational, and ecological functions at risk. Thousands of acres of shellfish aquaculture and harvesting areas are currently closed due to health hazards posed by bacterial contamination. Likewise, many swimming beaches are closed annually to protect beachgoers from getting sick. Low DO concentrations caused by excess nutrients in the water have resulted in large die-offs of marine life in several areas of Puget Sound.

Microbial pathogens, disinfection chemicals, and other additives present in MSD discharges degrade water quality and pose direct threats to human health. According to the Clean Vessel Act (CVA) of 1992, "sewage discharged by recreational vessels because of an inadequate number of pumpouts is a substantial contributor to localized degradation of water quality in the United States." Substantial progress has been made since passage of the CVA in providing boaters access to pumpout facilities. However, the discharge of MSD treated waste from recreational and commercial vessels still poses a risk to water quality of Puget Sound. Under the current regulatory framework, illegal discharges are very difficult to prevent and enforce, and even legal, treated sewage discharges contain fecal bacteria concentrations that are many times higher than the state water quality standards.

Most previous and ongoing water quality improvement efforts focus on reducing watershed-based sources of pollution. Point source pollution is largely addressed through the National Pollutant Discharge Elimination System (NPDES). Non-point source pollution is being reduced through watershed rehabilitation, pollutant source reduction, and new water treatment technologies.

Vessel sewage is a type of non-point source pollution. Even though vessel sewage discharges may account for only a small portion of the total pollutant load entering Puget Sound, their impacts may be disproportionally large. Because vessels are mobile, their discharges may occur directly over sensitive environmental resources, causing localized water quality problems. Eliminating vessel sewage discharges by establishing a NDZ for Puget Sound will work in concert with watershed-based pollutant reduction efforts to restore water quality and maintain the many beneficial human uses and ecological functions of Puget Sound.

4.1. Puget Sound Partnership Action Agenda

Tremendous efforts are being made by the state, local municipalities, and environmental advocacy groups aimed at improving water quality and restoring habitat in Puget Sound. The Puget Sound Partnership (PSP) is a state agency established to lead efforts to protect and restore Puget Sound.

The Puget Sound Partnership has developed an Action Agenda, a roadmap to restore Puget Sound by 2020. As part of the most recent Action Agenda update, PSP developed a set of recovery targets to be achieved by 2020 (PSP 2011a). Addressing vessel sewage is a

component of the Action Agenda. Designating Puget Sound as a NDZ will offer the greatest protection possible from vessel sewage pollution and will satisfy the Action Agenda marine sewage goal. The Action Agenda and recovery targets can be viewed at PSP's website (http://www.psp.wa.gov/action_agenda_center.php).

To help target restoration efforts tied to the Action Agenda, PSP has designated "Action Areas" that roughly correspond to the main basins of Puget Sound. While Action Areas are not specifically related to the NDZ, they are referenced several times in this petition because they are useful geographic units for framing discussions about the NDZ.

4.2. Puget Sound's Economic and Recreational Importance

Puget Sound is an economic engine for the region. It was recently estimated that industries and activities conducted on Puget Sound account for $20 billion of the region's economy on an annual basis. A large portion of this comes from commercial and recreational fishing, shellfish aquaculture, tourism, and boating, all of which are dependent on good water quality.

Probably the most direct link between the economic vitality of the region and excellent water quality is through the commercial shellfish industry. In 2008, the Puget Sound shellfish industry was estimated to have generated $44 million in revenue. Shellfish aquaculture has shown steady growth since 1985, with over 20 million pounds harvested in recent years (PSP 2009). The Washington State Department of Health designates the status of commercial shellfish and recreational harvesting areas based on the potential health risk posed to people by consuming shellfish harvested in those areas. Approximately 190,000 acres of tidelands are classified for commercial and recreational shellfish harvest. In 2011, approximately 36,000 acres, or 19 percent, of the total potential growing area was closed to harvesting, representing substantial revenue losses. The majority of the acreage was closed due to fecal bacteria pollution (PSP 2011b). The Puget Sound Partnership has set a recovery goal of a net increase of 10,800 acres where shellfish may be harvested, including 7,000 acres where harvest is currently prohibited.

Recreational shellfish harvesting is nearly as important to the regional economy as commercial harvest. The value of shellfish harvested recreationally is estimated to be $42 million annually. Recreational shellfish harvest takes place at hundreds of beaches throughout Puget Sound As with commercial shellfish growing areas, WDOH is responsible for ensuring that shellfish that are harvested recreationally are safe to eat.

Shellfish resources are particularly vulnerable to vessel sewage discharges. As will be described in detail later in this petition, even treated vessel sewage discharges have very high bacteria concentrations and the treatment processes used would provide no real treatment for viruses or other pathogens. The fact that these discharges can occur directly over or very near shellfish beds or swimming areas means that they pose a much greater public health risk than other waste discharges. Each year, about 390,000 people participate in recreation activities in the waters or on the beaches of Puget Sound. Thousands of people use Puget Sound beaches every weekend to enjoy the scenery and the water, as well as to dig for clams and oysters. Public swimming beaches are monitored for bacteria and other toxins. In 2011, one-quarter of monitored swimming beaches were closed because of fecal bacteria contamination (PSP 2012).

The Puget Sound Partnership has set recovery target of having all public swimming beaches meeting the US EPA bacteria standard by 2020 (PSP 2012).

Recreational fishing is valued at $57 million annually when peripheral expenses such as fuel and equipment purchases are considered (Ecology 2008).

4.3. Costs and Benefits of Establishing a NDZ for Puget Sound

Clearly, Puget Sound is crucial to the economic vitality and cultural identity of the region and the State. Maintaining and improving the water quality of Puget Sound by establishing a NDZ will help ensure that industries dependent on excellent water quality will sustain their success and continue to grow. There are however costs associated with establishing a NDZ that will affect a range of stakeholders (Herrera 2012a). The primary cost to vessel operators is the cost to retrofit vessels that do not have adequate holding capacity. There are also indirect costs, which are difficult to quantify, such as the cost in time required navigating to and from pumpout facilities. Building and maintaining pumpout facilities, particularly large capacity facilities for commercial vessels can be also costly. The Clean Vessel Act grant program pays the bulk of the costs associated with recreational pumpouts, but there are no similar programs for commercial pumpouts. Even in light of the costs of establishing a NDZ, they are outweighed by the benefits of clean water.

4.4. Protected Areas and Beneficial Uses

Puget Sound provides critical and unique habitat for a variety of species, ranging from orca whales to forage fish and native shellfish. Marine protected areas (MPAs) are areas that are designated as requiring extra protection due to their fragile and unique habitats or species, or because they are culturally historic sites or they enhance fisheries abundance and biodiversity. While MPAs by no means provide a complete inventory of the valuable marine resources, they are an important tool for visualizing the extent of environmentally important areas throughout Puget Sound.

Washington State has designated 127 MPAs that are administered by a number of different agencies; 71 are located in Puget Sound (Figure 2). Marine protected areas are generally small (the average size is 23 acres); only about 5 percent of the Puget Sound coast is covered by an MPA. Marine protected areas offer various degrees of protection for marine resources by having harvest and access restrictions, for example. Despite their status, with a few exceptions, MPAs are not protected from vessel discharges.

4.5. Hydrology

Puget Sound comprises four deep basins connected by shallower sills. The basins correspond to the Hood Canal, Central Puget Sound (North and South), and Whidbey Basin (Figure 1) (University of Washington 2009). Central Puget Sound is the deepest basin, with depths consistently exceeding 200 meters (m) (Cannon 1983). South Puget Sound is much shallower. Although water depths in South Puget Sound reach 150 m, many of the inlets are 50 m or shallower (Ecology 2009). The Whidbey Basin is also shallower than the main basin in Central Puget Sound and has variable depths ranging from 8 to 150 m (University of Washington 2012). Hood Canal is deep throughout the north-south trending portion, with depths frequently exceeding 175 m. Where Hood Canal bends to the east and changes to an east-west

orientation, it is much shallower, with depths only reaching about 40 m (Turney 2004). Lake Washington and Lake Union, while not part of Puget Sound, are connected via the Lake Washington Ship Canal to Shilshole Bay.

Puget Sound has complex hydrology that results from the interaction of tidal currents, freshwater inflow, and the physical features that define the bathymetry of the basin. The deeply incised fingers left behind by the last glaciations resulted in a network of narrow channels and shallow sills, which restrict and alter the mixing and circulation of water throughout the Sound. As a result, some areas of the Sound, particularly South Puget Sound and Hood Canal, experience poor circulation and are prone to water quality impairments (PSP 2010).

Water circulation in Puget Sound is driven by tidal currents, the surface outflow of fresh water, and the deep inflow of salt water from the ocean. There are 10,000 rivers and streams that contribute fresh water to Puget Sound, but 14 main rivers located predominately in central and north Puget Sound account for the majority of the freshwater sources (PSP 2008). Due to density differences, the less dense fresh water remains near the surface and flows out of the Sound through Admiralty Inlet. The majority of the oceanic input, which is denser and typically more nutrient-rich, enters into Puget Sound at depth through Admiralty Inlet and travels south through the main basin. Some mixing between the more saline ocean water and the less dense surface water occurs, as the ocean water is forced upward as it travels over the Admiralty Inlet Sill and near the south end of the main basin at the Tacoma Narrows Sill between Central and South Puget Sound (Newton 2002).

Water circulation and flushing rates influence water quality and are especially important factors in determining an area's susceptibility to eutrophication. In general, circulation and flushing is more rapid in the northern segments of Puget Sound. Greater river water inputs and a shorter, more direct connection with the ocean facilitate greater net flow and circulation in these areas. Hood Canal and South Puget Sound are much more poorly flushed due, in part, to sills at their mouths, which restrict exchange with the rest of Puget Sound. Other factors related to the timing and strength of stratification in Hood Canal and South Puget Sound also limit the net volume of water exchange flushing time (Gustafson et al. 2000).

4.6. Water Quality

Good water quality is at the heart of the ecological, economic, and recreational benefits provided by Puget Sound. Over the past several decades, human-caused sources of nutrients, pathogens, and toxic contaminants are thought to have degraded the water quality of Puget Sound and are putting many of its beneficial functions at risk. Treated vessel sewage discharges often contain high concentrations of nutrients and pathogens, may contribute to decreased DO, and are likely to contain toxic disinfection chemicals as well as pharmaceuticals. The following sections provide a general overview of Puget Sound water quality in relation to four indicators: bacteria, DO, nutrients, and toxic chemicals.

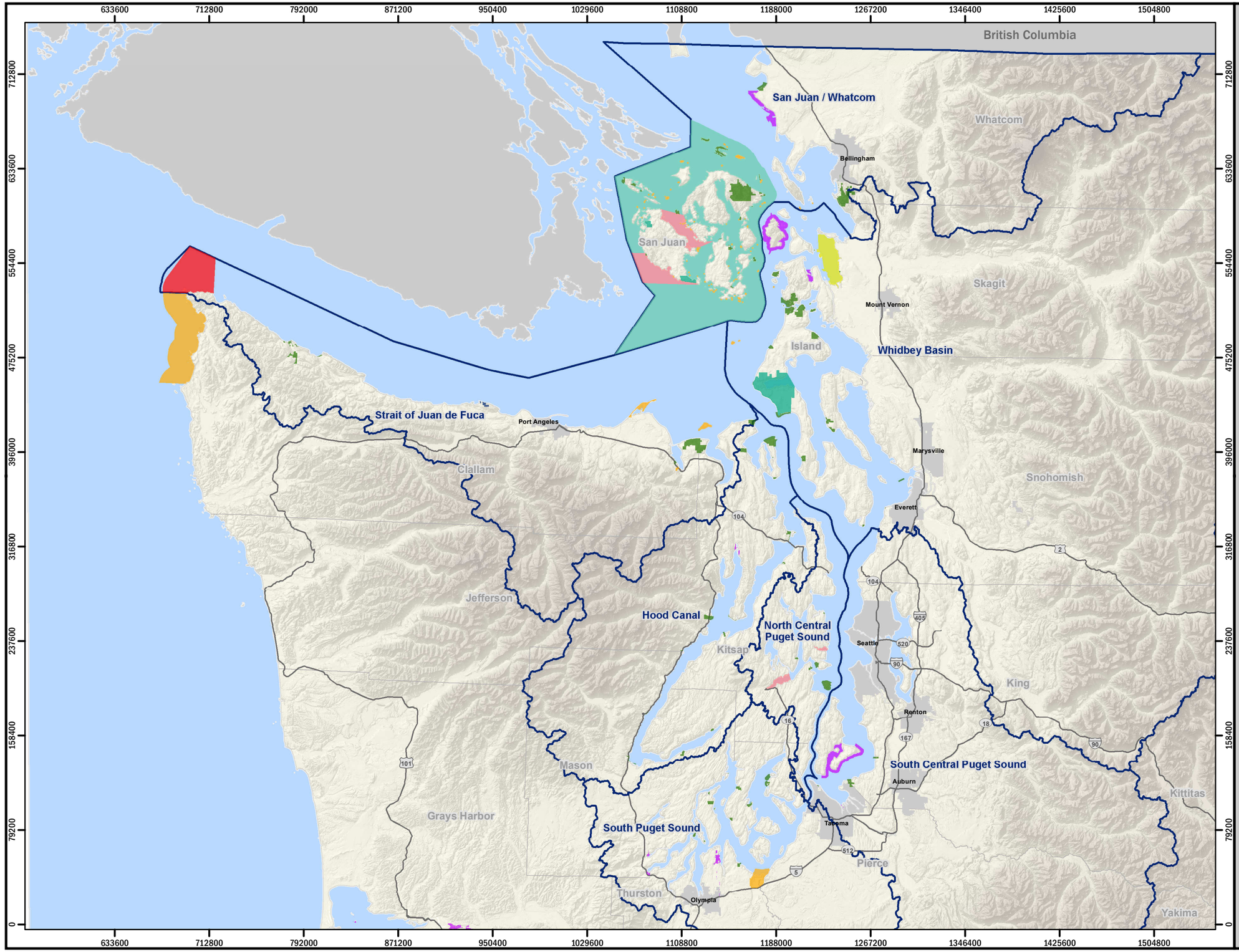

Figure 2.
Marine Protected Areas.

Legend

Managing agency

- National Parks Service (NPS)
- National Oceanic and Atmospheric Administration (NOAA)
- US Fish & Wildlife Service (US F&WS)
- WA Department of Fish & Wildlife (WA DFW)
- WA Department of Natural Resources (WA DNR)
- WA Department of Ecology (WA DOE)
- WA Parks and Recreation Commission (WA P&RC)
- University of Washington Friday Harbor Laboratories (UW FHL)
- County
- Action area boundary

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Miles

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Coordinates: NAD83 Wahington State Plane North (feet)

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4.6.1. Water Quality Standards

In Washington, water quality is regularly evaluated against the surface water quality standards that are set forth in WAC 173-201 to assess whether the water complies with the CWA. The water quality standards establish numeric and narrative criteria for a water body to protect its existing beneficial uses for both aquatic life and recreation. Figure 3 shows the beneficial use designations of Puget Sound waters. The majority of Puget Sound is designated as *extraordinary or excellent* aquatic life use and as *primary contact recreation* beneficial uses. These designations speak to the importance and value of good water quality throughout all of Puget Sound and demonstrate that the need for clean water is not limited to just a few areas.

Of the four water quality indicators selected for summary in this report, fecal bacteria and DO are the two that are assigned specific water quality standards. Some toxic contaminants are also assigned numeric standards and are most frequently evaluated by fish tissue and sediment sampling, rather than water quality monitoring. Nutrients are not discussed in relation to the water quality standards because there are no marine water quality standards for nutrients. However, low DO concentrations are often an indicator of elevated nutrients and eutrophication; therefore, the discussion of DO impairments cannot be isolated from the discussion of elevated nutrients.

