CENTRAL KITSAP WASTEWATER GMA COMPLIANCE PLAN

Prepared for

Kitsap County, Washington

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CHAPTER 1

1. INTRODUCTION

Kitsap County Public Works Utilities is the lead agency responsible for providing sewerage service to unincorporated Central Kitsap County. The overall goal of providing sewer service is to protect public health and the quality of water resources. The purpose of a wastewater facilities plan is to identify the facilities required to meet these goals under a future anticipated growth level, as influenced by land use zoning.

The wastewater facilities plan provides guidance for the orderly, logical, and cost-efficient implementation of the optimum wastewater collection, conveyance, treatment, and disposal facilities as the area grows toward its anticipated ultimate density. It will serve as a resource to the County to direct new developments with respect to the wastewater infrastructure that each development will need to contribute to the completion of the planned facilities.

1.1 Background

Kitsap County has prepared a number of sewerage planning documents since the 1960s. As development occurred in the late 1960s, dry-line sewers were constructed in anticipation of the addition of County sewerage facilities in the Central Kitsap planning area. The Central Kitsap Wastewater Treatment Plant was constructed and first put into service in 1979. With the installation at the Navy base at Bangor, and significant growth in the Silverdale and Meadowdale areas, this wastewater service area has become the largest sewered unincorporated area within Kitsap County.

The last wastewater facilities plan for the Central Kitsap County planning area was prepared in May 1994 and updated in November 1999. Since then, the Central Kitsap planning area, and the County as a whole, has experienced significant growth. Concurrently, the area served by sewers has also expanded greatly. Therefore, the County contracted the Consultants to make a renewed evaluation of sewerage service to the entire County. This 2008 Central Kitsap Wastewater GMA Compliance Plan presents the Consultant's findings and recommendations for the Central Kitsap wastewater facilities.

To facilitate understanding of terminology in this document, a glossary of commonly used technical terms is included in Appendix A.

1.2 Scope of Work

This Central Kitsap Wastewater GMA Compliance Plan provides an inventory of the complete system of existing collection, conveyance, treatment, and outfall facilities. The total and remaining capacities of the facilities are estimated in this plan, identifying any shortfalls that exist.

The time period applicable for development of wastewater system needs spans the years 2005-2025. Projections of wastewater flows are made at 10-year increments, including an estimate of the ultimate flow expected given the current land use zoning. Based on these projections, the general size, type, and approximate location of facilities required to service the estimated ultimate flows are determined. Scheduling of implementation is based on the 10-year projections.

This document serves as an interim plan until the formal Central Kitsap Wastewater Facilities Plan can be fully completed in the near future. The intent of this interim plan is to focus on collection and conveyance issues, with only an initial assessment of treatment alternatives.

The formal Central Kitsap Wastewater Facilties Plan is underway and this latter document will provide a fuller description and more complete analysis of wastewater system needs, especially at the Central Kitsap Wastewater Treatment Plant

1.3 General Planning Area

The general planning area for Central Kitsap includes those areas in unincorporated Kitsap County from the Hood Canal to the Port Orchard Inlet, and from north of Bremerton up to and including Poulsbo, and those areas within the county that drain toward the Poulsbo collection system. See Figure 1-1 for a vicinity map showing the general planning area under consideration in this Report.

The general planning area is narrowed in scope as physical, regulatory, and jurisdictional considerations are taken into account in Chapter 2. This modified area becomes the study area for which specific recommendations are made.

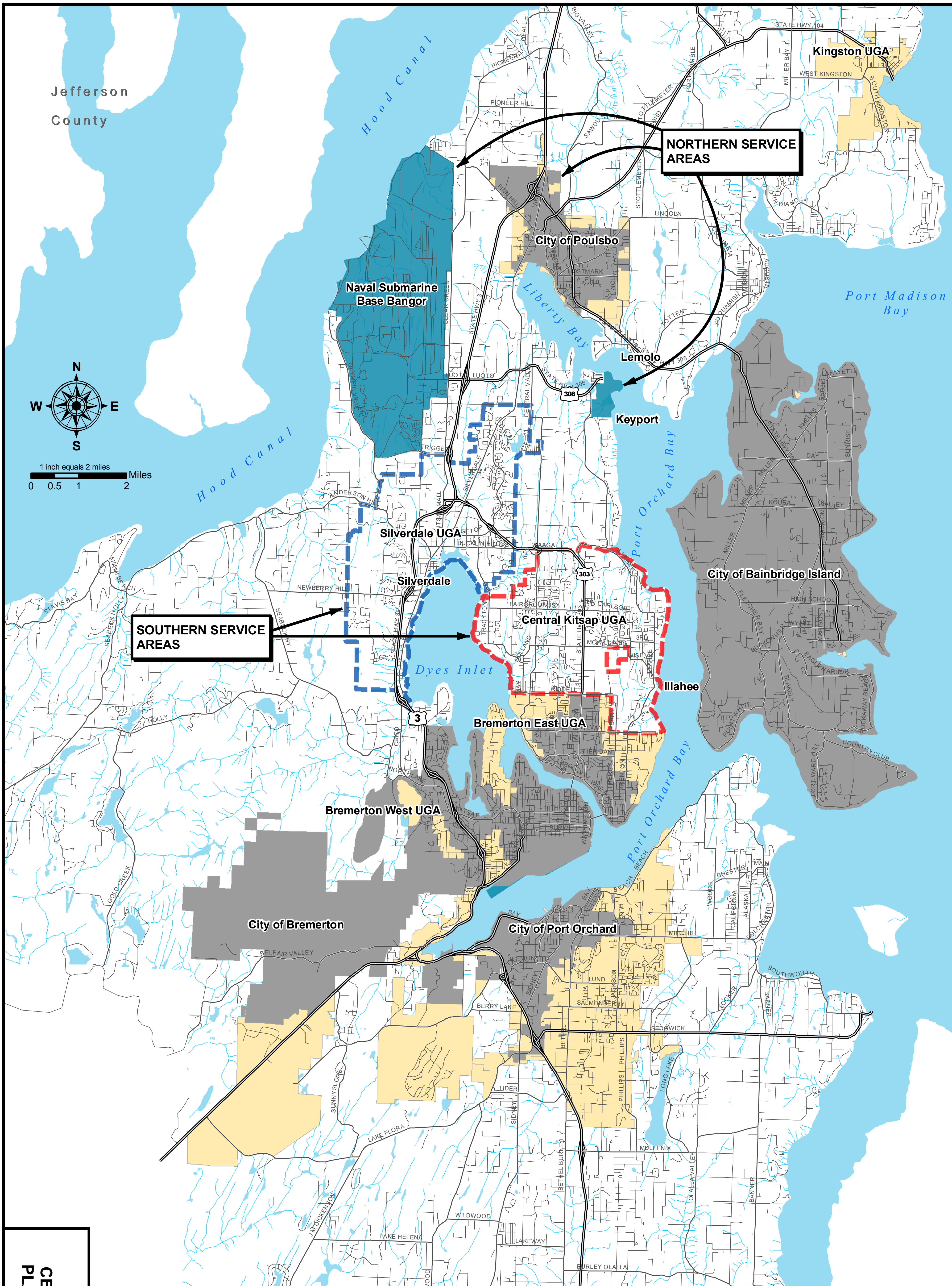

FIGURE 1-1
CENTRAL KITSAP
PLANNING AREAS

LEGEND

- Central Kitsap UGA
- Silverdale UGA
- Urban Growth Areas
- Incorporated City Limits
- Military Locations
- State HWY/Route
- Principal Arterial
- Water Bodies
- Water Courses

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CHAPTER 2

2. PLANNING AREA CHARACTERISTICS

Kitsap County Public Works is the lead agency responsible for providing various levels of sewerage service to the Central Kitsap service areas. These areas generally cover from Bremerton to Poulsbo and from Port Orchard Bay to the Hood Canal. Specifically, these service areas include the Central Kitsap Urban Growth Area (UGA) and Silverdale UGA, Poulsbo City and UGA, the Keyport community, and the Bangor and Keyport Naval Bases. Additionally, septage collected county-wide and biosolids generated at other County wastewater treatment plants located in Manchester, Suquamish, and Kingston are trucked to the Central Kitsap Wastewater Treatment Plant (CKWWTP) for processing and disposal. The locations of the service areas and treatment plants are shown in Figure 2-1, Service Areas and Local Treatment Plants.

The objective of this document is to identify the infrastructure and operational requirements necessary to provide sewerage services to the Central Kitsap Service Area for the 20-year planning period from 2005 through 2025. This chapter presents the physical and demographic characteristics of the planning area, with a focus on those features that are considered or evaluated during the facilities planning process. The information is provided to show the interrelationships between the components of wastewater infrastructure and its community and environs.

2.1 Planning and Service Areas

The Central Kitsap planning area is defined as the communities and areas that receive wastewater services from the CKWWTP. The areas are generally divided into the County-wide, Northern, and Southern Service Areas. The various areas and services provided by the County are identified in Table 2-1 below and described in more detail in the following paragraphs.

Table 2-1. Wastewater Service Responsibilities by Service Area

	Collection System Owner	Owner's Responsibility	Kitsap County Role
County-Wide Service Area			
Septage Haulers	Private	Private Systems	Biosolids Processing and Disposal
Other Treatment Plants	Kitsap County		
Future Facilities by Others	Port Gamble, State Parks MBRs[a], other	To be determined	To be determined
Northern Service Area			
Bangor	U.S. Navy	Conveyance System Capital Costs Treatment Costs Flow Metering	WW Treatment Biosolids O&M of conveyance facilities (outside of Owner's service area in the County)
Keyport Navy	U.S. Navy		
Poulsbo City and UGA	Poulsbo City		
Keyport Community	Kitsap County	Infrastructure and O&M for Conveyance and Treatment	

Southern Service Area		
Silverdale UGA	Kitsap County	Infrastructure and O&M for Conveyance and Treatment
Central Kitsap UGA		
Special Connections		

[a] *MBRs: Membrane Bioreactors*

2.1.1 County-Wide Service Area

The CKWWTP provides biosolids processing and disposal for additional, non-contiguous "service areas." Biosolids from ancillary treatment plants for Suquamish, Kingston, and Manchester are trucked to the CKWWTP for processing. Port Gamble may, in the future, expand its wastewater treatment facilities to accommodate growth. At such time, the County could own and operate the plant or the community could contract to utilize the CKWWTP facility for biosolids management. It should be noted that biosolids may also be received from other smaller WWTPs in the future, such as the membrane bioreactor (MBR) plants being constructed for state parks on Bainbridge Island and Hood Canal.

2.1.2 Northern Service Area

Flows generated in the Northern Service Area are predominantly from areas that have contracted for or been allocated portions of the CKWWTP capacity. The contracted areas are Poulsbo and the Keyport Naval Base. The Bangor Naval Base is allocated capacity and served at straight commercial rates. Each of these service areas is responsible for collection, flow measurement, and conveyance to the County facilities. The Navy flows are not expected to increase over the next 20 years; however, a portion of plant capacity is set aside for the Bangor and Keyport Bases. The Keyport community, with a small served population, is the only residentially permitted flow generator in the Northern Service Area. Keyport is a Local Area of More Intense Development (LAMIRD) and although it is assumed to currently be near ultimate density, future connections are permitted for this area. Future flows from Poulsbo were estimated in the Draft Comprehensive Sanitary Sewer Plan 2007 Update for the planning period 2005 through 2025 (Parametrix, 2007).

2.1.3 Southern Service Area

The Southern Service Area includes the Silverdale UGA, the Central Kitsap UGA, and special connections. Because the County-Wide and Northern Service Areas have limited potential for future expansion, the total plant influent and wastewater flows from the Southern Service Area are the primary focus of collection and conveyance infrastructure requirements for this document. Population allocations and future estimated flows from the Southern Service Area are based on population data from the Kitsap County Department of Community Development. Future growth in the Southern Service Area will drive the majority of the future facility needs for collection, conveyance, and treatment of wastewater that is generated in the CKWWTP service area

2.1.3.1 Silverdale UGA

The Silverdale UGA includes the unincorporated area of Silverdale and is located to the north and west of Dyes Inlet. It includes approximately 7,400 gross acres. Outside of the Silverdale downtown area, which is comprised primarily of commercial uses, the surrounding community is suburban in character and has predominantly single family residential development. The Silverdale UGA boundary is outlined on Figure 2-1

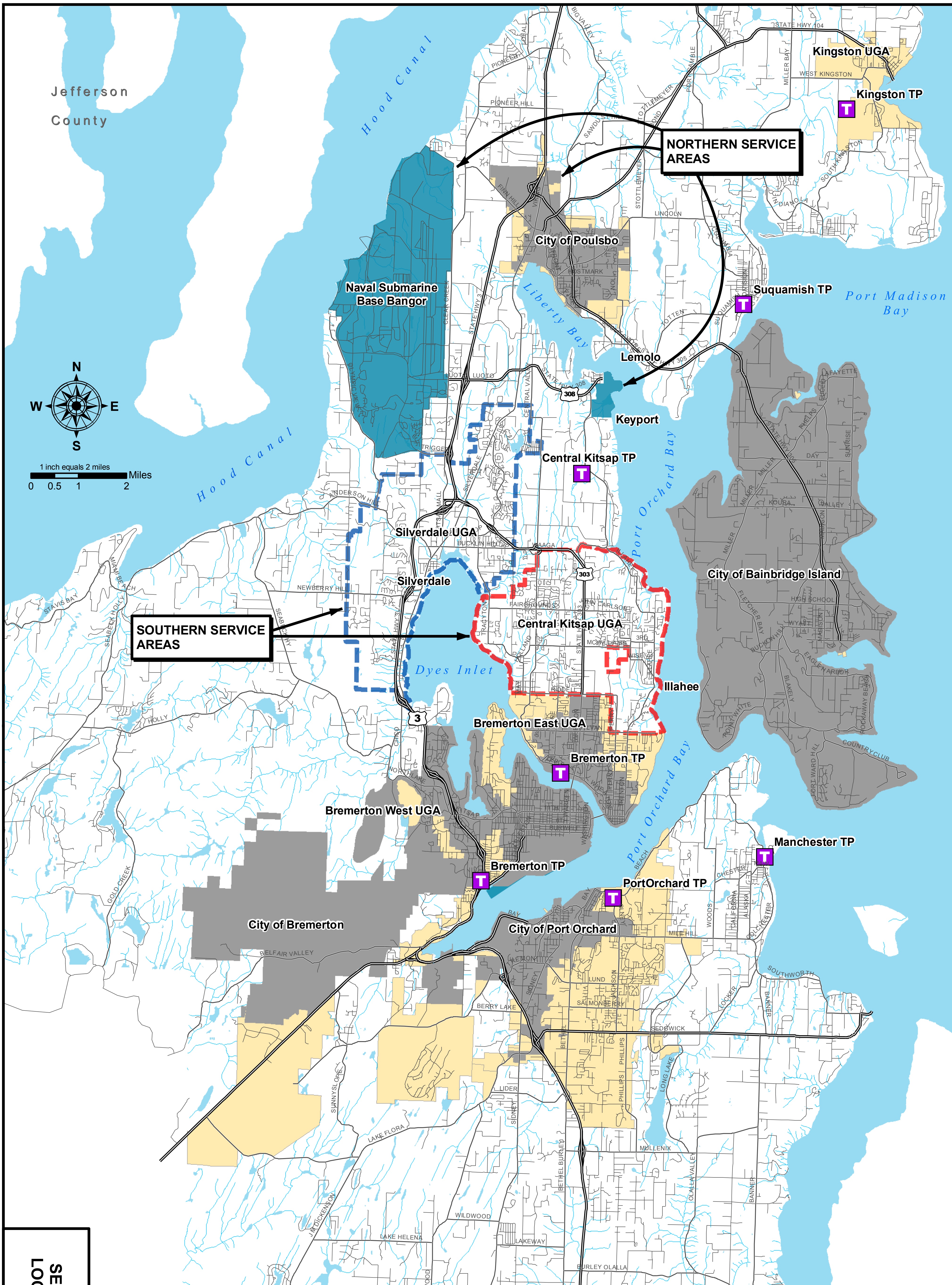

FIGURE 2-1
SERVICE AREAS &
LOCAL TREATMENT
PLANTS

LEGEND

- Treatment Plant
- Central Kitsap UGA
- Silverdale UGA
- Urban Growth Areas
- Incorporated City Limits
- Military Locations
- State HWY/Route
- Principal Arterial
- Water Bodies
- Water Courses

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2.1.3.2 Central Kitsap UGA

The Central Kitsap UGA is located just north of the City of Bremerton between Dyes Inlet to the west and Port Orchard Bay to the east. The Central Kitsap UGA has approximately 6,400 gross acres of area and includes the community of Illahee. It has a predominantly suburban character with commercial uses concentrated along SR 303 which bisects the area from south to north. The Central Kitsap UGA boundary is outlined on Figure 2-1.

2.2 Natural Systems

This section presents an overview of the natural systems that comprise the central Kitsap service areas. Natural systems include topography, precipitation, geology and soils, water resources, and sensitive areas.

2.2.1 Topography

The topography and drainage of the Central Kitsap Planning Area is shown in Figure 2-2. The elevation ranges from a low of 0 at sea level to 500 feet in the planning area, which consists of generally rolling hills.

2.2.1.1 Basins

The boundaries of drainage basins and the topography by which they are defined have an important role in determining the location and size of wastewater conveyance facilities. The hilly terrain of the Kitsap Peninsula divides the area into many drainage basins and smaller sub-basins. While sewage can be pumped anywhere, it is better to minimize high costs of deep excavation, energy, and the total number of facilities to be maintained, by collecting wastewater in common areas to which sewage can flow by gravity.

However, because the hilly terrain of the Kitsap Peninsula divides the area into many drainage basins and smaller sub-basins, a significant amount of pumping is required to provide service to the entire service area. Additionally, where sewage is pumped a vertical distance greater that 150 feet, a second set of pumps is required to “boost” wastewater to higher elevations. This—along with topography, which can place many hills and valleys between the collection point and the CKWWTP—may make it necessary for wastewater to be pumped several times before arriving at the plant.

2.2.2 Precipitation

The Kitsap Peninsula is located partially within the Olympic Mountain rain shadow. More than 80 percent of the annual rainfall in this area typically falls between October and April and is characterized by a moderate and continuous rainfall pattern rather than heavy downpour for brief intervals. August is typically the driest month; the wettest weather occurs in December and January.

Regional historical precipitation data are available from a number of U.S. Geological Survey (USGS) gauging stations located in the area. These data tend to be reliable and extend over a number of years (in some cases over 50 years). However, USGS stations are relatively broadly spaced. For this reason, stations may be too far from a particular location of interest to provide data that are truly reflective of actual conditions. The availability of meaningful precipitation data has increased over the past several years. More and more frequently, monitoring stations are being installed by local public utilities. Kitsap County Public Utility District (PUD) maintains a monitoring station near Silverdale. Total rainfall recorded at this location for the years 2001 to 2006 is provided in Table 2-2.

Table 2-2. Kitsap County PUD Rainfall Records (Silverdale)

Year	Total Rainfall (inches)
2001	33.52
2002	57.40
2003	49.46
2004	50.87
2005	35.52
2006	40.96

Source: Kitsap County PUD Rain gage 62 SW SSWM (Silverdale Wixon Site).

Local precipitation data may be used to analyze and project wastewater flows. Daily rainfall data may be correlated to daily wastewater flows as a means of approximating infiltration and inflow (I/I). As precipitation infiltrates into the ground, raising the groundwater table, and flows into the sewer system through manhole lids, roof drains, or other connections, the response of sewer flow rates may be dramatic. An I/I analysis of the Central Kitsap service areas is included as part of Chapter 3.

2.2.3 Geology and Soils

The dominant geologic unit covering the service area (>60 percent) is glacially deposited till known as Alderwood, an unsorted mixture of silty sand and sandy silt with cobbles and boulders. The till, commonly referred to as hardpan, is very dense, compact, and low in permeability. In the southeastern part of the service area, coarse sandy glacial outwash known as Indianola becomes more prevalent. The Indianola series consists of very deep, somewhat excessively drained soils formed in sandy glacial drift. Additional information on geology, groundwater, and soils characterization is included in Appendix B.

Soil characteristics are important with respect to groundwater quality and the potential for water reuse through infiltration to groundwater. The Indianola series, when located on slopes that are less that 15 percent, may be appropriately considered for water reuse. Areas identified with the Indianola series, as described by the U. S. Soil Conservation Service (USCS) are shown as permeable soils on Figure 2-3, Potential Reuse Investigation Sites. Potential water reuse is discussed further in Section 2.2.4.3.

2.2.4 Water Resources

While this document focuses primarily on the water quality of water bodies that are directly impacted by the discharge of wastewater effluent from the CKWWTP facilities, both groundwater and surface water resources are discussed with respect to their importance, distribution, function, and quality. The technical memorandum, *Central Kitsap County Wastewater Facilities Development Strategy Plan Preliminary Water Quality Issues, BHC, June 2006* (Water Quality Memo), which reviewed readily available and significant reports to identify water quality-related issues for future consideration, is attached as Appendix C.

