The Problems with Water Quality Standards in Oakland Bay associated with the Shelton Sewage Treatment Plant

by

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ABSTRACT

The City of Shelton, Washington has recently produced the document *Shelton Area Water and Sewer Regional Plan* (November 2002). This plan looks at a regional system that would include the City of Shelton, the Washington Correction Center, the State Patrol Academy, the Port of Shelton and Mason County. This plan for a regional system may bring changes to the wastewater plant over the next few years. In this thesis, I examine the problems associated with existing water quality standards in Oakland Bay (fecal coliform, low dissolved oxygen, high water temperatures, and low instream flows).

I then analyze the stakeholders' positions and the City of Shelton's Sewage treatment proposal for increasing the discharge into the Oakland Bay. I have evaluated five plans to deal with the scientific, environmental, technical and economic impacts of managing Mason County's wastewater in the future. Each plan's solution has a summery of possible benefits and issues. The plans further discuss how the City of Shelton's wastewater treatment plant will be brought into regulatory compliance during winter storms and how the region's capacity for growth will be expanded.

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Introduction

The Federal Clean Water Act was passed in 1972 to reduce water pollution inputs from industrial stakeholders, sewage treatment plants and municipal sources (Title 33, Section 125). There have been significant improvements to our nation's waters because of this act, but water quality problems remain due in part to point and nonpoint sources. Despite this legislation, Oakland Bay in the city of Shelton WA is one of many estuaries still not meeting Federal clean water standards.

Federal law requires states to identify sources of pollution in waters that fail to meet state water quality standards and to develop plans to reduce the pollution. Water cleanup plans are developed from total maximum daily load, TMDL, studies. The plans establish limits on the amount of pollution that can be discharged to water bodies while allowing state standards to be met. Oakland Bay is among 700 water bodies on Washington State's current cleanup list. Since the passage of the Federal clean water act three water quality studies show that water quality has not improved in the Oakland Bay in the past 32 years,

The City of Shelton owns and operates a sewage treatment plant which discharges treated waste water into Oakland Bay. As population in Shelton and surrounding Mason counties grow, there will be an increase the amount of wastewater discharged at an outfall that straddles two sanitary lines defining a shellfish closure zone in Oakland Bay. Therefore, the condition of the current facility and the plan for a future sewage treatment system is critical to local and regional water quality.

The Shelton existing waste water treatment plant is designed to serve the Shelton area as shown in figure one. However, the city wants to expand its coverage to include the Washington Correction Center (WCC), Washington State Patrol (WSP), and the Port of Shelton. I focus on the existing poor water quality in the basin; the sources of the problems, the issues with the existing sewage treatment plant, and suggestion for solutions. My conclusion summarizes five different options for managing the Shelton's wastewater in the future.

The first chapter focuses on the history of Oakland Bay, Mason County and the City of Shelton. The chapter concludes with demographic, social and economic information on the human populations of Mason County including the indigenous First Peoples.

Chapter two defines the boundaries of Oakland Bay and describes its flushing characteristic. I then look at the legal framework of the Federal Clean Water Act and the requirements that all states must meet in identifying water bodies that are water quality limited or impaired. This chapter also addresses how land use affects water quality in the Bay.

Chapter three addresses the sources of contamination in the Bay. Water contamination is caused by both point and nonpoint sources. The main water quality concerns are: fecal coliform, biochemical oxygen demand, toxic chemicals, and temperature. I continue with a discussion of point and nonpoint sources which are responsible for bacterial waterborne illnesses that affect fish habitat and shellfish production. I then analyze changes associated with water quality and quantity which has a significant impact on economic costs and benefits to landowners and to a wide range of users.

In chapter four I identify and discuss the advocates of the regional expansion project including the City of Shelton, Mason County, the Port of Shelton, the Washington Correction center and the Washington State Patrol Academy, as well as the opponents such as shellfish growers and the Squaxin Tribe.

Problems with the existing sewage treatment plant are discussed in chapter five. My examination of the three different studies done on the sewage treatment plant is followed with a discussion about the consequences of non compliance with National

Pollution Discharge Elimination System Permits (NPDES), and by an evaluation of the Regional System Wastewater Projections 2020 documents.

My last chapter is an analysis of the current paradigm and where we are going. It also includes my recommendations for achieving the water quality goals as defined by the 1972 Federal Clean Water Act.

1: The History of the Oakland Bay

Mason County, City of Shelton

Mason County is located in Western Washington at the southwest end of Puget Sound. It is bordered to the north by Jefferson County, to the west and southwest by Grays Harbor County and to the southeast by Thurston County. The populace residing in and around the county live predominantly in twelve unincorporated townships, most of which are platted along either Hood Canal or South Puget Sound inlets in west Mason County. The County is also home to the Skokomish and Squaxin Island Indian tribes. Most of the Skokomish and Squaxin live on or near the tribe's reservation which is located at the southern end of Hood Canal. As of June 2007, seventeen percent of Mason counties 54,600 residents live in Shelton, the county's only municipality and seat of county government.

Shelton, meets the economic, social and recreational needs of its 9,250 residents, in addition to the needs of 28,540 County residents. Shelton is the largest and most important economical contributor for Mason County. Largely due to Oakland Bay's geography and it’s proximity to the surrounding woodlands and water ways make it critical for companies such as Simpson Timber Company and industries such as: Lumber, Shellfish, evergreens, and Christmas tree.

Mason County and Shelton's history started when first settlers arrived in the South Puget Sound region. They found a landscape dominated by expansive stands of old-growth coniferous trees. Douglas-fir, western hemlock, western red cedar, and Sitka spruce were all present. These vast forests were the main attraction for the first settlers.

David Shelton (the namesake of the largest city in the basin) and his family crossed the Great Plains with an ox team and covered wagon and arrived near Portland in 1847. Five years later, they moved to Olympia. The Shelton family moved to a donation land claim of 640 acres at the present site of Shelton in 1853. They later added an additional 171 acres from a homestead claim and purchase. By 1800, Shelton was a member of the first legislative assembly of the Washington Territory.

During that period several mills were established. Michael Simmons opened the first mill in Shelton near the mouth of Mill Creek. Because of large old growth (100 to 150 feet tall and 14 feet in diameter) were common in the early days, several other mills soon followed. Joe Sherwood constructed one near the mouth of Sherwood Creek in 1854 (Deegan, 1960). Arkada's mill (now Arcadia) was established in 1853 and Kamilche (now Old Kamilche) in 1854.

At the time, Thurston County included what is today Mason County. Concerns with the difficulty of traveling from the settlements in the northern portion of the county to the county seat in Olympia led to the division of the county. In 1854, David Shelton introduced a bill to split Thurston County thus creating Sa-heh-wamish or Sawamish County. In 1864 the county was renamed Mason County in honor of Charles Mason, who was first secretary of Washington Territory and often acting governor when Governor Stevens was absent.

The Willey Mill was constructed in 1871 at the mouth of Johns Creek. In 1883, William Kneeland built a small mill in the Shelton Valley and floated lumber down a flume to tidewaters. Many of the trees had such a large swell at the base that loggers employed "spring boards" to climb higher up the trunk for easier cutting. Notches were cut with an axe and the springboard was wedged in, providing a platform for the logger to stand on. An axe was used to cut an initial notch in the tree to control the direction of falling, and then the trunk was cut with a saw (the “misery whip” of logging lore). Oxen were used to drag the huge logs to water, limiting most of the early activity to within a mile of water. As the logging industry grew and became more competitive new methods were employed to increase efficiency.

In 1886, the Port Blakely Mill Company constructed a railroad that stretched from Kamilche Point at the mouth of Little Skookum Inlet to Montesano. This railroad was called the Blakely Road and was the shortest route from Puget Sound to Grays Harbor. Sol Simpson later bought the Blakely railroad. Simpson also owned a railroad (constructed in 1884) that began at Shelton and eventually terminated at Camp Grisdale near the present site of Wynoochee Lake in the Olympic National Forest (Deegan, 1960).

In 1892, another railroad was constructed from Shelton up the Shelton Valley to Grays Harbor. Logging along this railroad opened up land for agricultural production (Deegan 1960). Much of the cutover lands were cleared of stumps and converted to farmland. For example, in one year alone, farmers in the Shelton area purchased 40 tons of stump blasting powder (Thomas, 1985).

While timber production was (and remains) the dominant industry in 1900, oyster production was also a valuable local commodity. Oysters proved so popular that the beds in Oyster Bay were depleted by 1887, less than ten years after harvest began. The Oakland Bay was reseeded and production resumed. By 1902, 25,000 sacks of oysters per year were harvested from the waters of Mason County (Deegan, 1960).

In 1923, Goldsborough Creek produced a sizable flood, inundating Shelton from Seventh Street downstream to Oakland Bay. In response, the stream was channelized into a straight channel with steeper banks. Land on both sides of the stream was then filled and developed. In 1924, two mills were built on the Shelton waterfront. A wall of pilings was driven across the bay front and the lower tidelands were dredged to fill about 30 acres on the landward side of the pilings.

The two mills were located just south of the mouth of Goldsborough Creek. In 1926, the Rainier Pulp and Paper Company built a pulp mill next to the two lumber mills already present on the Shelton waterfront. The pulp mill was dedicated to rayon production. Rayon became so popular that the company name was later changed to Rayonier, a combination of rayon and Rainier (Thomas, 1985). The pulp production process produced a waste product called spent sulfite liquor.

Traditionally this waste was released into a nearby water body, but this plant was located on a narrow tidal basin and people were concerned about protecting oyster production. A pipeline five-mile long was built to the mouth of Mill Creek. Storage tanks were constructed on-site so the waste liquor could be released only on outgoing tides. In 1930, oyster growers proved in the court that the sulfite waste liquor was harmful to oysters. In response, a pipeline was built three-miles inland to dispose of the waste in Goose Lake.

Eventually settling and evaporation ponds were constructed to contain the waste and let it disperse. The company attempted to make use of the waste product by concentrating it into thick syrup. By 1934, sulfite waste liquor was being used to settle dust on roads as far away as New Jersey. Unfortunately, the venture didn't work out, so the waste liquor was again pumped to the settling ponds in 1936.