Water quality standards for fecal indicator bacteria (fecal coliform and enterococci bacteria) and DO are defined in Table 1. Waters that fail to meet water quality standards are designated as impaired, and are included on the 303(d) list of impaired waters (CWA 40 CFR 130.7).

4.6.2. Status and Trends of Key Pollutants

This section provides an overview of the status and trends of bacteria pathogens, DO, nutrients, and toxic contaminants. These parameters were chosen because they are the most likely to be affected by vessel sewage discharges. A number of sources were used to develop the following summaries; however, the bulk of the information presented in the following sections was summarized from the 2011 Puget Sound Science Update (PSP 2011b).

Bacteria

In Puget Sound, fecal bacteria monitoring is conducted by numerous state and local agencies. Ecology conducts bacteria monitoring at Puget Sound Ecosystem Monitoring Program (PSEMP) stations. The Washington Department of Health (WDOH) monitors fecal bacteria in shellfish growing areas and administers the bacterial environmental assessment communication and health (BEACH) monitoring program for recreational beaches. Many local municipalities also have bacteria monitoring problems to study and address local problems. All of these programs have identified bacterial contamination problems in many areas of Puget Sound.

Water Quality Standard Impairments

In Puget Sound there are many areas where water quality is considered as impaired due to bacteria levels failing to meet water quality standards (Figure 4). The majority of fecal bacteria impairment listings are in South Puget Sound, Hood Canal, and other poorly flushed embayments. However, areas with better flushing are also susceptible to fecal bacteria problems, particularly near urbanized areas. For example, there are a number of fecal bacteria impairments along the east side of central Puget Sound, in spite of this region being relatively well flushed.

Table 1. Marine Water Quality Standards for Dissolved Oxygen and Indicator Bacteria in Puget Sound.

Beneficial Uses		Dissolved Oxygen Lowest 1-day Minimum	Indicator Bacteria
Aquatic Life	Recreation		
Extraordinary	Primary Contact	7.0 mg/L	Fecal coliform organism levels must not exceed a geometric mean value of 14 colonies/100mL, with not more than 10% of all samples (or any single sample when < 10 sample points exist) obtained for calculating the geometric mean value > 43 colonies/100 mL.
Excellent	Primary Contact	6.0 mg/L	Fecal coliform organism levels must not exceed a geometric mean value of 14 colonies/100mL, with not more than 10% of all samples (or any single sample when < 10 sample points exist) obtained for calculating the geometric mean value > 43 colonies/100 mL.
Good	Secondary Contact	5.0 mg/L	Enterococci organism levels must not exceed a geometric mean value of 70 colonies/100 mL, with not more than 10% of all samples (or any single sample when < 10 sample points exist) obtained for calculating the geometric mean value > 208 colonies/100 mL.
Fair	Secondary Contact	4.0 mg/L	Enterococci organism levels must not exceed a geometric mean value of 70 colonies/100 mL, with not more than 10% of all samples (or any single sample when < 10 sample points exist) obtained for calculating the geometric mean value > 208 colonies/100 mL.

mg/L = milligrams per liter

Recreational Beaches

Recreational beaches are monitored as part of the BEACH Program (Ecology 2011). The BEACH program monitoring uses the US EPA Beach Act (40 CFR 131) single sample maximum standard for enterococci of 104 colonies per 100 milliliters (mL) to determine whether beaches are safe for swimming. Between 2004 and 2011, 123 Puget Sound beaches were monitored. Among the sampled beaches, 86 had at least one sample exceeding the standard. BEACH program monitoring during 2004 and 2005 also documented that the highest number of bacteria exceedances were in locations where communities rely predominately on on-site septic systems (PSP 2007).

Data from the BEACH monitoring program was used to assign categories of low, moderate, and high based on the relative frequency of samples exceeding the standard. Thirty-one of 123 beaches monitored were rated as a high risk for bacteria contamination, and 85 were rated as a moderate risk. Of course, most of the public beaches are not monitored as part of the program, so it is likely that many more beaches pose a public health risk due to fecal contamination. The locations of the monitored beaches and the bacteria contamination risk are

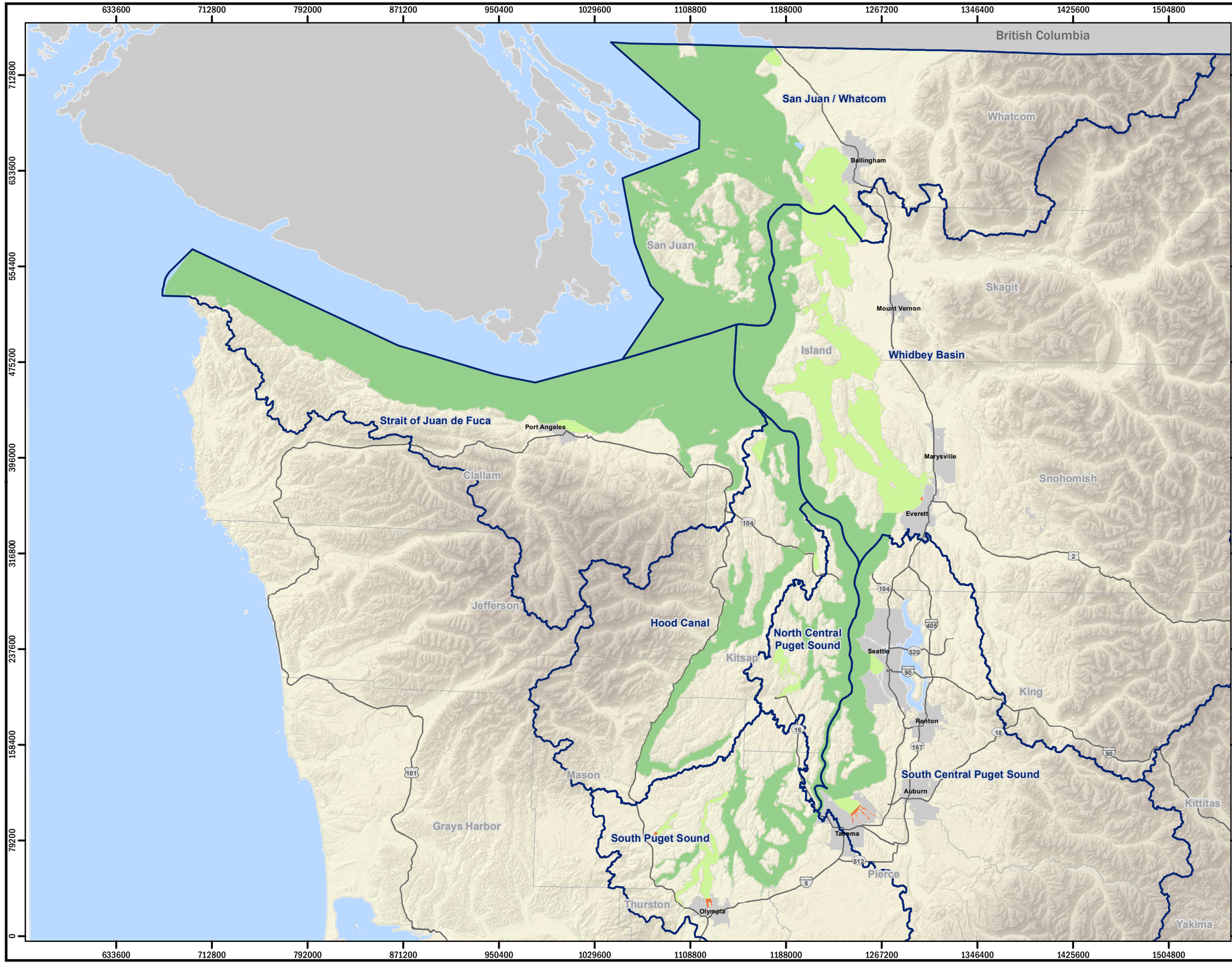

Figure 3.
Designated beneficial use of waters within Puget Sound based on water quality standards.

Legend

Aquatic life use

- Extraordinary - primary contact
- Excellent - primary contact
- Good - secondary contact
- Fair - secondary contact
- Action area boundary

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Miles

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Coordinates: NAD83 Wahington State Plane North (feet)

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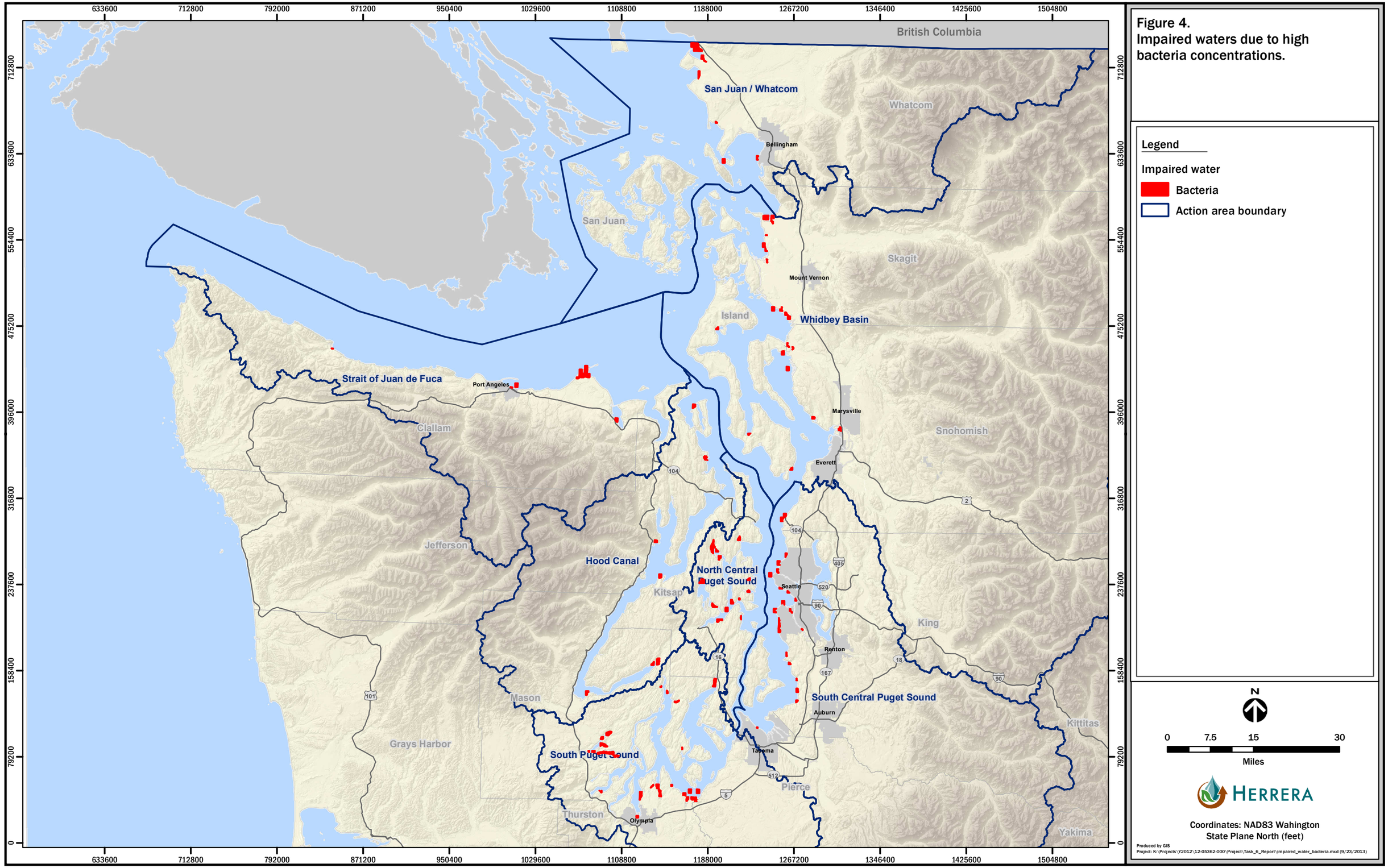

Figure 4.
Impaired waters due to high bacteria concentrations.

Legend

Impaired water

- Bacteria
- Action area boundary

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Miles

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Coordinates: NAD83 Wahington State Plane North (feet)

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illustrated in Figure 5. Nineteen beaches on Lake Washington and Lake Union are monitored by King County for bacteria. Closures due to bacteria contamination are rare, but they do occur. A listing of historical beach closures is available at King County's swimming beach monitoring website (http://green.kingcounty.gov/swimbeach/).

Commercial Shellfish Harvest

Shellfish are filter feeders, and they can accumulate pathogens that are present in the water column and sediments. High concentrations of bacteria can result in the closure of commercial shellfish growing areas and closures of beaches used for recreational shellfish harvest. Due to the potential health risk associated with eating contaminated shellfish, WDOH monitors bacteria concentrations in waters that are used for shellfish aquaculture or recreational harvest on a regular basis. Approximately 190,000 acres of commercial and recreational shellfish growing tidelands are monitored. All harvesting areas, whether commercial or recreational, are subject to the bacteria standard described in Table 1 for primary contact. Based on the results of sampling and other hydrologic factors, commercial shellfish growing areas are designated using the following systems:

- **Commercial Growing Areas**:
    - **Approved:** Mean concentration of fecal coliform bacteria does not exceed 14 colonies per 100 mL.
    - **Conditionally Approved**: Meets the 14 colonies per 100 mL standard during predictable periods and therefore is approved for use only during those periods.
    - **Restricted:** Bacterial water quality does not meet the standard for approved classification. Shellfish grown in restricted areas may be relayed (transplanted) to another area for an extended period before marketing.
    - **Prohibited:** Fecal material, pathogenic organisms, or otherwise harmful substances have been detected at dangerous concentrations. Commercial harvest is not allowed.

The locations and status designations of commercial growing areas are shown on Figure 6.

The majority of commercial harvest areas remain open or conditional. However, harvest is prohibited on about 36,000 acres, or 19 percent of the total potential growing area of 190,000 classified acres. Some of these areas are closed due to pollution sources such as biotoxins or synthetic chemicals, but the majority of closures are due to fecal bacteria pollution (PSP 2011c).

The Washington State Department of Health recently evaluated long-term trends in fecal pollution at 21 commercial growing areas for the period between 1998 and 2011. While there was some variability among the areas evaluated, most showed a moderate improving trend over the study period. A few areas showed marked improvements; these improvements were thought to be the result of remediation of failing onsite septic systems and public education (WDOH 2011).

Recreational Shellfish Harvest

Recreational shellfish harvest takes place at approximately 500 beaches throughout the Sound, which are shown on Figure 7. As with commercial shellfish growing areas, WDOH is responsible for ensuring that shellfish harvested from these beaches are also safe to eat. Evaluations of public harvesting beaches are similar to that of commercial shellfish growing areas. Based on factors such as proximity to pollutant sources and measured fecal indicator bacteria concentrations, WDOH will classify the beaches as:

- **Open:** Water has been tested and determined safe for shellfish harvest
- **Advisory:** Shellfish harvest is permitted, but thorough cooking of shellfish is recommended
- **Closed:** Harvest is prohibited either due to contaminants or fecal pollution, or because the beach hasn't been tested

A substantial number of recreational shellfish harvesting beaches are listed as closed, particularly in South Puget and Central Puget Sound. While many of these beaches may be closed because they have not been tested; many are closed due to known bacterial contamination. The locations and status designations of recreational growing areas are shown on Figure 7.