2.2.4.1 Groundwater and Drinking Water

Groundwater from aquifers represents 80 percent of the drinking water resources in Kitsap County. The Union River Reservoir supplies the other 20 percent (*Kitsap County PUD State of the Drinking Water Supply of Kitsap County*, October 2006). Drinking water wells within the Central Kitsap Service area are shown on Figure 2-4. The following general conclusions should be considered in wastewater planning for the Central Kitsap service areas:

FIGURE 2-2
TOPOGRAPHY AND DRAINAGE

LEGEND

Elevation
High : 1750 ft
Low : 0 ft

Surface Water Drainage Basins
100ft Contours
Central Kitsap UGA
Silverdale UGA
Other UGAs
State HWY/Route
Principal Arterial

Contours generated from LIDAR Imagery Kitsap County 2006
Surface Water Drainage Basins: Kitsap County March 2006
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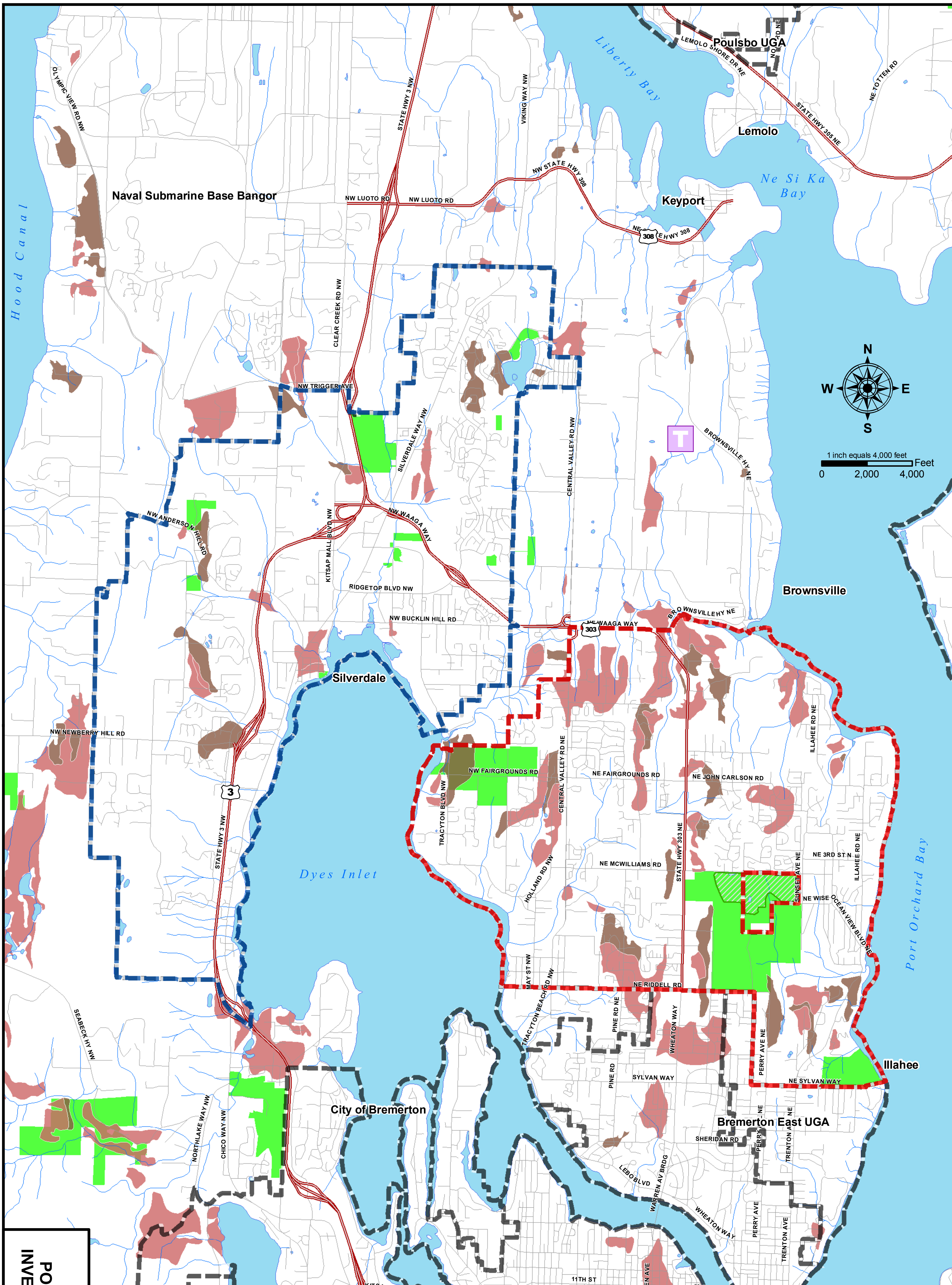

FIGURE 2-3
POTENTIAL REUSE INVESTIGATION SITES

LEGEND

- Central Kitsap UGA
- Silverdale UGA
- Other UGAs
- State HWY/Route
- Street Center Lines
- Golf Course
- Parks
- Wastewater Treatment Plant

Permeable Soils (NRCS)

- 0-6% Slopes
- 6-15% Slopes

Permitted Properties (Sewer Service) - Kitsap County Sept 7 2007

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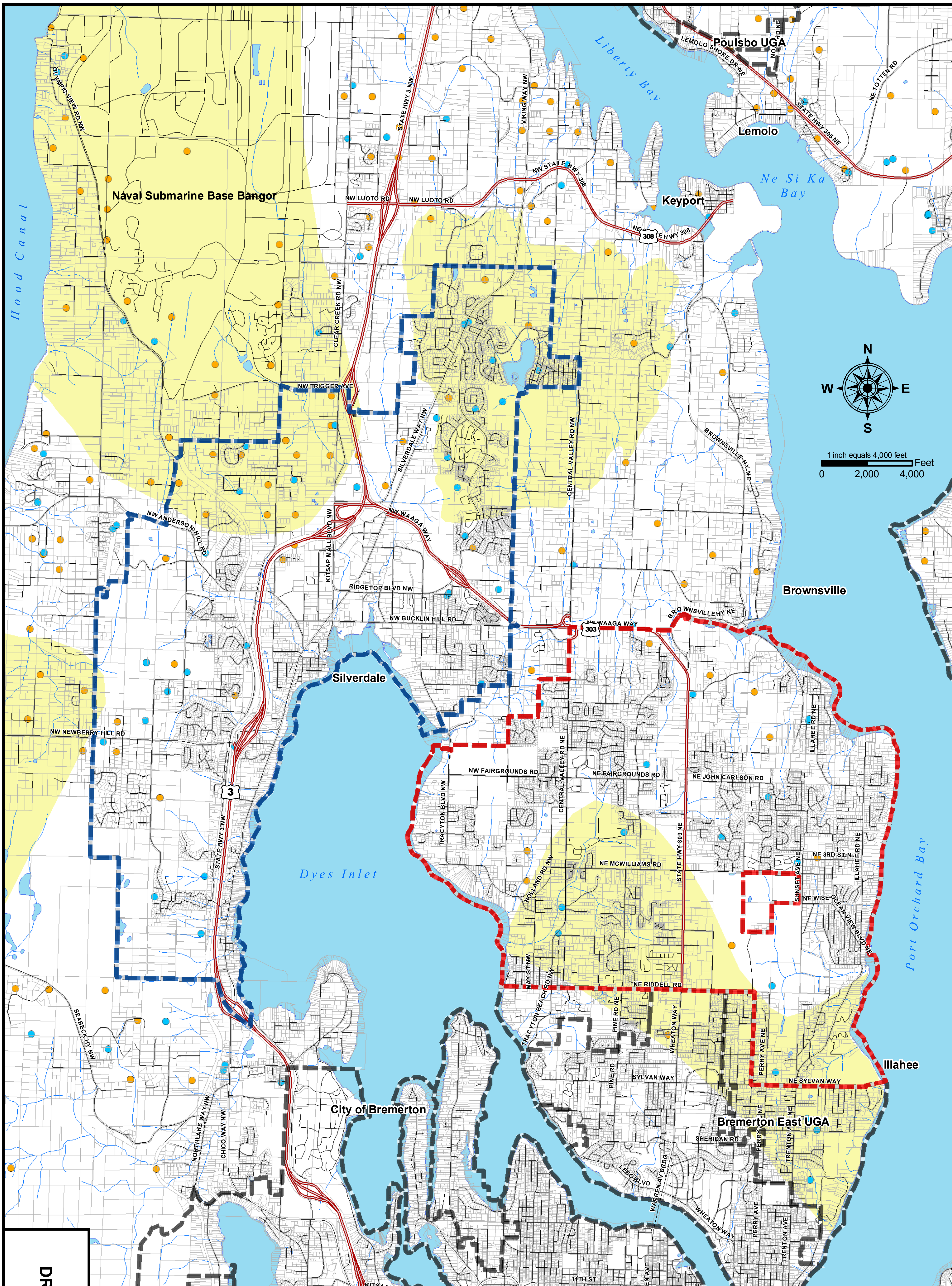

FIGURE 2-4
DRINKING WATER WELLS

LEGEND

- Wells (GroupA)
- Wells (GroupB)
- Principle Shallow Aquifers
- Central Kitsap UGA
- Silverdale UGA
- Other UGAs
- State HWY/Route
- Street Center Lines

Wells and TOT: Environmental Affairs Office, Washington State Department of Transportation 1999-2001
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- Local precipitation is the principal source of groundwater recharge in the Central Kitsap planning area.
- Groundwater recharge occurs primarily in the topographic highlands.
- Recent investigations have shown that groundwater recharge from septic systems represents a sizable proportion of the annual aquifer recharge. This has led to a recommendation that the County encourage on-site septic systems over sewer hook-ups where appropriate densities occur. Based on the Kitsap Watershed (WRIA 15) Water Quality Technical Assessment (June 2003), potential nitrate contamination of shallow groundwater systems may occur at densities exceeding 3.2 homes per acre (500 people per square mile).

In general, groundwater systems in the Central Kitsap Service area can be classified into either shallow or deep groundwater systems. An illustration of the principal shallow aquifers in the planning area is shown on Figure 2-4. Deeper aquifers are generally protected by low permeability units (aquitards).

A water-bearing unit ranging from 200 feet above sea level (ASL) to 200 feet below sea level (BSL) contains the Kitsap planning area's primary water supply source. This unit is referred to in the Kitsap County Groundwater Management Plan (GWMP) as the Qg3 hydrostratigraphic unit. This unit is host for many aquifers currently tapped for water supply, including:

- Bangor Aquifer (ranging from 25 feet ASL to 25 feet BSL.
- Island Lake Aquifer (0 to 150 feet ASL).
- Suquamish-Miller Bay Aquifer (0 to 300 feet BSL).
- Manette-Bremerton Aquifer (0 to 250 feet BSL).

Throughout most of the planning area, deep aquifers are generally well protected from contamination due to surface activities by one or more aquitards. However, the hydrostratigraphic unit is exposed in some areas along the coastline of the southern part of the planning area, particularly around Dyes Inlet and the drainage channels leading to Dyes Inlet. In these areas the primary water source is particularly vulnerable to contamination from surface activities (i.e., septic-tank drainfields).

2.2.4.2 Water Quality

Water quality conditions of ground and surface water bodies are generally excellent in the Central Kitsap service area. Water quality issues do exist for some water bodies—including streams, groundwater, and marine waters—and consist primarily of elevated fecal coliform bacteria counts and nitrogen concentrations relative to accepted criteria based on beneficial uses. Figure 2-5 identifies the monitoring locations and the streams that currently fail to meet the standards within the Central Kitsap service area.

The groundwater and streams issues are, in many cases, related to the failure of older on-site sewage disposal systems. These findings are based on a review of several extensive studies prepared by the Kitsap County Health District (Health District), Kitsap County Surface and Storm Water Management Program, and others. The review was incorporated into the Water Quality Memo (Appendix C). Study findings of water quality issues related to streams and groundwater conditions are summarized below.

- Streams within the CKWWTP service area having degraded water quality and identified by the Health District and Washington State Department of Ecology (Ecology) include Steele Creek, Illahee Creek, and Illahee State Park Creek in the Port Orchard/Burke Bay watershed and Barker Creek, Clear Creek, Mosher Creek, Parmann Creek, and Strawberry Creek in the Dyes Inlet watershed. Streams within the Liberty Bay/Miller Bay watershed identified as having degraded water quality include Big Scandia Creek, Daniels Creek, Dogfish Creek, Dogfish Creek (South Fork), and Johnson Creek . The streams with notable water quality issues are identified on Figure 2-5.

- The Health District has a Pollution Identification and Correction (PIC) Program for remedial activities in high priority areas. Future remedial activities by the Health District should be monitored and coordinated with the Central Kitsap Wastewater Facilities Plan.
- On-site septic systems are recognized as significant sources for recharge of Kitsap County aquifers. Where collection systems are considered in lieu of on-site systems, the impact on potential aquifer recharge needs to be considered.
- Adding recharge areas from satellite treatment systems with land disposal of reclaimed water or the disposal of reclaimed water from the CKWWTP should also be considered when ranking alternative approaches.

2.2.4.3 Water Reuse

RCW 90.48.112 requires consideration of reclaimed water in wastewater treatment plants. Although the law does not specifically require implementation of a reclaimed water alternative, it strongly encourages it. RCW 90.46.005 states in part that to the extent that reclaimed water is appropriate for beneficial uses, it should be used to preserve potable water for drinking purposes.

Water reuse can provide a number of beneficial uses, including irrigation, groundwater recharge, and stream flow enhancement. These uses can have a potential impact on the quality of the receiving water.

A preliminary assessment of the water reuse options for the Central Kitsap planning area was conducted and a methodology for pursuing these options in subsequent planning projects developed. A technical memorandum (Central Kitsap County Wastewater Facilities Development Plan Water Reuse, BC, August 2006) was prepared to review the potential for development of reuse sites. This memorandum is included in Appendix D.

The memorandum recommended that the following issues and alternatives regarding water reuse be further evaluated as part of the Facility Plan development for Central Kitsap County:

- Explore other potential reuse sites not considered in a previous study by Golder Associates, including options for satellite treatment.
- Initiate discussion with the appropriate regulatory agency (Ecology and/or Department of Health) to assess potential effluent limits for discharge to natural and constructed wetlands and groundwater recharge.
- Evaluate land acquisition needs and zoning and purchase required.
- Integrate any needed WWTP upgrade with level of treatment required for the reuse sites.
- Develop additional data on the hydrologic regime, function, and biology of the Steele Creek wetlands and categorize them under the Washington wetland rating system.
- Develop and compare costs of constructing satellite plants to produce reclaimed water with the costs of expanding the existing CKWWTP capacity and adding tertiary treatment.

More recently, the feasibility of water reclamation and reuse will be investigated in 2008 for the Chico area through an Ecology grant offered to the Silverdale Water District.

The County has organized a multi-agency taskforce to discuss the planning, funding, and construction of sewer infrastructure including a review of alternate sewer technologies, their potential applicability in Kitsap County and conceptual locations within the urban growth areas.

2.2.5 Sensitive Areas

Sensitive area mapping is used in the facility planning process to help identify those areas that may or may not be appropriate locations or require special considerations for future infrastructure. Sensitive areas are also used to identify lands that may not be considered developable for other purposes, such as residential structures.

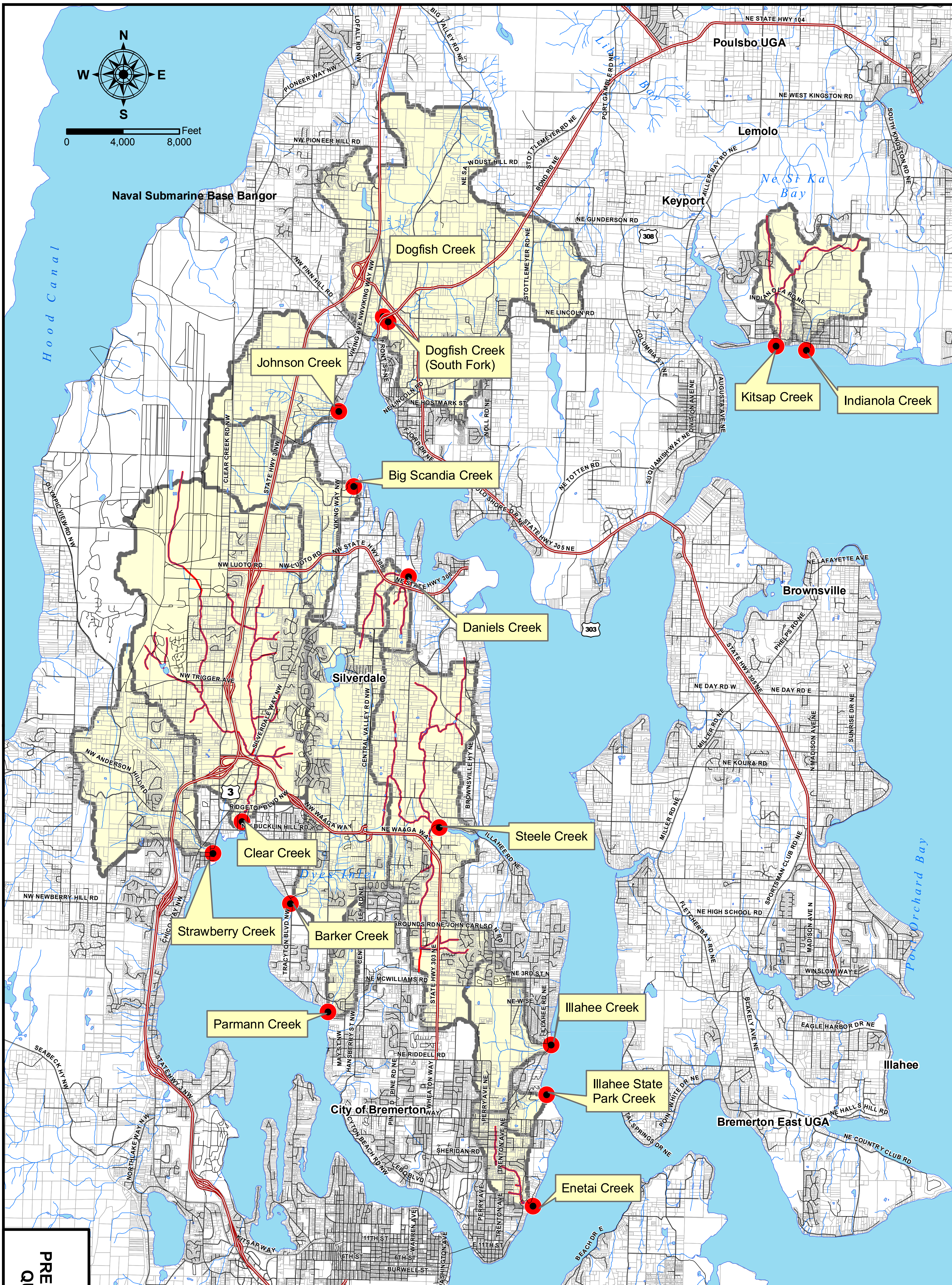

FIGURE 2-5
PRELIMINARY WATER QUALITY ISSUES

LEGEND

- State HWY/Route
- Street Center Lines
- Watersheds
- Failed to meet Water Quality Standard*
- Posted Public Health Advisory*
- Water Bodies

* Based on Kitsap County Health District 2004-2005 Water Quality Monitoring Report

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2.2.5.1 Geologically Hazardous Areas

Geologically hazardous areas are defined as areas of steep slope or unstable soils that are susceptible to erosion or slides. Within the service area, there are three areas with slopes or geological conditions that are classified as high hazard areas. These include slopes along Illahee Creek and Illahee State Park Creek to the south, and slopes along several creeks within the Central Kitsap UGA that flow into Port Orchard Bay near Brownsville. Areas classified as high hazard areas and moderate hazard areas are shown in Figure 2-6.

2.2.5.2 Aquifer Recharge

Many Kitsap County residents depend upon aquifers (groundwater) as their primary source of drinking water. Water pumped from the ground for use by residents is replaced via rainfall or recharge from other uses thorough infiltration. Aquifer recharge areas are characterized by areas of hydric soils above shallow aquifers that allow rain water to infiltrate easily to the groundwater. Critical aquifer recharge areas are locations where contaminants can enter into the groundwater and so must be protected. Figure 2-6 identifies the areas that are designated as aquifer recharge areas (Hydric Soils). These areas are typically found along streambeds and are scattered throughout the Central Kitsap planning area, but are somewhat concentrated along the Clear Creek watershed in the Silverdale UGA.

2.2.5.3 Flood Zones

Frequently flooded areas are defined as lands, shorelands, and waters designated by the Federal Emergency Management Agency that would be flooded during a 100-year storm event. While almost all uses are prohibited within these areas, special care must be taken when locating public utilities and structures within or adjacent to a flood-prone area. Designated flood zones within and near the Central Kitsap planning area are shown on Figure 2-6.

2.2.5.4 Wetlands

Wetlands are swamps, bogs, estuaries, and ponds less than 20 acres and their associated vegetation. These areas provide important functions in enhancing water quality by providing water storage, cleansing, and groundwater recharge. They also typically support a diversity of wildlife. Wetlands may be considered for water reuse sites. Wetlands are mapped in Figure 2-7, Sensitive Habitat.

2.2.5.5 Wildlife Conservation

Wildlife conservation areas are areas of critical importance to sustain endangered, threatened, or sensitive species, including wildlife, fish, and the environments that support them. The County has outlined a series of goals and policies in its 2006 Comprehensive Plan, including minimizing habitat fragmentation, providing appropriate review and consideration of potential impacts to wildlife during planning and site development, constructing adequate buffers around designated protection areas, and assuring on-going mapping and assessment of the health of these communities. Figure 2-7 shows areas identified as bald eagle habitat and the associated buffers within or near the planning area.

2.3 Growth Management Act

This document differs from the previous Facility Plan (published in 1994 and amended in 1999) in that it uses Urban Growth Areas to define the service areas. A UGA is defined by the State of Washington as a mostly contiguous area around an urbanized area, often a commercial core, within which growth and services can be concentrated over time, resulting in a more efficient use of public infrastructure.

The State of Washington adopted the Growth Management Act (GMA) in 1990 with the intent of concentrating most new development and population gains within urban areas of the more populous and rapidly growing counties. These counties are required to define an urban growth boundary within which urban services, like sewers, are provided. New parcels developed outside the UGA boundary must be low density with sufficient acreage to support on-site sewage disposal systems conforming to County and State Health regulations. Once the boundaries have been established, counties can adjust or expand them only within a prescribed planning and legal framework. The Central Kitsap planning area includes three UGAs as well as several special districts occupied by naval facilities.

For Kitsap County, the UGA boundaries are identified in the *Kitsap County Comprehensive Land Use Plan 10-Year Update*, December 2006 (10-Year Update). The 10-Year Update included modifications in the extent of the Central Kitsap planning and service area as currently defined by the Silverdale and Central Kitsap UGA boundaries illustrated on Figure 2-8, 2006 Land Use.

Under the GMA, only four potential exceptions to the prohibitions of sewers outside of urban growth boundary are recognized under state law and case law:

1. Where it is a necessary response to a documented public health or environmental hazard and the County has determined that providing sewer service is financially supportable and will not permit urban growth; (RCW 36.70A.110(4))
2. If the property is an essential public facility and must be served by sewer in a rural area (this does not include schools, churches or certain types of residential facilities and will depend specifically on the circumstances surrounding a proposed essential public faciltiy); RCW 36.70A.200; RCW 36.70A.070(5)(b).
3. The county has entered into a pre-existing contractually binding agreement to provide sewer service to a property outside of the UGA; and Viking Properties, LLC v. Holm, 155 Wn.2d 112, 118 P.3d 322 (2005); City Of Anacortes, et al., Petitioners v. Skagit County, Respondent and Josh Wilson Properties, et al., Intervenors, WWGMHB No. 00-2-0049c, FDO, January 31, 2002
4. Where sewer service is required to service areas of more intensive rural development allowed by the Kitsap County Comprehensive Plan Land Use Map. RCW 36.70A.070(5)(d)(ii); City Of Anacortes, et al., Petitioners v. Skagit County, Respondent and Josh Wilson Properties, et al., Intervenors, WWGMHB No. 00-2-0049c, FDO, January 31, 2002.

Sewers provided in these cases may be satellite systems limited to serving just the qualified and defined parcels; or, a sewer extension may be "tight-lined" to convey wastewater from the qualified and defined parcels into the urban growth area for connection to the existing sewer system.

2.4 Population Estimates and Projections

The data used for population estimates for this report were prepared by Kitsap County Department of Community Development (DCD) in accordance with GMA requirements. Existing 2006 populations were estimated based on the 2000 Census. Population estimates within UGA boundaries are based on the GMA allocations, with the distribution within each unincorporated area projected by DCD as described in the following section. Population allocations for the period 2005 through 2025 have been well-documented and adopted by the County in the 10-Year Update.

Population values cited in this report for the Poulsbo area are based on 2005, 2015, and 2025 values used in the *City of Poulsbo Draft Comprehensive Sanitary Sewer Plan 2007 Update*, Parametrix, March 2007 (Poulsbo Draft Sewer Plan). Two growth rates were presented: one for the City at only 1.8 percent per year and a second rate of 2.7 percent that includes the future population allocations for the Poulsbo UGA. The latter rate was used for this report.