Ten years later, it was found that the waste disposal ponds were seeping into groundwater and the creek. To eliminate this problem the waste liquor was evaporated into thick syrup and burned (Thomas, 1985), by 1951the Rayonier Company closed its Shelton operation.

Goldsborough Creek again produced major floods in 1932 and 1935. The stream channel was thoroughly cleaned and armored to protect the city and its residents. In the mid-1940s, Simpson Timber Company built a bulkhead across the portion of Oakland Bay north of Goldsborough Creek and dredged gravel from the tidelands to fill behind the structure. A locomotive roundhouse and machine shop were then constructed on the fill.

In 1946, an additional building was constructed to lightly shred and cook Douglas-fir waste. The fibers were then pressed into a thick sheet and dried to make building tile and insulating board (Thomas, 1985).

In conclusion, the history of settlement and industrialization of the area substantiates that human activities and the growth of industry had a significant impact, including degradation of the shorelines and forests, on Mason County. Specifically as timber production and timber processing byproducts of such activities impacted water quality.

2: The Physical, Biological, and Human Attributes of the Oakland Bay

The Washington Administrative Code sets state water quality standards for surface waters in the State of Washington. This standard was established for public health, public enjoyment through recreation, and propagation and protection of fish, shellfish, and wildlife. All surface waters in the state are classified according to their beneficial uses. If state waters do not meet their intended uses, then they are classified as limited or impaired and placed on Washington State's 303 (d) lists, as mandated by the Clean Water Act to include all impaired waters in the state that fail to meet state water quality standards (Chapter, 173-201).

Oakland Bay has significant water quality problems from past industrial uses and current urban land uses and physical characteristics of the Bay. It is on Washington State’s 303(d) lists and the near inner harbor of Oakland Bay is classified as class B. Class B waters do not support salmonid spawning or contact recreation, but do support limited fishing (Mason County public health, 2007).

Oakland bay is a prominent feature in the Washington State Department of ecology and Mason County landscape. It is receiving water from two large river basins and from the regional wastewater treatment plant. As discussed in this chapter, fresh water inputs to Oakland Bay, particularly the waste water treatment plant and Shelton

River and Goldsborough river system influence circulation and several water quality parameters of the Bay

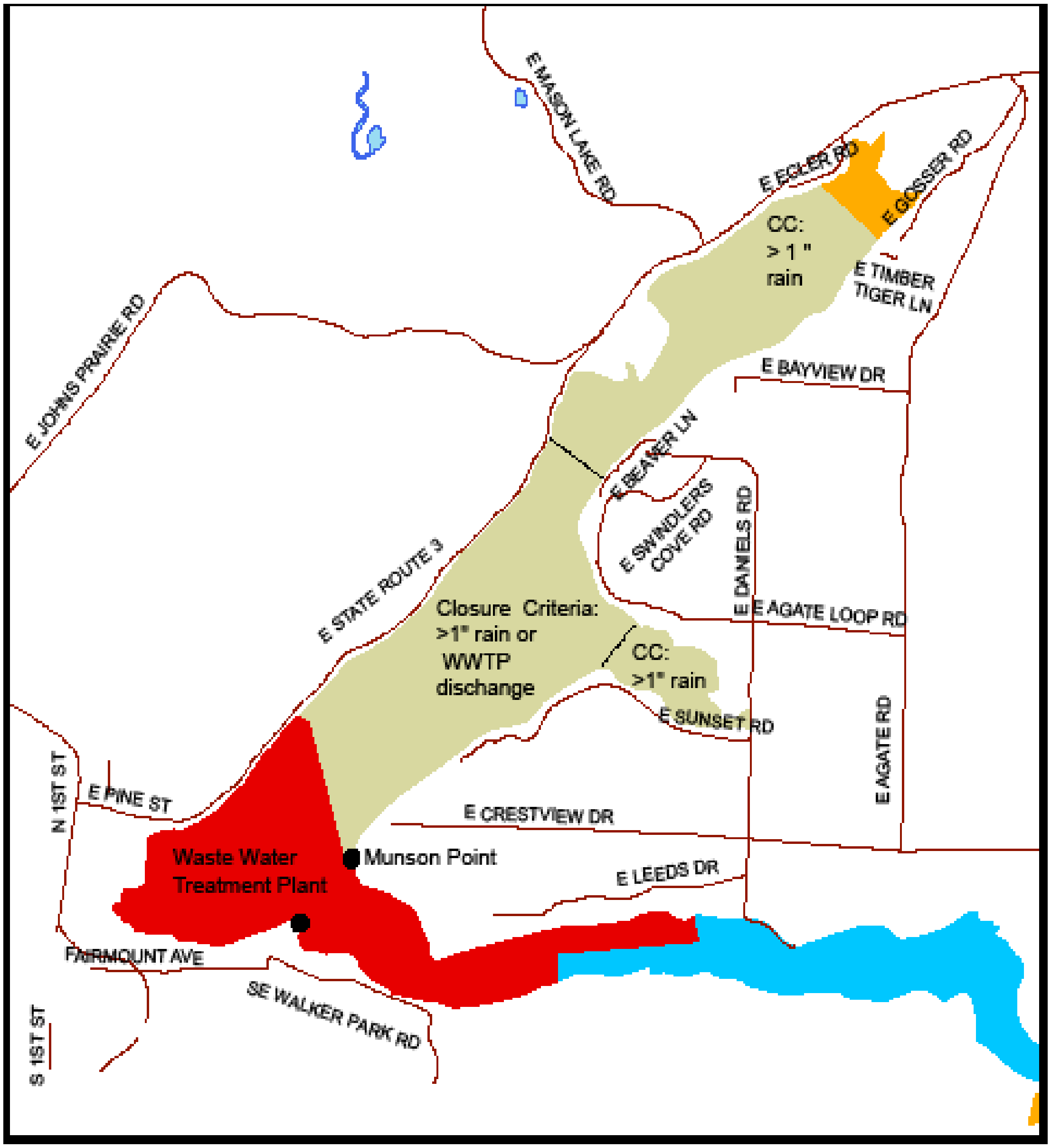
The Physical Attributes of Oakland Bay

Oakland Bay is a broad shallow estuary connected by the narrow channel of Hammersley Inlet to outer Puget Sound. A volume of 7.9×10^7 m^3 of water enters Oakland Bay during a typical flood tide, which only has a volume of 8.7×10^7 m^3 (Oakland Bay and Hammersley Inlet combined are about 14.8×10^7 m^3).
Oakland Bay in Southern Puget Sound is about four miles long and three quarters of a mile wide at its widest point. It flows into the northern end of Totten Inlet and Hammersley Inlet.

A number of industries are situated in the inner harbor area of the Bay. Two main streams flow into the inner harbor, Goldsborough and Shelton Creek. Goldsborough Creek is the larger of the two and had an estimated yearly average flow of 350 cfs (Department of Ecology, 2007).

Goldsborough Creek flows through Shelton, but is flanked on its south side by a steep ravine and in its northern side by railroad tracks. Consequently, there is little development close to its banks. However storm water from Shelton and the inner harbor industrial area is discharged to the creek in a number of places. Goldsborough creek flows into the center of the inner harbor shoreline (WRIA 14, 1998).

Figure1: Oakland Bay & Hammersley Inlet.



Source: Oakland Bay figure map created with Arc GIS 9.2. Watershed Goldsborough Sub-basin boundary is from Golder& Associates. Streams are from the Washington Department of Natural Resource.

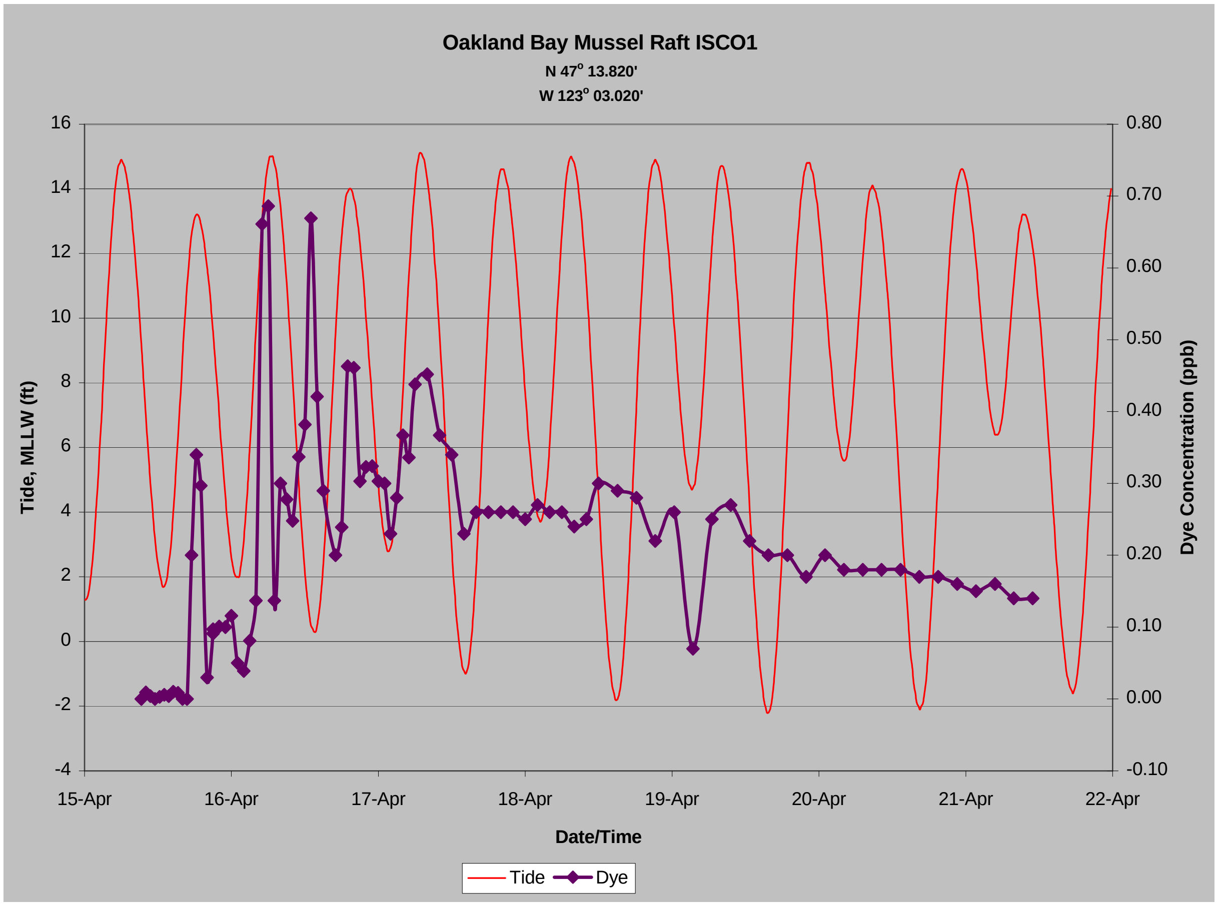
Shelton Creek originates in springs located northwest of Shelton proper, and had an estimated flow of 16 cfs. A large tributary that originates northeast of Shelton accounts for most of its volume. Shelton Creek flows through an older residential area in Shelton and is often routed below ground. The water occasionally is used for lawn irrigation. City and industrial storm water is also discharged to Shelton Creek. Shelton Creek flows into Oakland Bay along the northern edge of the inner harbor (WRIA 14, 1998). Other tributaries are Johns Creek, Cranberry Creek, Deer Creek, Uncle Johns Creek, Mill Creek, Malaney Creek, and Campbell Creek (Washington Department of Ecology, 2003).