Nutrients

Puget Sound is a naturally nutrient-rich water body. Coastal upwelling, the process by which nutrient-rich but oxygen-poor bottom water is transported to the surface, typically occurs along the Pacific Coast between April and September (Gustafson et al. 2000). Exchange of this water through the Strait of Juan de Fuca is the single largest source of dissolved inorganic nitrogen (DIN) to Puget Sound; this "marine loading" accounts for about 86 percent of the nitrogen load to the Sound. Rivers, sewage, groundwater, and atmospheric deposition contribute a substantial quantity of nitrogen, but individually account for only small portions of the nitrogen load (Table 2) (Herrera 2010). There are no marine water standards for nutrients, so there are no documented impairments as the result of high nutrient concentrations.

Table 2. Major Components of the Puget Sound Nitrogen Cycle.

DIN Input	Annual Loading (MT/year)	Annual Loading (percent)
Marine Loading	148,920	86.4%
Rivers	11,000	6.4%
Sewage	5,658	3.3%
Groundwater	3,650	2.1%
Atmospheric Deposition	3,103	1.8%
Total Input	172,331	100%

DIN = dissolved inorganic nitrogen
MT/yr = million tons per year
Note: This table was adapted from Table 2 in Herrera (2010).

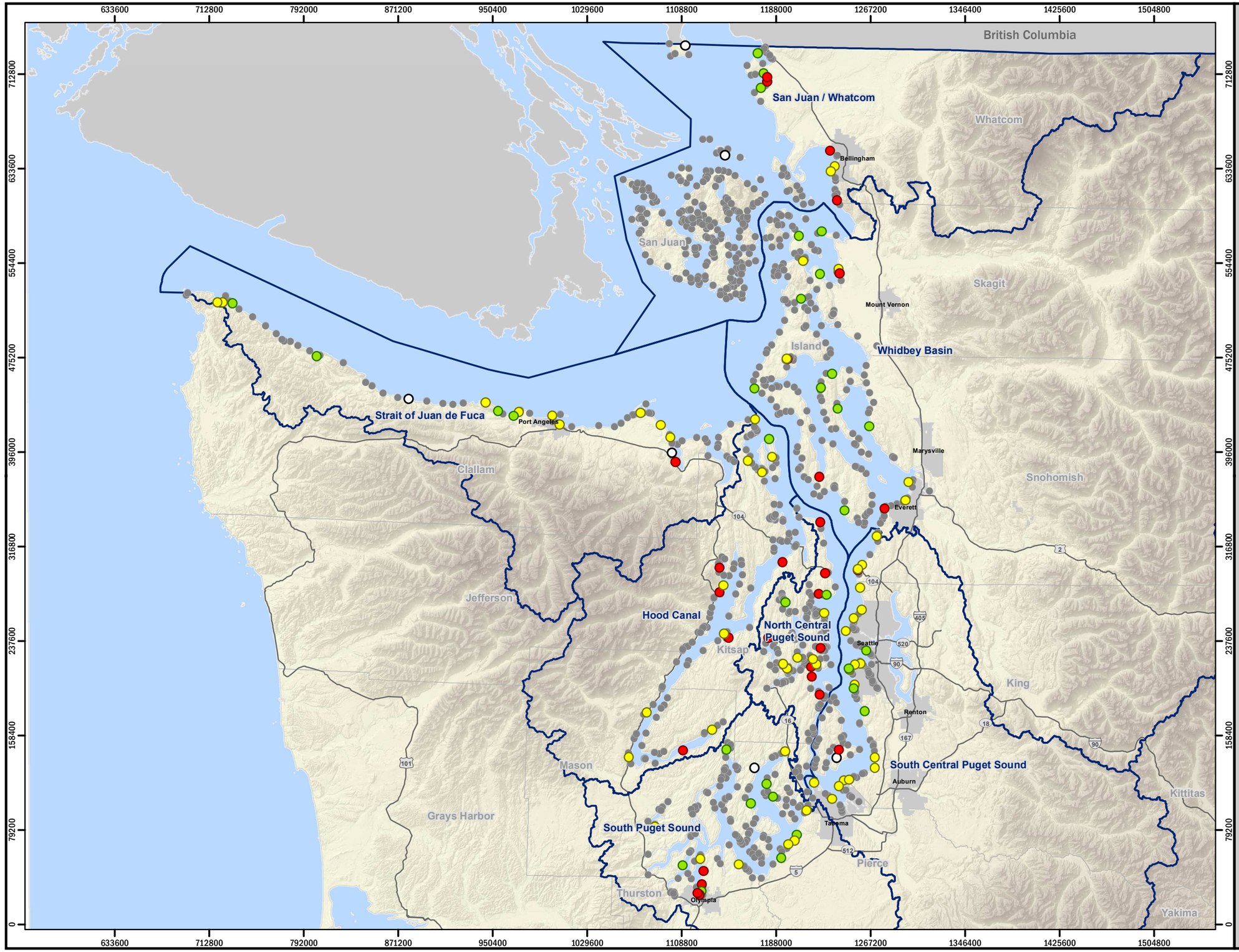


Figure 5.
Frequency of water samples exceeding the bacteria standard in Puget Sound.

Legend

- Not monitored
- Insufficient data (<10 samples)
- No samples exceed criterion
- ≤ 7.5% of samples exceed criterion
- > 7.5% of samples exceed criterion
- Action area boundary

Note: Bacteria standard is 104 MPN/100 mL for Enterococcus.

N

0 7.5 15 30

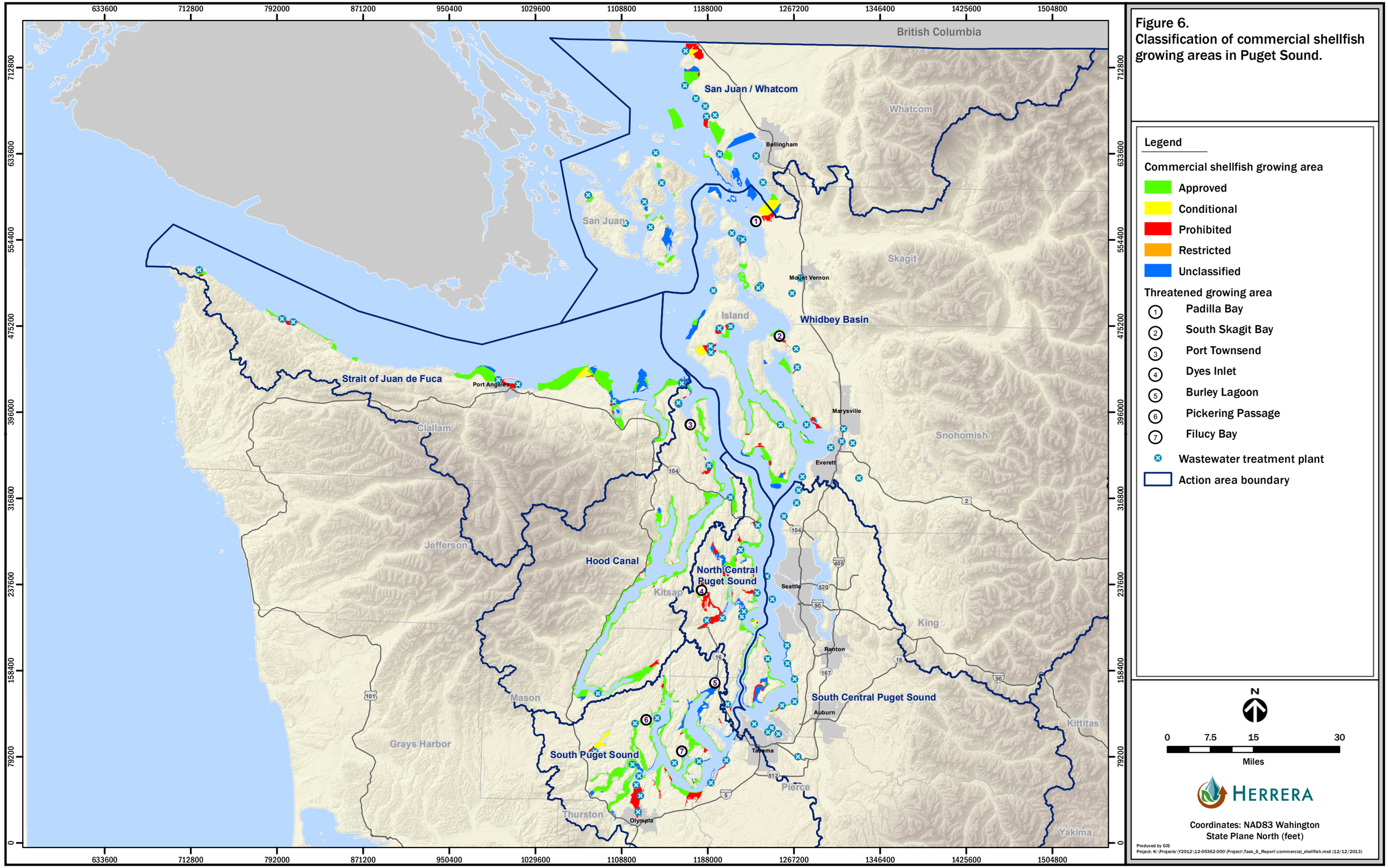
Miles

HERRERA

Coordinates: NAD83 Wahington State Plane North (feet)

Produced by GIS
Project: K:\Projects\Y2012\12-05362-000\Project\Task_6_Report\water_samples_public_beach.mxd (10/31/2013)

Figure 6.
Classification of commercial shellfish growing areas in Puget Sound.



Legend

Commercial shellfish growing area
- Approved
- Conditional
- Prohibited
- Restricted
- Unclassified

Threatened growing area
- (1) Padilla Bay
- (2) South Skagit Bay
- (3) Port Townsend
- (4) Dyes Inlet
- (5) Burley Lagoon
- (6) Pickering Passage
- (7) Filucy Bay

- Wastewater treatment plant
- Action area boundary

N

0 7.5 15 30

Miles

HERRERA

Coordinates: NAD83 Wahington State Plane North (feet)

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Project: K:\Projects\Y2012\12-05362-000\Project\Task_6_Report\commercial_shellfish.mxd (12/12/2013)

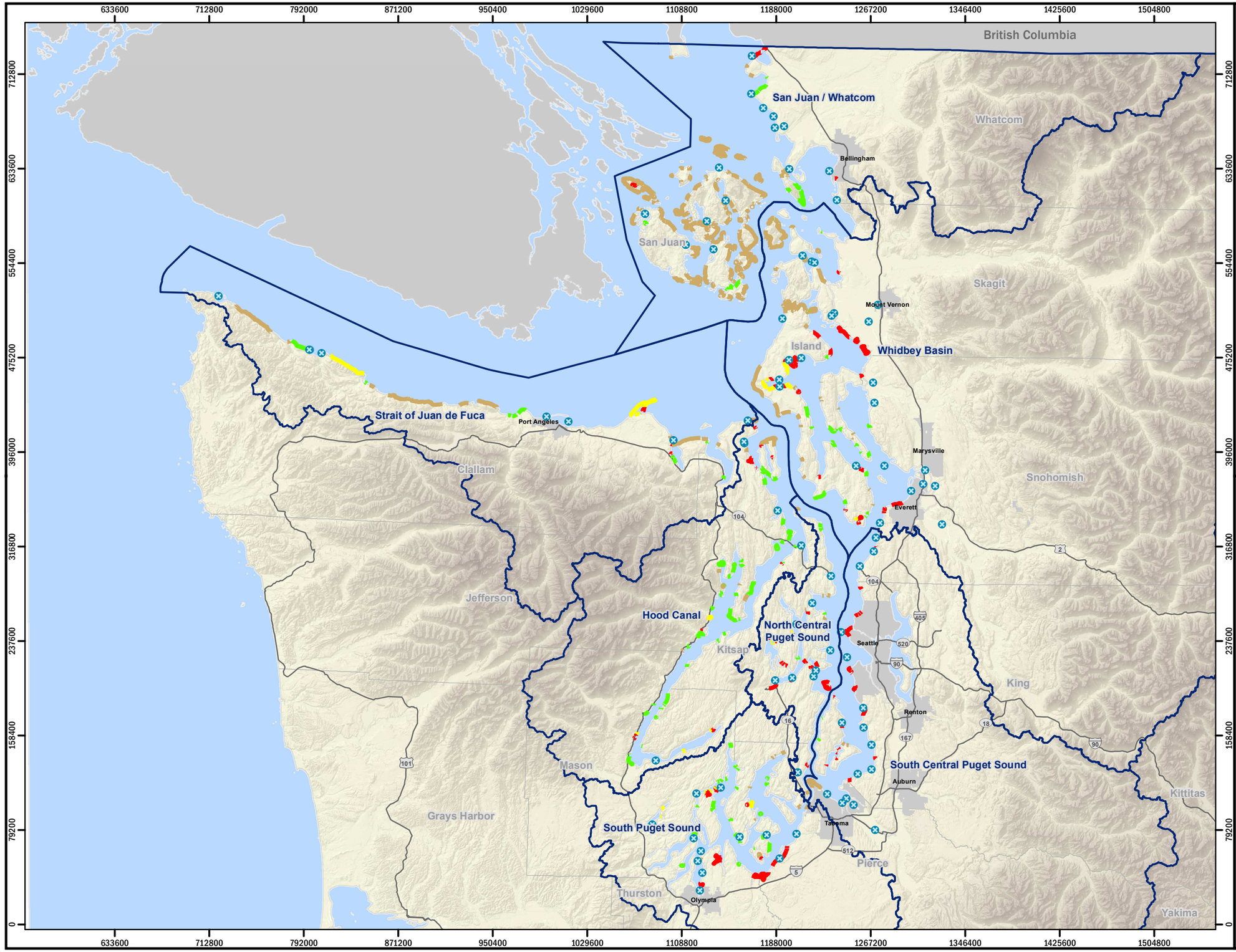


Figure 7.
Status of recreational shellfish harvesting areas in Puget Sound.

Legend

Recreational shellfish beach
- Approved
- Closed
- Conditional
- Unclassified

Wastewater treatment plant

Action area boundary

N

0 7.5 15 30

Miles

HERRERA

Coordinates: NAD83 Wahington State Plane North (feet)

Produced by GIS
Project: K:\Projects\Y2012\12-05362-000\Project\Task_6_Report\recreational_shellfish.mxd (12/12/2013)

The abundance of nutrients is responsible for the incredible biomass and biodiversity supported by Puget Sound, but it is also a liability because excessive amounts of nutrients lead to increased algal growth, causing eutrophication and increased frequency of harmful algal blooms (HABs).

Nitrogen is the limiting nutrient for algal growth in Puget Sound during the summer months. As a result, increases in nitrogen during the summer can cause a corresponding increase in algae production. Most species of algae cause little direct harm to the aquatic environment. However, when the algae die and decompose, oxygen levels in the water column can be depleted, resulting in oxygen concentrations that are too low to support fish and other aquatic life. Dissolved oxygen is discussed in greater detail in the following section.

Another problem associated with increased algae growth is the potential for development of harmful algal blooms (HABs). HABs which are caused by the proliferation of acutely toxic algae, pose a risk to humans and marine life. Shellfish may accumulate dangerous levels of biotoxins during HAB events. Consumption of contaminated shellfish by humans, marine mammals, and birds leads to illnesses such as paralytic shellfish poisoning or amnesic shellfish poisoning. HABs can also pose a risk to bathers and pets exposed to the water. WDOH regularly monitors biotoxin levels in shellfish collected in commercial growing areas and at some recreational beaches. HABs most frequently cause shellfish bed closures and advisories during the summer. HABs can occur in both fresh and saltwater, so the lakes included in the NDZ also have the potential to experience HABs. While it is as yet unknown what causes algae to start developing biotoxins, any discharge of waste and resultant change in chemical characteristic of the water, such as from vessels, is a potential concern.