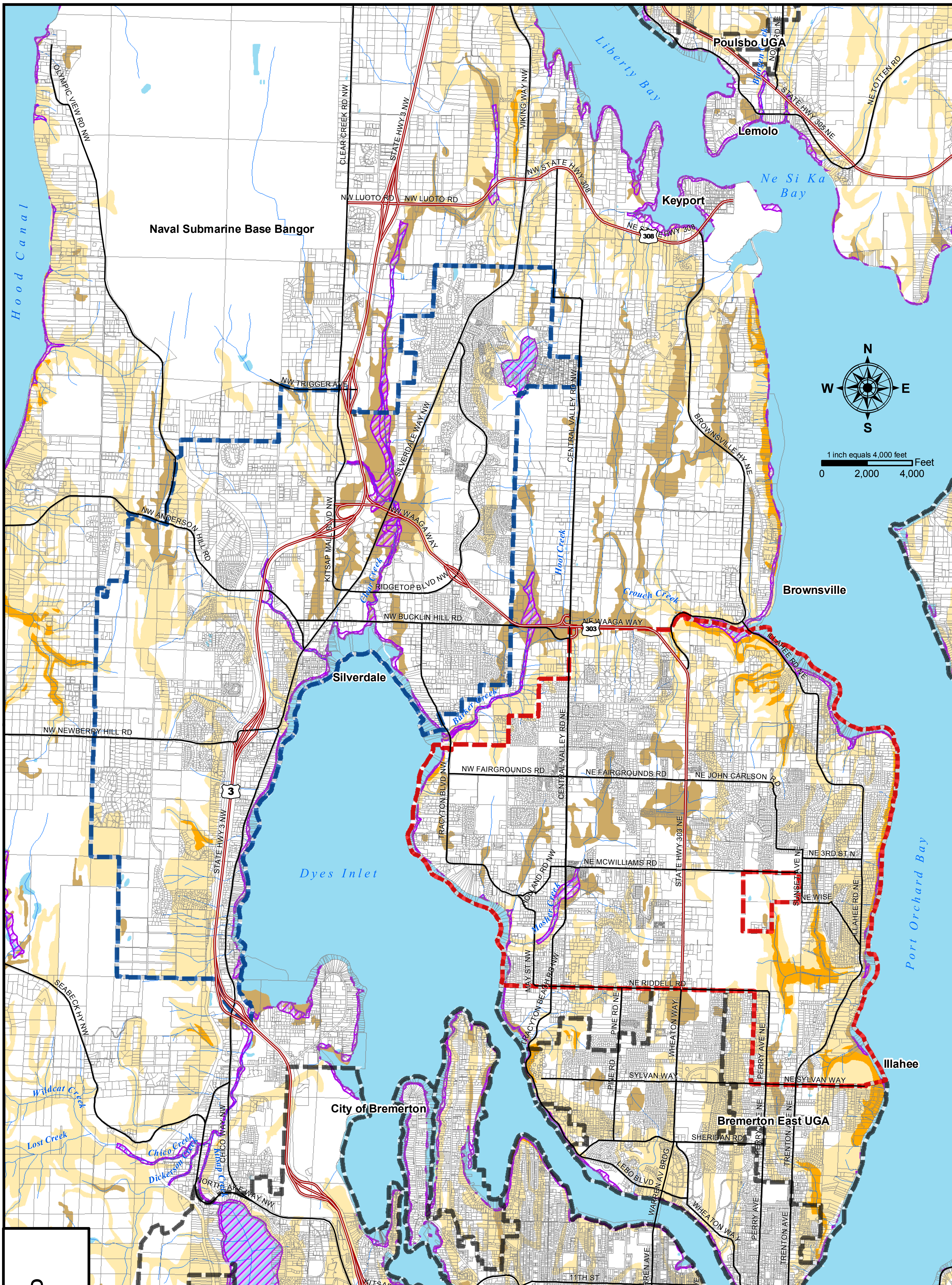

FIGURE 2-6
GEOHAZARDS

LEGEND

- High Hazard Areas
- Moderate Hazard Areas
- Hydric Soils
- Flood Zones
- Waterbodies
- Watercourses
- Parcels
- Central Kitsap UGA
- Silverdale UGA
- Other UGAs

Data sources supplied by Kitsap County 2007, and may not reflect actual or current conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

MAP DATE: DECEMBER 2007

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KITSAP COUNTY PUBLIC WORKS

CENTRAL KITSAP WASTEWATER GMA COMPLIANCE PLAN

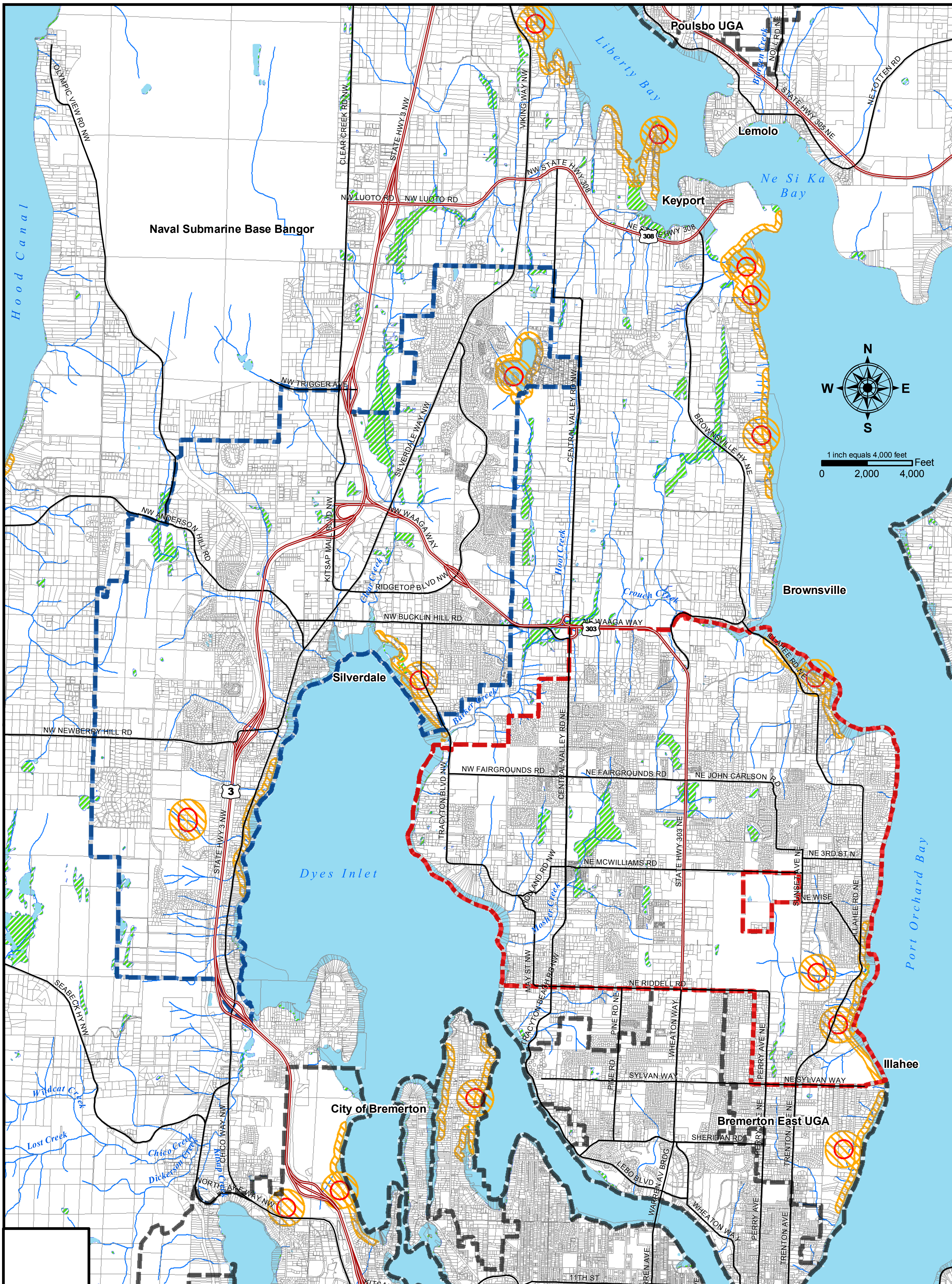

FIGURE 2-7
SENSITIVE HABITAT

LEGEND

- Priority 1: 400' buffer around Bald Eagle nest trees/roost sites.
- Priority 2: w/in 400'-800' of Bald Eagle nest tree.
- DNR, NWI, and Surveyed Wetlands
- Waterbodies
- Watercourses
- Central Kitsap UGA
- Silverdale UGA
- Other UGAs
- Parcels

Data sources supplied by Kitsap County 2007, and may not reflect actual or current conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

MAP DATE: DECEMBER 2007

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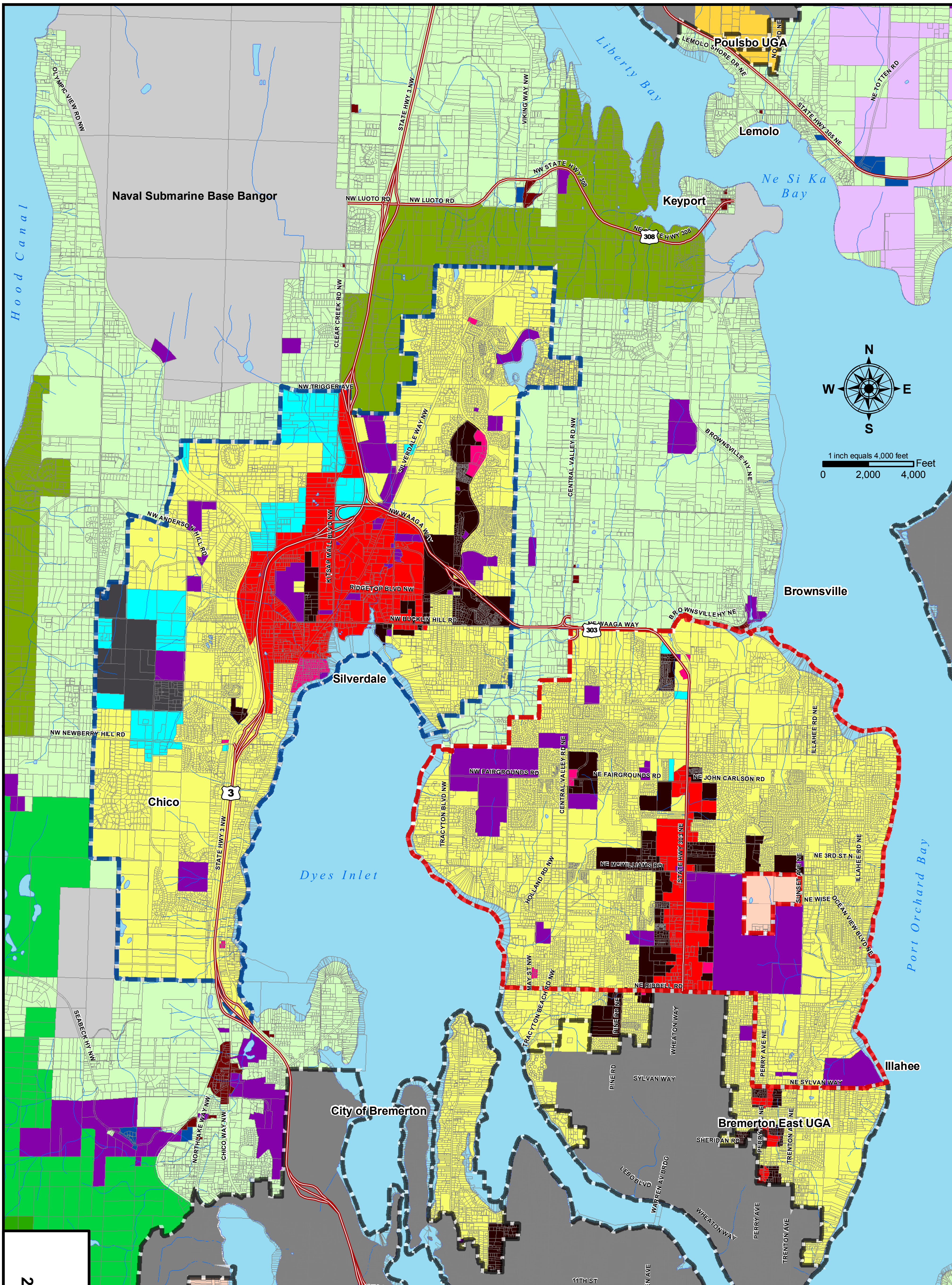
KITSAP COUNTY PUBLIC WORKS

CENTRAL KITSAP WASTEWATER GMA COMPLIANCE PLAN



COMPREHENSIVE PLAN DESIGNATIONS

- Central Kitsap UGA
- Silverdale UGA
- Other UGAs
- Parcels
- State HWY/Route
- Rural Residential
- Rural Protection
- Rural Wooded
- Urban Reserve
- Mineral Resource
- Rural Commercial
- Rural Industrial
- Urban High-Intensity Commercial/Mixed Use
- Urban Industrial
- Urban Low-Intensity Commercial/Mixed Use
- Urban Low-Density Residential
- Urban Medium/High-Density Residential
- Limited Area of More Intense Rural Development
- Incorporated City
- Tribal Land
- Poulsbo Urban Transition Area
- Public Facility
- Lake
- Salt Water
- Airport
- Forest Resource Lands
- Industrial Mulit-Purpose Recreational Area
- Military

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FIGURE 2-8
2006 LAND USE

KITSAP COUNTY PUBLIC WORKS

CENTRAL KITSAP WASTEWATER GMA COMPLIANCE PLAN

The population data used to estimate future flows are provided in Table 2-3: Population Projections for CKWWTP Service Area and Poulsbo.

Table 2-3. Population Projections for CKWWTP Service Area and Poulsbo[a]

Year	Central Kitsap UGA	Silverdale UGA	City of Poulsbo
2005	23,262	16,627	8,861
2015	26,626	19,697	11,288
2025	30,476	23,335	14,646

[a] *No population data are available for Bangor and Keyport Base. Minimal growth is projected for Keyport Community.*

2.5 Land Use, Zoning, and Population Distributions

Land use and zoning mapping are prepared by the County and utilized for a broad range of purposes. With respect to wastewater facilities planning, both are important tools used to understand existing and future infrastructure opportunities, limitations, and requirements. Land use mapping (see Figure 2-8) identifies the locations and types of existing development within the area of interest. Zoning (see Figure 2-9) identifies allowable potential future land uses and may be supplemented with sensitive area mapping as a means to identify undevelopable lands.

As part of the development of the Kitsap County Comprehensive Land Use Plan 10-year Update, 2006, a buildable lands analysis was prepared by the DCD. The study relied upon the sensitive areas, land use, and zoning mapping for the preparation of the *Updated Land Capacity Analysis* (ULCA), finalized in 2006 with the removal of the sewer reduction factor.

The ULCA was used by the County to identify developable and redevelopable parcels within the UGAs and, thus, the distribution of future populations. Once the developable and redevelopable lands were identified, zoning was used as the basis to determine future population densities of the parcels. The population distributions were estimated on a parcel-level basis, allowing for a high level of detail. The parcel-level data were extracted from the County database and used for this report for modeling and mapping existing and future population distributions.

Land use, zoning and population distributions for the Northern Service areas are not necessary for this analysis since each of those customers (except Keyport Community) evaluates their own forecasts.

2.6 Equivalent Populations

In order to determine future wastewater infrastructure needs, anticipated wastewater flow rates must be estimated. The estimates require an understanding of the existing system and its flow sources and quantities. Flow sources include single- and multi-family residences, commercial, industrial, and institutional (public facility) flows. For the purposes of this Central Kitsap Wastewater GMA Compliance Plan, "commercial" flows include all non-residential flows.

Flows originating from a variety of sources, including commercial, schools, residences, etc., are converted to a common unit, "equivalent population." Population equivalents are derived as follows:

- Each single family residential unit (ERU) = 2.5 users
- Each multi-family ERU = 1.8 users
- Commercial (based on water usage) ERU= 2.5 users

Each parcel that is sewered (permitted) is converted to an estimated number of users, or equivalent population, and thus flow rates are estimated based on equivalent populations. Equivalent populations are higher than actual populations because they account for commercial users.

Sewered parcel data and wastewater flow data for the Southern Service Area were provided by the Kitsap County Department of Public Works Wastewater Division. The quantity and distribution of existing sewered populations were coupled with existing wastewater flow data to estimate flows per capita, which are used and considered when planning future needs.

Historic average annual wastewater flows for Central Kitsap and Silverdale service areas are 76 gallons per day per capita (gpcd) as determined for the 2002-2006 period. For the Northern Service Areas equivalent populations include employees and residents of the Navy Bases: Keyport and Bangor, Poulsbo and Keyport Community. The equivalent populations of the military bases are not known, so in cases where a population is needed, a place-holder or literature reference per capita flow of 100 gpcd is assigned and then divided into the flow. The average annual flows (AAFs) for the areas are 140,000 and 480,000 gpd, respectively; therefore, the respective existing populations are assigned a placeholder value of 1,400 and 4,800. Poulsbo estimates are based on the Poulsbo Draft Sewer Plan. Keyport Community was not analyzed for this report.

2.7 Future Sewered Equivalents

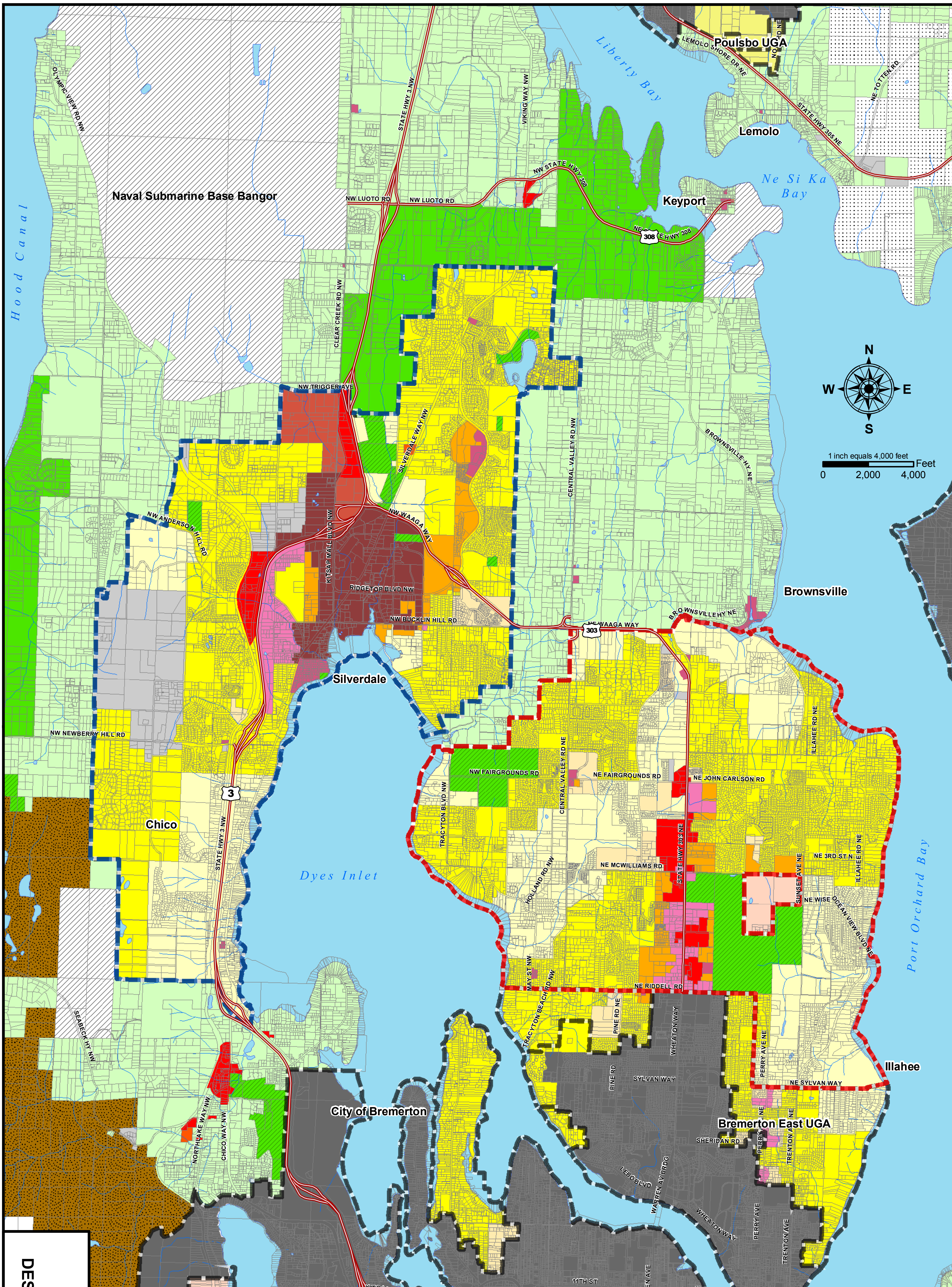
Future population estimates are a necessary component for projecting wastewater flows. Future sewered populations are unknown for the Navy bases so set-aside flows are based on agreement between the Navy and the County. The City of Poulsbo reports that 100 percent of the population is sewered and that future customers will be generated by growth in the City and UGA as presented in the population estimates and projections section above.

Future equivalent sewered populations in the Southern Service Areas include existing unsewered populations that become sewered as well as incoming populations and growing commercial sources. Existing populations that are not connected must be accounted for and are assumed to become connected at some time in the future. The future incoming populations within the service areas are assumed to eventually become connected to the system as well. Existing sewered and unsewered developed properties are identified on Figure 2-10.

As of December 2006, approximately 62 percent of the existing population within the Southern Service Area was connected to the wastewater conveyance and treatment system. That leaves approximately 38 percent that may become sewered during the planning period. To estimate future CKWWTP flows, three components are assumed as follows:

- The unsewered portion of the existing population is assumed to convert from septic systems to sewer service over the next 20 years. Since there is no way to accurately predict exactly how and when this would occur, half of this is applied to the 2015 Equivalent Population estimate and the remainder to the 2025 estimate.
- Of the future incoming population that is attributed to growth, 100 percent is assumed to become sewered. The sum of converted and incoming users provides the additional Sewered Residential Population for each of 2015 and 2025.
- A future commercial growth component is also added. This value is based approximated on the existing commercial-to-residential ratio of 11 percent for Central Kitsap UGA and 34 percent for Silverdale. On this basis, the Silverdale commercial projections may appear to be high; however, the net effective commercial portion for the combined areas would be 22 percent, which is considered a reasonable collective value.

These three components are added to the base Existing Equivalent Population to provide estimates for the 2015 and 2025 total Equivalent Populations that will be sewered.



ZONING

Rural Residential	Business Park	Industrial	Residential Low	Central Kitsap UGA
Rural Protection	Highway/Tourist Commercial	Urban Restricted	Incorporated City	Silverdale UGA
Urban Reserve	Neighborhood Commercial	Urban Low Residential	Park	Other UGAs
Rural Wooded	Regional Commercial	Urban High Residential	Military	Parcels
Business Center	Mixed Use	Urban Medium Residential	Tribal Land	State HWY/Route

Zoning Designations: Kitsap County - January 2007

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MAP DATE: DECEMBER 2007

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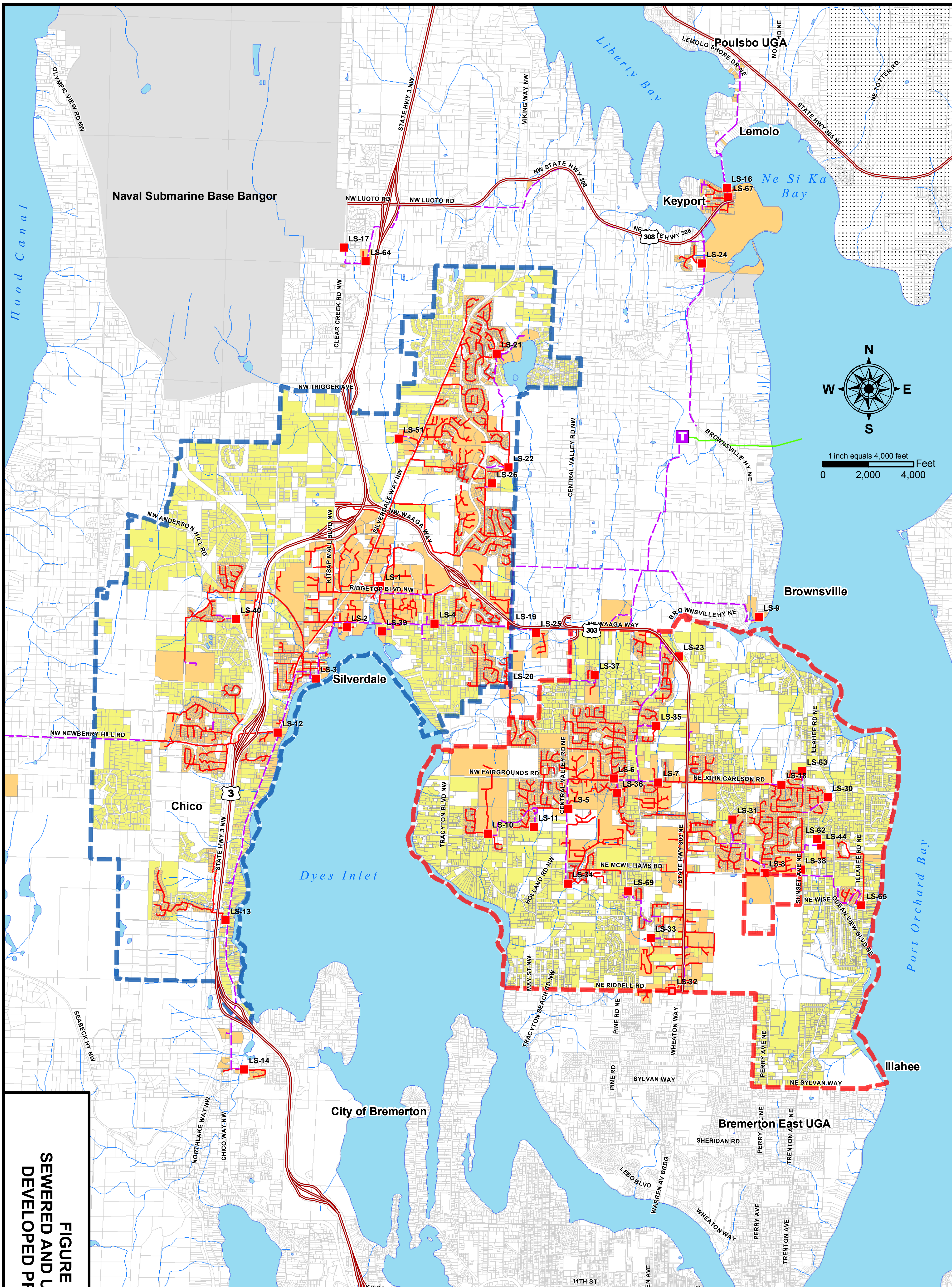
FIGURE 2-9
ZONING DESIGNATIONS MAP

KITSAP COUNTY PUBLIC WORKS

CENTRAL KITSAP WASTEWATER GMA COMPLIANCE PLAN



LEGEND

- Central Kitsap Treatment Plant
- Existing Lift Stations
- Forcemain
- Gravity
- Outfall
- Permitted Properties (Sewer Service)
- Developed Properties (No Sewer Service)
- Military Locations
- Pt Madison Suquamish Indian Reservation
- Central Kitsap UGA
- Silverdale UGA
- Parcels
- State HWY/Route

SEWER SYSTEM: SEPT 2007
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MAP DATE: DECEMBER 2007

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FIGURE 2-10
SEWERED AND UNSEWERED DEVELOPED PROPERTIES

KITSAP COUNTY PUBLIC WORKS

CENTRAL KITSAP WASTEWATER GMA COMPLIANCE PLAN

CHAPTER 3

3. WASTEWATER CHARACTERISTICS

Wastewater flow projections are one of the primary bases for design of wastewater facilities. In this chapter, existing wastewater flows to the Central Kitsap Wastewater Treatment Plant are characterized, then projected in proportion to the estimated population expected to be served throughout the study period.