Flushing Characteristics

Oakland Bay is one of the more energetic estuaries in Puget Sound with two meter tidal ranges and strong tidal current in the navigational channel. During the high river flow portion of the year, the combination of energetic tidal mixing and fresh water flushing of the tributary rivers prevent the accumulation of material in the system. However, if there was an incident in the summer or early fall the lower river flow conditions into Oakland Bay would cause any introduced material to be retained for a long time; unfortunately, this is deemed by Department of Health the more likely time for an upset event at the wastewater treatment plant (WWTP) to occur. Thus, in summer and early fall, when fresh water flow is lowest, there is a higher retention of effluent in the Bay. (Washington Department of Ecology, 2003).

A dye study, in April 2003, determined that Oakland Bay has high refluxing, low flushing and a naturally high retention rate. In the experiment they injected dye at the outfall of WWTP, to measure the Bay's dilution directly during this spring period (see Figure. 2) at several fixed points. The result shows every ebb tide would remove 8% of the dye from the east end of Hammersley Inlet, but every flood tide would return 92% of it. The dilution factor was such that after 4 days, half of the dye still remained (Department of Ecology, 2003).

Figure 2: Oakland Bay Mussel Raft.



Source: A time series of dye concentration in Oakland Bay (Washington Department Ecology, 2003).This figure illustrates on 15 April the concentration of effluent (bold) during the initial response phase of release is highly dependent on the initial conditions of the tide (light). During the steady-state phase, the response exhibits first- order (exponential) decay.

Hydrology

Hydrology of the Oakland Bay system is typical of midsize estuaries, with high flows in the late fall through late spring and low flows in the summer and early fall. The surface waters in the Oakland Bay are classified as class A marine estuarine receiving water in the vicinity of the outfall.

Climate

The region is characterized by the West Coast marine climate. Summers are relatively dry and cool. Winters are mild, wet, and cloudy. Daily air temperatures generally vary about 15ºF in the winter and 25 to 30ºF in the summer. Average temperature is between 38ºF to 64ºF also, the annual precipitation is about 55 inches.

Rainfall is generally a light to moderate drizzle rather than brief heavy downpours. Winds are generally from the southwest. Snowfall from 10 to 15 inches occurs from November through April in the higher elevations of the Black Hills (Thurston County Planning Department, 1989).

Vegetation

Early seral hardwood forests and mid seral conifer forests are the dominant land covers, each occupying about 28% of Mason County. Saltwater covers about 13% of the basin. Early seral conifer forests occupy about 9% of the basin, while mixed-early seral forests cover about 5%. Late seral conifer forests and non-forested lands each cover about 1% of the basin (City of Shelton Land Capacity Analysis: Proposed Land Use Plan April 17, 2007; updated August 27, 2007).

Land Use

High density residential development occupies only 1.1% of the basin, primarily in the Shelton area (City of Shelton Land Capacity Analysis: Proposed Land Use Plan April 17, 2007; updated August 27, 2007). In 2007, the population of Mason County was 54,600 people, 9,250 of which lived in the Shelton area (Jones & Stokes 2007). Road density for the entire water resource inventory area (WRIA) is 4.6 miles per square mile

(Washington State Conservation Commission and Northwest Indian Fisheries Commission, 2002).

Biological Impact

The Bay supports different types of fish that are affected by degraded water quality for a number of reasons. According to WRIA 14 study, the rate of flow drops and the bay tributaries rivers moves more slowly and becomes less turbulent. Oxygen enters the Bay more slowly and mixes poorly with deeper waters. The surface water begins to warm, which limits the amount of oxygen entering the water.

Low summer flows are a natural condition for most of the bays along the Puget Sound. But the history of poor logging practices in the past and new developments along Oakland Bay and its tributaries led increasing discharge of point and nonpoint into the Bay. These pollutions along with summer conditions increase Water temperatures and decreased dissolved oxygen for the marines' life in the Bay (Beaker et al. 1995).

In summary, long-standing water quality problems in Oakland Bay exist due to many different issues; one of the most important being the physical characteristics of the Bay. Seasonal changes in rainfall and stream flow further impact water quality. Due to the poor flushing characteristics of the Bay, these pollutants - including high level of fecal coliform(Stephanie Kenny,2007) remain in the waters for lengthy period effecting marine conditions, thus reinforcing the State's class B classification and limitation of human contact of the Bay's compromised water.

3: The Potential Sources of Contamination in the Oakland Bay

By reviewing water quality studies from 1980- 2007, this chapter examines the levels and sources of contaminants in Oakland Bay to show why water quality has remained poor despite water quality laws. Both point and nonpoint sources are contributing to the poor water quality in the basin. The contaminants of concern are fecal coliform bacteria, water temperature, dissolved oxygen, biochemical oxygen demand chlorine residual, ammonia, nitrate and total suspended solid. This chapter is divided into two parts: Part One focuses on reviews the history of high level fecal coliform contamination in Bay and also identifies the major sources of pollutant. Part two will discuss how poor water quality will impact on marine's life in Oakland Bay.

Part One- History of High Levels of Contamination

As stated in Chapter two, flushing characteristics of Oakland Bay causes any material that enter the waters to remain in the Bay for more than twenty days (Department of Ecology Dye Study 2003). There are three major sources of contamination in the Bay: Simpson Timber Company, the waste water treatment plant and nonpoint discharge, all impacting water quality in the creeks and the inner bay. For this reason Oakland Bay suffers from high level of contaminations.

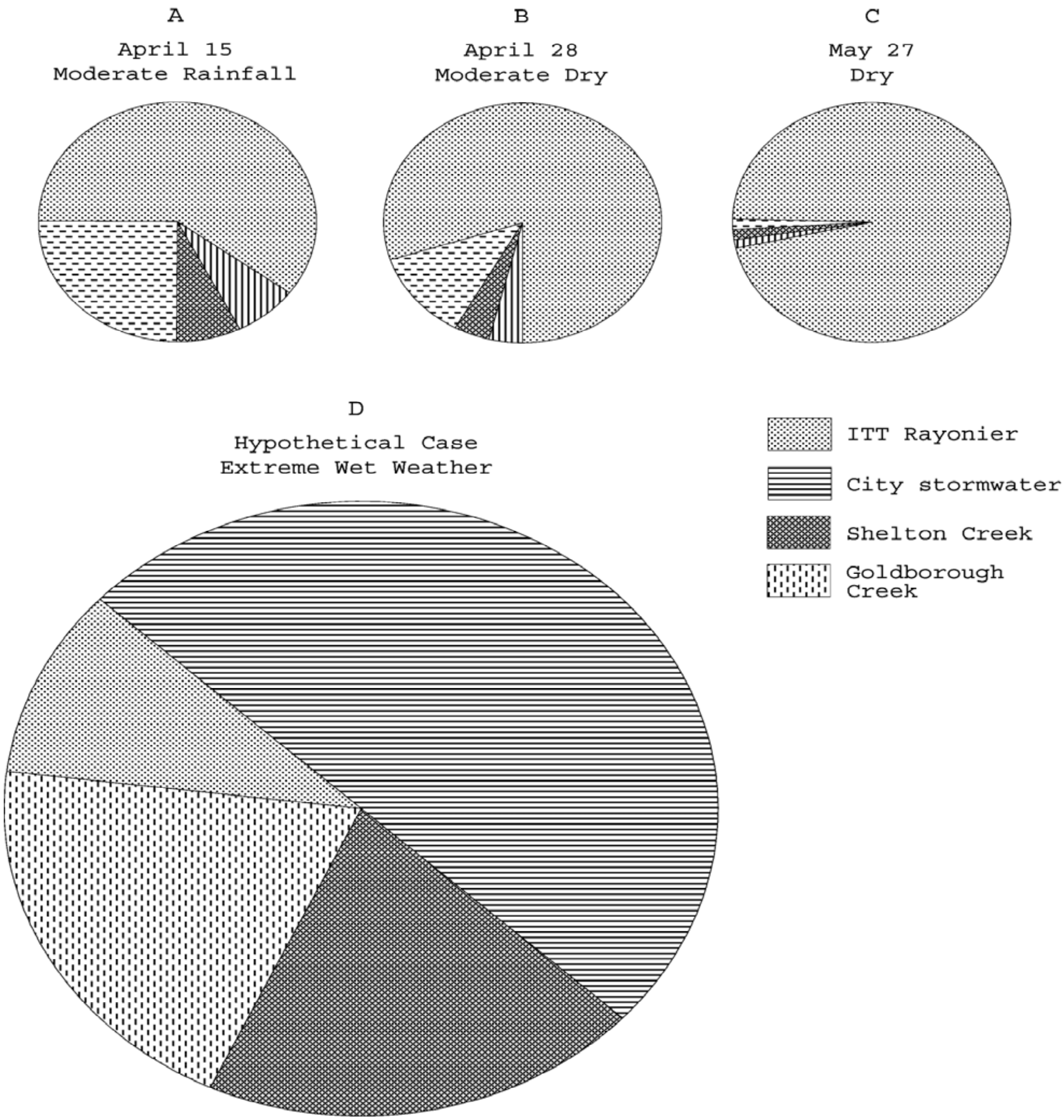
Water Quality Studies

Three major water quality studies funded by the Washington State Department of Ecology serve as benchmark indicators of poor water quality in Oakland Bay. The first study was in 1980, by the Department of Social and Health Services (DSHS). At that time, DSHS was responsible for evaluating the sanitary quality of commercial shellfish growing waters in Washington State. The evaluation and approval was based on periodic bacteriological studies of the water. DSHS conducted an intensive water quality survey in Oakland Bay during December 1986 and January 1987 as part of their routine monitoring program. Survey results indicated a bacterial contamination problem, and the Bay was reclassified as "Restricted" (DSHS, 1987). In February 1987, the Department of Ecology began to investigate sources of bacteria to the Bay. The investigation centered on the inner harbor where bacteria levels were highest (DSHS, 1987). The primary objectives of the study were to determine the significant sources of fecal coliform bacteria to the inner harbor and to conclude whether the high bacteria concentrations were related to wet weather. The Department of Ecology identified three major sources of pollutants, which discharged into the bay.