Dissolved Oxygen

Dissolved oxygen depletion in Puget Sound is related to nutrient enrichment and water stratification and circulation. In many regions of Puget Sound, low DO is a natural consequence of the Sound's deep, fjord-like bathymetry, where water column stratification and slow flushing lead to long residence times of deep water that is not in contact with the atmosphere. Low DO concentrations and related fish kills in Hood Canal have been observed as early as the 1950s (Turney 2004), suggesting that low DO is not a new phenomenon. However, there is some evidence to suggest that the frequency and severity of low DO events, particularly in Hood Canal and South Puget Sound, are increasing in severity and duration (Turney 2004; PSP 2011b). For example, DO concentrations in Hood Canal in late summer 2010 were the lowest on record. Given the increase in human activities over the past 50 years (e.g., development, recreation, deforestation, and other watershed modifications), it is suspected that human factors are leading to increasing DO problems (PSP 2011b).

Dissolved oxygen problems are not limited to Hood Canal and South Puget Sound. Low DO is present seasonally at many locations. Figure 8 identifies Ecology's PSEMP water quality monitoring stations and the frequency of low DO concentrations at those stations. The spatial distribution of DO problems is also visible on Figure 9, which shows waters impaired due to low DO. While the number and severity of low DO occurrences is highest in Hood Canal and South Puget Sound, low DO events have been documented throughout Puget Sound. These typically occur in protected embayments with poor flushing.

Toxic Contaminants

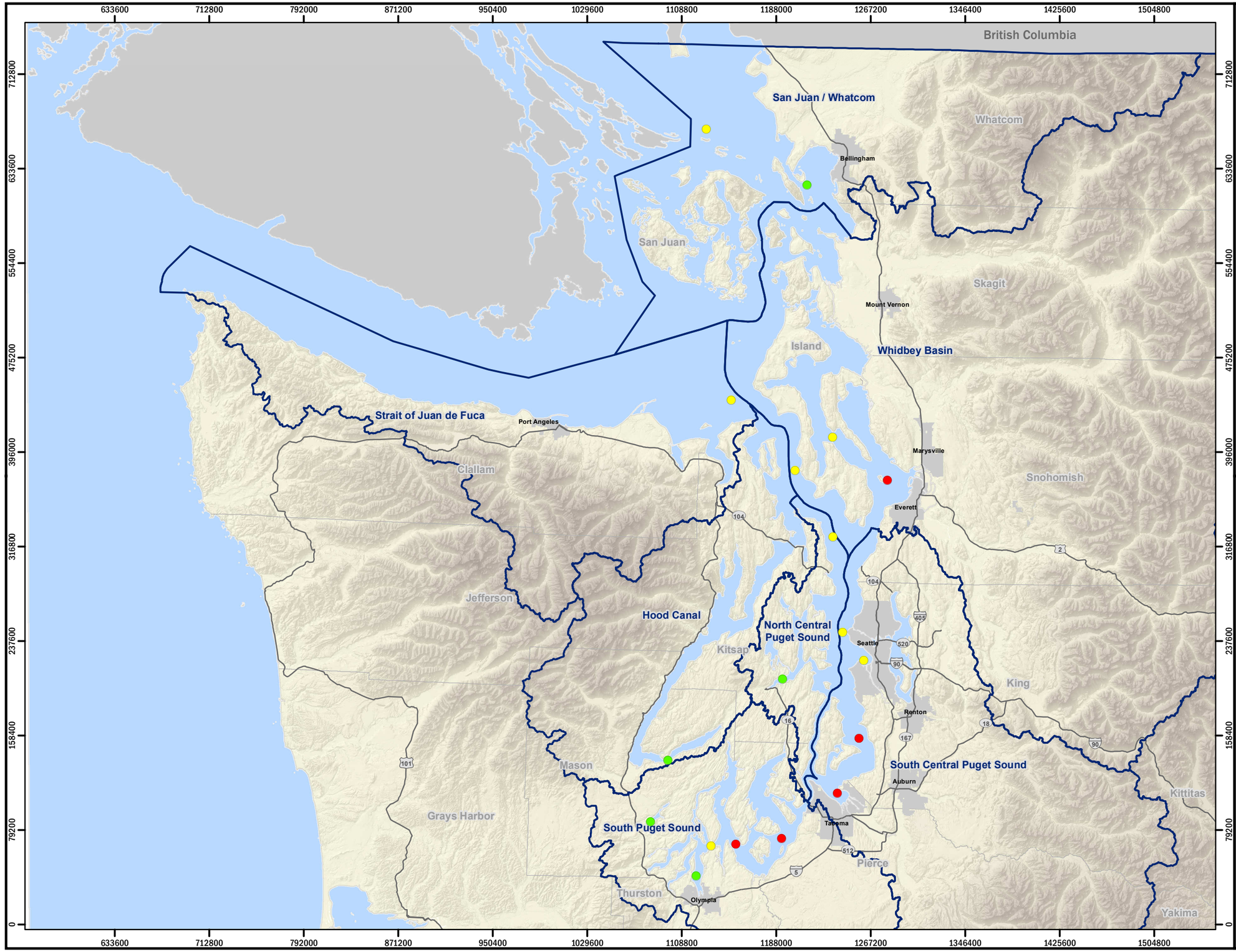
Human activities have also resulted in the introduction or increase in a number of toxic contaminants in Puget Sound. There are many pathways by which these chemicals have entered the water. They may have been discharged by factories, deposited from the air, or have been washed off the land surface via rainwater. Vessel sewage, even when treated, is a source of contaminants. For example, treated vessel sewages contain disinfection chemicals like chlorine and formaldehyde which are toxic to both humans and marine life. Vessel sewage discharges also contain personal care products and excreted pharmaceuticals which can cause reproductive problems in animals.

4.7. Existing Pollutant Reduction Measures

Many water quality improvement programs are underway throughout the Puget Sound basin. These programs are administered at all levels of government (federal, tribal, state, county, and municipal) and also include efforts by community-based, non-profit organizations. The scope of the programs range from adoption of federal and state regulations aimed at reducing non-point source pollution, to small tributary- or parcel-scale cleanup and mitigation efforts. These efforts are addressing pollution from many different sources, including; stormwater runoff, agricultural runoff, industrial and wastewater discharges, failing septic systems, and combined sewer outfalls, to name a few. The main directive of the Puget Sound Partnership (PSP) is to coordinate and track these efforts. The PSP has established recovery targets for multiple indicators and an Action Agenda for meeting those targets. Details on the Action Agenda, recovery targets, and ongoing work for improving Puget Sound can be found at the PSP Action Agenda web page (http://www.psp.wa.gov/action_agenda_center.php).

Several voluntary and compulsory measures are in place to reduce vessel sewage discharges into Puget Sound or reduce their impact. Section 312 of the CWA prohibits discharge of **untreated** vessel sewage within 3 miles from shore within state boundaries, which is generally assumed to include most inland waters of Puget Sound. Most of the cruise ships that transit through Puget Sound have agreed to a voluntary memorandum of understanding that prohibits them from discharging sewage within Puget Sound without seeking special advanced treatment permission from Ecology. Via funding through the CVA, Washington State Parks has worked to build a network of pumpout facilities available to recreational boaters to safely discharge sewage waste to land based facilities.

Even with measures in place to reduce vessel sewage discharges, Puget Sound is still vulnerable to many of the impacts related to such discharges. The treated vessel sewage that is allowed to be discharged under existing regulations, still degrades water quality and poses a potential health threat. As described below, bacteria levels in treated vessel sewage is typically far higher than state water quality standards and far higher than what is allowed by municipal wastewater treatment facilities. And, as described previously, these vessel discharges can occur directly over or very near shellfish beds and recreational beaches and swimming areas. In addition, some of the sewage discharge reduction measures, such as the MOU signed by cruise ship operators are voluntary and may be halted at any time.


633600
712800
792000
871200
950400
1029600
1108800
1188000
1267200
1346400
1425600
1504800
712800
633600
554400
475200
396000
316800
237600
158400
79200
0
British Columbia
San Juan / Whatcom
Whatcom
Bellingham
San Juan
Skagit
Mount Vernon
Island
Whidbey Basin
Strait of Juan de Fuca
Port Angeles
Clallam
Marysville
Snohomish
Everett
Jefferson
Hood Canal
North Central
Puget Sound
Seattle
Kitsap
King
Renton
Mason
South Central Puget Sound
Auburn
Kittitas
Grays Harbor
South Puget Sound
Tacoma
Pierce
Thurston
Olympia
Yakima
104
2
405
520
90
18
167
101
512
5
Figure 8.
Relative Ranking of median dissolved oxygen concentrations at Ecology PSEMP stations between 1999 and 2008.
Legend
Relative ranking
Low
Medium
High
Action area boundary
Note: Low represents 25th percentile.
Medium represents inner quartile range.
High represents 75th percentile.
N
0
7.5
15
30
Miles
HERRERA
Coordinates: NAD83 Wahington State Plane North (feet)
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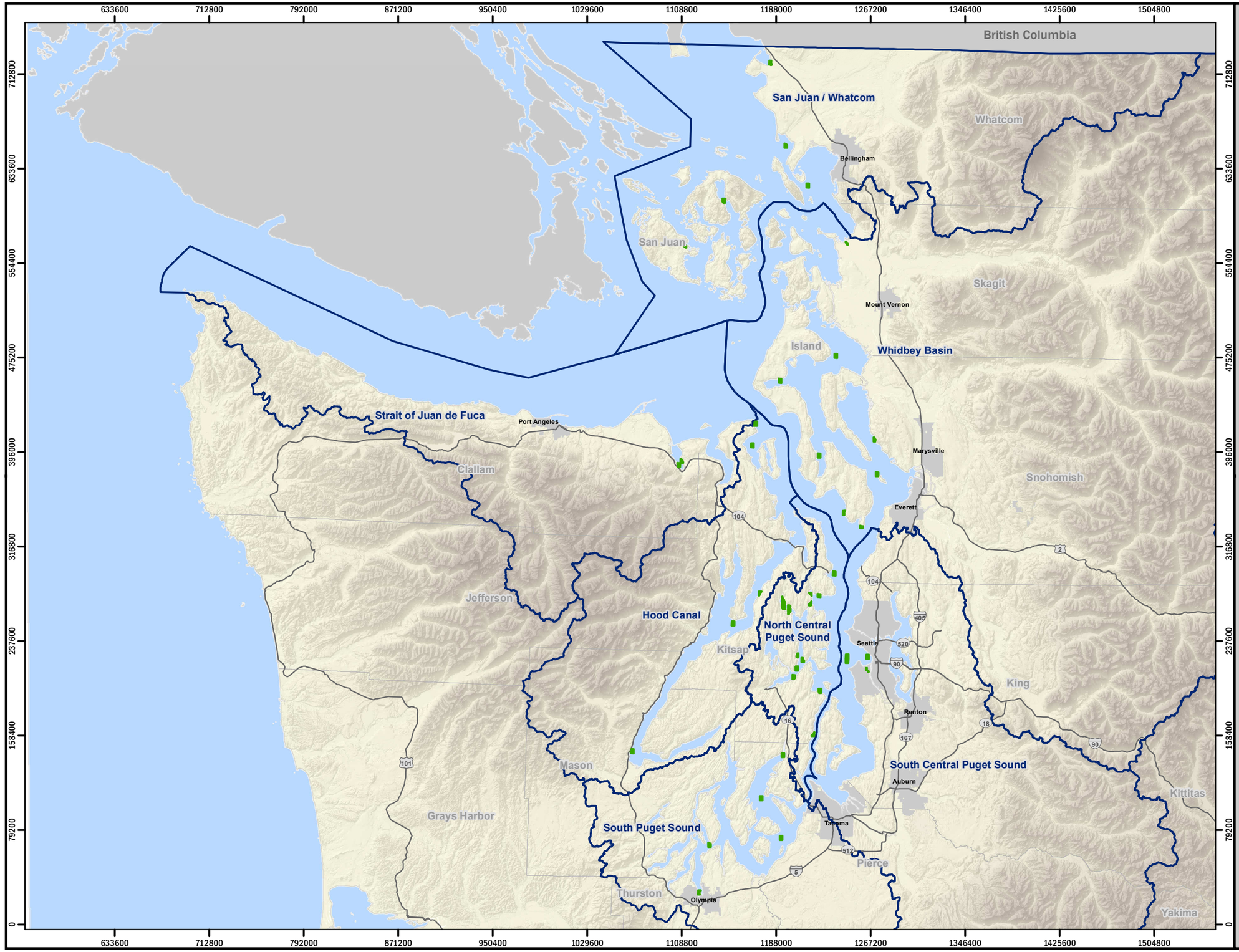

Figure 9.
Impaired waters due to low dissolved oxygen.

Legend

Impaired water

- Dissolved oxygen
- Action area boundary

N

0 7.5 15 30

Miles

HERRERA

Coordinates: NAD83 Wahington
State Plane North (feet)

Produced by GIS
Project: K:\Projects\Y2012\12-05362-000\Project\Task_6_Report\impaired_water_bacteria_DO.mxd (10/31/2013)

4.7.1. Marine Sanitation Devices

Even though it is required that sewage discharged from vessels in Puget Sound is treated by an MSD, such discharges can still degrade water quality. A range of types and expected performance from the MSDs are currently available. Table 3 summarizes the treatment performance standards for each type of MSD and compares them to bacterial water quality standards. For all types of MSDs, the vessel technology treatment standard for bacteria is lower than the Washington State water quality standard for primary contact recreation (Table 1, Table 3) (USACE 2004). Additionally, many MSDs often perform far below the mandated treatment standards under normal use (US EPA 2008). There are also concerns over the impacts associated with the disinfection chemicals that are used and then released to the environment.

Results from a survey conducted in 2012 indicate that approximately 96 percent of survey respondents indicated that the recreational vessels used on Puget Sound have an MSD. The overwhelming majority (91 percent) had a holding tank (Herrera 2013) and was required to use pumpout facilities under existing state environmental laws. About 5 percent of the vessel population used Type I or Type II MSDs. A holding tank would need to be installed on these vessels in addition to, or instead of, the existing MSD to be able to comply with a NDZ.

Commercial vessel operators were contacted directly or sent questionnaires regarding marine sanitation practices in the summer of 2012. Most commercial vessels had a Type II MSD, and many commercial vessels had a holding tank installed in addition to the treatment device. Some vessels, particularly tug boats, only had a Type II MSD (i.e., no holding tank). As with the recreational vessels, a holding tank would need to be installed on these vessels in addition to, or instead of, the existing MSD to be able to comply with a NDZ.

Table 3. Marine Sanitation Device Summary.

MSD Type	Allowable Vessel Installations	Primary Mode of Operation	Discharge Currently Allowed in Washington Waters?	USCG Treatment Standards	Bacteria Standard for Primary Contact Recreation and Extraordinary Aquatic Life Use	Bacteria Standard for Secondary Contact Recreation and Fair Aquatic Life Use
Type I	Recreational vessels <69 feet in length	Maceration / Chlorination	Yes	No visible floating solids: A fecal coliform bacteria count not greater than 1,000 per 100 mL	Fecal coliform organism levels must not exceed a geometric mean value of 14 colonies/100 mL, with not more than 10% of all samples (or any single sample when < 10 sample points exist) obtained for calculating the geometric mean value > 43 colonies/100 mL.	Enterococci organism levels must not exceed a geometric mean value of 70 colonies/100 mL, with not more than 10% of all samples (or any single sample when < 10 sample points exist) obtained for calculating the geometric mean value > 208 colonies/100 mL.
Type II	All vessels	Aeration, Clarification, Disinfection	Yes	A fecal coliform bacteria count not greater than 200 per 100 mL; no more than 150 milligrams of total suspended solids per liter		
Type III	All vessels	Holding Tank	No	Storage only. No discharge allowed and therefore no performance standard.		
AWTS	All vessels[a]	Biological reactor / UV Sterilization	Yes	Same as Type II		

[a] While AWTS are allowed on any vessel type, they are large and costly, therefore they are typically only installed on large passenger vessels.