3.1 Wastewater Flows

To evaluate the current operating capacity of the CKWWTP and estimate future conveyance and treatment capacity requirements, it is necessary to understand the historic and existing wastewater flows and their relationship to population and rainfall events. This section discusses flow measurement, historic wastewater flow rates, I/I analyses, and estimated hydraulic peaking factors and flows per capita. The peaking factors and historic flows per capita are considered in estimating future flows.

The flow rate patterns unique to the Central Kitsap wastewater system can lend valuable information to understanding the system's current performance. Diurnal and seasonal flow variations provide a framework for predicting system response to future demands. Wastewater flow projections presented in this section are used to identify treatment and collection system requirements in later chapters.

3.1.1 Wastewater Flow Parameters

This section defines common flow parameters and how they apply to the design of facilities. Definitions and engineering uses of flow parameters often used in wastewater studies and designs are summarized in Table 3-1. Perhaps the most widely used of these flow parameters in planning and designing wastewater facilities are average design flow (ADF) and the peak design flow (PDF). ADF (defined as the average daily flow occurring in a maximum-flow month) will have a significant bearing on the size and selection of wastewater treatment process units. This flow parameter is recognized by Ecology as the primary design parameter used to rate wastewater treatment plants.

PDF is defined as the maximum flow rate likely to be sustained over a 60-minute period. PDF is used to properly size treatment and conveyance units where hydraulic capacity is of primary concern, such as treatment plant headworks structures, sewers, and wastewater pumping stations. PDF is equivalent to the peak wet-weather flow (PWWF), another common term used to characterize peak flows.

Table 3-1. Applications of Wastewater Flow Parameters

Parameter	Definition	Application
Average Annual Flow (AAF)	The average daily flow computed from year-long flow records.	Detention times, energy usage, chemical usage and storage, sludge quantities produced.
Average Dry Weather Flow (ADWF)	Average daily flow occurring in dry-weather seasons (May – Sept).	Useful in determining I/I. Used in this study as the basis for projecting flows.
Average Wet Weather Flow (AWWF)	Average daily flow occurring in wet-weather seasons (Oct – April).	Useful in I/I studies.
Peak Dry Weather Flow (PDWF)	Peak hourly flow rate occurring in a dry weather season.	Useful in I/I studies.
Peak Design Flow (PDF)	Peak hourly flow rate occurring in a wet-weather season; often called peak wet weather flow (PWWF).	Sizing of unit operations such as pipelines, channels, flow measuring structures, inlet and outlet structures, peak power demands.
Average Design Flow (ADF)	Peak month average daily flow rate.	Basis of treatment process design and of contractual agreements for wastewater treatment.
Maximum Day Flow (MDF)	Maximum daily flow experienced in the year	Basis of sizing maximum capacities of unit processes to treat sewage.
Minimum Daily Flow	Minimum daily flow rate.	Sizing of conduits to avoid solids deposition. Usually most important during early stages of planning period when flows are still well below future ADWF.

Other flow parameters, such as average dry-weather flow (ADWF) and peak dry-weather flow (PDWF), are useful in determining the amount of infiltration and inflow entering a collection system, and for determining an effective peaking factor (such as the ratio of PDF to ADWF) for sanitary flows entering the collection system.

3.1.2 Historic and Existing Flows

This section discusses flow measurement, current wastewater flow rates, and development of hydraulic peaking factors and flows per capita.

3.1.2.1 Flow Measurement

Accurate wastewater flow measurement and recording is a critical factor in the effective planning, design, and operation of wastewater facilities. Ecology requires that flow measurement be provided at all treatment plants with capacities greater than 50,000 gallons per day (gpd), and at pump stations with capacities greater than 1.0 million gallons per day (mgd).

3.1.2.1.1 Permanent Flow Metering

Permanent flow metering with instantaneous data recording provides information needed to most accurately assess system performance. Where metering is not available, wastewater flows may be estimated on the basis of population and land use using standard literature reference factors. Since literature reference-generated values are estimates only, they should not be relied on as the sole basis for determining existing or projecting future flows. Rather, flow data should be incorporated into the flow analysis model to calibrate and verify the reasonableness of the assumptions made when using literature reference values.

For example, note that the peak wet weather flow (PWWF) is the primary design parameter for conveyance facilities. Peak flows may be dominated by I/I, a highly variable contributor to system flows. When using literature reference estimates, the first step in determining PWWF is to estimate average dry weather flow (usually based on population). Next, a literature reference peaking factor is applied to the dry weather flow. The peaking factor accounts for diurnal and seasonal population behaviors, and omits I/I. PWWF values are then obtained by adding I/I estimates. Literature reference values for I/I are typically expressed on an annualized gallon per day per acre (gpd/acre) basis and are, therefore, not representative of seasonal and storm-related peaks or local system conditions.

Metered flows that include hourly data for both dry and wet weather conditions provide the most reliable basis for existing flow conditions. Given actual data, base dry weather flows, I/I, and wet weather and peak flows may be obtained and used as a basis for determining available system capacities, model calibrations, and future flow projections.

3.1.2.1.2 Existing Flow Metering Locations

Existing wastewater flows are metered by flow measurement devices at several locations in the Central Kitsap wastewater collection and conveyance system. These locations include Bangor, Keyport Navy, Poulsbo, Lift Station 24 (LS-24), Aeration Station 1 (AS-1), and the CKWWTP. Metering locations are identified on Figure 3-1. Existing flow metering locations, equipment, and available historical flow parameters are summarized in Table 3-2.

Table 3-2. 2006-2007 Flow Meters for the CKWWTP Service Area				
Source of Measured Flows	Measurement Location	Measurement Equipment	Data Format and Limitations	Availability of Flow Parameters
Bangor Base (Contract)	LS-17	One 12-inch Parshall flume; ultrasonic transducer	Chart recorder and totalizer reported as weekly totals only	Peak day and peak hour unavailable
Keyport Base (Contract)	LS-67	One 3-inch Parshall flume; ultrasonic transducer	Chart recorder and totalizer reported as weekly totals only / inconvenient access to flume and meter manholes	Peak day and peak hour unavailable
Poulsbo (Contract)	Upstream of Lemolo siphon	One 9-inch Parshall flume; ultrasonic transducer	Chart recorder and totalizer - Flume is submerged at flows >2.0 mgd per 1994 facility plan - reported as weekly totals only	Peak day and peak hour unavailable
Total Northern Flows	LS-24	One 24-inch pipe spool; magmeter	Totalizer downloaded weekly prior to strip chart recorder installation in summer 2006	Since the summer of 2006 hourly flow data has been recorded: All necessary design parameters may be determined
Total Southern Flows	Aeration Station 1	One 24-inch pipe spool; dual path transit time; four ultrasonic transducers	Totalizer downloaded weekly prior to strip chart recorder installation in summer 2006	Since the summer of 2006 hourly flow data has been recorded: All parameters may be determined
Total Central Kitsap Plant Flows	Existing CKWWTP Headworks	Two 18-inch Parshall flumes; two ultrasonic transducers	Circular chart recorder and totalizer - peak events exceed the maximum recordable flow of 11.6 mgd (5.8 mgd through each flume).	Historical peak day and peak hour unavailable
CKWWTP Effluent		Two 54-inch rectangular weirs; two ultrasonic transducers	Not recorded on a regular basis	None

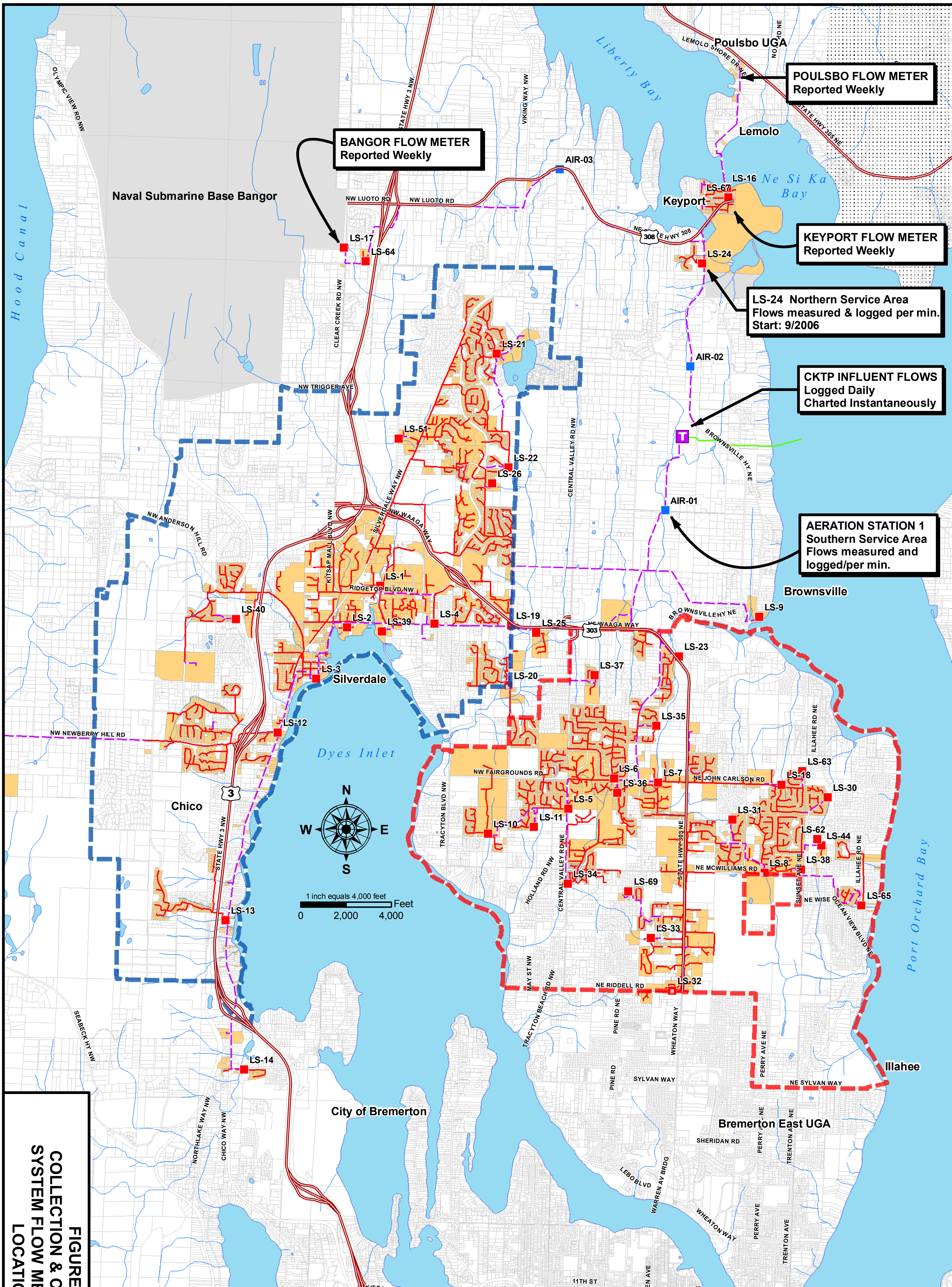


FIGURE 3-1
COLLECTION & CONVEYANCE SYSTEM FLOW MEASUREMENT LOCATIONS

LEGEND

- Central Kitsap Treatment Plant
- Existing Lift Stations
- Aeration Stations
- Forcemain
- Gravity
- Outfall
- Permitted Properties (Sewer Service)
- Military Locations
- Pt Madison Suquamish Indian Reservation
- Central Kitsap UGA
- Silverdale UGA
- Parcels
- State HWY/Route

SEWER SYSTEM: SEPT 2007
Data sources supplied by Kitsap County 2007, and may not reflect actual or current conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

MAP DATE: DECEMBER 2007 P:\Mapping\Maps_Generated\KitsapCounty\Projects\07_10072.00\task\220\maps\122007\Fig03-1_CollectionConveyance&FlowMeasurementLocations_11x17.mxd

KITSAP COUNTY PUBLIC WORKS

CENTRAL KITSAP WASTEWATER GMA COMPLIANCE PLAN

Wastewater flow data from each measurement location for 2002 to 2006 were obtained from Kitsap County Public Works Operations staff (Operations). Weekly total flows are available for all locations. Daily totals for the time period are available for CKWWTP only. Northern and southern flow measurements have been recorded on a per-minute basis for about 1 year. Historic peak hour flows are not available at the CKWWTP; however, meters for the northern and southern flows at LS-24 and AS-1, respectively, will provide this information in the future.

3.1.2.1.3 Northern Service Area Flows

Wastewater flows generated in the Northern Service Area are measured at several locations. The Navy operates flow metering stations at the Bangor and Keyport Naval Bases. Poulsbo measures its contribution at a Parshall flume located just north of the Lemolo siphon. These three locations are reported to the County as weekly totals. A 5-year data set from 2002 to 2006 was used to determine average flows, peak month flows, dry season flows, and wet season flows.

The County has a flow meter at the discharge of LS-24. Weekly flows have been recorded at LS-24 since 2004. Operations installed a data logger at the meter in September 2006 and is now able to tabulate flows on a per-minute basis. These data are used for I/I analyses.

Peak flows from Poulsbo and the Poulsbo UGA were estimated by Parametrix in the City's Draft Sewer Plan at 2.7 mgd for a 5-year storm.

3.1.2.1.4 Southern Service Area Flows

The County has historically relied on the total flow data at CKWWTP to estimate flows from the Southern Service Area. Total northern flows, with the exception of the Keyport community, are estimated by adding the flows from Bangor, Keyport Base, and Poulsbo. When this total is subtracted from the flows measured at the CKWWTP influent flow meter, an estimate for southern flows plus Keyport Community is obtained. A 5-year data set from 2002 to 2006 was used to determine average flows, peak month flows, dry season flows, and wet season flows.

Wastewater flows that are generated in the Southern Service Area are measured at the inline flow meter near AS-1. Similar to the LS-24 meter, weekly flows have been totaled at this location since its installation 5 years ago. These values, when compared to those estimated by subtraction, would be equivalent if flow measuring devices had near-perfect accuracy. Since they are not equivalent, the County prefers the subtraction method so that when all flows are combined, they will equal the CKWWTP total.

Operations staff installed a data logger at AS-1in July of 2006 and is now able to record flows on a per-minute basis at this location. The flow meter at AS-1 measures the aggregate flows from the entire Southern Service Area. These data are used for I/I analyses. Currently, separate flow measurements for the Central Kitsap and Silverdale UGAs are not possible.

3.1.2.1.5 Plant Influent

The interceptors from the Northern and Southern Service Areas deliver flow to the headworks of the CKWWTP via two main interceptors, a 24-inch diameter and 24/30-inch diameter interceptor, respectively. Flows combine at a "tee" , discharge into a common channel and then routed through parallel Parshall flumes for measurement and concurrent recording of the measurements. The flumes have a throat width of 18 inches and are therefore expected to measure flow rates up to 15 mgd each, for a total capacity of 30 mgd.

Instantaneous flows are recorded on 7-day circular pen charts, one for each flume. Although difficult to read with accuracy due to pumping and turbulence fluctuations, approximate hourly flows may be ascertained from these charts. The charts are scaled to record flow rates as a percentage of the rated hydraulic capacity of the plant, which is 11.8 mgd. Therefore, the maximum recordable flow rate is 11.8 mgd, and any flow rates that are in excess of this are omitted and recorded at 100 percent, or 11.8 mgd total. For daily record-keeping and plant operations, this system is appropriate and useful to the operators.

Daily and weekly total flows at the Parshall flumes obtained from Operations staff for 5 years beginning in 2002 and ending in 2006 were used to determine average flows, peak month flows, dry season flows, and wet season flows. Circular pen charts were reviewed for the 14 highest volume days for the period 2002 to 2006. Peak flow rates exceeded the 11.8 mgd maximum recordable flow rate for an hour or longer on five occasions. The missing data are necessary to estimate peak hour flows, which are required for designing wastewater infrastructure. However, the available hourly data were used for this document and, where necessary, are further explained when used. Even though peak day and peak hour flow rates are not available, average annual flows and peak month flows (average design flow) can be calculated and are useful.

3.1.2.2 Hydraulic Peaking Factors

Reliable hydraulic peaking factors are required to effectively design wastewater facilities. There are two acceptable methods for determining hydraulic peaking factors. The first method includes examining actual flow records to determine the ratio of a peak flow parameter to an average flow rate parameter. The peak hourly flow to ADWF ratio, or peak hour peaking factor, is one such ratio.

With the exception of Poulsbo (Poulsbo Draft Sewer Plan), sufficient historic data were not available from any of the metering stations to develop a peak hour peaking factor. While 1 year's worth of per-minute flow data are now available for northern and southern flows (LS-24 and AS-1), the recorded data did not capture a storm event that would be considered appropriate to use as a design basis. The event selected to support peak hour design flows should have a minimum of a 5-year recurrence interval, and preferably be a 10- to 20-year event.

Because peak hour flows were not available, the peak hour peaking factor could not be calculated from historical flow records. However, it can also be estimated from information found in generally accepted engineering sources. The American Society of Civil Engineers (ASCE) publishes curves that express PDWF to ADWF ratios as a function of ADWF. A copy of the curves may be found in Appendix E- ASCE Peaking Factor Curves.

3.1.2.3 Historic Wastewater Flows

Table 3-3 summarizes existing Central Kitsap wastewater flows for the years 2002 to 2006. The flows are developed from the flow measurement data as discussed in Section 3.1.2.1.

Table 3-3. Summary of Central Kitsap Wastewater Flows from 2002 to 2006 for the CKWWTP Service Area					
	Southern Service Area	Northern Service Area			Total System
Flow Parameter	Central Kitsap and Silverdale (mgd)	Poulsbo (mgd)	Bangor (mgd)	Keyport (Base) (mgd)	CKWWTP (mgd)
Average Annual Flow (AAF)	2.36	0.66	0.48	0.13	3.63
Average Dry Weather Flow (ADWF)	2.09	0.59	0.44	0.10	3.22
Average Wet Weather Flow (AWWF)	2.70	0.79	0.52	0.19	4.21
Average Design Flow (ADF)	2.88	0.91	0.58	0.22	4.58
Peak Design (Hour) Flow (PDF)	N/A [a]	2.70 [b]	N/A [a]	N/A [a]	N/A [a]

[a]. *Existing flow data are insufficient to estimate peak hour flow*

[b]. *From City of Poulsbo Draft Comprehensive Sanitary Sewer Plan 2007 Update, Parametrix.*

3.1.2.4 Infiltration and Inflow

An evaluation of I/I is required for the Facility Plan under the General Sewer Plan requirements (WAC 173-240-050). For this evaluation, two approaches are presented for estimating I/I. The first is Ecology's guidance document publication #97-03 prepared by the US EPA, *I/I Analysis and Project Certification*, May 1985. The Environmental Protection Agency (EPA) approach establishes maximum allowable per capita flow rates that, when surpassed, trigger requirement for additional analyses. The second approach provides an estimate of per acre I/I that may be considered when calibrating the forthcoming hydraulic model of the collection and conveyance system.

In reviewing overall system performance with Operations staff, no specific infiltration problems were noted and there were no occurrences of wet weather related overflows or discharges. The County maintains a database for inspections and maintenance of the collection and conveyance systems. The County uses the database to direct a rigorous video inspection and repair program emphasizing repair of broken or leaky connections and pipes.

The following service areas are the focus of I/I analyses for the Facility Plan:

5. Total Southern Service Area flows based on limited flow data at Aeration Station 1
6. CKWWTP Service Area - Plant influent flows

The Northern Service Area is not analyzed separately. The two primary contributors to the Northern Service Area flows are the naval bases and the Poulsbo area. The demography of the Naval bases is unknown; therefore, per capita flows cannot be determined to estimate I/I. Poulsbo has a known I/I problem that is currently being addressed by the City. Since these areas are included in the CKWWTP influent data, their I/I contribution on an overall basis is discussed, where appropriate, in the following sections.

3.1.2.4.1 Ecology I/I Guidance: EPA Prescribed I/I Analysis

The following guidance was used to define the flow data requirements, analysis, and thresholds to determine excessive I/I, as specified in Ecology Publication No. 97-03:

- Infiltration: "If the average daily flow per capita (excluding major industrial and commercial flows greater than 50,000 gpd each) is less than 120 gpcd (i.e., a 7- to 14-day average measured during periods of seasonal high groundwater), the amount of infiltration is considered non-excessive."
- Inflow: "If the average daily flow during periods of significant rainfall (i.e., any storm event that creates surface ponding and surface runoff; this can be related to a minimum rainfall amount for a particular geographic area) does not exceed 275 gpcd, the amount of inflow is considered non-excessive."

The data needed for this analysis for each of the two study areas are summarized as follows:

- Existing sewered population equivalents, including commercial, industrial, institutional
- Dry weather, wet season, average daily wastewater flows (no rain/high groundwater)
- Wet weather, wet season average daily wastewater flows (rainfall event/high groundwater)

The I/I analysis for the study areas was completed using concurrent data; that is, flow data for the same time period and using the same rainfall event. Concurrent daily flow data for the study areas are available only from June 2006 through July 2007; therefore, the time frame for the I/I analysis is limited to the winter and spring of 2006-2007. This period is considered representative based on a review of rainfall data, plant flows, and total Southern Service Area weekly flows for the 5-year study period (2002 to 2006).

CKWWTP Service Area flows include the Navy Bases: Keyport and Bangor. The actual populations of the military bases are not known, so in cases where a population is needed, a place-holder or literature reference per capita flow of 100 gpcd is assigned and then divided into the flow. The average annual flows (AAFs) for these areas are 140,000 and 480,000 gpd, respectively; therefore, the respective populations are 1,400 and 4,800. When these values are aggregated with the rest of the equivalent populations (for Poulsbo, Central Kitsap, Silverdale, and Keyport Community) and the flow per capita is estimated, the resulting value is somewhat affected by the place-holder per capita flow. This estimate is considered conservative, however, because the per capita flows for the unknown areas (and subsequent infiltration) are considerably higher than the flow rates for the known areas.

3.1.2.4.1.1 Determination of Non-Excessive Infiltration

For total Southern Service Area flows, three 2-week periods of dry weather during the wet season were selected from the available flow measurements at Aeration Station 1 and averaged on a daily basis. Evaluated on a per capita basis using the equivalent sewered population of 32,200 (Chapter 2), the average daily flow per capita during the 2006-2007 wet season was 85 gpcd. This is well below the EPA recommended maximum per capita flow rate of 120 gpcd.

For total CKWWTP Service Area flows, a similar analysis was performed using the daily influent flow meter for the same time frame. The equivalent sewered population for the entire CKWWTP service area (including military as estimated above) was estimated at 49,800 (Chapter 2). Dry weather flows during the 2006-2007 wet season averaged 3,880,000 gpd. This equates to 78 gallons gpcd, also well below the EPA Criteria of 120 gpcd.. Thus, based on the Ecology guidance, infiltration is considered non-excessive for both areas.

3.1.2.4.1.2 Determination of Non-Excessive Inflow

Limited data were available to evaluate the influence of rain-induced inflow. One significant rainy period of several days was found for which southern flow meter data were available. (Other periods of significant rainy weather occurred during the study period; however, these occurred on days for which the flow meter data were absent.) The rainy period used in the southern analysis occurred on December 11 through 14, 2006. The event produced rainfall totaling 2.30 inches and 0.59 inch, respectively on the first 2 days. The first 2 days were followed by a 0.29-inch and 1.83-inch event, for a total rainfall of just over 5 inches over the 4 days.

The peak flow day of the selected rainfall event occurred at both the southern flow meter and the CKWWTP on December 14, 2006. Southern flows were recorded at 3,950,000 gpd and the CKWWTP flows were 6,770,000 gpd. This 4-day event is considered a qualifying event for the EPA analysis because the flow records indicate saturated soil conditions that would cause ponding and, hence, infiltration or inflows into the sewer system. Plant flows remained high over the 4-day period, even through the 2 days where the rainfall lessened. This indicates saturated conditions that continue to supply infiltration even as the rain subsides. This condition will cause ponding on the surface.

For total Southern Service Area, using the equivalent sewered population of 32,200, the highest per capita daily flow over the period was 125 gpcd. This compares to the EPA recommended maximum per capita flow rate of 275 gpcd.