- ITT Rayonier (removed from Shelton in 1950)
- The Shelton Waste Water Plant
- Simpson Timber Company

The relative contribution of these sources varies with season. ITT Rayonier was the largest loading source except during periods of high runoff when Shelton storm water was estimated to dominate. Its pulp production process produced a waste product called spent sulfite liquor. This substance is the liquid waste resulting from the manufacture of cellulose pulp from wood and contains organic matter in the sulfate and chemicals in the liquor. Discharging sulfate liquor in water will change the balance of oxygen in the water by decreasing oxygen and increasing carbon dioxide. Low dissolved oxygen will suffocate the marine animals and chemical waste will poison the shellfish and oysters in nearby discharge location. In effects to offset discharge, ITT Rayonier tried to recycle the sulfite waste liquor and use it for settling dust on roads. This remedy proved too expensive, therefore contributing to the closure of its Shelton facility in 1950 (Thomas, 1990). After identifying ITT Rayonier, the Department of Ecology listed Shelton storm water discharge as another significant source of contamination during wet weather. It appeared to account for only a small portion of the loading during dry weather. During the critical wet weather period it became the major source of bacteria in the Bay (figure 3).

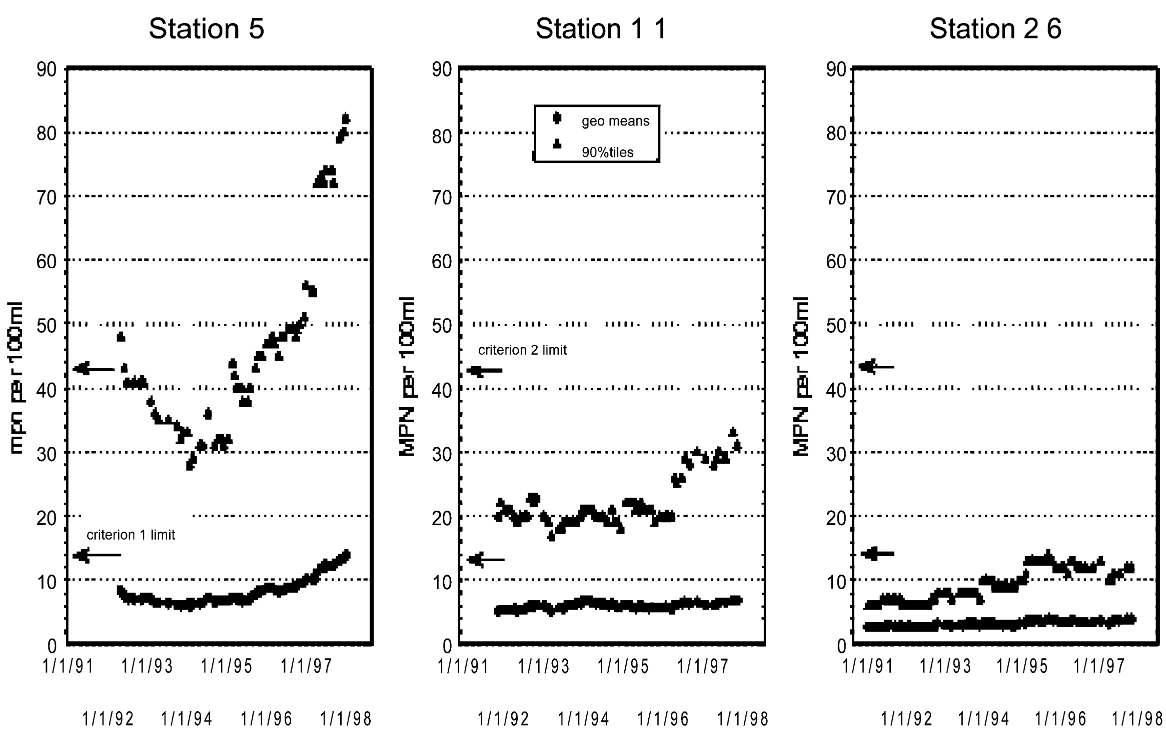
Figure 3: Point and Nonpoint Sources of Pollutant from beginning in the Oakland Bay



Source: Water Quality Survey of Oakland Bay by Department of Health (DSHS 1986). Comparison of Contributions from Bacteria Loading Source during Different Weather Conditions.

The second study funded by Washington State Department of Health (DOH) was to protect the health of shellfish consumers from fecal contamination. In 1991, DOH selected Oakland Bay areas for long term Puget Sound Ambient Monitoring Program (PSAMP). In this study, DOH used a systematic random sampling strategy to study three different stations in Oakland Bay from 1991 through 1998. The result of seven years ofsampling indicated the highest fecal coliform levels occurred near the discharge point of the Shelton Sewage Treatment Plant (Tim Determan, Office of Shellfish Programs, Washington State Department of Health, 2001). This study placed both Hammersley Inlet and Oakland Bay to be listed on the 303(d) list of impaired and threatened water bodies (Washington Sate Department of Health, 1991). Figure 4 illustrates the level of fecal coliform pollution during seven years of study in three different locations in Oakland Bay. The highest contamination of fecal coliform is at section three (station 5) which is in Hammersley Inlet near a waste water plant discharge.

Figure 4: Fecal coliform trends in Oakland



Source: Office of Shellfish Program, Washington State Department of Health.

The graph illustrates the highest contamination of fecal coliform is in Hammersley Inlet.

The third study was initiated by the City of Shelton to possibly expand its Waste Water Treatment Plant (WWTP) output without compromising the closure zones for shellfish harvest areas (sanitary lines). Before shellfish can be grown or harvested for commercial sale, the area must be assessed to determine that shellfish can be safely grown or harvested. The boundaries of a wild harvest or aquaculture area are established by considering the natural topography, sources of natural contamination, industrial developments or human habitation, and potential for additional growing or harvesting sites within the area. These sanitary lines are maintained by the Washington State Department of Health (DOH) and are critical to many commercial and tribal aquaculture interests in the area (Department of Ecology, 2004).

In April 2003, Department of Ecology determined the flushing characteristics of Oakland Bay by conducting Rhodomine dye release study (fig.2). In this model, fecal coliform bacteria were interchangeable with dye and injected at the critical areas of the Waste Water Treatment Plant. As a result, they were able to measure dye dilution directly at several fix points for a period of two months. The study indicated 46,300 fecal coliform bacteria units per 100/ml would satisfactorily dilute to the Class A water quality standard of (fig 5). 14 fcb crossing the sanitary lines when discharge is set at 2.6 million gallons per day. But any additional discharge rate clearly effect Oakland Bay sanitary lines (Department of Ecology, 2004).

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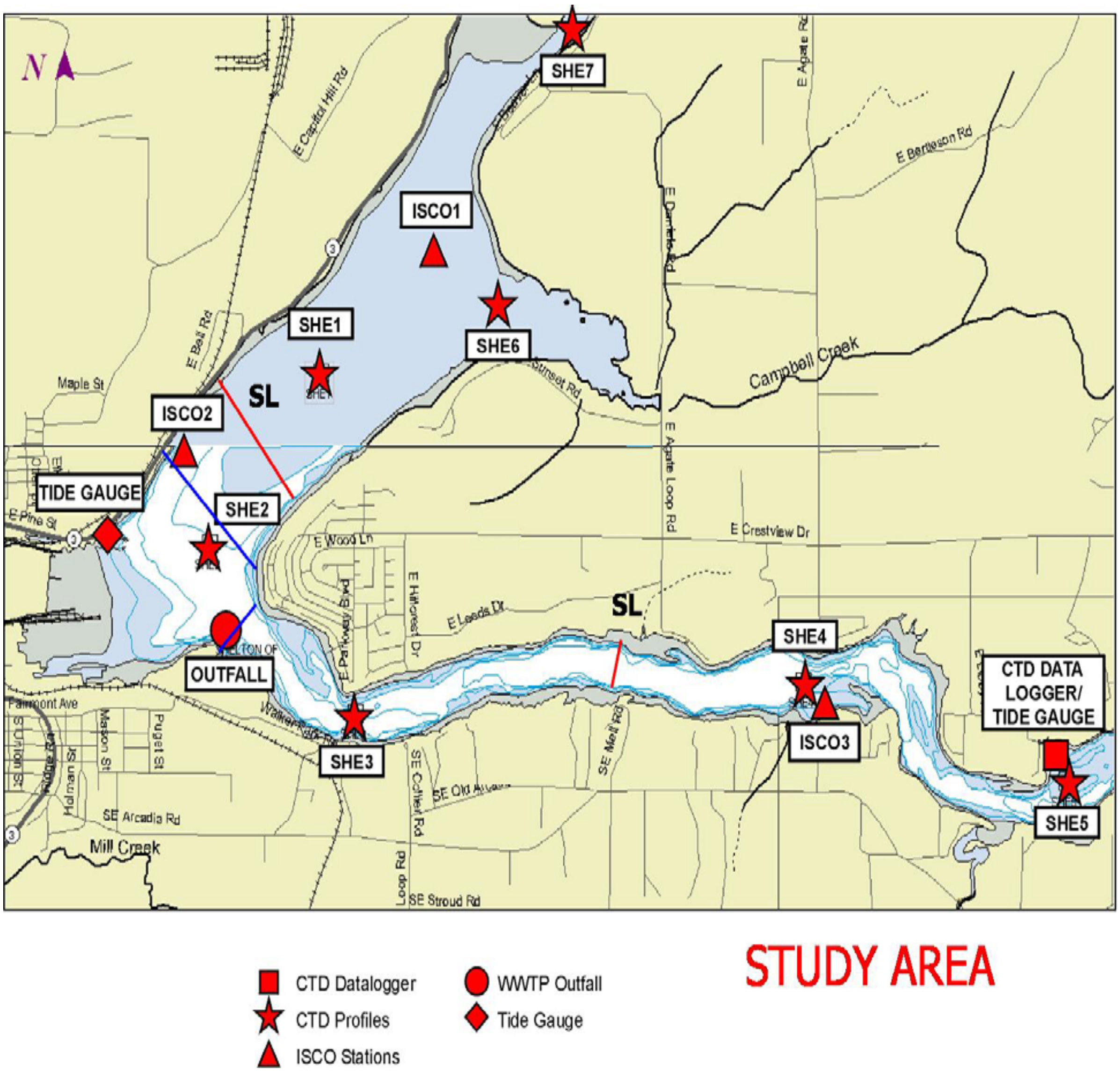
Figure 5: The Oakland Bay – Hammersley Inlet study area.