AWTS = Advanced Wastewater Treatment System
USCG = US Coast Guard
UV = ultraviolet
mL = milliliters

5. VESSEL POPULATION

Evaluating whether access to pumpout facilities is sufficient to meet the requirements of CWA 312(f)(3) begins with estimating the vessel population of the water body. Since Puget Sound experiences high volumes of recreational and commercial vessel traffic, and the sewage disposal considerations are vastly different between the two vessel groups, they will be discussed separately.

5.1. Recreational Vessels

Two methods were used to estimate the recreational vessel population of Puget Sound. One method was based on boater registration records obtained from the Washington State Department of Licensing (DOL), and the second was obtained by counting the number of moorages and slips available to boaters. The results from both methods are described below.

Table 4 and Figure 10 provide a summary of the vessel registration data from 2011, which was obtained from DOL. (While vessel registration does vary between years from 2005 to 2011, the relative standard deviation in vessel registrations was less than 1 percent; therefore, 2011 registration data can be considered representative of the current vessel population.) The data lists the number of boats registered in each county by size class. In 2011, there were 153,103 vessels registered in the counties adjacent to Puget Sound. This number includes recreational vessels as well as some commercial vessels registered in Washington State. This data set is not a perfect measure of boats using Puget Sound. For example, not every vessel registered in a county adjacent to Puget Sound is moored or operated in the same county, or even in Puget Sound, and many boats may be exclusively used on lakes and rivers. Conversely, a vessel which is moored and operated in Puget Sound may be registered somewhere far away. It is believed that the number of registered vessels listed by county in Table 4 represents a conservative (high) estimate of the potential recreational vessel population.

Not all of the registered vessels would require access to pumpout facilities. Smaller boats, such as day sailors or runabouts that are used for excursions of a few hours in length rather than for entire days, do not typically have any kind of toilet facility or MSD. If boats shorter than 21 feet in length are subtracted from the DOL database (i.e., counting only boats 21 feet in length and larger), there are a total of 43,677 registered vessels. This represents the maximum population of locally registered recreational vessels that might require access to pumpout facilities or services under NDZ regulations. A small number of registered vessels may also be small, locally registered, commercial vessels such as fishing boats or tug boats, which are included in the registration data and would result in an overestimate of the number of recreational vessels.

Not surprisingly, there are more registered vessels in counties with larger populations, i.e., Snohomish, King, Pierce, and Thurston counties. Similarly, there are more large vessels (those likely requiring access to pumpout facilities) in the more populated counties bordering Puget Sound. Although vessels may be registered in one county and moored or operated in another,

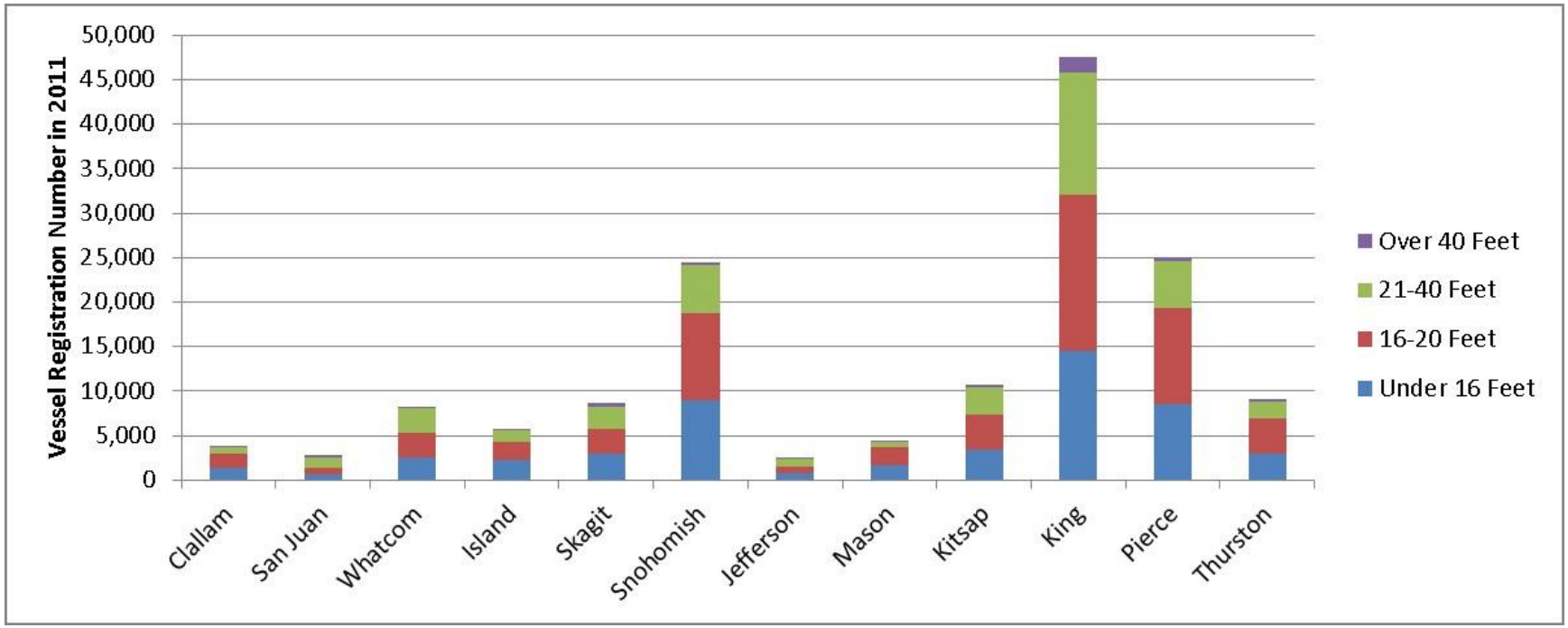

Figure 10. Puget Sound Vessel Registrations by County and Vessel Length.

there is likely a correlation between registration location and boat location. Therefore, there is probably a greater need for pumpout stations in the more populated areas of Puget Sound than in the less populated areas.

Table 4. Vessel Registrations by Vessel Length and County in 2011.

County	Vessel Length				Total Registered
	Under 16 Feet	16-20 Feet	21-40 Feet	Over 40 Feet	
Clallam	1,414	1,565	771	64	3,814
San Juan	696	601	1,303	229	2,829
Whatcom	2,501	2,850	2,669	259	8,279
Island	2,254	2,104	1,180	75	5,613
Skagit	2,920	2,844	2,517	458	8,739
Snohomish	9,013	9,748	5,469	253	24,483
Jefferson	809	731	891	104	2,535
Mason	1,693	1,975	679	44	4,391
Kitsap	3,372	4,012	2,978	377	10,739
King	14,508	17,520	13,754	1,742	47,524
Pierce	8,457	10,884	5,283	477	25,101
Thurston	2,986	3,969	1,938	163	9,056
Total	50,623	58,803	39,432	4,245	153,103

The number of recreational vessels was also estimated by counting moorages and slips available to Puget Sound boaters. The number and location of moorages (slips and buoys) were estimated by conducting a virtual flyover of Puget Sound using Google Earth imagery captured during the summers of 2011 and 2012. Marina slips (both vacant and occupied), as well as vessels moored at popular mooring areas (e.g., Sucia Island in the San Juan Islands), were counted. During the virtual flyover, all marina slips, as well as any group of more than 15 moored vessels (signifying a mooring field) were counted and recorded. This data was used to create a map showing the concentrations of moorages (Figure 11). Individual marinas were not singled out because the goal of this exercise was to determine the potential number of boats in a given geographic area, rather than a marina-by-marina assessment of boater population. Personal moorages (i.e., shoreside docks and personal mooring buoys) were not counted. Boats stored at personal moorages are thought to only represent a small portion of the total vessel population, and in many cases the boats that are moored at personal moorages are less than 21 feet in length and, therefore, would not have toilet facilities. Therefore, excluding boats stored at personal moorages is not thought to have significantly affected the accuracy of this vessel population estimate.

Vessel moorage capacity provides a valuable insight into where and how many boats there may be in Puget Sound. Larger vessels, particularly those with MSDs, are likely to be moored during the boating season. Smaller vessels are likely to be trailered. Therefore, using moorage capacity (i.e., the number of slips and buoys available for boats) ensures that fewer vessels without MSDs are included in the total vessel count. Slips used by commercial fishing boats and other

smaller commercial vessels would have been included in the estimate, but it was estimated that this would account for only about 500 vessels (Herrera 2012b).

There are approximately 23,555 moorages in Puget Sound, based on the virtual flyover estimate (Figure 11). While this number is much smaller than the number of registered vessels over 21 feet (43,677), similar, albeit more detailed spatial patterns, were observed. For example, as with registered vessels, there are much higher concentrations of moorages in more urban and populated areas (e.g., Seattle, Everett, and Tacoma). But, there are also a large number of moorages in popular boating destinations like the San Juan Islands, Anacortes, and Bellingham. The Strait of Juan de Fuca and the area around Whidbey Island have the lowest number of moorages compared with the rest of Puget Sound.

The method used for estimating the number of moorages underestimates the total Puget Sound moorage capacity. Personal moorages were not counted, and neither were areas with less than 15 slips or moorages. There are many personal moorages and small marinas with less than 15 slips throughout Puget Sound, particularly in Hood Canal and Lake Washington, so this method could be underestimating the available moorages by a thousand moorages or more. It is generally accepted that smaller boats (those less likely to have toilet facilities beyond a porta-potty) are found at personal moorages, so ignoring this sector is not expected to contribute to a significant underestimate of the need for pumpout facilities. However, many of those vessels moored at smaller marinas are likely to be large enough to contain an MSD, so leaving them out could lead to an underestimate of pumpout facility needs. Conversely, this exercise counted slips and buoys, not boats. Although some marinas may operate at full capacity during peak seasons, many do not. To meet the needs of a mobile boating population, there needs to be an excess of moorages to allow boaters to move freely between areas, so it can be assumed that there are fewer boats than the total number of moorages available. The various problems (overestimates and underestimates) with the methodology may balance each other out to some extent. Overall, however, the results obtained by using this methodology likely represent an overestimate of the boat population, albeit less of an overestimate than what was calculated based on DOL registration information.

5.2. Commercial Vessels

Many different sizes and types of commercial vessels frequent Puget Sound. They range from smaller vessels used for charter fishing to huge freighters, tankers, and cruise ships. The number of commercial vessels was estimated from a study conducted by the Puget Sound Maritime Air Forum (Starcrest 2007). According to that study, there were 2,937 entries of large oceangoing vessels into Puget Sound in 2005 (Table 5). It was estimated that there are 678 other commercial vessels that operate mostly within Puget Sound (e.g., escort tugs) or have Puget Sound as their home port (e.g., the fleet of fishing vessels that travels to Alaska each year) (Table 6). Since the location of commercial vessels is more dynamic than that of recreational vessels, the question is less about the absolute number of commercial vessels in Puget Sound and more about vessel traffic patterns such as how many, what kind, and where are vessels operating at a given time.

Most commercial vessels are required to send out an Automated Identification System (AIS) signal (US Department of Homeland Security 2013). The AIS signal announces a ship's identity,

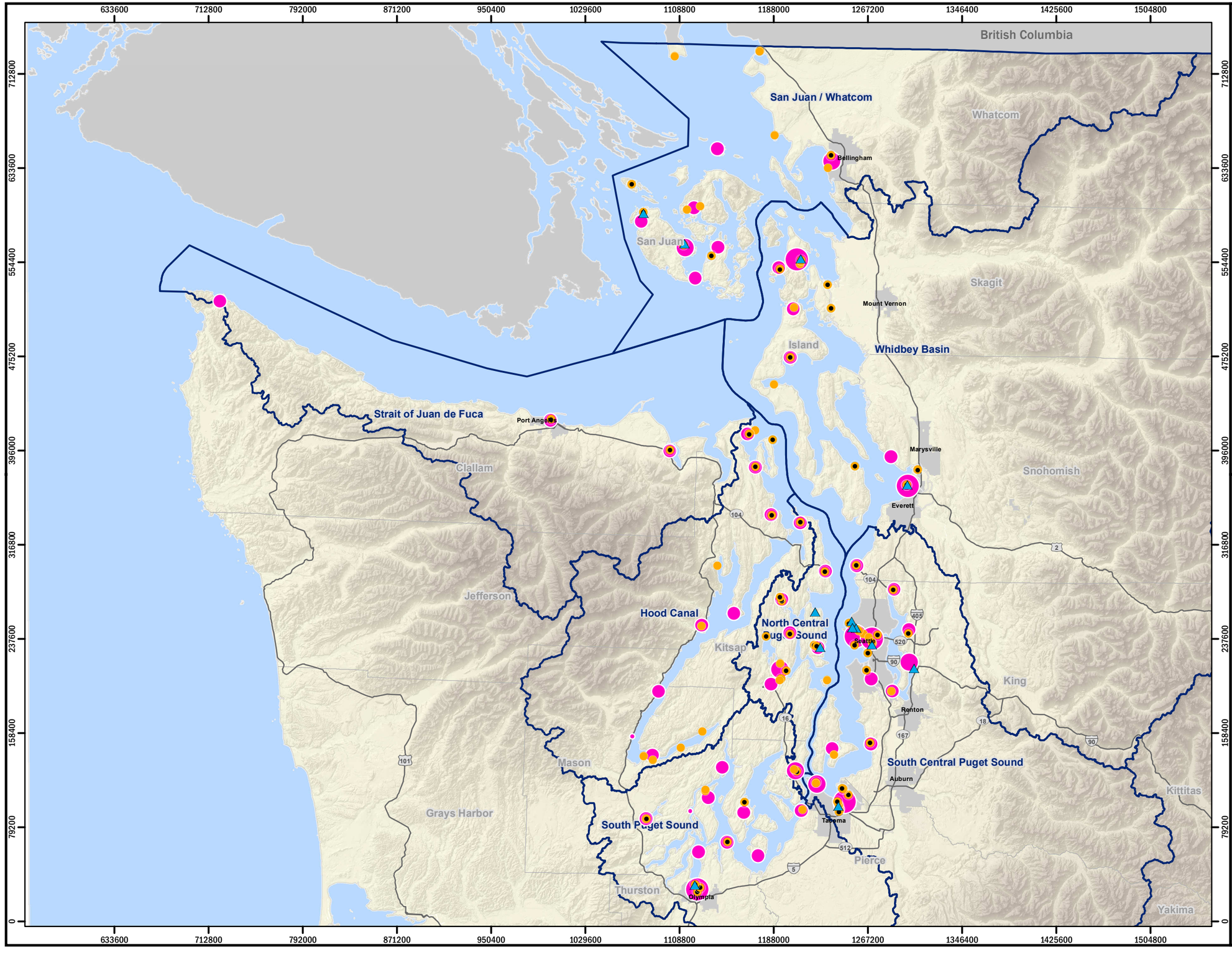

Figure 11.
Estimates of Moorage Number and Locations and Public Pumpout Facilities in Puget Sound.[1]

Legend

Moorage Count

- < 25
- 25 - 100
- 100 - 500
- 500 - 1000
- > 1000

- Mobile pumpout[2]
- Pumpout only
- Pumpout with dump station
- Action area boundary

Notes:

1. Pumpout facility information is continually changing. For up-to-date information, the Washington State Parks pumpout database should be accessed.