For total CKWWTP Service Area flows, a similar analysis was performed using daily influent flow meter data for the same time frame and the same December 11 through 14, 2006 rainfall event. The daily total wastewater flow on the higher day was 6.77 million gallons. The equivalent sewered population for the entire service area was estimated at 47,500. This equates to 142 gpcd. Thus, based on the Ecology guidance, inflow is considered non-excessive for both study areas.

3.1.2.4.2 Acreage-based I/I Analyses

Base sewage flow, wet season base infiltration, and peak day infiltration and inflow were evaluated on a per-acre basis for the sewered areas. Typical values for I/I on a per developed-acre basis range from 500 to 1,000 gal/acre/day for systems in good to average condition. These numbers can be much higher for older systems and/or for those in poor condition, and have been found to exceed 2,000 gal/acre/day for some systems in the latter category. For planning purposes, King County uses a value of 1,500 gal/acre/day with a 7 percent increase for every decade of service life.

Hourly flow data required for these analyses were available for the total Southern Service Area. These include data collected at the Aeration Station 1 flow meter on the southern interceptor. Hourly flow readings for Aeration Station 1 were available for approximately 1 year, from the fall of 2006 through the summer of 2007. While some days were absent, there were adequate periods of wet and dry weather during the wet season for I/I analyses. Several multiple-day periods in 2006 and 2007, representing dry weather flows and rainy weather flows, were selected for analysis.

Total Wet Season Peak Day I/I is the sum of two components: the wet season base infiltration volume and the rainfall induced I/I storm volume that exceeds the average wet season daily flow volume. This is illustrated graphically on Figure 3-2.

The wet season base infiltration component was found by reviewing daily rainfall measurement data to find extended periods of dry weather during the wet season. The hourly Southern Service Area flows for these periods were averaged on a daily basis to develop a wet season average day flow rate curve. From this curve, the minimum daily flow rate was found. The minimum hourly flow rate during each day typically occurs in the early morning hours, when little water usage is assumed to be occurring. Therefore, this minimum flow rate is presumed to be primarily infiltration. The minimum flow rate over a 24-hour period provides a daily wet season base infiltration rate. For the Central Kitsap and Silverdale UGAs, the wet season base infiltration was estimated to be 410 gal/acre/day. Similarly, a dry season average day was also plotted. The minimum flow rate for dry season was about 300 gal/acre/day.

To determine the rainfall induced I/I component, daily rainfall measurements were reviewed to find a significant period of rainy weather during the wet season. For this analysis, the 4-day period of wet weather occurring from Dec 11 through 14, 2006, which produced a total of 5.06 inches of rain, was used. Hourly flows for the period were averaged on a daily basis to develop peak day hourly flow rates. The difference in the peak day and the wet season average day flow rates is assumed to be the rainfall-induced I/I. For the

Central Kitsap and Silverdale UGAs during the 4-day period reviewed, the rainfall-induced I/I was estimated at 417 gal/acre/day based on a sewered (permitted) area of 2,890 acres (excluding right-of-way). This value summed with the wet season base infiltration gives a total Wet Season Peak Day I/I of 829 gal/acre/day, which is within the low end of the range reported previously.

3.1.2.4.3 Infiltration and Inflow Conclusion

It should be recognized that limited data were used to analyze I/I. Ideally, several years of flow data correlated with rainfall would be used to evaluate the effects of I/I on the wastewater system. However, based on the data currently available, a rigorous inspection and repair program, and the observations of Operations staff, I/I does not appear to be a significant problem for the CKWWTP. There have been no specific infiltration problems noted, nor have there been any occurrences of wet weather related overflows or discharges as of the date of this Central Kitsap Wastewater GMA Compliance Plan. Wastewater conveyance systems do tend to degrade over time and an allowance for additional I/I has been included in the projected wastewater flows, discussed in the next section.

3.1.3 Wastewater Flow Projections

Future wastewater flow projections for AAF and ADF consider historic per capita flows and literature reference per capita flows. Future wastewater flow projections for peak hour flows consider historic flows and literature reference methods for estimating peaking factors.

3.1.3.1 Per Capita Flows

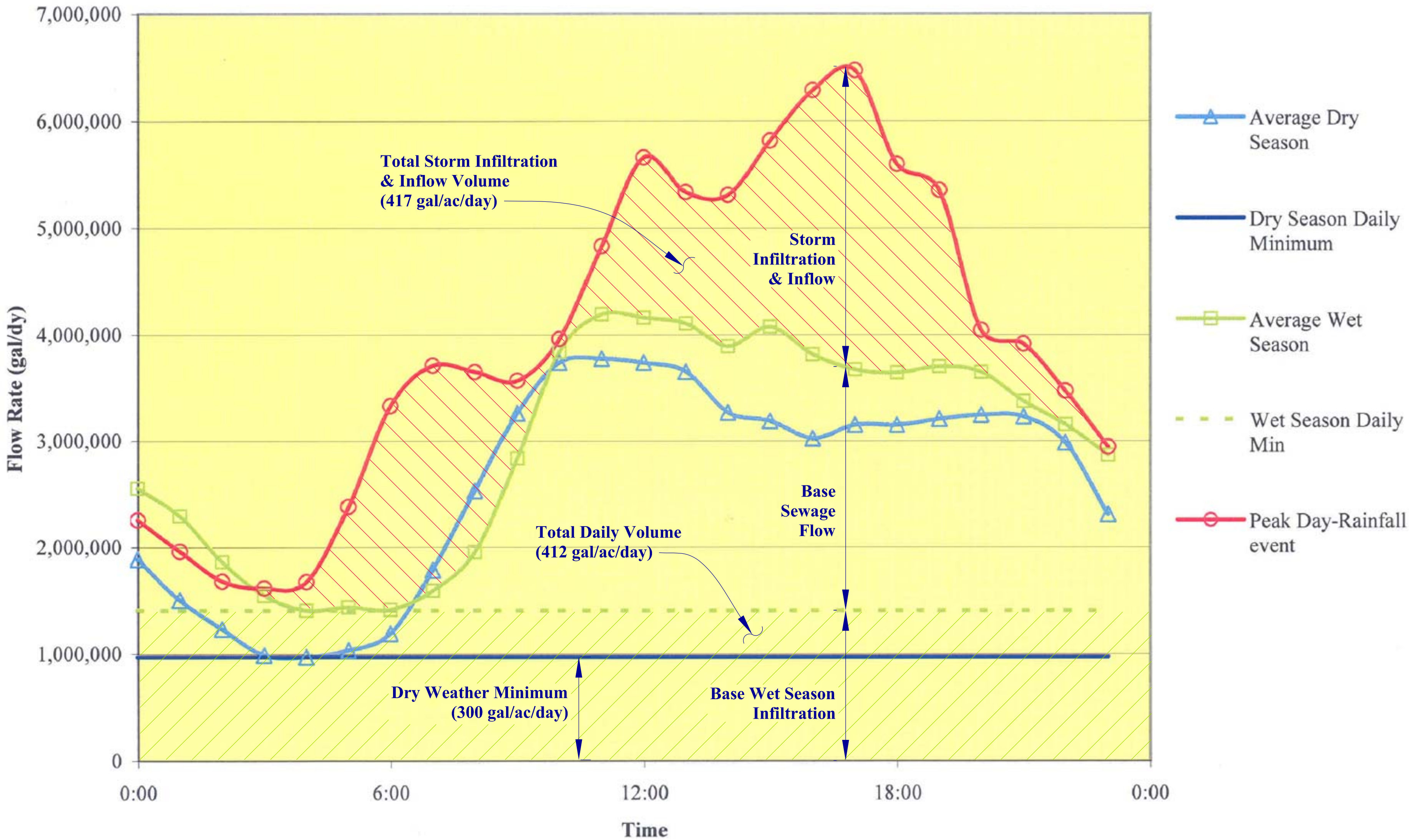
Existing flows per capita were used to estimate future wastewater flows. The historic AAF and the ADF for each of the 5 years from 2002 to 2006 were divided by the associated Equivalent Population for that year to obtain the historic flows per capita. The annual flows per capita were then averaged to determine the 5-year average per capita flow, which is used with the calculated future Equivalent Population to estimate future sewage flow rates.

Flows per capita were developed from the metered wastewater flows and Equivalent Population for the Central Kitsap and Silverdale UGAs (Southern Service Area). These are presented in Table 3-4.

Table 3-4. Per Capita Wastewater Flows for the Southern Service Area

Year	Equivalent Population	Average Annual Flow		Average Design Flow (Max Month)		ADF/AAF
		gpd	gpcd	gpd	gpcd	
Central Kitsap - Silverdale						
2002	30,000	2,310,000	76	3,150,000	104	1.36
2003	30,700	2,500,000	81	2,885,000	94	1.16
2004	31,200`	2,300,000	74	2,725,000	87	1.19
2005	31,700	2,200,000	69	2,500,000	78	1.13
2006	32,200	2,500,000	78	3,150,000	98	1.26
Average	31,220	2,362,000	76	2,882,000	92	1.22

Figure 3-2 Daily Southern Flow Patterns for Estimation of Infiltration and Inflow



The historic per capita AAF of 76 gpcd includes roughly 60 to 66 gpcd of sewage along with I/I as averaged over the entire year. A literature reference value of 100 gpcd was used to estimate future average annual flows and is assumed to include a 34 to 40 gpcd allowance for infiltration that may develop as the existing collection facilities age. The 100 gpcd is recommended by Ecology's "*Criteria for Sewage Works Design*" as a minimum value for per capita AAF and is intended to include typical I/I. A peaking factor of 1.22, based on the historic ADF to AAF ratio, is used to estimate the per capita ADF of 122 gpcd for future flows.

3.1.3.2 Peak Design (Hour) Flows

Peak design (hour) flows for this Central Kitsap Wastewater GMA Compliance Plan were estimated on a population basis, using literature reference values as described below.

The future peak hour flow rate was calculated using an ADF peaking factor of 3.3. Because of limited current measured flow data, a historical peak hour peaking factor was not available. Therefore, the peaking factor value of 3.3 is based on American Society of Civil Engineers, *Design and Construction of Sanitary and Storm Sewers*, ASCE/WPCF, 1969 flow ratio curve. The ASCE curve provides a correlation extreme flows to AAF and is in Appendix E ASCE Peaking Factor Curves. Evaluation of individual UGAs or sewer basins within the Southern Service Area may utilize slightly higher peak hour peaking factors based on smaller contributing populations and AAF.

Existing per capita flow characteristics and the peak hour peaking factor, described above, were assumed to be appropriate to develop the future flow estimates presented in Table 3-5. Flow projections were estimated for the Southern Service Area of Central Kitsap and Silverdale, and for the Poulsbo City and UGA in the Northern Service Area. It is assumed that the AAF and ADF per capita flow characteristics for the Southern Service Area are applicable to both Central Kitsap and Silverdale individually. As such, future AAF and ADF were estimated individually for each UGA.

The population estimates and projections for the Bangor and Keyport Bases were not available; however, historical flows were reported. These values are well below the capacity contracted or set aside for these facilities; therefore, it was assumed that contracted or set-aside values are acceptable for the 2025 projection. Future values shown for the Bases are place-holders only and should be verified through discussions with appropriate representatives for each facility.

As stated previously, future flows from Poulsbo were estimated in the Draft Sewer Plan, prepared by Parametrix for the planning period 2005 through 2025. The estimates were linearly prorated to match the planning period for this study and are used herein.

Table 3-5 summarizes the projected wastewater flows discussed in this section.

Table 3-5. Summary of Projected Wastewater Flows

Flow Parameter	Central Kitsap UGA (mgd)	Silverdale UGA (mgd)	Southern Service Area Total [a] (mgd)	Poulsbo Total (mgd)	Navy Set-aside (mgd)	CKWWTP Influent (mgd)
2015 Projected Flows						
Average Annual Flow (AAF)	2.23	2.31	4.67	1.00	0.80	6.44
Average Design Flow (ADF)	2.71	2.82	5.70	1.37	1.07	8.09
Peak Design (Hour) Flow (PDF)	NC	NC	15.4	3.71	3.54	22.6
2025 Projected Flows						
Average Annual Flow (AAF)	3.07	2.92	6.15	1.30	0.98	8.45
Average Design Flow (ADF)	3.74	3.56	7.49	1.79	1.35	10.6
Peak Design (Hour) Flow (PDF)	NC	NC	20.3	4.82	4.13	29.3

[a] Includes Served Population Outside UGA.

NC – Not Calculated.

3.2 Wastewater Composition and Loadings

Wastewater characteristics that are significant in the design of wastewater treatment facilities include concentrations of suspended solids and oxygen-demanding substances in the wastewater stream. Knowledge of the concentration of various other chemical constituents such as minerals and toxicants are also required to reclaim water or to estimate effects on downstream water uses. The parameters used most often to quantify wastewater strength produced from municipal sources are total suspended solids (TSS) and 5-day biochemical oxygen demand (BOD_5).

The effluent concentration of TSS and BOD_5 serve (along with the effluent concentrations of other wastewater constituents) as the basis for evaluating treatment plant performance through the National Pollution Discharge and Elimination System (NPDES).

3.2.1 Wastewater Loading Parameters

Suspended solids are a measure of particulate and insoluble matter transported in the wastewater, the quantity of which is determined by filtering a sample of wastewater and weighing the material retained on the filter. Total suspended solids refers to both the organic-volatile suspended solids (VSS) and inorganic-fixed suspended solids.

Oxygen-demanding substances consist of soluble and insoluble organic matter that, as a result of bacterial decomposition, causes the removal of dissolved oxygen from the wastewater. The quantity of oxygen-demanding substances present in wastewater has usually been expressed as BOD_5.

The standard BOD test is primarily a test for carbonaceous biological oxygen demand (CBOD). However, limitations of standard BOD test procedures often cause nitrogenous biological oxygen demand (NBOD) to be confused with CBOD, resulting in a higher BOD value than would be apparent if the test were constrained to determine CBOD alone.

Suppression of nitrifying bacteria to determine CBOD alone is now quite common. The suppressed version of the test is currently being used as a substitute for the standard BOD test in discharge permits because, in general terms, treatment plant owners are only required to remove carbonaceous oxygen demand. The modified version of the BOD test therefore has the advantage of limiting the amount of wastewater treatment required to achieve NPDES permit limitations.

Removal of nitrogen from the wastewater stream, if required by the plant's permit, is usually monitored by testing ammonia levels in the plant effluent. Specific tests for NBOD can be employed in addition to ammonia testing.

Figure 3-3 shows the monthly average flows and loadings for the 2002 to 2006 period. The average and maximum month values, as well as various calculated loading peaking factors for each year, are summarized in Table 3-6. Figure 3-3 and Table 3-6 indicate high TSS loadings in 2002. Higher TSS loadings were also measured in 2001 (not shown in Figure 3-3 and Table 3-6). Previous investigations, described in the *Central Kitsap Wastewater Treatment Plant Influent Solids Analysis Report* (November 21, 2006), determined that the solids loading spikes in summer 2001 were caused by polymer spills during startup of the new centrifuge. However, no specific causes for the high loadings from November 2001 to February 2002, and then again from August to October 2002, were identified. Table 3-7 shows monthly data for septage and sludge received from the other Kitsap County wastewater treatment plants from 2004 to 2006.

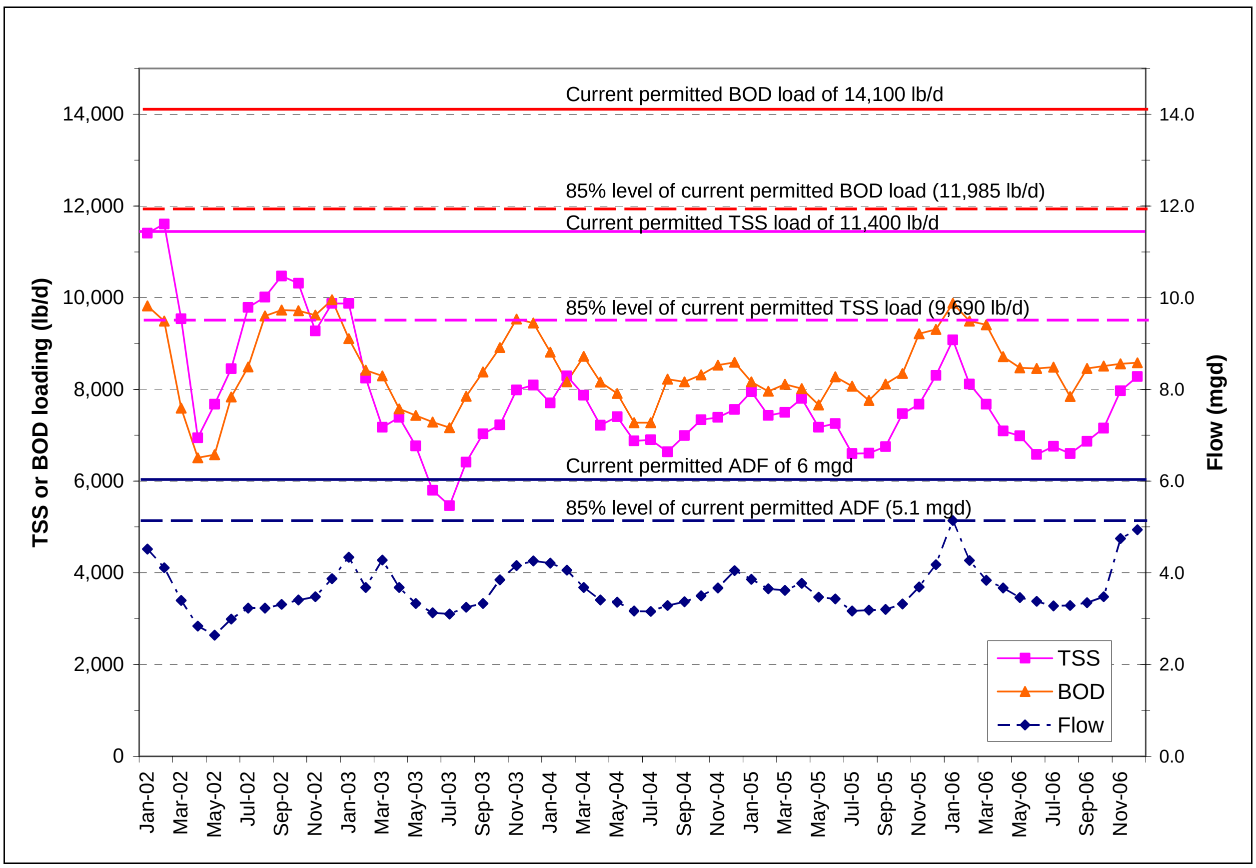


Figure 3-3. CKWWTP Monthly Average Flows and Loadings from 2002 to 2006

Table 3-6. Summary of CKWWTP Flows and Loading Data

Parameter	2002	2003	2004	2005	2006	Average
Annual average flow (AAF), mgd	3.42	3.70	3.58	3.55	3.90	*3.63*
Avg. dry weather flow (ADWF) [a], mgd	3.14	3.33	3.31	3.30	3.37	*3.29*
Maximum month flow (ADF), mgd	4.52 (Jan)	4.34 (Jan)	4.21 (Jan)	4.18 (Dec)	5.14 (Jan)	*4.48*
Maximum day flow (MDF), mgd	8.91 (Jan)	7.41 (Oct)	6.06 (Jan)	5.88 (Dec)	8.16 (Jan)	*7.28*
Peaking factors						
ADF/ADWF	1.44	1.30	1.27	1.27	1.52	*1.36*
AAF/ADWF	1.09	1.11	1.08	1.08	1.16	*1.10*
MDF/ADWF	2.84	2.22	1.83	1.78	2.42	*2.22*
Annual average BOD load, lb/d	8,745	8,283	8,179	8,251	8,738	*8,439*
Annual average BOD concentration, mg/L	310	270	278	280	277	*283*
Average dry weather BOD load, lb/d	8,658	7,837	7,862	8,040	8,371	*8,154*
Maximum month BOD load, lb/d	9,957 (Dec)	9,533 (Nov)	8,811 (Jan)	9,307 (Dec)	9,877 (Jan)	*9,497*
Maximum day BOD load, lb/d	11,825 (Feb)	11,073 (Jan)	10,482 (Jan)	10,779 (Nov)	11,890 (Jan)	*11,210*
Peaking factors						
Max month/annual average	1.14	1.15	1.08	1.13	1.13	*1.13*
Max day/max month	1.19	1.16	1.19	1.16	1.20	*1.18*
Annual average TSS load, lb/d	9,614	7,289	7,350	7,378	7,430	*7,812*
Annual average TSS concentration, mg/L	338	236	246	249	233	*241* [b]
Average dry weather TSS load, lb/d	9,453	6,451	7,026	6,977	6825	*7,346*
Maximum month TSS load, lb/d	11,605 (Feb)	9,873 (Jan)	8,294 (Feb)	8,303 (Dec)	9,080 (Jan)	*7,623*
Maximum day TSS load, lb/d	17,468 (Feb)	12,632 (Jan)	11,569 (Feb)	11,240 (Dec)	14,800 (Jan)	*13,542*
Peaking factors						
Max month/annual average [b]	1.21	1.35	1.13	1.13	1.22	*1.21*
Max day/max month [b]	1.51	1.28	1.39	1.35	1.63	*1.41*
Annual average NH_3-N load, lb/d	916	942	1,204	963	1,024	*1,010*
Avg. dry weather NH_3-N load, lb/d	842	890	1,185	856	1,046	*964*
Maximum month NH_3-N load, lb/d	1,630 (Feb)	1,258 (Dec)	1,441 (Nov)	1,413 (Jan)	1,260 (Jan)	*1,400*
Peaking factors						
Max month/annual average [c]	1.78	1.34	1.20	1.47	1.23	*1.31*
Annual average influent temp, deg C	16.6	17.0	17.3	17.2	17.1	*17.0*
Max month influent temp, deg C	20.6	21.0	21.5	21.0	21.9	*21.0*
Min month influent temp, deg C	13.0	13.7	13.3	13.9	13.7	*13.5*

[a] Dry weather period = May –October

[b] Average excludes 2002 data due to abnormally high TSS concentrations measured during a few months of that year.

[c] Average excludes 2002 data due to abnormally high NH3-N concentrations measured in February 2002.