Source: Department of Ecology 2004.

The outfall location is indicated with a circle, the sanitary lines (Oakland Bay and Hammersley Inlet) demarking the closure zones for shellfish harvesting are indicated as red lines on either side of the outfall.

Fecal Coliform

The use of fecal-coliform (FC) bacteria as a standard was adopted in 1979 (EPA, 1979). This group of bacteria was thought to relate more directly to pathogens associated with warm blooded animals than a measure of total coliform bacteria which was the standard previously in use. The fecal coliform group is primarily composed of Escherichia coli and Klebsiella. The Escherichia coli are normally an intestinal organism associated with human fecal waste.

The presence of fecal coliform bacteria in water is commonly used for measuring the bacteriological pollution of water. Coliform bacteria are found in great numbers in the feces of human and other mammals. Most coliform bacteria are not harmful but the presence of large numbers of these bacteria in water indicates contamination by untreated feces.

As stated in chapter two, the surface waters in Oakland Bay in the vicinity of the outfall are classified as a Class A marine estuarine. The Class A water standard for fecal coliform is 100 colonies per 100ml (milliliters) of water. It means when water samples are collected, not more then 10 percent of the samples collected can exceed a mean value of 200 colonies per 100ml in Class A water (Pickett, 1994).

Three major studies and numerous sampling indicated that Oakland Bay and some of its tributaries (see pages 8-10) have failed to meet water quality standards. Data from Mason County Health Department recorded fecal counts ranging 30 to 220 fecal coliform per 100 ml in Oakland Bay. High level of fecal coliform bacteria caused both Hammersley Inlet and Oakland Bay to be listed on the 303(d) list of impaired and threaten shellfish water bodies (Washington State Department of Ecology 2007).

Despite wastewater plant impact, there are other sources of fecal coliform discharge in Oakland Bay. Both city and industrial stormwater sources impact water quality in the creeks and the inner bay. This is supported by the fact that bacteria concentrations increase with distance downstream and with the rain events. It is expected these impacts would be more significant during a typical wet weather period. The 1988 study identified Shelton Creek and Goldsborough Creek as not meeting Class A water quality standards, and both are important fecal coliform bacteria loading sources to the inner harbor (Department of Ecology, 1988). Shelton Creek appeared to have higher concentrations and more affected by rain events than Goldsborough Creek.

Shelton Creek and several tributaries of Oakland Bay were placed on the federal 303(d) list (1996, 1998, and proposed 2002/2004) for not meeting state water quality standard for fecal coliform bacteria (Department of Ecology, October 19, 2005). Therefore, in accordance with the Federal Clean Water Act, total daily maximum loads (TMDLs) for fecal coliform bacteria were studied by Department of Ecology. The field work identified effluent from leaking septic tanks as a significant contributor of bacteria into Shelton Creek (Department of Ecology, 2006).

Part two- The Impact of Poor Water Quality on Marine Life in Oakland Bay

Oakland Bay is a well-developed estuary characterized by estuarine emergent wetlands with deep pools that provide quality habitat for juvenile salmonids. About 74 acres of this area are protected within a Natural Area Preserve managed by the Washington Department of Natural Resources (Taylor et al. 1999).

The Oakland Bay and its tributaries are important for fish such as Chinook, Coho, Chum, Steelhead, Cutthroat Trout and different kinds of shellfish. In 1998 the state legislative session produced a number of bills aimed at salmon recovery. Engrossed Substitute House Bill (ESHB) 2496 (later codified to RCW 77) was a key piece of the 1998 Legislature’s salmon recovery effort, with the focus directed at salmon habitat issues. Since 1998, several studies indicated poor water quality impacted marine life in Oakland Bay and its tributaries.

In 2000 the Squaxin Tribe conducted numerous samplings throughout Puget Sound. They found wild stocks of anadromous fish species are in the worst condition in the Oakland Bay tributaries especially in Goldsborough and Shelton. Other rivers which empty into Oakland Bay have been documented to have problems with low dissolved oxygen and high temperature level in late summer and early fall (Squaxin Island Tribe 2002, unpublished work).

In 2002 North Thurston Conservation District conducted a study on Samonid Habitat Limiting Factors in Water Resource Inventory Area 14, Kennedy-Goldsborough Basin. This report describes the inventory of different types of salmonid in the Kennedy-Goldsborough and Shelton Creek Basin (Michael Kuttel, Washington State Conservation Commission. November 2002). Table 1 illustrates the decline of salmon in Goldsborough and Shelton creek.

In 2005 South Puget Sound Three-Year Freshwater and Near shore Implementation Priorities conducted a study about Samonid Habitat Limiting Factors Water Resource Inventory Area 13, 14 and 15. The region encompasses the extreme southwest terminus of Puget Sound, including three quarters of a mile of the Malaney Creek, forested Oakland Bay estuary, eighty acres of forest and meadow, and two thousand feet of forested marine shoreline on Oakland Bay. This report describes the salmon populations have been decreasing in this region, and identify specific recovery actions for this specific geographic area.

Table 1: Chum Escapement to Oakland Bay/Hammersley Intel 1987 to 1998.

Year	Mill Creek	Goldsborough Creek	Shelton Creek	Johns Creek	Cranberry Creek	Deer Creek	Malaney Creek	Uncle John Creek	Campbell Creek
1987	5,383	13,741	1431	7,800	4,345	629	42	0	2
1988	4,391	16,132	1,100	9,068	6,578	2,821	3	2	NS
1989	840	5,679	1,242	15,176	5,802	1,346	11	1	NS
1990	6,717	1,502	913	9,031	6,125	1,790	36	NS	NS
1991	2,200	2,708	1,085	7,823	2,296	1,091	23	NS	NS
1992	16,469	2,263	28	10,066	4,490	2,512	11	NS	NS
1993	16,373	4,872	749	9,242	5,693	3,750	0	6	NS
1994	15,437	1,302	101	6,282	5,609	2,544	NS	NS	NS
1995	1,233	2,378	100	4,309	3,401	1,421	0	NS	NS
1996	29,369	546	2	8,996	2,394	2,746	NS	NS	NS
1997	5,811	393	44	3,077	5,115	1,036	0	NS	42
1998	NS	NS	NS	12	NS	NS	NS	NS	NS
Mean	9,475	4,683	527	7,574	4,713	1,971	14	2	22

Data source: Taylor et al.2000. Note: NS = No survey data.

The highlighted numbers illustrates the enormous decline in the number of salmon.

Fish Habitat

Fish and shellfish are affected by a number of factors, which include low dissolved oxygen, turbidity, and high water temperatures. Fish require a minimum dissolved oxygen concentration of 5 mg/L (also read as [ppm] or parts per million) for survival (Bjornn and Reiser, 1991). Washington State water quality standards require a value of 8 mg/L of DO for protection of fish resources in Class A waters (WAC 173-201A). Increasing turbidity, from flood event erode stream bank and smothers eggs.. Fish require cold and clean water for optimal survival. Water temperature requirements vary depending upon salmonid life stage and species, but in general, a range of 50-57°F (10-14°C) is preferred. Long-term exposure to temperatures greater than 75°F (24°C) is fatal to salmonid (Bjornn and Reiser, 1991). Therefore canopy loss over large areas can affect water temperature, and negatively effect salmon. Total suspended solids (TSS) refer to the weight of particles including soil, and algae suspended in a given volume of water (Michaud, 1991) which will effect fish in different ways. To protect salmon species the U.S. Fish and Wildlife Service recommends a maximum TSS level of 80 mg/L (Fish and Wildlife Service, 1995). Other water quality parameters including pH, the concentration of hydrogen ions in water, and chemical pollution can also degrade habitat quality.

Water Temperature

Warmer water temperatures affect dissolved oxygen levels by decreasing the solubility of oxygen in the water. Warmer water causes aquatic organisms to increase their respiration rates, which in turn consumes more oxygen. Washington state Class A standards for water temperature in general should not exceed 18.0° C and should support fish migration, rearing, and spawning of cold water fish. When natural conditions in a water body exceed these limits, no temperature increases can be allowed that would raise the receiving waters by more that 0.3º C (Pickett, 1994). Increasing temperature in Oakland Bay is caused by a number of different sources and conditions, such as irrigation return flow, exposed stream segments due to logging practices, loss of canopy cover to the water body, inputs from industrial outfalls, and slow moving water.

As a point source of pollution, the Shelton Sewage Treatment Plant is one of the given reasons for increased water temperature in Oakland Bay. According to the Plant's National Pollutant Discharge Elimination System (NPDES) the effluent temperature from the plant is 20ºC which is more than water Quality standards. In a whole picture the discharge of 2.6(mgd) to 10(mgd) in the wet weather event will increase the Bay's temperature more than 2ºC.