2. Mobile pumpout locations indicate the home marina for the pumpout vessels. The area serviced by each vessel, and maximum distance traveled varies by company and the demand for their services.

N

0 7.5 15 30

Miles

HERRERA

Coordinates: NAD83 Wahington State Plane North (feet)

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type, and position in real time. The data is used by the US Coast Guard for homeland security purposes and by ship captains to help avoid collisions. Some larger recreational vessels (such as yachts) may also use an AIS system and, therefore, would be included in this dataset.

Table 5. Oceangoing Vessel Entries into Puget Sound for 2005.

Vessel Type	Number of Vessels
Auto Carriers	188
Bulk Carriers	310
Container Ships	1,336
Cruise Ships	167
General Cargo	169
Oceangoing Tugs	146
Miscellaneous	16
Reefer	5
Roll on Roll Off	133
Tanker	467
Total	**2,937**

Table 6. Puget Sound Harbor Vessel Population for 2005.

Harbor Craft Vessel Type	Number of Vessels
Commercial Fishing	347
Ocean Tugboats	68
Harbor Tugboats	60
Excursion	60
Government	52
Ferry	45
Workboat	27
Assist and Escort Tugboats	19
Total	**678**

Automated Identification System data for 2005 was collected and compiled by the George Washington University Engineering Management and Systems Engineering Department. This data set is a compilation of every transit by large vessels with AIS transponders. The geographic units for this analysis were 'Action Areas,' which were assigned by PSP as part of the Action Agenda. The boundaries of each action area are depicted on all the maps included in this document. The data was combined and summarized to reveal traffic density for each vessel type by day, and for each Action Area, as shown in Table 7.

Traffic density, for the purpose of this analysis, is defined as the total number of signals (the number of vessels) received in 2005, divided by 365 (the number of days in the year), and divided again by the square mileage of the Action Area. The result of this calculation gives an average

number of vessels that passed through each square mile of an Action Area on any given day. Data from the table can be interpreted in many ways. The table can be used to determine which type of commercial vessels have the highest average density in Puget Sound (i.e., fishing vessels); which Action Area has the greatest density of commercial vessels (i.e., South Central Puget Sound); and, for individual Action Areas, which commercial vessels are dominant (for example in South Puget Sound, the tug-barge category has the greatest density, while in North Central Puget Sound, it is ferry traffic).

Table 7. Vessel Traffic Density (number of signals/mile^2/day) by Vessel Type and Action Area in 2005 for the VTRA Model.

Action Area	Cargo Ship	Ferry	Fishing Vessel	Military Vessel	Passenger Ship	Research-Other	Sail-Whale	Tug-Barge	Total
Strait of Juan de Fuca	5.82	0.65	6.81	0.86	0.34	0.23	0.49	2.69	17.89
San Juan/ Whatcom	2.89	1.98	17.62	1.19	0.35	0.04	0.50	4.31	28.88
Whidbey Basin	0.74	3.70	17.59	0.65	0.08	0.10	1.71	5.87	30.43
North Central Puget Sound	3.09	14.71	2.37	2.28	0.40	0.38	3.65	8.98	35.85
South Central Puget Sound	1.73	50.02	1.60	2.54	0.39	0.20	7.15	14.42	78.04
South Puget Sound	0.03	0.00	0.00	1.26	0.00	0.00	1.88	9.60	12.78
Hood Canal	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Puget Sound	3.90	5.35	9.91	1.18	0.32	0.17	1.30	4.87	26.99

VTRA = Vessel Traffic Risk Assessment

The South Central Puget Sound Action Area experiences the most commercial vessel traffic for almost all vessel categories (Table 7, Figure 12). The majority of the traffic is ferry vessels, but there is also a substantial amount of tugboat and 'sail whale' traffic (yachts and whale-watching boats), followed by the other vessel categories. Cargo ship and fishing vessel traffic is highest along transit routes (such as the Strait of Juan de Fuca) and where there are major ports and refineries.

Washington State Department of Transportation Ferries and U.S. military vessels use their own pumpout facilities (Herrera 2012b). Therefore, for the purpose of this analysis, these vessel categories were omitted, as their need for access to pumpout facilities is already met and would not be affected by the institution of a NDZ. When ferries and military vessels are omitted (Figure 13) patterns in traffic among the other vessel categories become more apparent. Fishing vessels are the dominant vessel traffic category in the San Juan/Whatcom, Whidbey Basin, and the Strait of Juan de Fuca Action Areas. Tugs and barges are the dominant vessel traffic category in North and South Central Puget Sound, and the South Puget Sound Action Areas, although tug and barge traffic is moderately high in all of the Action Areas. Sail-whale activity is largely limited to the more urban action areas.

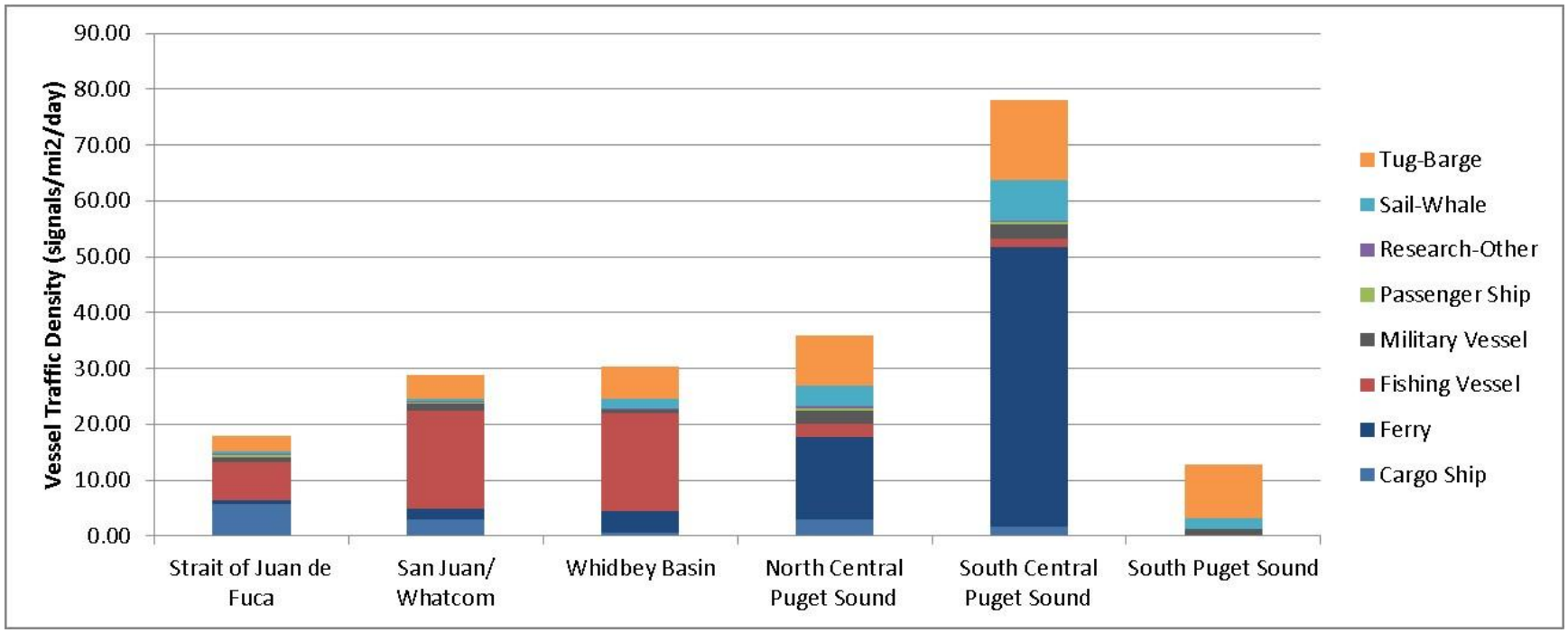

Figure 12. Summary of All Commercial Vessel Traffic in Puget Sound.

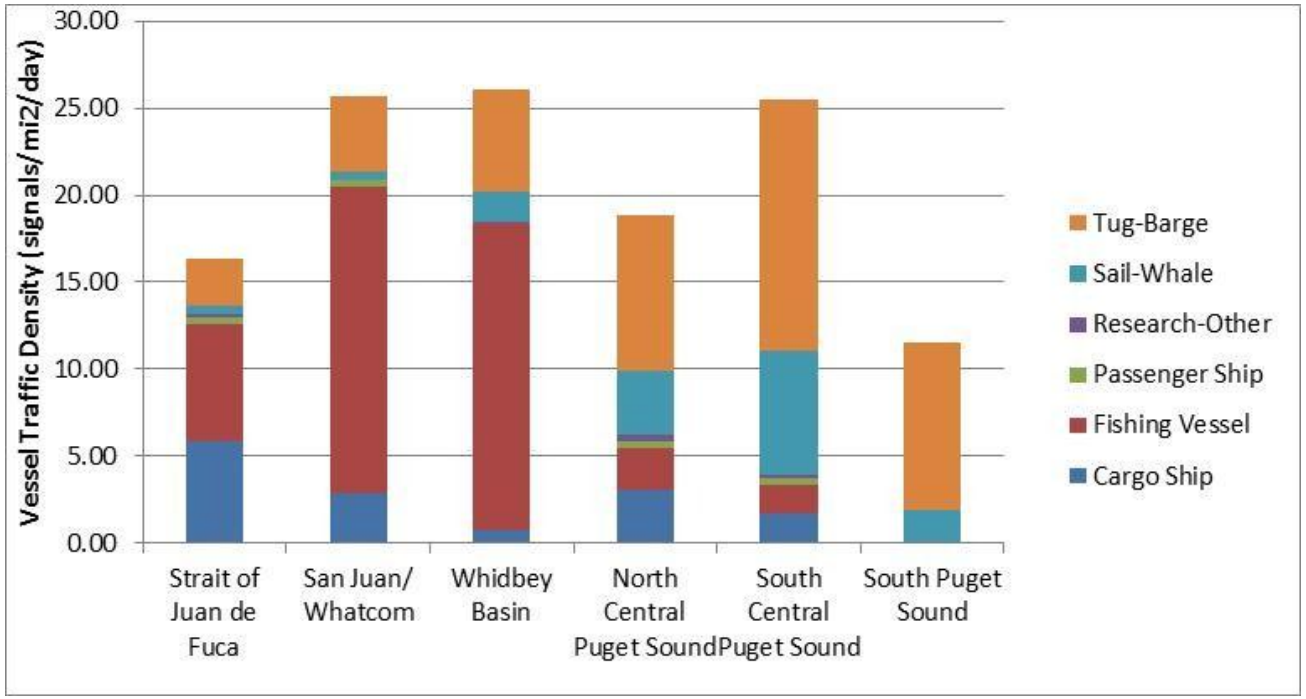

Figure 13. Selected Commercial Vessel Traffic in Puget Sound.

Many, if not most commercial vessels, will not have to modify their routines or vessels to be able to comply with the NDZ. The majority of large freight vessels (Table 5) and the commercial fishing fleet that works out of Alaska, already hold their waste and discharge it outside of State waters, although these are voluntary measures. All WSDOT ferries and U.S. military vessels have holding tanks and use large scale pumpout facilities where they are moored. It appears from the research that the primary vessels that may have to change their practices and likely retrofit their vessels are tug boats and those commercial fishing boats that operate almost exclusively within the proposed NDZ.

6. PUMPOUT FACILITIES

6.1. Pumpout Facilities for Recreational Vessels

A review of Puget Sound pumpout facilities and mobile pumpout services conducted in the spring of 2013 documented that there are 113 publicly accessible, land-based pumpout facilities and 12 pumpout boats that operate in Puget Sound (Herrera 2013). The locations of the pumpout facilities and home harbors for the pumpout boats are shown on Figure 11 and Table 8. Details for each facility consistent with the requirements of CWS 312(f)(3) are included in Appendix A. (Ecology will confirm the final number of pumpout facilities and provide missing details before the final petition is submitted to EPA.)

Pumpout facilities and mobile services appear to be conveniently located for most Puget Sound boaters. Land-based pumpout facilities appear to be approximately proportionally distributed with vessel population. Likewise, the pumpout boats operate in the areas where there are more boats. Figure 11 shows pumpout facilities and mobile pumpouts with moorage locations. Clearly, there are more pumpouts where there are the more boats. Even where there are only a small number of moorages, there is usually a pumpout close by, or the area is within the service areas of the pumpout boats (Table 8).

Based on CVA guidelines, the Puget Sound area, overall, has plenty of pumpout facilities to serve the recreational vessel population. The CVA guidelines suggest that there should be a ratio of between 300 to 600 boats per pumpout during the period of peak occupancy. The definition of occupancy rate and a detailed procedure on completing the CVA calculations is described in the CVA guidelines (CVA 1994). Based on DOL vessel registration data, there are a maximum of 43,667 boats in Puget Sound that could require access to pumpout facilities. At the 40 percent peak occupancy rate recommended by the CVA guidelines, 17,467 of the 43,667 boats would require access to a pumpout facility during peak boating season. Under this scenario, there would be a ratio of 177 boats for each pumpout facility, not including the mobile services. Using the lower and probably more reasonable boat population estimate of 23,555 obtained from the moorage count, and the same 40 percent occupancy rate (9,422 boats), there would be a ratio of 96 boats per pumpout, not including the mobile services. By these calculations, the Puget Sound has at a minimum nearly two times, to a maximum of more than six times, more pumpout facilities than what is suggested in the CVA guidelines. A few respondents to the boater survey indicated that there are some locations where access to pumpout facilities could be improved. . Although the overall capacity for recreational vessels comfortably exceeds the guidelines Ecology is continuing to work on adding additional pumpouts in key areas.

6.2. Pumpout Facilities and Commercial Vessels

The sewage management considerations of large commercial vessels are different than those of small recreational vessels. The ability of large commercial vessels to comply with NDZ regulations is dependent on the vessel's sewage holding capacity.

Table 8. Mobile Pumpout Services Available to Puget Sound Boaters.

Company	Service Areas	Number of Boats	Price	Primary Type of Vessels Serviced	Capacity to Serve Large Vessels	Where Is Pumped Sewage Disposed?
Terry and Sons	Seattle Area	1	Free	All vessels	Yes	Public pumpouts
Rose Head Service	Port Everett Only	1	$15-23	All vessels	Yes	Public pumpout
SS Head	Seattle Area	2	$20 and up	95% liveaboard	Yes	Seattle wastewater system
Seattle Sanitation Service	Seattle Area	1	$25	Primarily liveaboards	Yes	Seattle wastewater system
Pelican Pump	Olympia Area	1	~$24 (more for big tanks)	Primarily liveaboards	Yes	Swantown Pumpout
Pump Me Out	Seattle Area, Tacoma Area, Anacortes, and San Juan Islands	3	$25-35	Liveaboards and other vessels	Yes	Generally public pumpouts
Sweet Pea Pumping Service	Liberty Bay and Port Madison	2	$20-30 (more for big tanks)	Unknown	110 gallon capacity	Poulsbo wastewater system
Phecal Phreak	Roche Harbor Marina	1	Free as part of moorage fee	All vessels	Yes	Public pumpout
Pumpty Dumpty	Port of Friday Harbor and nearby Marinas	1	$5-32 (more for big tanks)	All	150 gallon capacity	Friday Harbor wastewater system

Most of the large, transient commercial vessels that are only in Puget Sound for a short period of time (e.g., cruise ships, freighters and tankers) have large enough holding tanks so that they can hold their waste during the time they are in Puget Sound. Should these vessels need to be pumped out, they can contract with a shore-based pumper truck or one of the mobile pumpout services listed in Table 8.