Table 3-7. Summary of Septage and Other Sludge Data												
	Septage			Manchester Sludge			Suquamish Sludge			Kingston Sludge		
	Gallons	% TS	lb/mth [a]	Gallons	% TS	lb/mth [a]	Gallons	% TS	lb/mth [a]	Gallons	% TS	lb/mth [a]
Jan-04	171,700	1.05%	14,982	21,000	3.80%	6,655	93,000	0.91%	7,087	105,000	0.49%	4,259
Feb-04	206,500	2.54%	43,814	25,200	3.48%	7,309	96,000	0.89%	7,134	100,000	0.50%	4,148
Mar-04	287,300	1.71%	40,976	24,000	4.09%	8,196	94,000	1.28%	10,040	131,000	0.47%	5,132
Apr-04	292,300	1.25%	30,440	16,800	3.37%	4,716	69,200	1.40%	8,103	131,000	0.43%	4,733
May-04	262,700	1.93%	42,291	20,000	3.03%	5,054	79,000	1.20%	7,927	152,000	0.43%	5,487
Jun-04	312,500	2.54%	66,315	16,800	2.60%	3,640	103,000	0.93%	8,012	176,600	0.38%	5,652
Jul-04	287,900	2.14%	51,370	21,000	3.23%	5,649	114,000	0.86%	8,130	213,200	0.40%	7,110
Aug-04	321,500	1.40%	37,664	21,000	3.32%	5,810	120,000	0.96%	9,585	176,400	0.34%	4,928
Sep-04	334,900	2.03%	56,734	21,000	3.35%	5,865	134,000	0.84%	9,390	166,400	0.34%	4,774
Oct-04	238,200	2.08%	41,374	16,800	4.02%	5,630	152,000	0.74%	9,337	118,400	0.37%	3,628
Nov-04	219,700	2.56%	46,883	19,800	3.33%	5,495	210,400	0.49%	8,618	153,600	0.41%	5,252
Dec-04	181,100	2.20%	33,276	25,200	4.05%	8,507	91,000	1.46%	11,051	173,000	0.38%	5,511
Jan-05	198,900	1.07%	17,815	21,000	3.99%	6,986	52,000	2.30%	9,982	188,800	0.37%	5,788
Feb-05	206,400	3.79%	65,291	12,600	4.28%	4,500	24,000	2.99%	5,991	208,000	0.31%	5,404
Mar-05	137,800	2.48%	28,537	12,600	4.85%	5,097	52,000	2.26%	9,797	236,800	0.30%	5,906
Apr-05	256,800	1.12%	24,062	12,600	4.85%	5,095	36,000	2.79%	8,381	227,200	0.28%	5,361
May-05	271,100	1.49%	33,709	21,000	4.44%	7,778	60,000	2.18%	10,906	39,800	0.25%	817
Jun-05	311,200	1.32%	34,291	12,600	4.24%	4,453	32,000	3.06%	8,177	12,600	3.26%	3,423
Jul-05	250,200	1.70%	35,498	19,800	4.12%	6,809	48,000	2.79%	11,158	8,700	4.12%	2,987
Aug-05	293,800	2.21%	54,167	21,000	4.30%	7,534	36,000	3.22%	9,681	12,600	3.38%	3,550
Sep-05	311,900	1.67%	43,434	25,200	4.13%	8,688	38,800	3.17%	10,254	8,400	3.42%	2,398
Oct-05	274,200	2.09%	47,806	8,400	3.91%	2,736	32,000	2.86%	7,642	8,400	3.58%	2,507
Nov-05	200,700	2.80%	46,835	12,400	4.54%	4,699	56,400	1.47%	6,921	12,600	3.40%	3,572
Dec-05	218,800	1.89%	34,409	20,500	4.70%	8,034	62,000	1.83%	9,444	12,600	4.03%	4,233
Jan-06	224,750	2.57%	48,172	19,100	4.46%	7,105	75,600	1.62%	10,214	12,600	4.24%	4,456
Feb-06	206,000	1.61%	27,660	25,300	4.40%	9,284	50,400	2.47%	10,382	12,600	3.02%	3,174
Mar-06	254,900	2.04%	43,368	17,900	4.63%	6,912	54,600	2.30%	10,473	12,600	4.03%	4,235
Apr-06	240,800	2.34%	46,994	18,900	4.70%	7,408	54,600	1.93%	8,789	12,600	3.83%	4,025
May-06	278,600	1.62%	37,641	23,100	4.64%	8,939	58,800	1.88%	9,219	16,800	3.24%	4,540
Jun-06	300,700	2.62%	65,705	16,500	4.50%	6,192	50,400	2.12%	8,911	8,400	4.87%	3,412
Jul-06	278,800	2.51%	58,362	16,000	4.61%	6,152	58,800	1.54%	7,552	13,600	2.34%	2,654
Aug-06	323,100	2.08%	56,049	20,000	4.09%	6,822	54,000	1.82%	8,197	24,500	2.71%	5,537
Sep-06	249,000	1.35%	28,035	16,800	N/A	N/A	46,200	N/A	N/A	12,600	N/A	N/A
Oct-06	244,550	2.87%	58,535	29,400	2.50%	6,130	58,400	1.96%	9,546	21,000	2.34%	4,098
Nov-06	174,600	1.80%	26,211	25,200	2.31%	4,855	69,800	2.04%	11,875	12,600	2.80%	2,942
Dec-06	185,300	1.04%	16,072	25,200	2.50%	5,254	58,800	2.29%	11,230	21,000	2.75%	4,816
(per day)												
2004 avg	8,514	1.95%	1,383	679	3.47%	198	3,704	1.00%	285	4,009	0.41%	166
2005 avg	8,032	1.97%	1,276	547	4.36%	198	1,450	2.58%	297	2,675	2.22%	126
2006 avg	8,113	2.04%	1,405	694	3.94%	224	1,892	2.00%	318	496	3.29%	131

[a] *Total pounds of dry solids per month*

3.2.1.1 Chemical Constituents

The chemical constituents of the influent flows are important to note because certain chemical compounds can adversely affect biological treatment processes, including odor problems, water quality degradation, and reduction of the options for sludge management and disposal. Constituents most commonly present in wastewaters are organic toxicants such as surfactants, phenols, ammonia, nitrogen, and phosphorus. Heavy metals such as cadmium, chromium, copper, lead, nickel, zinc, mercury, iron, manganese, and cyanide are of concern because they ultimately end up in sludge and plant effluent.

Data pertaining to phenols, surfactants, and phosphorus in the influent are not currently available. Monthly average concentrations of the other listed constituents are summarized in Table 3-8 for 2005 and 2006, and compared to the EPA acceptable ranges where applicable. Heavy metal influent concentrations at CKWWTP were within the specified EPA ranges.

Table 3-8. CKWWTP Average Influent Metals Concentrations

Month	Influent metals constituents, mg/L							
	Cd	Cr	Cu	Hg	Pb	Ni	Se	Zn
Jan-05	<3	<7	25	<0.22	<40	<15	<80	91
Feb-05	<3	<7	23	<0.22	<40	<15	nm	120
Mar-05	<3	<7	23	0.54	<40	<15		120
Apr-05	<3	11	25	<0.22	<40	<15		93
May-05	<0.4	3	42	0.25	4.6	5.6	<5.1	119
Jun-05	<0.4	3.5	50	0.20	4.4	5.4	8.8	133
Jul-05	<0.4	3.6	45	<0.22	5.2	5.4	<5.1	138
Aug-05	<0.4	3.9	44	<0.22	6	5.1	<5.1	141
Sep-05	<0.4	4.4	45	<0.22	6.0	5.4	<5.1	137
Oct-05	<0.4	3.6	54	<0.22	4.9	7.6	<5.1	142
Nov-05	0.60	3.4	42	0.25	5.2	6.8	<5.1	145
Dec-05	0.57	2.8	46	<0.22	4.8	6.7	<5.1	153
Jan-06	0.54	6.8	33	0.25	4.6	8.4	<5.1	126
Feb-06	0.51	2.8	32	<0.22	<4.3	6.3	<5.1	110
Mar-06	0.58	2.4	44	<0.22	5.1	7.1	<5.1	124
Apr-06	0.75	3.2	105	0.45	4.4	12	<5.1	167
May-06	0.58	2.9	41	0.29	<4.3	5.4	<5.1	127
Jun-06	0.54	3.1	41	<0.22	<4.3	4.4	<5.1	168
Jul-06	0.62	3.2	53	<0.22	<4.3	11	<5.1	171
Aug-06	<0.4	3.5	42	<0.22	<4.3	6.8	<5.1	139
Sep-06	0.44	3.3	54	<0.22	<4.3	7.4	<5.1	144
Oct-06	<0.4	2.2	43	<0.22	<4.3	4.3	13.4	133
Nov-06	<8.6	<5.3	44	0.24	<6.0	7.3	<7.9	150
Dec-06	<8.6	<5.3	36	0.25	<6.0	5.6	<7.9	108
EPA range[b]	1-1800	8-2400	7-2300	0.2-4	16-2500	5-6000	-	22-9300

N/A = not available

[a]Source = CKWWTP Discharge Monitoring Reports

[b]Representative ranges presented in EPA's Fate of Priority Toxic Pollutants.

3.2.1.2 Wastewater Temperature

Sewage temperature affects the biological activity of the micro-organisms. As a result, the treatment processes must be designed to meet the effluent limits at the lowest operating temperatures likely to occur. Influent wastewater temperature data at the CKWWTP during the period from 2002 to 2006 are summarized in Table 3-6. During this period, a minimum influent temperature of 10°C (50°F) was recorded.

3.2.1.3 Special Wastewater Characterization Study

A special wastewater characterization study was conducted to identify current wastewater characteristics to verify the biological process simulator, and subsequently evaluate existing plant capacity as well as future plant expansion alternatives. The study consisted of daily composite sampling as well as diurnal grab sampling of various process streams in the liquids and solids treatment trains. The samples were analyzed for a number of constituents to characterize different organic, solid, and nutrient components of the wastewater, such as chemical oxygen demand (COD), soluble COD, BOD, TSS, VSS, and ammonia-nitrogen. The diurnal sampling was conducted to determine diurnal variation of the major wastewater constituents.

Table 3-9 summarizes the wastewater characteristics collected during the special sampling period in March 2007.

Table 3-9. Summary of Wastewater Characteristics during Special Sampling Period[a]

Parameter	Average Concentration
Primary Effluent Concentrations	
Total BOD, mg/L	136
Soluble BOD, mg/L	56
TSS, mg/L	104
VSS, mg/L	89
Total COD, mg/L	308
Soluble COD, mg/L	124
TKN, mg/L	49
Soluble TKN, mg/L	42
Ammonia-nitrogen (NH_3-N), mg/L	40
Total Phosphorus, mg/L	13
Ortho-Phosphorus, mg/L	11
Alkalinity, mg/L $CaCO_3$	238
Mixed liquor temperature, °C	14
COD fractions:	
Readily biodegradable COD	0.17
Unbiodegradable soluble COD	0.09
Unbiodegradable particulate COD	0.19
Nutrients fractions:	
Fraction of TKN that is ammonia-nitrogen	0.82
Fraction of biodegradable organic TKN that is particulate	0.67
Fraction of TP that is ortho-phosphate	0.81

[a] *Based on composite samples collected from March 5 to 15, 2007*

3.2.2 Wastewater Loadings Projection

Plant influent BOD and TSS loadings were projected based on predicted annual average flow and annual average concentrations determined from the historical plant data analysis. As shown in Table 3-6, the annual average BOD and TSS concentrations are 283 and 241 milligrams per liter (mg/L), respectively. Loadings under the various seasonal conditions were calculated from historical peaking factors shown in Table 3-6. The projected 2025 flows and BOD and TSS loadings are summarized in Table 3-10. Table 3-10 also includes current plant design flows and loadings as well as the projected loadings for septage and sludges from the Kingston, Manchester, and Suquamish plants. Septage loads were estimated assuming that they remain about the same as those measured in 2006. Sludge loads from the three Kitsap treatment plants were estimated from 2004 data and estimated increases in sludge production rates at the three plants.

Table 3-10. Projected Flows and Loadings at CKWWTP

Parameter	Current Design[a]	Year 2025
Raw Influent:		
Average Annual Flow (AAF), mgd	4.6	8.5
Average Dry Weather Flow (ADWF), mgd	4.3	7.7
Average Peak Month Flow (ADF), mgd	6.0	10.6
Maximum Day Flow (MDF), mgd	11.0	17.2
Peak Design (Hour) Flow (PDF), mgd	15.0	29.3
Annual Average TSS, ppd	8,844	17,000
Average Peak Month TSS, ppd	11,400	20,600
Maximum Day TSS, ppd	-	29,000
Annual Average BOD, ppd	8,403	19,900
Average Peak Month BOD, ppd	14,100	22,500
Maximum Day BOD, ppd	-	26,600
Septage:		
Average Annual Flow (AAF), gpd	26,900	8,300
Average Annual TSS, ppd	5,830	1,410
Average Peak Month TSS, ppd	-	2,190
Average Annual BOD, ppd	1,570	390
Average Peak Month BOD, ppd	-	610
Sludge from other plants:		
Average Annual Flow (AAF), gpd	13,300	5,400
Average Annual TSS, ppd	900	1,160
Average Peak Month TSS, ppd	-	1,560
Average Annual BOD, ppd	390	220
Average Peak Month BOD, ppd	-	300

[a] Corresponds to Contract I design flows and loads, except for average peak month TSS and BOD loadings, which correspond to the design loadings shown in the current NPDES permit.

CHAPTER 4

4. EXISTING WASTEWATER SYSTEM

One of the basic objectives of facilities planning is to evaluate the feasibility and cost-effectiveness of incorporating existing wastewater systems into a long-range program for wastewater management. Facilities discussed in this system include wastewater collection, conveyance, and treatment facilities, along with the treatment plant outfall and diffuser. Accordingly, information regarding characteristics and conditions of the existing sewer collection and conveyance system components for the Central Kitsap service areas was collected, compiled, and analyzed to define each component's potential role in the long-range program. Maximum utilization of existing facilities will be considered as the baseline condition for planning improvements. Information in this chapter is, in part, derived from interviews with officials of the governing public agencies and operators of the existing systems, reviews of existing engineering plans and reports, pumping station test results, operational performance test data, and other field investigations.

4.1 Existing Collection and Conveyance Facilities

The collection system receives wastewater from the City of Poulsbo, the U.S. Navy stations at Bangor and the Keyport Community, and the Central Kitsap and Silverdale UGAs. Wastewater from these areas is conveyed to the Central Kitsap Wastewater Treatment Plant, located in the Central Valley area. Due to the hilly terrain over much of the Central Kitsap service areas, a network of 44 lift stations is utilized to bring flows to the treatment plant site, which is approximately 155 feet above mean sea level (MSL). Eleven of the lift stations are considered major facilities, with capacities exceeding 1,000 gpm. Of the remaining 33 lift stations, only two have design capacities between 500 and 1,000 gpm; 31 lift stations have capacities less than 500 gpm.

The system is divided into the Northern and Southern Service Areas. Flows generated from the Northern Service Area are primarily from contracted users and, therefore, are not addressed as capital requirements for the County. System improvements in the Northern Service Area, while managed by the County, are the fiscal responsibility of others. Operation and management of these facilities are the responsibility of the County.

The existing system consists of lift stations, gravity and force mains, trunks, and interceptors. Flow routing in the collection and conveyance system is described in the following section to facilitate an understanding of the system components and establish a basis for evaluating the existing system's capacity. The Southern Service Area served by the County collection and conveyance system is illustrated on Figure 4-1. System modeling is discussed in Chapter 7.

4.1.2 Flow Routing

Figure 4-2, Existing Conveyance System Schematic, shows the conveyance system flow diagram for Central Kitsap County. Flows arrive at CKWWTP through two major force mains from the northern and southern sections of the service areas. The Northern Service Area force main serves the City of Poulsbo, the U.S. Naval bases at Bangor and Keyport, and the Keyport community. Unincorporated areas of Kitsap County are served by the Southern Service Area force main.

4.1.2.1 Northern Service Area

Lift Station 24 is the primary collection and flow measurement point for all flows generated in the Northern Service Area. Flows from the Northern Service Area are conveyed to the CKWWTP from Lift Station 24 via a 24-inch force main. Lift Stations tributary to Lift Station 24 are listed below:

- Lift Station 16 is tributary to Lift Station 24 and receives flows from Keyport Community and Keyport Naval Base, as well as from Poulsbo. Wastewater from the City of Poulsbo is conveyed from Lemolo under the mouth of Liberty Bay to Lift Station 16 in Keyport via a 12-inch-diameter, twin-barrel siphon. Flows are measured at a flow station on the Lemolo side.
- Lift Station 67 is tributary to Lift Station 16.
- Lift Station 17 is tributary to Lift Station 24 and receives flow from Bangor Naval Base. Flows are metered at this station.
- Lift Station 64 is tributary to Lift Station 24 and discharges to the force main from Lift Station 17.

4.1.2.2 Southern Service Area

For the purposes of this Plan, the Southern Service Area has been divided into four sub-areas: Central Kitsap East, Central Kitsap West, Silverdale North, and Silverdale South. The delineations, illustrated on Figure 4-1, are used as a key for the individual maps of each sub-area, as shown on Figures 4-3 to 4-6. Each of these maps shows the existing collection and conveyance system, lift stations, and their respective basins.

4.1.2.2.1 Wastewater Basins

As illustrated on Figure 4-1, the Southern Service Area includes the Central Kitsap and Silverdale UGAs. Each of the UGAs was divided into two parts: Central Kitsap East and West, and Silverdale North and South. The existing collection and conveyance system is made up of a large number of basins and sub-basins. The basins are generally defined as being the area served by a particular lift station. The areas (basins) that are currently served by each lift station are identified by lift station number. Basin delineations for the Southern Service Area are shown on Figures 4-3 to 4-6.

4.1.2.2.2 Primary Conveyance Facilities

The Southern Service Area has a number of primary lift stations to which a large number of tributary lift stations pump. The primary lift stations include Lift Station 7 in Central Kitsap East; Lift Stations 6 and 34 in Central Kitsap West; Lift Stations 1, 4, and 19 in Silverdale North; and Lift Station 3 in Silverdale South.

All flows generated in the Southern Service Area are delivered to the CKWWTP via a low-pressure gravity system. The system consists of two upstream reaches of 16- and 20-inch-diameter pipe that transmit flows under gravity pressure (essentially surcharged) to a 24-inch-diameter followed by a 30-inch-diameter interceptor that delivers the pressure flows to the plant. The 16- and 20-inch-diameter interceptors deliver flows from Central Kitsap and Silverdale, respectively. Detailed system information follows.

Flows from the Central Kitsap UGA, Lift Stations 6 and 7, are discharged through a 10- and 14-inch-diameter force main (respectively) to a junction at the intersection of Fairgrounds Road and Old Military Road. From this junction, the combined flow is conveyed over a rise along Old Military Road through a series of 16- and 18-inch-diameter gravity pipes and inverted siphons. There are seven manholes in series near the crown of this hill, connected by the 18-inch-diameter gravity pipeline. Gravity flows from local neighborhoods and from Pumping Station 35 enter at manholes along this reach. At the last manhole, H17-4001, the line diameter is reduced back to 16 inches for pressure flow to the plant.

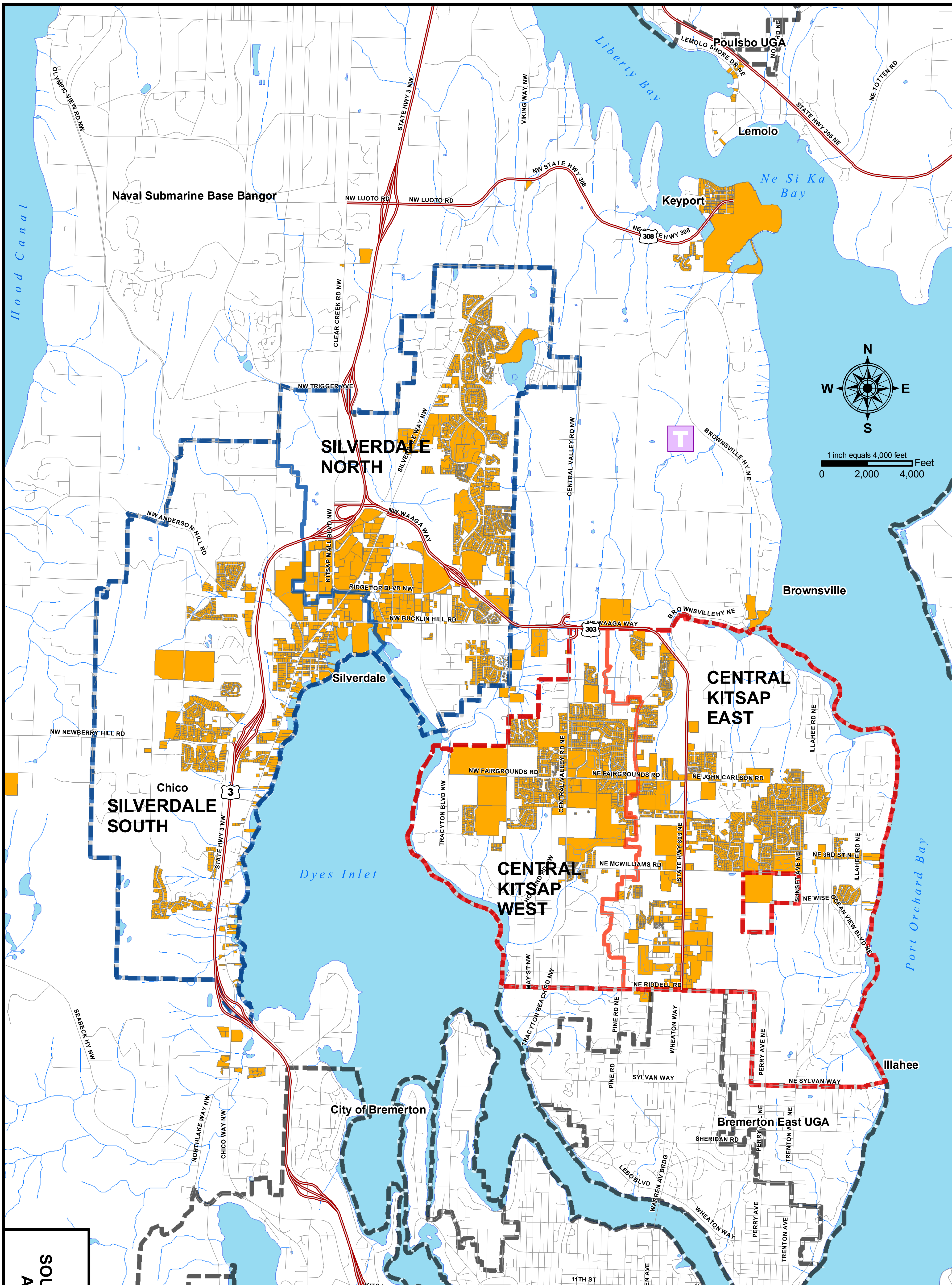


FIGURE 4-1
SOUTHERN SERVICE
AREA KEY MAP

LEGEND

- Central Kitsap UGA East & West
- Silverdale UGA North & South
- Other UGAs
- Permitted Properties (Sewer Service)
- Street Center Lines
- State HWY/Route
- Wastewater Treatment Plant

Permitted Properties (Sewer Service) - Kitsap County Sept 7 2007

Data sources supplied by Kitsap County 2007, and may not reflect actual or current conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

MAP DATE: DECEMBER 2007

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KITSAP COUNTY PUBLIC WORKS

CENTRAL KITSAP WASTEWATER GMA COMPLIANCE PLAN

FILE NAME (UPDATED BY)	PLOT DATE & TIME
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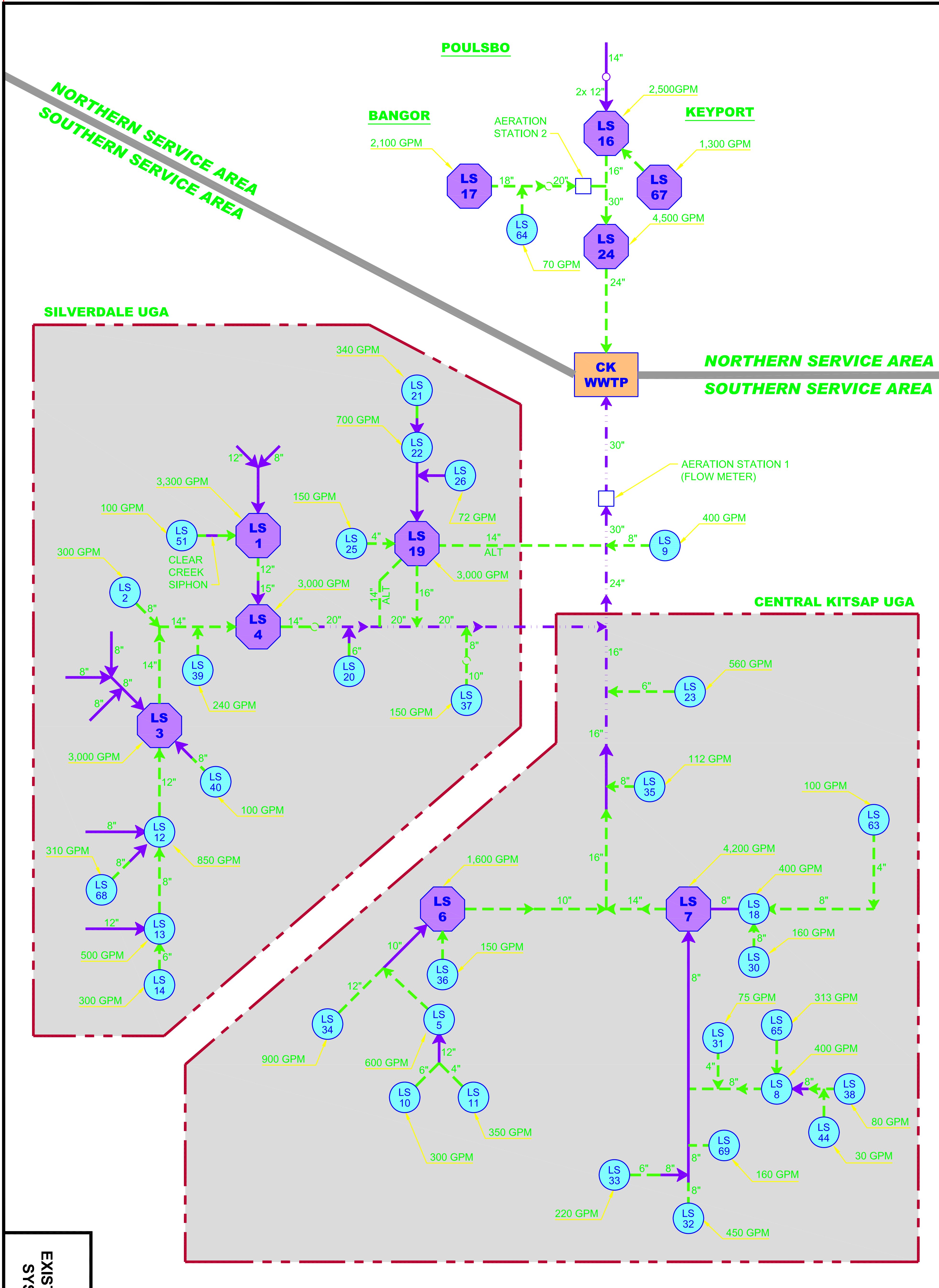