Agricultural and urban run off are major source of non-point pollution in Oakland Bay tributaries. According to the WRIA 14 the summer water temperatures of many rivers in the Oakland Bay basin approached or exceeded temperature limits for Class A standard. For example Shelton Creek water temperature during August was ranging from 18.8°C to 21.5°C (65.8°F to 70.7°F). Also daily maximum water temperatures at Goldsborough Creek exceeded 18.0°C nearly every day from July through September in 2000, 2001, 2004, and 2005; often reaching 22°C to 24°C (Squaxin Island Tribe 2005).

Dissolve Oxygen

A good indicator of water quality is the dissolved oxygen content needed to support aquatic life. This is the amount of oxygen gas dissolved in a given quantity of water at a given water temperature and atmospheric pressure.

When surface water is loaded with biodegradable wastes, there are explosions of aerobic decomposers that reduce the supply of dissolved oxygen so that fish and shellfish die of suffocation. Nutrient rich waters with high nitrogen levels also lead to elimination of sensitive species, which are the least able to cope with adverse conditions. Sensitive species such as sport fish decline because they cannot tolerate low dissolved oxygen levels (Pickett, 1994).

Class A standards for dissolved oxygen should exceed 8.0 mg/l (milligram per liter). Oakland Bay as a whole receives nitrogen from a variety of sources including septic systems, sewage facilities, atmospheric inputs, and fertilizers used on lawns, golf courses, and agricultural areas. The nitrogen from these sources is conveyed to the Bay by effluent outfalls, streams and rivers, overland runoff, and groundwater that drains from the land (Kuttel, 2002).

Department of Ecology identified sewage treatment facilities, together with the Simpson Company, are the principal source of nitrogen entering the Bay (South Puget Sound Three-Year Freshwater and Near shore Implementation Priorities, 2005). Although studies conducted by the Department of Ecology have shown Oakland Bay's dissolved oxygen levels currently comply with water quality standards. The population in this area continues to increase, in turn the wastewater production from residential, commercial, and industrial sources will increase too. These increases will raise Oakland Bay's nitrogen level lower dissolved oxygen levels.

For the most part, detrimental effects from the discharges of sewage treatment facilities are localized near the sites of discharge. These effects are most acute when the discharge occurs in poorly flushed areas.

Septic systems are also a significant source of nitrogen for Oakland Bay. Septic systems release large amounts of nitrogen as ammonia, which is rapidly transformed to nitrate in the presence of oxygen in groundwater. In general, nitrate in groundwater flows great distances without attenuation (or dilution) and with little chance of uptake by plants. In rural agricultural areas more nitrogen may be contributed by fertilizers and animal wastes than by septic systems (Washington State Department of Ecology, 1999).

Biochemical Oxygen Demand

Microorganisms such as bacteria are responsible for decomposing organic waste. When organic matter such as dead plants, leaves, grass clippings, manure, sewage, or even food waste is present in a water supply, the bacteria will begin the process of breaking down this waste. When this happens, much of the available dissolved oxygen is consumed by aerobic bacteria, robbing other aquatic organisms of the oxygen they need to live.

Biological Oxygen Demand (BOD) is a measure of the oxygen used by microorganisms to decompose this waste. Nitrates and phosphates in a body of water contribute to high BOD levels. Nitrates and phosphates are plant nutrients and can cause plants and algae to grow quickly. When plants grow quickly, they also die quickly. This contributes to higher levels of organic waste in the water, which is then processed by bacteria, resulting in a high BOD level. When BOD levels are high, dissolved oxygen levels decrease because the oxygen available in the water is being consumed by bacteria.

Since less dissolved oxygen is available in the water, fish and other aquatic organisms may not survive.

A Class A standard for BOD is 30 mg/l per month. But according to the Waste Water Treatment Plants data monthly average BOD in Oakland Bay varies in from 30 mg/l to 328 mg/l, and during an upset event it exceeded up to 450 mg/l. The Hammersley Inlet's BOD showed to be very vulnerable because of slow moving currents, which retard air transfer and prevent vertical mixing (Fact Sheet for NPDES Permit, 2001).

Toxic Chemicals

The Water Pollution Control Federation's <u>Chlorine of Wastewater</u> (1976) states that a properly designed and maintained wastewater treatment plant can achieve adequate disinfection if a 0.5 mg/l chlorine residual is maintained after fifteen minutes contact time. Thereby, state and federal governments regulate the discharges of sewage treatment facilities through permits granted under the National Pollutant Discharge Elimination System. If an industry tied into the system is known to produce toxic materials, or if there has been contaminant problem identified in the past, the permit may also contain chemical-specific limits, so that special attention can be focused on the contaminants of concern.

The main source of toxic pollution in the Oakland Bay is the Shelton Sewage Treatment Plant. The facility use chlorine to disinfect the wastewater. At present the average number of bacteria in treated wastewater discharged into the bay is around 5,000 per 100 ml. it is impossible to consistently reduce the number of bacteria below an average 5000 per 100 ml with only Using natural technique. Therefore, the facility uses chlorine to disinfect the waste water (Department of Ecology, 2002).

Oakland Bay and its tributaries are classified on Washington State's 303(d) list because, of past contamination and a high level of chlorine use by the Wastewater Treatment Plant (Department of Ecology, 2007). According to treatment plant data, the corresponding weekly average of chlorine usage is 0.75 mg/l. This exceeds water quality limits by 0.25 mg/l.

Although chlorine is an efficient and cost-effective means of disinfection, there is concern that chlorine residuals in wastewater discharged into the Oakland Bay may have detrimental effects on the long-term viability of the ecosystem and a negative impact on marine life and human health. According to the WIRA, the populations of salmon and some varieties of shellfish have declined by one-fifth over the last decade in Oakland Bay's tributaries (Konovsky 2002, personal communication).

Research shows decrease of salmon stocks and shellfish is attributed to a long banned class of industrials chemicals and toxins which had been use for decades by timber companies, mills and pulp production. These chemical have penetrated into the sediment at the base of the Bay and unfortunately do not dissipate and will stay for ever. Tribes along with Department of Ecology are trying to figure out ways to remove these chemicals from the food chain. Scientists believe that tiny animals that live in the sediment are first in the food chain to be contaminated. They are then eaten by larger animals. At each step, the eater takes in flesh contaminated with toxins. Wastes are excreted, but the toxins remain. It seems once incorporated into the food chain, is impossible to remove the toxin (Washington State Department of Fish and wildlife, 2006).

In summary, according to three independent studies conducted by Washington State Department of Ecology, DSHS, and DOH Oakland Bay suffers from high level of fecal coliform bacteria and toxics. The studies indicate a history of contamination in the Oakland Bay. Stemming from the industrialization of timber industry and the average growing demands of the sewage treatment plant are increasing contamination of non-point discharge into the creeks and the inner Bay.

Data from DSHS in 1988 indicated high concentration of fecal coliform bacteria close to the Simpson Timber Company. In addition the facility had been discharging industrial runoff at many points of the inner harbor, Goldsborough and Shelton Creeks without any regulations. 2002, Department of Ecology fined Simpson Timber Company for $16,000 because 71 gallons of soluble lube oil spilled into Oakland Bay. The plant has had 13 previous spills in the past six years, four of which involved oil that spilled inside their building and then into the bay (Washington State Department of Ecology in April, 2002).

The Shelton sewage treatment facility has been a significant source of pollution in Oakland Bay. Nitrogen from this facility impacts the receiving waters, especially in the areas of slow moving currents such as Hammersley inlet. All three studies identified the Shelton treatment facility as the top source of fecal coliform contamination in the Bay. As population in Mason County grows, there will be a need to expand the treatment capacity; however, as it stands, the existing facility cannot sufficiently treat more without increasing its discharge of contaminates into Oakland Bay.

In the next chapter I will discuss problems with the existing treatment plant and the consequences of non compliance with Federal Water Pollution Control Act. I will also discuss issues concerning the proposal of extending coverage to additional areas without updating the current treatment system. Advocates and opponents of this regional project will be highlighted along with their direct concerns.

4: Shelton Waste Water Treatment Plan

All sewage facilities cause, or have the potential to cause, local declines in water quality. In many instances, sewage treatment facilities have caused regional declines in the health of many coastal ecosystems. The type of treatment provided, the location of the discharge, and the types of wastes collected by sewers are critically important to the impacts made on these costal areas.

The Federal Water Pollution Control Act of 1972 required that, by 1983 (later adjusted to 1988), sewage treatment facilities that discharge to surface waters must provide a secondary treatment through biological processes that remove a minimum of 85% of the organic matter.

The sewage treatment facility plan discharge as point sources under the National Pollution Discharge Elimination System permit (NPDES) process. Section 402 of the Federal Clean Water Act created a permit process where discharging is allowed by the State of Washington and Environmental Protection Agency (Findley& Farber, 1996).

Sewage treatment Plant and Process

Sewage treatment technology exists in three incrementally more sophisticated forms. Primary treatment simply removes solid materials form wastewater by letting them settle. Solids settle with little of no mechanical or chemical processing. Secondary treatment is a biological process in which bacteria are injected into the waste water. These microorganisms consume the high nutrient solids in the sewage, producing slurry-like sludge with a low solid content. Finally, the tertiary treatment is a chemical process in which lime, organic polymers of aluminum and iron salts are added to the sewage to remove unwanted nutrients such as nitrates and phosphates (Environmental Protection Agency, 1984: 3).

The City of Shelton owns and operates secondary treatment plant which is located in the southern part of Hammersley Inlet that utilizes an activated sludge process. This plant's preliminary treatment consists of two processes, scum removal and pumping, and aerated grit removal and dewatering. The treatment process consists of two 1.1 million gallon oxidation ditches. Wastewater flows from the oxidation ditches by gravity to the secondary clarifiers which feed, peripheral overflow units. Scum is then removed by surface scum skimmers. The effluent then overflows the peripheral weirs to a 16-inch pipe into the chlorine contact channel.

The majority of the Shelton treatment plant was built in 1978 and has not received any significant upgrades or expansions since that time. The City of Shelton experiences excessive infiltration and inflow (I&I) of extraneous water into the sewers during periods of high rainfalls. The I&I flows consume the remaining capacity at the treatment plant to meet the water quality requirements for the treatment process (Cosmopolitan Engineering Group, 2007).