As a result of the studies and outreach done in 2012 and 2013, it was agreed that certain commercial vessel groups (resident tug boats, resident commercial fishing vessels, and NOAA research vessels) might need time to retrofit their vessels for compliance and that additional pumpout facilities were needed to provide the infrastructure for compliance. Due to the unique challenges associated with retrofitting these types of vessels, such as requiring an engineering design and formal approval for safety, these vessels will be allowed 3 years, or until their next dry dock maintenance event, before they would be required to comply with the NDZ. They will still be responsible for complying with existing state and federal regulations.

7. Implementation Strategy

The implementation strategy for the Puget Sound NDZ will be a continually evolving process. While a designation of a NDZ represents a point in time, the NDZ will exist in perpetuity, and its success is contingent on continued management and commitment from stakeholders. The specifics of the implementation strategy will no doubt change as time passes, as vessel practices change, and new information technologies become available. However, the basic elements discussed below outline a basic framework that will facilitate the successful implementation of the NDZ.

7.1. Education and Outreach

Education and outreach is a central strategy for other successful NDZs in the United States. The more boaters are aware of the requirements, the reasons for them (i.e., water quality protection), and the locations of pump out facilities, the more likely they are to comply with the requirements and have a positive attitude about doing so.

Education and outreach for the Puget Sound NDZ began in 2011 by reaching out to recreational and commercial boating organizations, marina operators, ports, other state agencies, environmental groups, the shellfish industry, and tribal interests. A recreational boater survey was conducted during the summer of 2012, and Ecology launched an informational website outlining the NDZ development. In addition, Ecology identified more than 300 stakeholder groups and individuals and requested early input from them throughout the NDZ evaluation process. This allowed Ecology to both obtain valuable input and started the process of bringing awareness of potential new requirements regarding how vessel sewage is managed. Outreach efforts will continue, especially in the early years of the NDZ, so that boaters and commercial vessel operators know that the new law is taking effect, what it means for them, and how they can manage their vessel sewage.

Outreach and education will focus on reaching the maximum number of boaters and raising awareness of the new requirements. A combination of traditional strategies and new technologies will be used. The following list identifies a few strategies that have proved successful in other states, and some new ones that may help Washington boaters.

- Including NDZ information sheets with vessel registration renewal paperwork
- Informational signs at boat launches and marinas
- Social media to get the word out
- Meetings and notifications to commercial vessel groups and associations
- Information on Ecology's existing Clean, Green Boating websites as well as State Park's existing website on pumpout information and related vessel websites
- Building on the Clean Marina program to provide information to boaters and to encourage marinas assistance in preventing sewage discharges.

- Including NDZ education as part of boater education curriculum
- A GPS linked mobile app that would show boaters when they are in the NDZ and where they can find the nearest pumpout based on their current location
- Community meetings to discuss the requirements of the NDZ and enforcement approaches
- Inclusion of NDZ information on the "Puget Sound Starts Here" web page

The time leading up to the establishment of a NDZ can also be used to test outreach and messaging strategies and to determine which ones are most effective at educating boaters on what they need to do to comply with the NDZ and where they can find the nearest pumpouts.

7.2. Enforcement

Active and extensive enforcement will not be a central strategy to successful implementation of an NDZ in Puget Sound. Yet, the NDZ does need to be enforceable to be effective. The threat of high fines may be the only effective tool for deterring illegal discharges in certain situations. What entities may enforce the NDZ requirements, and how fines may be assessed and allocated has not been determined yet. It is the experience of other states with NDZs that enforcement is most effective when multiple agencies can enforce the requirements. Examples of these agencies might include harbor masters, public health officials, and fish and wildlife law enforcement. Ecology is working with State lawmakers and the USCG to ensure that all levels of law enforcement may enforce the NDZ. This will likely include lawmaking for the delineation of authority and monetary fines. It is the desire of Ecology to ensure that any fines assessed as a result of NDZ infractions will go into a fund dedicated to water quality improvement.

Ecology will work with EPA, USGS and any identified local authorities to formalize enforcement authorities and develop enforcement protocols. Then Ecology will work with state legislators to establish monitory fines and possibly delineate enforcement authorities. Factors to be considered in identifying authorizing entities include current authorities of agencies, agency resources and capacities, boater legal rights, and successful enforcement strategies from elsewhere.

7.3. Evaluation and Continued Success

Ecology will conduct or sponsor boater survey efforts that will evaluate attitudes towards the NDZ and difficulties that they may have complying with NDZ requirements. The questions asked on this survey will be similar to those asked during the 2012 boater survey that was jointly conducted by Washington Sea Grant and Ecology (Herrera 2013). These surveys were conducted in person at boat ramps and boat shows, but surveys could also be conducted by mail as part of the boat registration renewal process, or via monthly mailers sent by marinas.

Washington State Parks will continue to track the estimated number of gallons of sewage pumped at pumpouts funded by CVA grants and will encourage accurate data gathering. The installation of most of the public pumpout facilities in Puget Sound was funded by CVA grants and represents a majority of the pumpouts likely to be used by boaters. The State

Parks data will be used to track pumpout facility usage. A sharp increase in usage following implementation of the NDZ would indicate that the program is having a positive effect on boater's sewage disposal habits. A decrease in usage over time, taking into account other factors such as weather and the economy, could indicate that boaters are losing interest in the program, and that more outreach and education is needed.

Washington State Parks will continue to maintain and update the database of pumpout facilities available to boaters and continue to ensure that pumpouts are operational and in compliance. Continued favorable opinion of the NDZ is contingent on maintaining and documenting the number of pumpout facilities available to boaters. The data State Parks collects for the CVA program will be used to fulfill this requirement. Maintaining an accurate database of operational pumpouts is also important for boaters because they are dependent on current information to know where they may go for a pumpout. If this list is not accurate or up-to-date boaters are likely to become frustrated and less likely to comply with requirements in the future. An annual review of pumpout facilities will be submitted to US EPA. Ideas are being considered on how to get information about broken pumpouts quickly transmitted from boaters to repair persons in order to minimize the downtime of pumpouts. New technology is also being looked at that might be able to help boaters obtain real-time data on wait times at stationary pumpouts or to schedule a mobile pumpout.

The number of shellfish beds upgraded or opened and water quality improvements are also potential metrics for evaluating the success of a NDZ. Directly linking a water quality improvement, however, with the establishment of a NDZ is difficult due to the many sources of pollution. As all of these sources of pollution are being addressed over time through the efforts of agencies, businesses and the public, Puget Sound ecological health is expected to recover.

8. REFERENCES

Cannon, G.A. 1983. An Overview of Circulation in the Puget Sound Estuarine System. Technical Memorandum ERL PMEL-48. NOAA Pacific Marine Environmental Laboratory, Seattle, Washington. June 1983.

CVA. 1994. The Clean Vessel Act Pump Station and Dump Station Technical Guidelines. Federal Register, Vol. 59, No. 47, March 10, 1994.

Ecology. 2008. Focus on Puget Sound: Economic Facts. Publication Number 06-01-006 (rev. 10/08). Washington State Department of Ecology.

Ecology. 2009. South Puget Sound Dissolved Oxygen Study- South and Central Puget Sound Water Circulation Model Development and Calibration External Draft Review. Washington Department of Ecology, Olympia, Washington. October 15, 2009.

Ecology. 2011. South Puget Sound Dissolved Oxygen Study: Interim Nutrient Load Summary for 2006-2007. Publication Number 11-03-001. Washington Department of Ecology. January 2011.

Gustafson, R.G., W.H. Lenarz, B.B. McCain, C.C. Schmitt, W.S. Grant, T.L. Builder, and R.D. Methot. 2000. Status Review of Pacific Hake, Pacific Cod, and Walleye Pollock from Puget Sound, Washington. Technical Memo-44. NOAA Marine Fisheries Science Center. November 2000.

Herrera. 2010. Nitrogen Removal with Shellfish Harvest in Oakland Bay and Puget Sound. Prepared for Pacific Shellfish institute by Herrera Environmental Consultants, Inc., Seattle, Washington. February 25, 2010.

Herrera. 2012a. Puget Sound No Discharge Zone For Vessel Sewage: Puget Sound Condition, Sewage Discharge, and the Costs and Benefits of Establishing a NDZ. Ecology Publication Number 12-10-031. Prepared for Washington State Department of Ecology, Olympia, Washington, by Herrera Environmental Consultants, Inc., Olympia, Washington. April 2012.

Herrera. 2012b. Puget Sound No Discharge Zone for Vessel Sewage: Puget Sound Vessel Population and Pumpout Facilities. Ecology Publication Number 12-10-031. Prepared for Washington State Department of Ecology, Olympia, Washington, by Herrera Environmental Consultants, Inc., Olympia, Washington. May 2012.

Herrera. 2013. Puget Sound No Discharge Zone For Vessel Sewage: Recreational Boater Survey. Prepared for Washington State Department of Ecology, Olympia, Washington, by Herrera Environmental Consultants, Inc., Olympia, Washington. May 2013.

Newton, J. 2002. Summary of South Puget Sound Area Water Quality Study. Publication Number 02-03-020. Washington Department of Ecology. May 2002.

PSP. 2007. Puget Sound Update: Ninth Report of the Puget Sound Assessment and Monitoring Program. Seattle, Washington. Pg. 260.

PSP. 2008. Puget Sound Facts. Puget Sound Partnership Resource Center website: http://www.psparchives.com/puget_sound/psfacts.htm.

PSP. 2010. Strategic Science Plan. June 2010 final review draft.

PSP. 2011a. Ecosystem Recovery Targets. Puget Sound Partnership website: http://www.psp.wa.gov/downloads/AA2011/062011EcosystemRecoveryTargetList.pdf. July 2011.

PSP. 2011c. Puget Sound Vital Signs: Shellfish Beds Reopened. Puget Sound Partnership website: http://www.psp.wa.gov/vitalsigns/shellfish_beds_reopened.php.

PSP. 2012. The 2012/2013 Action Agenda for Puget Sound. Puget Sound Partnership. August 2012.

Puget Sound Partnership. 2011b. Puget Sound Science Update. April 2011.

Starcrest. 2007. Puget Sound Maritime Air Emissions Inventory. Prepared for Puget Sound Maritime Air Forum by Starcrest Consulting Group, LLC. April 2007.

Turney. 2004. An Introduction to Hood Canal. United States Geological Survey Western Leadership Team Meeting: http://wa.water.usgs.gov/projects/hoodcanal/data/HC.pdf.

University of Washington. 2009. Puget Sound Basin. University of Washington River Systems Research Group Center for Environmental Visualization. University of Washington River Systems Research Group website.

University of Washington. 2012. Physical and Biological Oceanography of the Puget Sound. University of Washington Center for Environmental Visualization website: http://www.cev.washington.edu/lc/CLFISH497/Web5.html.

US EPA. 2008. Cruise Ship Discharge Assessment Report. US Environmental Protection Agency, Oceans and Coastal Protection Division, Office of Wetlands, Oceans and Watersheds, Washington, D.C. December 2008.

US Department of Homeland Security. 2013. AIS Frequently Asked Questions. US Department of Homeland Security Website. http://www.navcen.uscg.gov/?pageName=AISFAQ. Site accessed April 27, 2013.

USACE. 2004. Marine Sanitation Devices. US Army Corps of Engineers Clean Marinas website: http://www.lrn.usace.army.mil/CleanMarinas/pdf/msd.pdf.

WDOH. 2011. Status and Trends in Fecal Coliform Pollution in Shellfish Growing Areas of Puget Sound: Year 2010. Washington Department of Health, Office of Shellfish and Water Protection. December 2011.

APPENDIX A

Pumpout Facility Information

Appendix A: Pumpout Facility Information.

Facility Name	Location	Water Body	Marina Phone Number	Latitude	Longitude	Hours of Operation[b]	Max Vessel Length	Min Depth at Low Tide	Where Treated
Port of Allyn Hood Canal Dock	Allyn	Hood Canal	(360) 275-2455	46°24'"	122°49'"	24 hours	50 feet	20 feet	North Bay Case Inlet Water Reclamation Facility
Marine Servicenter	Anacortes	Puget Sound	(360) 293-8200	48°30'06"	122°36'02"	Variable	60	20+	Anacortes WWTP
Port of Anacortes - Cap Sante Boat Haven	Anacortes	Puget Sound	(360) 293-0694	48°30'39"	122°36'13"	24 hours	90	12	Anacortes WWTP
Skyline Marina	Anacortes	Puget Sound	(360) 293-5134	48°29'18"	122°40'37"	Mon-Friday	100	10	Anacortes WWTP
Washington State Ferry Terminal, Anacortes	Anacortes	Puget Sound							Anacortes WWTP
Pump Me Out	Anacortes, Tacoma, Seattle	Tacoma to Pt. Roberts	(877) 786-6731						Public Pumpouts
City of Bainbridge Island, Eagle Harbor Waterfront Park	Bainbridge Island	Puget Sound	(206) 730-5165	47°37'15"	122°31'10"	24 hours	150	5	City of Bainbridge Island Winslow WWTP
Harbour Marina	Bainbridge Island	Puget Sound	(206) 842-6502	47°37'25"	122°31'37"	24 hours	60	15	Seattle City Sewer
Winslow Wharf Marina	Bainbridge Island	Puget Sound	(206) 842-4202	47°37'40"	122°31'20"	9:00 am - 5:00 pm	80	12	City of Bainbridge Island Winslow WWTP
US Submarine Base – Bangor	Bangor	Puget Sound							Central Kitsap WWTP
Port of Allyn NorthShore Dock	Belfair	Puget Sound	(360) 275-2430	47°25'09"	122°54'11"	Variable	50	3	Allyn North Bay Sewer System
Bellingham Cruise Terminal – Port of Bellingham	Bellingham	Puget Sound							Bellingham WWTP
Squalicum Harbor-Port of Bellingham	Bellingham	Strait of Georgia	(360) 676-2542	48°45'13"	122°30'29"	24 hours	100	10	Bellingham WWTP
Seacrest Marina	Between Marysville and Everett	Puget Sound	(425) 252-4823	48°1'52"	122°11'17"	24 hours	40 ft	5-Apr	Offsite

Facility Name	Location	Water Body	Marina Phone Number	Latitude	Longitude	Hours of Operation[b]	Max Vessel Length	Min Depth at Low Tide	Where Treated
Blaine Harbor-Port of Bellingham	Blaine	Strait of Georgia	(360) 647-6176	48°59'26"	122°45'56"	8:00 am - 5:00 pm	120	12	Blaine WWTP
Semiahmoo Marina	Blaine	Strait of Georgia	(360) 371-0440	48°59'22"	122°46'02"	24 hours	75	12	Blaine WWTP
Port of Brownsville	Bremerton	Puget Sound	(360) 692-5498	47°38'58"	122°36'46"	24 hours	65	25	Central Kitsap WWTP
Port Washington Marina	Bremerton	Puget Sound	(360) 479-3037	47°34'46"	122°38'39"	24 hours	60	20	
Pleasant Harbor Marina	Brinnon	Hood Canal	(360) 796-4611	47°39'70"	122°55'07"	24 hours	150	8	On-Site Septic System
Port of Coupeville	Coupeville	Strait of Juan de Fuca	(360) 678-5020	48°13'29"	122°41'34"	24 hours	80	2	City of Coupeville WWTP
Deer Harbor Marina	Deer Harbor	Puget Sound	(360) 376-3037	48°37'14"	123°0'17"	8:30 am - 4:30 pm	150	5	Offsite
City of Des Moines Marina	Des Moines	Puget Sound	(206)-824-5700	47°24'06"	122°19'58"	24 hours	75	unknown	Midway Sewer District System
Port of Edmonds	Edmonds	Puget Sound	(425)774-0549 ext. 232	47°48'36"	122°23'31"	24 hours	110		Edmonds WWTP
Washington State Ferry Terminal, Edmonds	Edmonds	Puget Sound							Edmonds WWTP
Naval Station Everett	Everett	Puget Sound							Everett WPCF
Port of Everett Marina	Everett	Puget Sound	(425) 259-6001	47°59'51"	122°13'26"	24 hours		11	Everett WPCF
Port of Everett Marine Park & Boat Ramp	Everett	Puget Sound	(425) 259-6001	47°59'52"	122°13'26"	24 hours	143	14,18	Everett WPCF
Rose Head Service	Everett	Puget Sound	(425) 501-5242			By appointment			Everett WPCF
Port of South Whidbey	Freeland	Puget Sound	(360) 331-5494	48°02'18"	122°24'11"		70	6	
Port of Friday Harbor Marina	Friday Harbor	Puget Sound	(360) 378-2688	48°32'21"	123°00'48"	24 hours	64	10	Friday Harbor WWTP