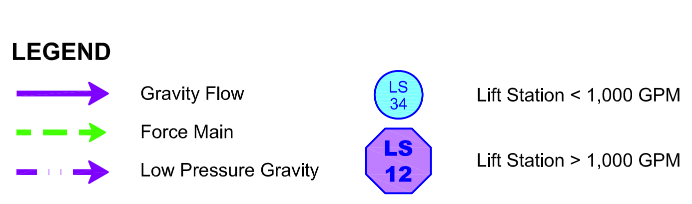

FIGURE 4-2
EXISTING CONVEYANCE SYSTEM SCHEMATIC

KITSAP COUNTY PUBLIC WORKS

CENTRAL KITSAP WASTEWATER GMA COMPLIANCE PLAN

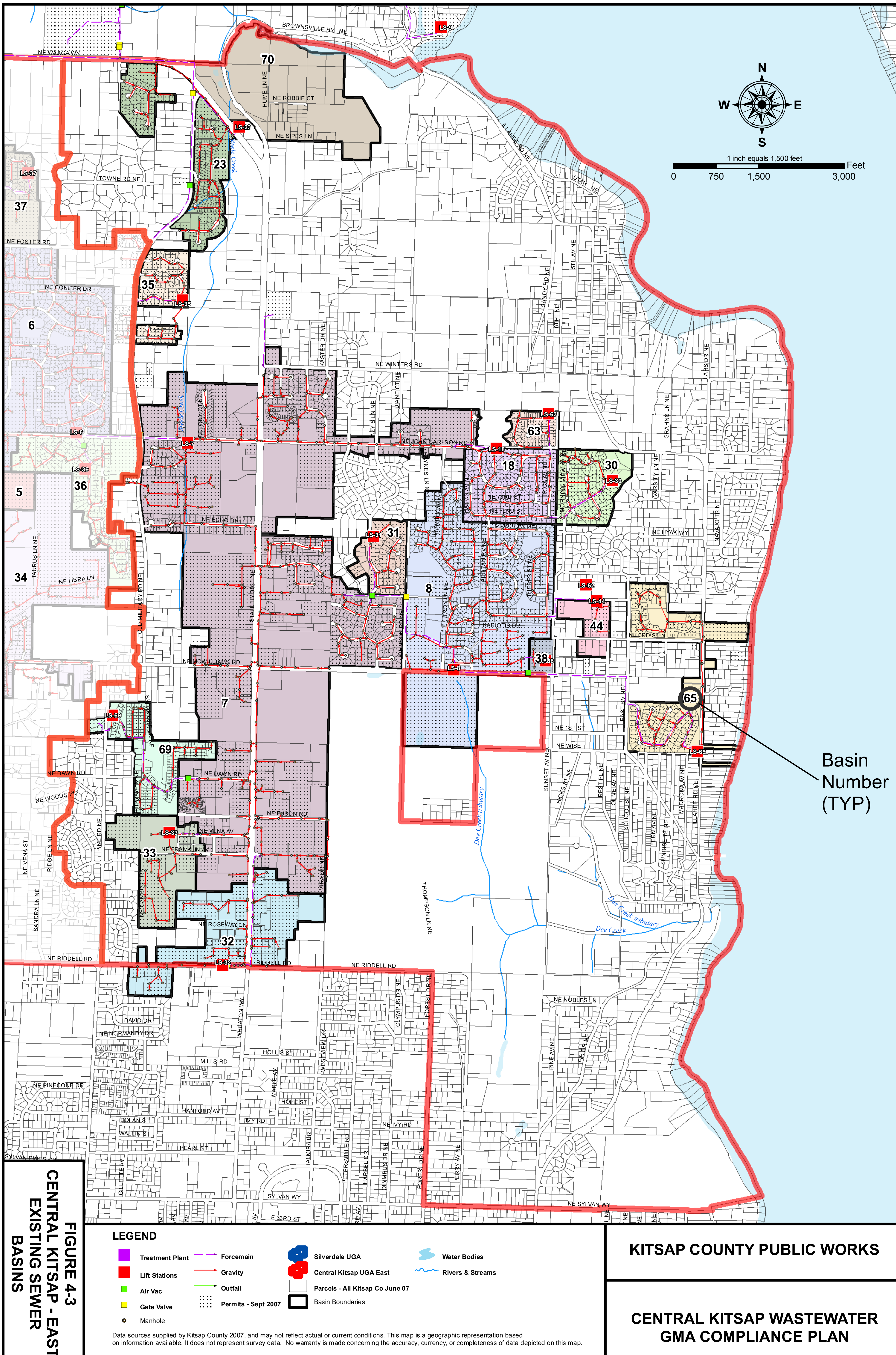

FIGURE 4-3
CENTRAL KITSAP - EAST
EXISTING SEWER
BASINS

KITSAP COUNTY PUBLIC WORKS

CENTRAL KITSAP WASTEWATER
GMA COMPLIANCE PLAN

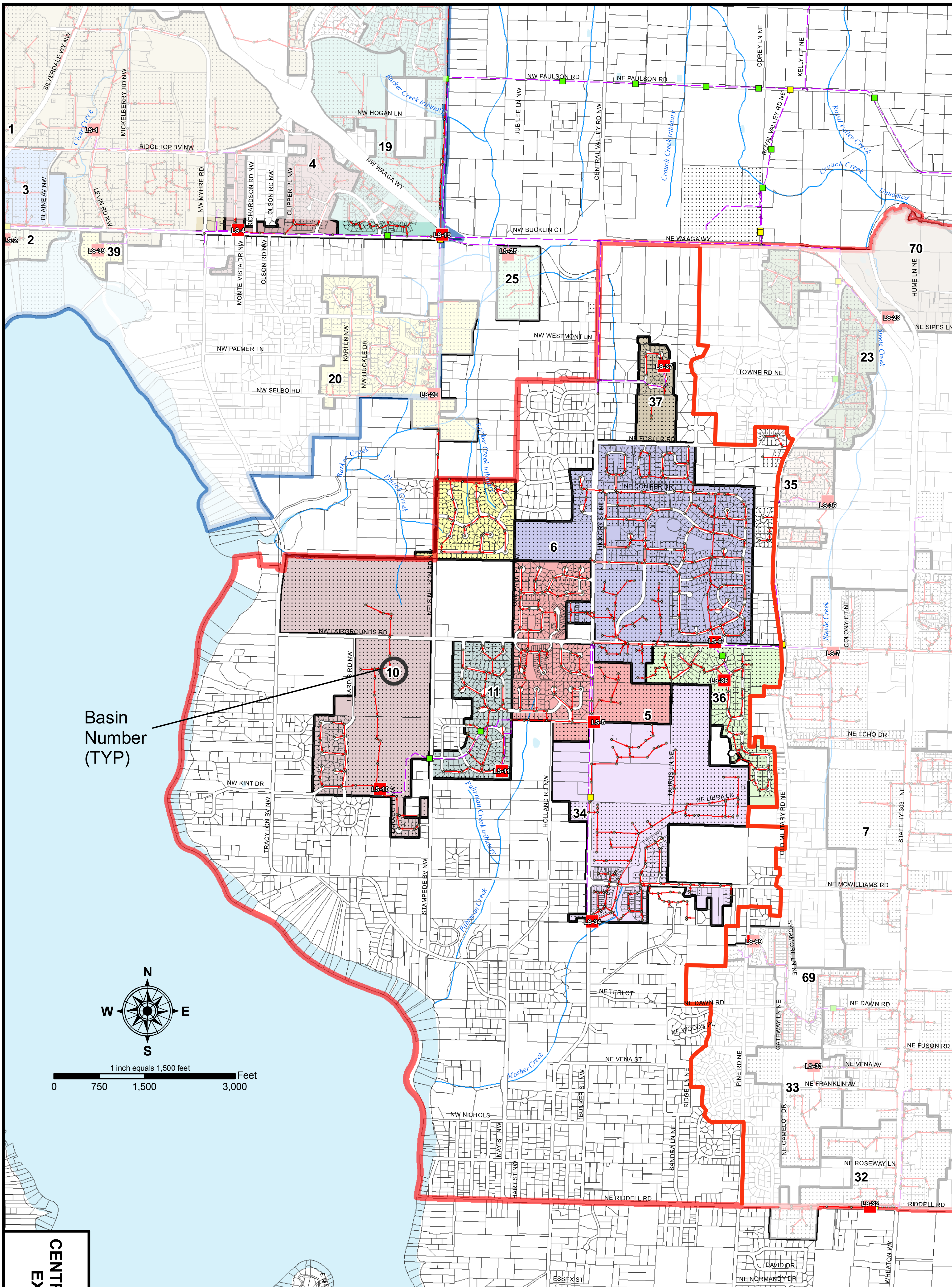

FIGURE 4-4
CENTRAL KITSAP - WEST EXISTING SEWER BASINS

LEGEND

- Treatment Plant
- Lift Stations
- Air Vac
- Gate Valve
- Manhole
- Forcemain
- Gravity
- Outfall
- Permits - Sept 2007
- Silverdale UGA
- Central Kitsap UGA West
- Parcels - All Kitsap Co June 07
- Water Bodies
- Rivers & Streams

Data sources supplied by Kitsap County 2007, and may not reflect actual or current conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

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KITSAP COUNTY PUBLIC WORKS

CENTRAL KITSAP WASTEWATER GMA COMPLIANCE PLAN

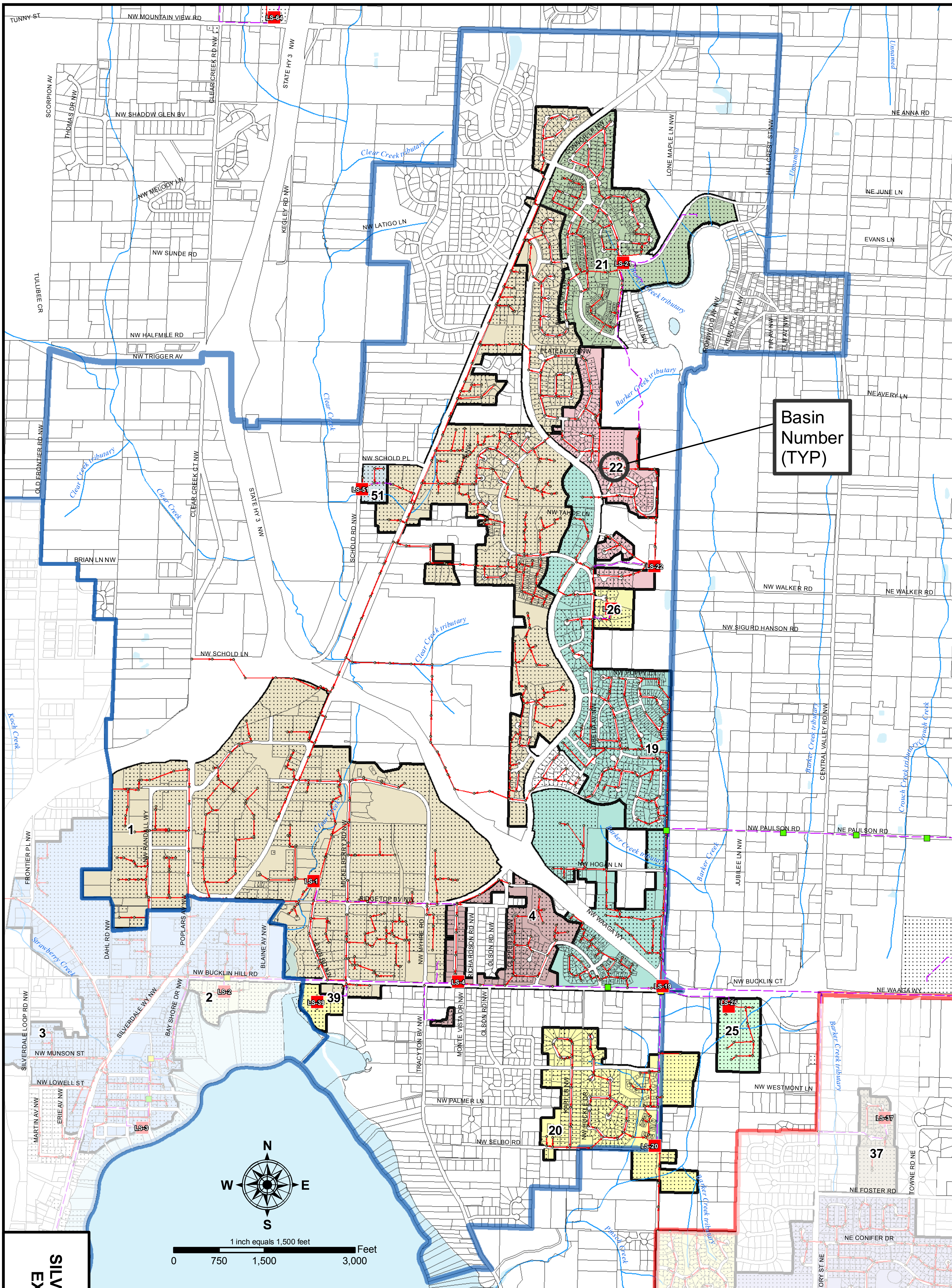

FIGURE 4-5 SILVERDALE - NORTH EXISTING SEWER BASINS

LEGEND

- Treatment Plant
- Lift Stations
- Air Vac
- Gate Valve
- Manhole
- Forcemain
- Gravity
- Outfall
- Permits - Sept 2007
- Silverdale UGA North
- Central Kitsap UGA
- Parcels - All Kitsap Co June 07
- Water Bodies
- Rivers & Streams

Data sources supplied by Kitsap County 2007, and may not reflect actual or current conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

MAP DATE: DECEMBER 2007

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KITSAP COUNTY PUBLIC WORKS

CENTRAL KITSAP WASTEWATER GMA COMPLIANCE PLAN

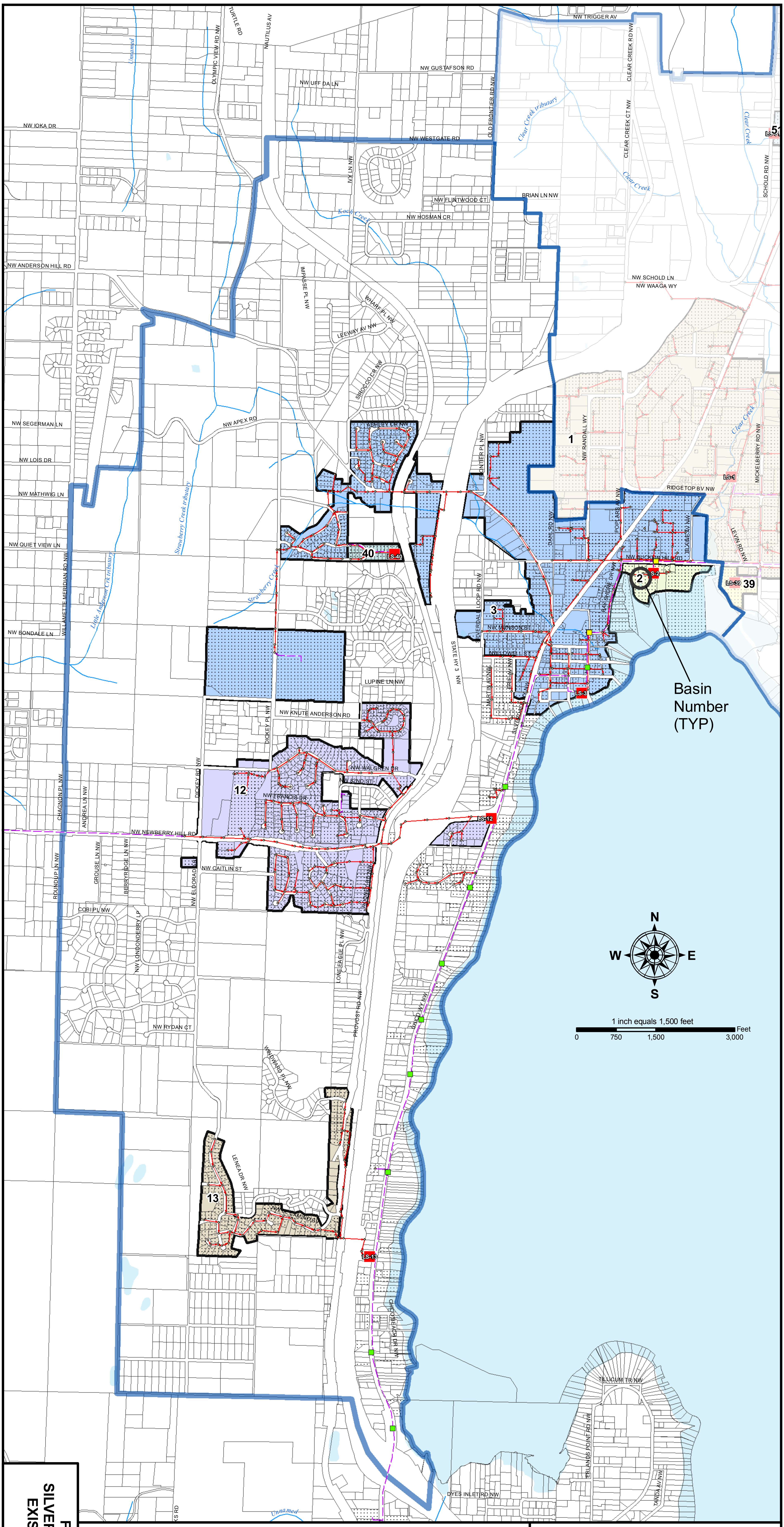

FIGURE 4-6 SILVERDALE - SOUTH EXISTING SEWER BASINS

LEGEND

- Treatment Plant
- Lift Stations
- Air Vac
- Gate Valve
- Manhole
- Forcemain
- Gravity
- Outfall
- Silverdale UGA South
- Central Kitsap UGA
- Parcels - All Kitsap Co June 07
- Water Bodies
- Rivers & Streams

Data sources supplied by Kitsap County 2007, and may not reflect actual or current conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

MAP DATE: DECEMBER 2007

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KITSAP COUNTY PUBLIC WORKS

CENTRAL KITSAP WASTEWATER GMA COMPLIANCE PLAN

Flows from Silverdale UGA Lift Station 4 are pumped through a 14-inch-diameter force main along Bucklin Hill Road to a high point in the roadway from which flows are conveyed under a gravity pressure head through a 20-inch-diameter line. At the junction of Nels Nelson Road and Bucklin Hill Road, a 16-inch-diameter force main from Lift Station 19 connects to the 20-inch-diameter line.

Flows from Central Kitsap join with flows from Silverdale at the intersection of Wagga Way and Royal Valley Road NE. The combined flows head north via a 24-inch-diameter low pressure main. A force main from Lift Station 9 in the Brownsville area connects to the 24-inch-diameter main at Paulson Road. At the same location, the 14-inch-diameter alternate pipe from Lift Station 19 (and Lift Station 4) ties into the system. The pressure main changes to a 30-inch-diameter line and conveys the sum of the Southern Service Area flows into the CKWWTP. The 30-inch-diameter section from Paulson to the plant is slated for replacement in 2009-2010. Southern flows are measured along the route at Aeration Station No. 1.

The hydraulics and future requirements of the low pressure system are discussed further in Chapter 7. Lift stations tributary to the primary stations listed above are outlined below for each service sub-area.

4.1.2.2.3 Central Kitsap East

The existing collection and conveyance system and associated wastewater basins for the Central Kitsap East Area are shown on Figure 4-3. Lift Station 7 is the primary lift station serving the Central Kitsap East Area as described in the previous section. This lift station was recently reconstructed to provide the maximum capacity that could be attained given site constraints. The facility’s firm capacity is 4,200 gpd, which is expected to be adequate to serve the area for about 10 years.

- Lift Stations 8, 31, 32, 33, and 69 are directly tributary to Lift Station 7. Flows are conveyed to Lift Station 7 via a network of force mains and gravity lines.
- Several smaller lift stations – Lift Stations 65, 38, and 44 – are tributary to Lift Station 8.
- An emergency gravity overflow pipeline to the Bremerton system is connected to Lift Station 32 at the southern boundary of the service area.
- Lift Station 18 is also tributary to Lift Station 7. Several smaller lift stations – Lift Stations 30 and 63 – are tributary to Lift Station 18.
- Approximately half the existing flow to Lift Station 7 is conveyed to the station entirely by gravity.

4.1.2.2.4 Central Kitsap West

The existing collection and conveyance system and associated wastewater basins for the Central Kitsap West Area are illustrated on Figure 4-4. Lift Station 6 is the primary lift station serving the Central Kitsap West Area and conveys sewage to the CKWWTP as described in Section 4.1.2.2 above.

- Lift Stations 5, 34, and 36 are tributary to Lift Station 6. Lift Station 5, located near Central Valley Road and Holland Road, receives flow from smaller Lift Stations 10 and 11.
- Lift Station 5 receives additional flow from the residential areas of Bridle Vale, Woodridge, and Oak Park. Flow from Lift Station 5 is routed north down Central Valley Road and east along Fairgrounds Road to Lift Station 6.
- A force main from Lift Station 34 follows a parallel route along Central Valley Road and joins with the force main from Lift Station 5. This force main is scheduled to be replaced as part of the Central Valley Asbestos Cement Force Main Replacement Project.
- A force main from Lift Station 36 in the Ravenswood neighborhood also discharges to Lift Station 6.
- Lift Station 10 is tributary to Lift Station 5 and serves the Fairview neighborhood, Olympic High School, and the Kitsap County Fairgrounds.

- Additional flow from Lift Station 37 discharges to the 20-inch low pressure gravity line from Lift Stations 4 and 19 along Wagga Way.

4.1.2.2.5 Silverdale North

The existing collection and conveyance system and associated wastewater basins for the Silverdale North Area are shown on Figure 4-5. Lift Stations 4 and 19 are the primary lift stations serving the Silverdale North Area and convey flows to the CKWWTP as described in Section 4.1.2.2. Lift Station 19 serves the majority of the north and east portion of Silverdale, while Lift Station 4 serves the west. From Lift Station 3, flows from the Silverdale South Area are also conveyed through Lift Station 4.

- Lift Stations 22, 25, and 26 are tributary to Lift Station 19. Lift Station 22 also receives flow from Lift Station 21.
- Lift Station 1 is tributary to Lift Station 4 and conveys sewage from the northwest part of Silverdale. Gravity flows from this area include two 6-inch diameter siphon barrels that cross under Clear Creek prior to entering Lift Station 1 on Levin Road.
- Flows from Lift Station 19 normally pump into the 20-inch diameter line from Lift Station 4 on Bucklin Hill Road. However, a flow-splitter valve can divert flow from Lift Station 4 into Lift Station 19 through an alternate 14-inch diameter line. In this case, flows from the entire Silverdale UGA are pumped by Lift Station 19 through the alternate 14-inch diameter force main to an intersection point on the Southern Service Area force main, just south of Aeration Station No. 1.

4.1.2.2.6 Silverdale South

The existing collection and conveyance system and associated wastewater basins for the Silverdale South Area are shown on Figure 4-6. Lift Station 3 is the primary lift station for the Silverdale South Area. Lift Station 3 conveys flows through a 14-inch diameter force main to Lift Station 4, located at the intersection of Bucklin Hill and Frederickson Roads.

- Flows from the central Silverdale area are received by Lift Station 3 through a network of gravity sewers. Lift Station 40, a small lift station in a residential area west of the downtown Silverdale area, discharges to this gravity network.
- Lift Station 12 is tributary to Lift Station 3. Lift Station 12 receives flow from the south and serves the Loretta Heights residential area. Additional flows from the residential areas of Terrace Heights and El Dorado Hills are conveyed to Lift Station 12.
- Lift Station 13 is tributary to Lift Station 12.
- Lift Station 14 is tributary to Lift Station 13. Wastewater is pumped north along Chico Way through a force main to Lift Station 13.

4.1.3 Conveyance Piping

The existing conveyance piping is summarized in Table 4-1. The existing system includes over 103 miles of gravity sewer and 12 miles of force mains. A small fraction of the system functions as a siphon.