Collection System

The waste water treatment plant is categorized as a major facility, with a design flow of 4.02 million gallons a day (mgd) for the maximum month. Existing wastewater collection system encompasses the majority of the current city limits. The system consist of 4 inch through 24 inch diameter gravity sewers, three small cul-de-sac pump stations and one main pump station and a 1.5 mile force main. According to the NPDES permit issued on October 2, 2002 many of the treatment units are approaching the end of their useful life. Most of the existing piping system is very old, many of the pipes in the downtown area were built in the 1910's; many sewer pipes in the southern part of town were built in the 1940's. Therefore the collection system is in generally poor condition having experienced excessive (I&I) within the last several years. Most of I&I is groundwater which leaks into the collection system through cracks in the underground pipes. Other sources of I&I include surface water entering the collection system from cracks in the pipes and drains into manholes around the city.

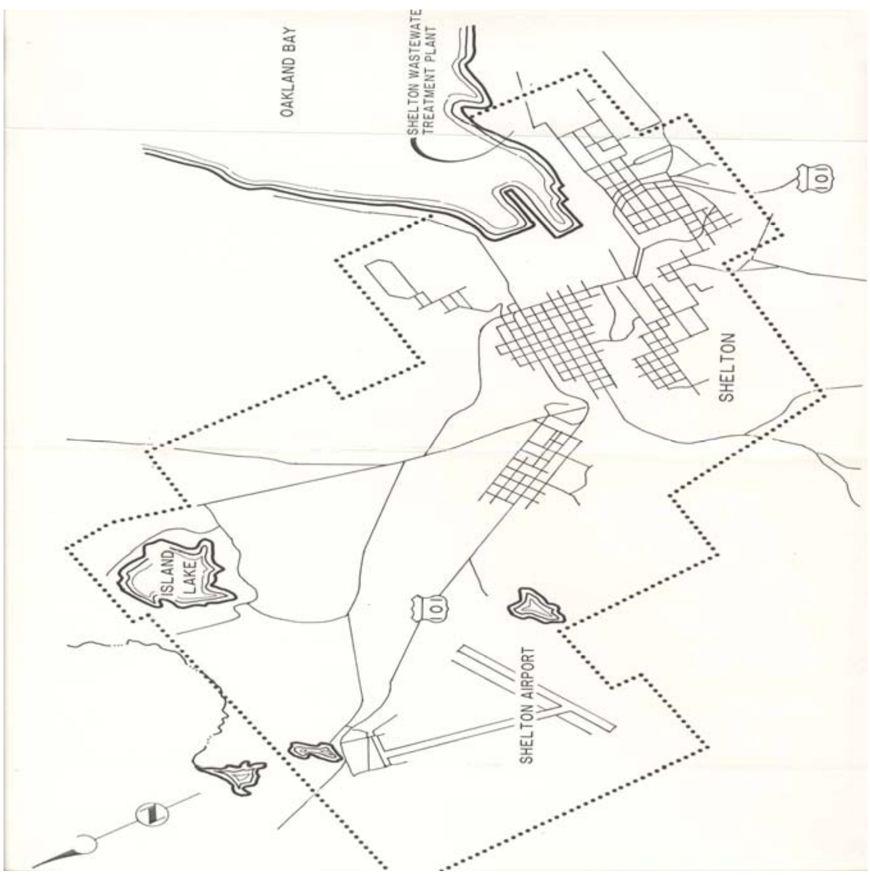
On December 30, 1998 the Department of Ecology issued Administrative Order #DE 97WQ-S182 to the city to complete sewer replacement in Basin 1, Basin 2 and Basin 3. Basin 1 was completed in 1998 and has had a positive effect on loads levels. Basin 2 and 3 has not been completed yet, and are estimated to cost of $25,000,000 (City of Shelton I/I Facility Plan Updated, 1997, EES). Since the city was behind schedule on the order the Department of Ecology plans to issue a new order in conjunction with the issuance of its last permit (City of Shelton 1997 I/I Facility Plan Update).

In 2006 City of Shelton submitted a loan application for $1,000,000 to design the Basin 5 Sewer Rehabilitation Project from the Department of Ecology's and State revolving Fund (SRF). In April of 2007, the City was notified that they would receive the resulted funding, with completion of the necessary paperwork. The money should be utilized to pay for the design of this project. Basin 2 and 3 still requires major repairs to the administrative order from DOE to remove the I&I from the sewer systems (Roth Hill Engineering partners, LLC 2007).The treatment plant has reached the capacity of its solid waste treatment system. The City of Shelton has recently received a loan in 2002 for expanding the existing solids handling capacity of their wastewater treatment facility. The Regional Task Force has chosen to pursue Class "A" biosolids treatment facility for the Regional System, which may also include sludge generated at Mason County operated treatment plants. Class "A" biosolids will use for variety of agricultural purposes (John Delton, 2002).

Stakeholders for Expanding Coverage the Shelton Waste Water Treatment Plant

As the population in the Mason County and Shelton grows, there will be a need to expand the capacity of existing facilities or to create new ones. The existing treatment plant is design to ultimately serve the grid area shown on figure 7.

Figure 7: Shelton Waste Water Treatment Plant



Source: Ron Robinson and Mike Price (Washington State Department of Ecology).

Captain: primary map of the waste water treatment plant.

With the anticipated growth, advocates propose to expand the sewer system area, to cover the Washington Correction Center (WCC), Washington State Patrol (WSP) and the Port of the Shelton. The advocates for the expansion project include the City of Shelton, Mason County, the Port of Shelton, the Washington Correction Center and the Washington State Patrol Academy, while the opponents are shellfish growers and Squaxin Tribe.

The following agencies have participated in the planning process discussions:

- Washington State Department of Health (DOH)
- Washington State Department of Ecology (Water Resources and Water Quality)
- Washington State Department of Community Development
- City of Shelton, staff and elected officials
- Port of Shelton, staff and elected officials
- Washington State Department of Corrections
- Washington State Patrol
- Mason County Planning, Utilities, and economic Development Council, and elected officials

Port of Shelton

Established June 4, 1957, the Port of Shelton district is a municipality of the State of Washington. Chartered for economic development, the Port of Shelton has 9600 registered voters and almost 15,000 people living and working in the port district. In 1988 city invested $1,000,000 to improve its two premier properties and attract long-term commercial/ industrial developments. Currently the city has problems with state building permit moratoriums due to an inadequate sewer system. The Port uses septic tank and drain field systems. These systems are very limited in expansion capability, and are unable to remove nitrates -which eventually infiltrate into the water table.

Washington State Correction Center

The Washington Correction Center (WCC) operates a tertiary wastewater treatment plant. Components of the existing facility are over 30 years old. The effluent disposal spray fields were designed as an interim measure until connection to a regional sewer system was available. The disposal method requires a very high level of treatment, and a correspondingly high level of monitoring and operation certification. Due to growing requirements for operating and maintaining a wastewater treatment system, it is likely to be more cost effective for WCC in the future to operate their own treatment facility (Gray & Osborn, Inc, 2001).

Washington State Patrol Academy

Washington State Patrol Academy located on the Dayton-Airport Road north of Shelton, this facility sits on 190 acres of ground adjacent to Sanderson Airport. The academy has classroom accommodations for 150 students and dormitory space for 68 students. The complex contains driving courses with vehicle skid pan, a firing range, a gymnasium, water training tank, staff office and conference room it's completion was completed in 1989. The academy also operates septic tank and drain field systems. These systems are also very limited in expansion capability, and are unable to remove nitrates, which eventually infiltrate into the water table.

Squaxin Tribe

Prior to the arrival of European settlers, several tribes of Native Americans were the principal inhabitants of South Puget Sound. The Squi-Aitl lived along Eld Inlet, the Sawamish/T'Peeksin lived along Totten Inlet, the Sa-Heh-Wa-Mish lived along Hammersley Inlet, and the Squaxin lived along Case Inlet. The waters of South Puget Sound were very important to their cultures. Salmon and shellfish provided food, while the numerous inlets provided travel routes via canoe. The Squaxin tribes were maritime people who have lived and prospered along the shores of Oakland Bay for thousands of years. Squaxin leaders signed the Medicine Creek Treaty with the U.S. Government in 1854, reserving the right to hunt, gather and fish at all usual and accustomed places, including Oakland Bay. As a result, Tribal scientists now manage natural resources in Oakland Bay with the State of Washington. The Federal government also maintains a trust responsibility for Tribal interests in Oakland Bay (Squaxin Island Tribe, 2007). Therefore, fishing has remained important to them economically and culturally. The tribes are also actively engaged in shellfish harvesting in various parts of South Puget Sound.

Shellfish Farmers

Shellfish are an integral part of the Mason County history and economy. The rich waters of southern Puget Sound and Hood Canal have produced shellfish for centuries. First used by local Indian tribes as an essential part of their diet, the early pioneers found shellfish to be a highly desirable commodity.

Currently, Oakland Bay is one of the most productive commercial shellfish growing areas in the country. Much of the nation's manila clam harvest is grown there, as well as high-value oysters. Approximately three million pounds of clams and 1.8 million pounds of oysters are harvested yearly. There are 21 shellfish growers in Oakland Bay in addition to the Squaxin Island Tribe. Some of the areas of public and private beaches support recreational shellfish harvesting. Approximately 2000 recreational harvesting licenses are obtained for the area each year (Environmental Health, Mason County Public Health, 2007).

The Washington State Dept. of Health is responsible for establishing shellfish closure zones for all existing and proposed outfalls anticipated impact the state's shellfish beds. Therefore any extra pollution will cause extended shellfish bed closures. The shellfish as filter feeders may actually benefit from the nutrients in fecal matter washed into the sea. However, people who consume the shellfish are adversely affected. Public health agencies will declare shellfish, from such polluted waters, unsuitable for collection and sale. Shellfish growers must wait for the appropriate government agency to determine the source of the fecal contamination and take action to stem the flow. Weeks, months, and years may pass before a shellfish beach is recertified as safe. In the meantime, growers must find other locations for raising shellfish or seek supplemental sources of income until conditions change.