Facility Name	Location	Water Body	Marina Phone Number	Latitude	Longitude	Hours of Operation[b]	Max Vessel Length	Min Depth at Low Tide	Where Treated
Pumpty Dumpty	Friday Harbor	San Juan Islands							Friday Harbor WWTP
Washington State Ferry Terminal, Friday Harbor	Friday Harbor	Puget Sound							Friday Harbor WWTP
Gray Goose Landing	Friday Harbor	Puget Sound		622 Warbass Way					Friday Harbor WWTP
Warbass Way Marina	Friday Harbor	Puget Sound		620 Warbass Way					Friday Harbor WWTP
Arabella's Landing Marina	Gig Harbor	Puget Sound	(253) 255-5050	47°20'03"	122°35'00"	24 hours	150	8	City of Gig Harbor WWTP
Gig Harbor	Gig Harbor	Puget Sound	(253) 858-3535	47°20'07"	122°35'13"	24 hours	50	4	City of Gig Harbor WWTP
Jeresich City Dock	Gig Harbor	Puget Sound	(253) 851-6170	47°19'54"	122°34'46"	24 hours	50	19	City of Gig Harbor WWTP
Murphy's Landing Marina	Gig Harbor	Puget Sound	(253) 851-3093	47°20'13"	122°35'19"	Variable			City of Gig Harbor WWTP
Poseidon's Landing - Maritime Chanlery	Gig Harbor	Puget Sound	(253) 853-7100	47°19'58"	122°34'52"				City of Gig Harbor WWTP
Driftwood Keys Club	Hansville	Hood Canal	(360) 638-2077	47°54'26"	122°35'11"	24 hours	40		
Sweet Pea Pumping Service	Hansville	Puget Sound							
Harbour Village Marina	Kenmore	Lake Washington	(425) 485-7557	47°45'35"	122°15'77"	24 hours	50	6	
Port of Kingston	Kingston	Puget Sound	(360) 297-3545	47°47'38"	122°29'58"	Variable	90	15	Kitsap County Kingston WWTP
Carillon Point Marina	Kirkland	Lake Washington	(425) 822-1700	47°39'21"	122°12'34"	24 hours	90	6	Kirkland City Sewer
La Conner Marina	La Conner	Puget Sound	(360) 466-3118	48°24'04"	122°29'48"	24 hours	60	10	La Conner City Sewer
Penrose Point State Park	Lakebay	Puget Sound	(253) 884-2514	47°15'29"	122°45'15"	24 hours	30	3	On site septic system
Islands Marine Center	Lopez Island	Puget Sound	(360) 468-3377	48°30'55"	122°54'56"	Variable	80	30	

Facility Name	Location	Water Body	Marina Phone Number	Latitude	Longitude	Hours of Operation[b]	Max Vessel Length	Min Depth at Low Tide	Where Treated
Blake Island State Park	Manchester	Puget Sound	(360) 731-8330	47°32'37"	122°29'00"	24 hours		10	
Navy Supply Center, Puget Sound	Manchester								Kitsap County - Manchester WWTP
Twin Bridges Marina	Mt Vernon	Puget Sound	(360) 466-1443	48°27'"	122°31'"	24 hrs	34	7	Offsite
Washington State Ferry Terminal, Mukilteo	Mukilteo	Puget Sound							Big Gulch (Mukilteo) WWTP
Mystery Bay State Park	Nordland	Admiralty Inlet	(360) 385-1259	48°03'27"	122°41'42"	24 hours	55	4	Offsite
Deception Pass State Park	Oak Harbor	Puget Sound	(360) 675-3767	48°24'06"	122°37'30"	24 hours	40 ft	10	Goes to Navy
Oak Harbor Marina	Oak Harbor	Puget Sound	(360) 279-4575	48°17'12"	122°38'03"	24	75	12	City of Oak Harbor Sewer
Pelican Pump	Olympia	Puget Sound	(360) 402-8231			By appointment			Swantown Public Pumpout
Percival Landing Park	Olympia	Puget Sound	(360) 753-8380	47°02'55"	122°54'19"	24 hours	50	8	LOTT
Port of Olympia - Swantown Marina	Olympia	Puget Sound	(360) 528-8049	47°03'31"	122°53'46"	24 hours	100	12	LOTT
Westbay Marina	Olympia	Puget Sound	(360) 943-2022	47°03'56"	122°54'47"	24 hours	50	4	LOTT
Zittel's Marina	Olympia	Puget Sound	(360) 459-1950	47°09'56"	122°48'28"	Variable	45	8	LOTT Via Pumper Truck
West Sound Marina	Orcas	Puget Sound	(360) 376-2314	48°37'46"	122°57'36"	Variable	40	5	Offsite
Point Roberts Marina	Point Roberts	Strait of Georgia	(360) 945-2255	48°58'21"	123°03'46"	24 hours	200	7	
Port Angeles Boat Haven	Port Angeles	Port Angeles Harbor	(360) 457-4505	48°07'33"	123°27'07"	24 hours	160	10	City of Port Angeles WWTP
Port Hadlock Marina	Port Hadlock	Admiralty Inlet	(360) 385-6368	48°01'54"	122°44'43"	24 hrs	150	15	Offsite

Facility Name	Location	Water Body	Marina Phone Number	Latitude	Longitude	Hours of Operation[b]	Max Vessel Length	Min Depth at Low Tide	Where Treated
Port Ludlow Bay Marina	Port Ludlow	Hood Canal	(360) 437-0513	47°55'17"	122°41'08"	24 hours	100	15	Olympic Water and Sewer Inc. WWTP
Port of Bremerton	Port Orchard	Puget Sound	(360) 876-5535	47°33'48"	122°37'21"	24 hrs		20	Bremerton WWTP
Point Hudson Marina	Port Townsend	Admiralty Inlet	(800) 228-2803	48°06'57"	122°44'58"	24 hours	100	8	Port Townsend WWTP
Washington State Ferry Terminal, Port Townsend	Port Townsend	Admiralty Inlet							Port Townsend WWTP
Liberty Bay Marina	Poulsbo	Puget Sound	(360) 779-7762	47°43'27"	122°38'38"	8:00 am - 6:00 pm	80	6	City of Poulsbo to Central Kitsap WWTP
Port of Poulsbo Marina	Poulsbo	Puget Sound	(360) 779-9905	47°43'58"	122°39'52"	8:00 am - 4:30 pm	80	7	City of Poulsbo to Central Kitsap WWTP
Quilcene Boat Haven	Quilcene	Hood Canal	(360) 765-3131	47°48'07"	122°51'58"	24 hours	40	6	Onsite Septic
Port Orchard Railway Marina	Reno	Puget Sound	(360) 876-2522	47°32'29"	122°38'43"	24 hours	150	0	South Kitsap Water Reclamation Facility (Port Orchard WWTP)
Phecal Phreak	Roche Harbor	Puget Sound				9:00 am - 5:00 pm		30	Roche Harbor Resort WWTP
Roche Harbor Resort	Roche Harbor	Puget Sound	(360) 378-2155	48°36'43"	123°09'25"	24 hours	80	15	Roche Harbor Resort WWTP
Ballard Mill Marina	Seattle	Lake Washington	(206) 789-4777	47°39'44"	122°22'58"	24 hours	50	15	City Sewer
Boat Street Marina	Seattle	Lake Union	(206) 634-2050	47°38'9"	122°18'8"	24 hours	70	>15	Seattle City Sewer
Elliott Bay Marina	Seattle	Puget Sound	(206) 285-4817	47°37'36"	122°23'31"	24 hours	160	30	Seattle City Sewer
Fairview Marina	Seattle	Lake Union	(888) 673-1118	47°37'54"	122°19'51"	24 hours	40	>15	city of seattle sewer

Facility Name	Location	Water Body	Marina Phone Number	Latitude	Longitude	Hours of Operation[b]	Max Vessel Length	Min Depth at Low Tide	Where Treated
Fishermen's Terminal - Port of Seattle	Seattle	Lake Union Ship Canal		47°39'33"	122°22'39"	7:00 am - 9:00 pm	100		
Morrison's North Star Fuel Dock/Diamond Marina	Seattle	Lake Union	(206) 284-6600	47°38'41"	122°20'38"	Variable	200	>15	Seattle City Sewer
Parkshore Marina	Seattle	Lake Washington	(206) 725-3330	47°31'20"	122°15'40"	24 hours	50	5	Seattle City Sewer
Port of Seattle - Bell Harbor Marina	Seattle	Puget Sound	(206) 787-3914	47°36'31"	122°20'48"	24 hours	100	22	Seattle City Sewer
Seattle Sanitation Service	Seattle	Lake Union Ship Canal	(206) 713-6436			By appointment			Seattle City Sewer
Shilshole Bay Marina	Seattle	Puget Sound	(206) 787-3387	47°40'33"	122°24'46"	24 hours	100	16	Seattle City Sewer
SS Head	Seattle	Puget Sound	(206 223-9991			By appointment			Closest Public Pumpout
port of everett	Sequim	Strait of Juan de Fuca	(360) 417-3440	48°03'56"	123°02'23"	24 hours	100	12	Large onsite septic system
Jarrell Cove State Park	Shelton	Puget Sound	(360) 426-9226	47°16'53"	122°53'16"	24 hours		4	
Jarrell's Cove Marina	Shelton	Puget Sound	(360) 426-8823	47°17'03"	122°53'12"	10:00 am - 6:00 pm	100	5	
Oakland Bay Marina	Shelton	Puget Sound	(360) 426-1151	47°13'24"	123°06'18"	24 hours	50	20	Offsite
Port of Silverdale	Silverdale	Puget Sound	(360) 698-4918	47°38'30"	122°41'41"	6:00 am - 10:00 pm	150	10	Central Kitsap WWTP
Stuart Island State Park/Reid Harbor & Prevost Harbor Marine Parks	Stuart Island	San Juan Islands	(360) 378-2044	48°40'30"	123°12'00"	24 hours	60	4	Roche Harbor Resort WWTP
16th Street Moorage	Tacoma	Puget Sound	(253) 572-2524	47°14'73"	122°26'00"	8:00 am - 12:00 am	300	15	City of Tacoma WWTP

Facility Name	Location	Water Body	Marina Phone Number	Latitude	Longitude	Hours of Operation[b]	Max Vessel Length	Min Depth at Low Tide	Where Treated
Breakwater Marina, Inc.	Tacoma	Puget Sound	(253) 752-6663	47°18'27"	122°30'48"	7:00 am - 8:00 pm		15	City of Tacoma WWTP
Chinook Landing Marina	Tacoma	Puget Sound	(253) 627-7676	47°16'50"	122°24'09"	8:30 am - 5:00 pm	65	8	City of Tacoma WWTP
Crow's Nest Marina	Tacoma	Puget Sound	(253) 272-2827	47°17'37"	122°25'14"	Variable	40	38	City of Tacoma WWTP
Delin Docks	Tacoma	Thea Foss Waterway	(206) 391-6431	47°15'00"	122°25'48"	8:00 am - 12:00 am	60	6	City of Tacoma WWTP
Dock Street Marina	Tacoma	Thea Foss Waterway	(253) 572-2524	47°14'29"	122°26'00"	8:00 am - 12:00 am	130	6	City of Tacoma WWTP
Dock Street Marina 17	Tacoma	Thea Foss Waterway	(253) 572-2524	47°14'29"	122°26'00"	8:00 am - 12:00 am	130	6	City of Tacoma WWTP
Dock Street Marina Albers	Tacoma	Thea Foss Waterway	(253) 572-2524	47°14'29"	122°26'00"	8:00 am - 12:00 am	130	6	City of Tacoma WWTP
Foss Harbor Marina	Tacoma	Puget Sound	(253) 272-4404	47°15'22"	122°26'01"	Variable	90	60	City of Tacoma WWTP
Foss Landing Marina	Tacoma	Puget Sound	(253) 627-4344	47°14'38"	122°25'55"	5-Aug	75	5	City of Tacoma WWTP
Narrows Marina	Tacoma	Puget Sound	(253) 564-3032			Variable			City of Tacoma WWTP
Point Defiance Boathouse Marina	Tacoma	Puget Sound		47°18'26"	122°30'56"	Variable	50		City of Tacoma WWTP
Point Defiance Marina Complex	Tacoma	Puget Sound	(253) 591-5325	47°18'22"	122°30'48"	24 hours	60	16	City of Tacoma WWTP
Tacoma Youth Marine Center/ (aka) Commencement Bay Marine services	Tacoma	Thea Foss Waterway	(253) 383-0851			Variable	90	No restriction	Tacoma City Sewer
Terry & Sons Marine Pumpout	Tacoma	Puget Sound	(206 437-6764			By appointment			Pumpouts in Parkshore Marina, Kirkland and Carylon Point

Facility Name	Location	Water Body	Marina Phone Number	Latitude	Longitude	Hours of Operation[b]	Max Vessel Length	Min Depth at Low Tide	Where Treated
Totem Moorage	Tacoma	Puget Sound	(253) 272-4404	47°15'27"	122°26'07"	24 hours	90	60	Tacoma City Sewer
Tyee Marina	Tacoma	Puget Sound	(253) 383-5321	47°17'42"	122°25'28"	Variable	65	65	City of Tacoma WWTP
Alderbrook Inn	Union	Hood Canal	(360) 898-2252	47°21'00"	123°04'05"	By appointment	85		Alderbrook Inn WWTP
Hood Canal Marina	Union	Hood Canal	(360) 898-2252	47°21'54"	123°05'67"				
Twanoh State Park	Union	Hood Canal	(360) 275-2222	47°22'49"	122°58'30"	24 hours		3	Large Scale OSS
Day Island Yacht Club	University Place	Puget Sound	(253) 565-3777	2120 91st Ave W.					Chambers Creek WWTP
Dockton Park	Vashon	Puget Sound	(206) 463-2947	47°22'22"	122°27'17"	Variable	60	20	

Note: Blue highlighting indicates pumpout facilities for government vessels. Green highlighting indicates mobile pumpout boats.

[a] The pumpout facilities listed in Appendix A primarily came from the Washington State Parks Pumpout Database with a few additions that were identified during this study. Additional details such as sewage treatment locations and hours of operation and draft restrictions are still being gathered and will be included with the final petition submitted to EPA.

[b] Hours of operation listed as 'variable' refers to pumpout facilities whose hours vary by season, day of the week, or are not open on some days of the week. Specific hours of operation may be obtained by calling the marina or by visiting the Washington State Parks website (http://www.parks.wa.gov/boating/pumpout/)