A comprehensive study recently conducted by the Washington State Health Department, the Federal Food and Drug Administration, Washington Department of Ecology, and the City of Shelton shows that sufficient mixing and dilution of the existing discharges from the Shelton Sewage Treatment Plant occurs in Hammersley Inlet to meet an "approved" classification in this specific area. The scientific study was also supported in part by the shellfish industry in Oakland Bay. The only approved area for shellfish harvest is on the south shoreline of the inlet between Bay view Road and Mell Road. Due to discharge from the treatment plant, shellfish harvest remains prohibited in the southern portion of Oakland Bay area near Shelton (Frank Meriwether, Environmental Engineer at the Department of Health, 2008).

In November 2007, the Washington State Department of Health restricted the north end of Oakland Bay for shellfish harvesting. The restricted classification means that direct harvest of shellfish is not allowed. Shellfish must be moved to an "approved" or "conditionally approved" area to cleanse and become safe for human consumption before it is harvested. One shellfish grower is currently affected by this restriction. While other areas of Oakland Bay still remain in an unchanged status; this reclassification of the end of Oakland Bay could be an indicator of widening water quality problems that may eventually affect many other growers and citizens who use the bay.

Future Project for Shelton Waste Water Plan

In 2001, City of Shelton employed Gray & Osborn, Inc Consulting Engineering to design a research project to identify potential long term regional solution for wastewater treatment that accommodates growth and economic development of the area. Wastewater production was projected for year 2020 based upon an annual growth rate of 2.0 percent, which is the historical growth rate in Shelton.

Table 2 was completed by the engineering firm, and illustrates all capacities for the projected regional wastewaters flows and loading (Gray & Osborn).

Table 2: Regional System Wastewater Projections (2020)

	Maximum Month Flow (mgd)	**Peak Hour Flow (mgd)**	**Maximum Month BOD Loading (Ibs/day)**
City of Shelton (existing)	5.81	11.01	2200
City of Shelton (UGA and growth)	0.78	1.91	1439
Washington Correction Center	0.47	1.14	1360
Washington State Patrol	0.09	0.25	163
Port of Shelton	0.07	0.19	123
Total	**7.22**	**14.49**	**5284**

Sources: Gray & Osborn, Inc. Consulting Engineers, 2001
Caption: Gray & Osborn, Inc has been selected to prepare a pre-design report to assess the condition of an existing and future sewer system capacity for the Shelton Wastewater Treatment Plant.

In conclusion, water legislation in America started in June 20, 1938 with the Rivers and Harbor Acts, which shows that people have been concerned about water quality issues for years. As time progressed, so did water legislation to deal with the changing pollutants that were being discharged (WRDAs, River and Harbor Acts, Flood Control Acts, 2008). The Federal Clean Water Act established specific goals in 1972. It called for all waters to be fishable and swimmable by 1983 and total elimination of waste being discharged into navigable waters by 1983 (Title 33, Section 1251 [a]). Certain water quality standards were set to achieve these goals with some states, such as Washington, setting more stringent standards.

The city of Shelton needs to be proactive in regards to their waste water treatment system. As population in the Mason County grows, there will be a need to expand the capacity of sewage treatment in the area. Rather than planning additional loads to the already maximized system, focus on the improved operation of the existing system and plans of a future treatment facility are critically important to local and regional water quality. The existing facility is obsolete and has not received significant upgrades or expansions since 1978. In addition the low flushing characteristic of the bay increase the fecal coliform and toxins that accumulates. This significantly impacts the health of the community and often results in lost revenue to the multimillion dollars shellfish industry, which is a staple to the regions economy.

The Clean Water Act seeks to prohibit the discharge of toxic pollutants, provide financial assistance to construct publicly owned waste treatment works, and develop a waste treatment management planning process to assure adequate control of pollution in each state (Title 33, Section 1251 [a]). In this case, if the advocates are looking to increase discharge without repairing the problems of the existing system, while regulators (Department of Health and Department of Ecology) are looking for only the minimum standards to be met; the long term of effect will be extremely costly for both the City of Shelton and State of Washington. Other goals of the Clean Water Act, are aimed to restore and maintain the physical and biological integrity of our nation's waters and protect water quality for fish, shellfish and wildlife, and provide recreation in and on the water (Title 33, Section 1251 [a]). The capacity and condition of Shelton’s waste water treatment system has a tremendous impact to the regions environment, health and quality of life for both people and marine life. These issues should be handled with balance and foresight. The following are some options for consideration to better manage the region's growing wastewater needs.

5: Recommendations

Presented here are five options being considered for increasing Shelton's waste water treatment capacity.

This section will identify a summery of possible benefits and issues for each.

- Discharge More During Summer
- Demand Management
- Reclamation
- Groundwater Recharge
- Combination of Options

Increase Discharging During Summer Months

Discharging more to Hammersley Inlet during summer is currently the treatment plans preferred alternative to meet the community's future wastewater needs. This option also involves increasing discharge released into Oakland Bay.

Oakland Bay is an estuary, a body of water where freshwater flow joins saltwater. The rate at which water flows and mixes within the inlet is very low, particularly during dry weather. Building a satellite or a storage tank to stores extra treated water during winter and discharging it in summer will change biological characteristic of the estuary, harming fish and other aquatic life in the area. The extra discharge will increase the nutrition and temperature, thus changing the level of dissolved oxygen, biochemical oxygen demand and other key water quality factors. Also to include this as part of the solution for handling increased wastewater flows, the treatment facility must renegotiate its existing discharge permit with the Washington State Department of Ecology.

Demand Management

Through a number of measures such as implementing community education and water conservation programs, also by diverting wastewater flows through gray water system or by increasing the number of on site disposal system (septic tanks)the immediate need for increasing capacity of the current treatment system would be diminished. Managing demand in these ways would certainly delay the need for an additional new wastewater treatment facility.

These options will maximize the use of current treatment facilities and reduces or postpones the need for large scale new construction, thus delaying significant capital investments. However, there are potential long term health impacts with septic tanks and gray water systems. Typically, soils in the Oakland Bay area are not considered acceptable for septic systems because of the high clay content in the southern portions of the bay. The northern portions of the basin are limited by gravelly soils that percolate too fast to groundwater sources. Individual property owners would be responsible for permit compliance. Due to local soil conditions and the need for drain fields, conventional on site disposal system are not suitable at urban densities. In addition, operating and maintaining a new wastewater disposal system by private companies could be very costly for home owners.

Reclamation

This option would use treated water for irrigation, non drinking water commercial uses, and industrial purposes. Reclamation will reduce the amount of wastewater being discharged to Oakland Bay and supplement the water supply (LOTT, 2002). However, a reclamation project would require building a new satellite treatment plant and pipelines which would cost an estimated $38,000,000 to construct. This is in addition to the $25,000,000 to replace portions of the deteriorated collection system to reducing inflows and infiltration of stormwater and groundwater that are currently entering the wastewater system (Mason County Press Release, 2008).

There are several points to be considered; besides the enormous expenses. For Mason County the updated treatment plant has to be capable of three times the capacity of the existing plant and be capable of 20% additional buffering capacity for peak demand. For example, if today's demand is 2.9 mgd and the projection for 2020 is 7.22 mgd the new or upgraded facility needs to be able to handle that capacity plus an additional safety factor. In spite of the high cost, the reclamation plant would be highly beneficial. The reclaimed water will reduce discharge of treated wastewater to the marine environment or other surface water in sensitive winter months and would maximize the use of wastewater as a resource in summer months. The State does however restricts and regulates on how reclaimed water can be used. In order to comply with the State restrictions, the plant needs to treat water to Class A Reclaimed Water standards, the highest quality of reclaimed water as defined by the Washington State Departments of Health and Ecology. Class A Reclaimed Water has nearly unrestricted uses, including public contact, but is not considered suitable for consumption.

Ground Water Recharge

Groundwater recharge involves using highly treated wastewater to replenish or "recharge" groundwater supplies for current and future needs. All of the recharge methods require advanced levels of treatment and may require a new treatment plant. New pipelines may also be needed to transport the treated water to a recharge area. There are currently three methods for recharging groundwater:

- Surface application
- Shallow infiltration basins
- Injection wells

The complex nature of groundwater system and high level treatment technologies warrant starting at small scale to safeguard against groundwater contamination. There are no current State standards for groundwater recharge yet, and the State is in the early stages of establishing guidelines. Their efforts focus on using shallow infiltration basins and constructed wetlands for the recharging process. This option provides an alternative to increasing the discharge of treated wastewater into marine environments and poses low risk of groundwater contamination. With the proposed level of treatment, however this option would require building a new satellite treatment plant and shallow infiltration basin which would also require large land area, potentially affecting sensitive habitat.

Conclusion

In order to achieve the goals of The Federal Clean Water Act, repairs to Shelton's existing waste water collection and treatment system need to be made. Even with the needed repairs, the facility operates over capacity and realistically would not meet the projected treatment demands of the near future.

In 2001 LOTT (wastewater Management Partnership) approved to build the first satellite plant in Thurston County on Martin Way. LOTT purchased a 3.38-acre site at 6121 Martin Way to serve as the reclaimed water plant site, and 40.9 acre site along Hogum Bay Road, between 28th and 31st Avenues. About 30 to 35 acres was needed for the constructed wetlands polishing and storage ponds and another 5 to 10 acres for the groundwater recharge basin. LOTT estimated $28.8 million, for building the reclaimed water plant to handle the initial 1.0 mgd, for the Martin Way plant. Designing and building the Shelton ponds and recharge basin to handle the ultimate 5.0 mgd will be considerably more expensive.

It is possible that no single options can meet the growing needs of the region. Thus, some combination of solutions may be best to meet the interim demands and a combination program as a transition to an ultimate long term solution that focuses on a single direction. Even though a reclamation system would incur considerable expense it would benefit the regions economic and environmental health and vitality. Besides improving the current waste water treatment system, it is extremely important to educate the citizens of the community that they have a direct impact on the regions waters. Whether individual household implemented their own water conservation effort, (such as checking for the repairing leaks, installing low flow faucets and shower head or even not letting the water run when brushing their teeth) or just being little more concisencious about the products that end up going down their drain, these efforts all make a difference. In addition the county may need to require septic system owners to have their system inspected regularly and require failing system to be repaired or replaced in a timely manner. There are certainly many things the government and individuals can do to improve water quality for this and other areas.

By recognizing and accepting responsibility for our environment and waters we will hopefully learn from the mistakes of our fore fathers and make decisions to correct our path as we build the foundation for future generations.

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