Table 4-1. Summary of Existing Conveyance Piping

	Central Kitsap	Silverdale	Total per Size
Force Mains			
2- inch diameter or smaller	0	4,138	4,138
4	0	3,171	3,171
6	5.699	6,923	12,621
8	6,419	1,694	8,113
10	1,160	7,075	8,235
12	4,695	6,854	11,549
14	921	8,901	9,822
16	7,155	46	7,201
20	0	1,818	1,818
Total Force Mains	26,049	40,620	66,669
Gravity			
6	3,777	4,919	8,696
8	243,434	255,371	498,805
10	2,649	6,491	9,140
12	4,582	13,257	17,839
15	5,181	5,272	10,454
16	0	41	41
18	1,038	873	1,911
Total Gravity	259,623	285,351	544,975

4.1.4 Lift Stations

There are currently 44 lift stations located throughout the Central Kitsap service areas. County staff gathered detailed information, conducted pump tests, and performed analyses on a majority of the lift stations in 2006. Testing and analyses were conducted three ways, depending on the priority of the lift station, the desired information, and the information available to correlate with:

1. Drawdown and Influent Flow Metering
2. Drawdown and Pressure Gauge Readings
3. Pump Run Times and Pressure Gauge Readings

Many of the lift stations have been in operation for over 20 years. For a number of these, manufacturers or design data are no longer available. As such, pump curves could not always be used to compare with pressure test results to gauge the operating condition of the facility. Thus, the operating condition could not always be determined.

Table 4-2 summarizes the existing lift stations and their firm pumping capacities. In general, it appears that most of the lift stations are operating at or below design capacity.

Table 4-2. Existing Lift Stations

Lift Station Information					Existing Conditions				
Lift Station	Year Installed	No. of Pumps	VFD	Constant Speed	Capacity		FM Length	Static Head	FM Dia.
					(gpm)	(cfs)	(ft)	(ft)	(in)
LS-1	1986/1995	3	✓	-	3,200	7.13	2,750	140	12/15
LS-2	1980	2	-	✓	264	0.59	240	125	8/14
LS-3	1980/2005	3	✓	-	1,800	4.01	7,300	135	14
LS-4	1980/2005	3	✓	-	2,865	6.38	1,585	100	14
							1,808		20
LS-5	1980	2		✓	530	1.18	1,800	80	8
LS-6	1980/2004	2	✓	-	1,200	2.67	3,275	65	10
LS-10	1980	2	-	✓	270	0.60	3,000	90	6
LS-18	1977	2	-	✓	301	0.67	800	35	4/12
LS-19	1986/1999	3	✓	-	3,264	7.27	50	70	16
LS-24	1988/2000	3	✓	-	8,000	17.82	8,800	160	24
LS-31	1975	2	-	✓	61	0.14	2,000	35	4/8
LS-38	1972	2	-	✓	70	0.16	400		8
LS-67	1998/1999	3	✓	-	700	1.56	480	40	
LS-11	1979/1985	2	-	✓	230	0.51	2,000	60	4/12
LS-16	1980	3	✓	-	2,000	4.46	4,080	40	16/30
LS-20	1981	2	-	✓	327	0.73	2,700	110	6/20
LS-8	1980	2	-	✓	300	0.67	3,000	40	8
LS-9	1980	4	-	✓	400	0.89	6,480	155	8
LS-12	1980	2	-	✓	250	0.56	1,900	15	12
LS-13	1980	2	-	✓	400	0.89	1,600	20	8
LS-17	1980	3	✓	-	3,000	6.68	22,000	40	18/20
LS-21	1986	2	-	✓	240	0.53	2,650	90	8
LS-22	1986	2	-	✓	380	0.85	1,050	120	
LS-23	1985	2	-	✓	600	1.34	1,250	105	
LS-25	1989	2	-	✓	150	0.33	1,250	30	4
LS-26	1990	2	-	✓	70	0.16	425	30	
LS-30	1993	2	-	✓	160	0.36	1,450	145	8
LS-32	1983	2	-	✓	165	0.37	2,500	30	8
LS-33	1983	2	-	✓	90	0.20	550	50	8
LS-34	1989	2	-	✓	900	2.01	6,000	130	12/10

Table 4-2. Existing Lift Stations

Lift Station Information					Existing Conditions				
Lift Station	Year Installed	No. of Pumps	VFD	Constant Speed	Capacity		FM Length	Static Head	FM Dia.
					(gpm)	(cfs)	(ft)	(ft)	(in)
LS-35	1983	2	-	✓	160	0.36	950	85	8
LS-36	1979/1999	2	-	✓	150	0.33	2,000	30	4
LS-37	1983	2	-	✓	170	0.38	3,500	25	13/8
LS-39	1994	2	-	✓	110	0.25	700	25	
LS-40	1993	2	-	✓		0.00	875	90	8
LS-44	1995	2	-	✓	50	0.11	1,200	80	
LS-51	1995	2	-	✓	250	0.56	500	40	
LS-64	2003	2	-	✓	70	0.16	50	40	
LS-65	1994	4	-	✓	300	0.67	5,950	275	
LS-69	1998	2	-	✓	160	0.36	2,700	95	
LS-14	1981	2	-	✓	300	0.67	6,880	25	6
LS-7	2006	3	✓	-	4,200	9.36	850		14
LS-63	2006	2	-	✓	90	0.20	750	35	4/8
LS-68		2	-	✓	310	0.69	8,360	50	8

While the modeling effort will reveal future system requirements based on future flows, this summary of existing lift station facilities, just by the age of the facilities, may be used as an indicator of future upgrade needs. Since this Compliance Plan considers infrastructure needs for the next 20 years and the lift station service life is between 20 and 30 years, many of the existing facilities are expected to require major overhauls or replacement by 2025. Several stations have undergone a range of rehabilitation in the recent past. Others are new. These stations would not be expected to require replacement based on service life, but could be included for improvement based on future flows:

- Lift Station 7 – Rebuilt in 2006
- Lift Station 63 is new
- Lift Station 6 received new pumps and motors in 2006
- Lift Station 3 received new pumps and motors in 2005
- Lift station 4 received new pumps and motors in 2005

4.2 Existing Wastewater Treatment Plant

The Central Kitsap Wastewater Treatment Plant has been providing full secondary treatment to a large part of the County since 1979. The performance, characteristics, and condition of the treatment plant are described in this section. This information serves as the basis of recommendations for improving plant performance and providing for future system growth. Wastewater treatment recommendations are provided in later chapters.

4.2.1 Location

The CKWWTP is located on the west side of State Route 303 (SR 303), approximately 1.5 miles north of the community of Brownsville, as shown on Figure 4-1. The overall plant site consists of about 62 acres, with the existing facilities occupying about 8.5 acres. The remaining area is set aside for future expansion and 150-foot buffer zones. Plant access is from SR 303 by a 25-foot-wide access road. The plant site is extensively landscaped, and public view is limited to that along SR 303.

4.2.2 Treatment Processes

The CKWWTP has capacity to provide secondary treatment for an average design flow of 6.0 mgd, and a peak hour flow of 15.0 mgd. The plant liquid stream facilities include prechlorination, coarse screening, primary clarification, activated sludge, secondary clarification, and ultraviolet effluent disinfection. The plant effluent is discharged into Port Orchard Bay.

The plant solid stream facilities include cyclone sludge degritting, gravity thickening, primary and secondary digestion, and dewatering via a centrifuge. Currently, as an interim measure, dewatered sludge is sent to Natural Selections in Yakima, Washington, where it is composted into a Class A product. The County is seeking a more economical, long-term strategy for sludge disposal.

The CKWWTP also receives septage hauled in by trucks and sludges generated at the other three Kitsap County wastewater treatment plants at Kingston, Manchester, and Suquamish. Septage and the other sludges are screened, diluted, degritted, and sent to the gravity thickeners. Each of the liquid-stream and solid-stream unit processes is discussed in further detail in the following sections.

4.2.2.1 Design Criteria

The CKWWTP was designed in 1977, and construction was completed in 1979. Some systems were updated in 1995 and 1996 as part of the Contract I improvements, and then in 2000-2001 as part of Contract IIC. Figure 4-7 shows the process flow diagram for the existing plant after the Contract I and IIC improvements. Design criteria for the existing facilities are presented in Table 4-3. Table 4-4 summarizes the current NPDES permit limits regarding flows, influent loadings, and effluent limitations. A copy of the NPDES Permit and its associated Fact Sheet are included in Appendix F.

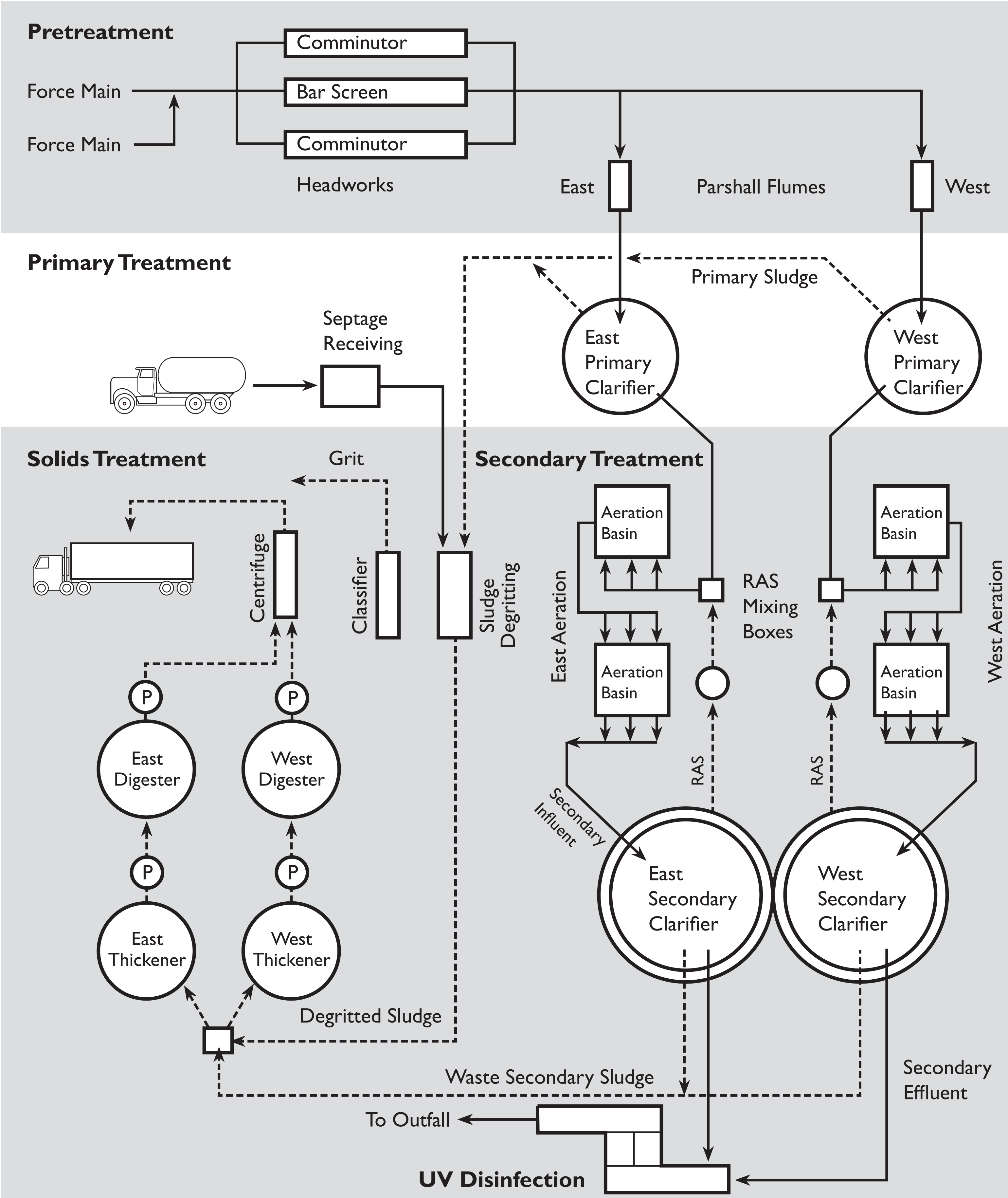

Figure 4-7 Existing CKWWTP Process Flow Schematic

Table 4-3. Central Kitsap WWTP Existing Process Design Data

Parameter	Unit	Existing Plant Rating or Design
Raw Sewage Flow		
Average Annual (AAF)	mgd	4.6
Average Dry Weather ADWF)	mgd	4.3
Average Peak Month (ADF)	mgd	6.0
Max Day (MDF)	mgd	11.0
Peak Design (Hour) (PDF)	mgd	15.0
Raw Sewage Loadings		
Annual Average BOD	ppd	8,403
Average Peak Month BOD	ppd	14,100
Annual Average TSS	ppd	8,844
Average Peak Month TSS	ppd	11,400
Comminutors		
Number		2
Channel width	ft	4.0
Capacity, each	mgd	17.0
Motor size	hp	2
Bar screens		
Number, mechanical		--
Number, manual		1
Peak hydraulic capacity, each	mgd	[a]
Primary clarifiers		
Number		2
Diameter	ft	65
Depth	ft	10.5
Total surface area	sq ft	6,600
Overflow rate		
@ ADF	gpd/sq ft	909
@ PDF	gpd/sq ft	2,260
Detention time		
@ ADF	hrs	2.1
@ PDF	Hrs	0.8
Primary sludge pumps		
Number		2
Capacity, each	gpm	200
Activated sludge basins		
Number		2
Volume, total	MG	1.62
Depth	ft	14.66
Hydraulic detention time @ ADF	hrs	6.5
Mixed liquor suspended solids (MLSS)	mg/L	2,300
Sludge retention time (SRT)	days	4.5-6
RAS to influent flow ratio	%	42-77
Loading @ADF		
BOD_5	ppd	7,940
NH_3-N	ppd	1,140
Oxygen demand		

Table 4-3. Central Kitsap WWTP Existing Process Design Data		
Parameter	Unit	Existing Plant Rating or Design
@ADWF	ppd	11,110
@ ADF	ppd	13,260
Maximum day	ppd	14,430
Air flow requirements		
@ ADWF	scfm	4,770
@ ADF	scfm	5,690
Maximum day	scfm	8,180
Aeration blowers		
Number, firm/total		2/3
Capacity, each	scfm	4,800
Total air flow, firm capacity	scfm	9,600
Return activated sludge pumps		
Number, firm/total		4/5
Capacity, each	mgd	1.3
Capacity, total	mgd	4.6
Waste activated sludge pumps [b]		
Number		2
Capacity each	gpm	225
Secondary clarifiers		
Number		2
Diameter	ft	104
Depth	ft	11.5
Total surface area	sq ft	16,990
Overflow rate		
@ ADF	gpd/sq ft	353
@ PDF	gpd/sq ft	883
UV channels		
Number		2
Length	ft	36
Width	ft	4.58
Depth	in	52
Design flow per channel	mgd	17
Design transmissivity		
Average	%	62
Minimum	%	55
Degritting system		
Number of cyclones		2
Total cyclone capacity	gpm	250
Number of classifiers		1
Total classifier capacity	tpd	10
Septage receiving station		
Number of receiving tanks		1
Volume, each	gal	4,500
Transfer capacity, each	gpm	50
Gravity Thickeners		
Number		2
Diameter	ft	45
Depth	ft	10
Solids loading rate		
Annual average	ppd/sq ft	5.4
Peak month	ppd/sq ft	7.5

Table 4-3. Central Kitsap WWTP Existing Process Design Data

Parameter	Unit	Existing Plant Rating or Design
Anaerobic Digesters		
Number		2
Diameter	ft	65
Depth	ft	26
Volume, each	cu ft	86,280
Annual average loadings		
Total solids feed	ppd TS	10,877
Volatile solids feed	ppd VS	9,336
Volatile solids loading	ppd VS /1000 cu ft	54
Detention time	days	35.5
Sludge dewatering		
Plate and frame press[c]		
Number		1
Filtration area	sq ft	2,800
Number/size of plates	m	55/1.5 x 2
Capacity	pph	---[c]
Centrifuges		
Number		1
Capacity, each	gpm	186[d]

Notes:

[a] *Capacity information unavailable. Unit to be removed in Phase III project.*

[b] *The existing WAS pumps are used for wasting either mixed liquor or RAS.*

[c] *Plate and frame press is currently not operated.*

[d] *Capacity based on 7 hours per day, 5 days per week dewatering at average annual sludge production.*

Table 4-4. Central Kitsap WWTP NPDES Requirements[a]

Design Criteria	Units	Design Quantity	
Max month flow	mgd	6.0	
Max month influent BOD loading	lb/d	14,100	
Max month influent TSS loading	lb/d	11,400	
Parameter		Effluent Limitations	
		Average Monthly	Average Weekly
$CBOD_5$[b]	lb/d	1,251	2,002
	mg/L	25	40
TSS[b]	lb/d	1,501	2,252
	mg/L	30	45
Fecal coliform[c]	# colonies/ 100 mL	200	400
pH		Between 6.0 and 9.0	

[a] *Effective date of NPDES permit – June 1, 2007.*

[b] *The average monthly effluent concentrations for CBOD and TSS shall not exceed 25 and 30 mg/L, respectively, or 15 percent of the respective monthly average influent concentrations, whichever is more stringent.*

[c] *Average limits for fecal coliform are based on geometric means.*

4.2.2.2 Overall Process Performance

Plant records were examined to determine overall process performance. Plant effluent quality and overall removal efficiencies are shown on Figure 4-8 and effluent metals concentrations are summarized in Table 4-5. Monthly dewatered biosolids production rates are shown on Figure 4-9.

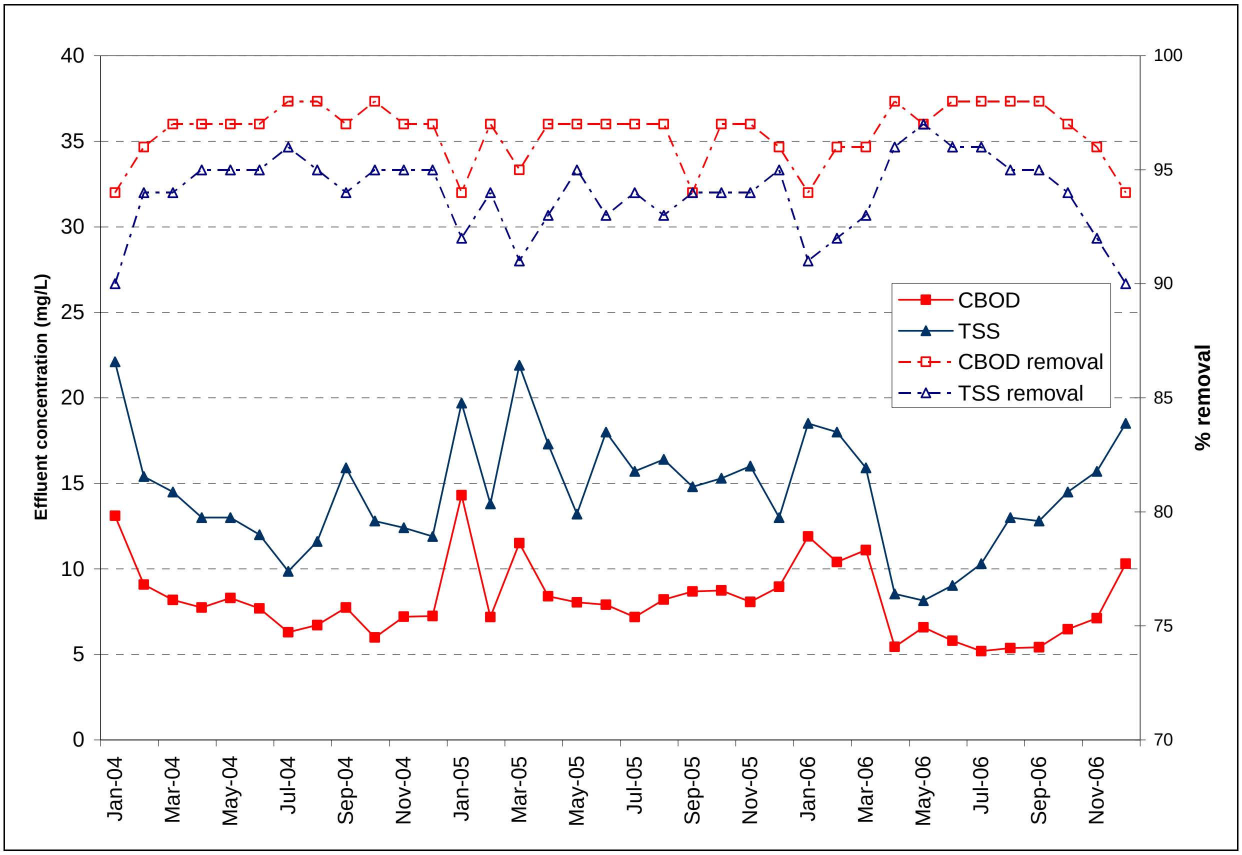

Figure 4-8. Plant Effluent Quality and Overall Removals from 2004 to 2006

Table 4-5. Central Kitsap WWTP Average Effluent Fecal Coliform, Ammonia, and Metals Concentrations from 2004 to 2006

Month	Fecal Col, #/100 mL	NH_3-N, mg/L	Cd, ug/L	Cr, ug/L	Cu, ug/L	Pb, ug/L	Ni, ug/L	Zn, ug/L	Hg, ug/L
2004									
January	10	30.4	< 0.3	0.8	6.5	3.0	4.6	17.0	< 0.2
February	9	37.0	< 0.3	0.9	7.2	< 1.8	2.5	33.2	< 0.2
March	19	30.6	< 0.3	1.2	9.2	< 1.8	2.7	38.9	< 0.2
April	61	39.8	< 0.3	1.2	7.4	3.9	3.5	45.9	< 0.2
May	18	38.8	< 0.3	< 0.8	6.2	2.7	3.0	24.0	< 0.2
June	79	50.4	< 0.3	0.9	6.2	3.7	3.6	27.5	< 0.2
July	42	34.7	< 6.0	< 3.0	12.0	< 8.0	< 7.0	42.0	< 0.2
August	36	34.0	< 0.3	< 0.8	29.0	8.0	4.0	32.0	< 0.2
September	81	38.9	< 6.0	< 3.0	< 7.0	< 8.0	< 7.0	34.0	< 0.2
October	26	23.0	< 0.3	< 0.8	< 6.1	1.8	< 1.9	33.0	< 0.2
November	24	43.6	< 0.3	< 7.0	< 6.0	< 40	< 15	22.0	< 0.2
December	16	39.7	< 0.3	< 7.0	< 6.0	< 40	< 15	170	< 0.2
2005									
January	18	45.1	< 3.0	< 7.0	< 6.0	< 40	< 15	22.0	< 0.2
February	12	44.9	< 3.0	< 7.0	< 6.0	< 40	< 15	64.0	< 0.2
March	12	36.3	< 3.0	< 3.0	< 6.0	< 40	< 15	29.0	< 0.2
April	48	23.5	< 3.0	<13.0	10.0	< 40	< 15	43.0	< 0.2
May	59	15.2	< 0.4	< 1.2	< 10.9	< 4.3	3.2	39.1	< 0.2
June	44	29.2	< 0.4	< 1.2	< 10.9	< 4.3	3.0	23.4	< 0.2
July	47	16.3	< 0.4	< 1.2	< 10.9	< 4.3	3.3	24.1	< 0.2
August	53	33.6	< 0.4	< 1.2	< 10.9	< 4.3	3.0	19.9	< 0.2
September	54	29.6	< 0.4	1.3	< 10.9	< 4.3	4.3	26.4	< 0.2
October	64	31.4	< 0.4	< 1.2	< 10.9	< 4.3	3.9	24.6	< 0.2
November	22	29.5	< 0.4	< 1.2	< 10.9	< 4.3	3.3	29.6	< 0.2
December	11	35.4	< 0.4	<1.2	< 10.9	< 4.3	4.0	26.8	< 0.2
2006									
January	8	31.9	< 0.4	< 1.2	< 10.9	< 4.3	2.7	36.0	< 0.2
February	15	23.8	< 0.4	< 1.2	< 10.9	< 4.3	3.8	41.9	< 0.2
March	31	25.5	< 0.4	< 1.2	< 10.9	< 4.3	3.8	36.4	< 0.2
April	53	32.8	< 0.4	< 1.2	< 10.9	< 4.3	3.0	35.8	< 0.2
May	70	28.9	< 0.4	< 1.2	< 10.9	< 4.3	2.7	30.1	< 0.2
June	54	19.2	< 0.4	< 1.2	< 10.9	< 4.3	2.6	30.3	< 0.2
July	55	18.5	< 0.4	1.4	< 10.9	< 4.3	4.3	23.8	< 0.2
August	37	28.6	< 0.4	< 1.2	< 10.9	< 4.3	2.9	16.1	< 0.2
September	40	34.5	< 0.4	< 1.2	12.2	< 4.3	3.0	18.2	< 0.2
October	45	21.1	< 0.4	< 1.2	< 10.9	< 4.3	2.5	9.7	< 0.2
November	37	20.0	< 8.6	< 5.3	9.2	< 6.0	2.9	26.7	< 0.2
December	12	32.3	< 8.6	< 5.3	7.9	< 6.0	3.4	33.4	< 0.2

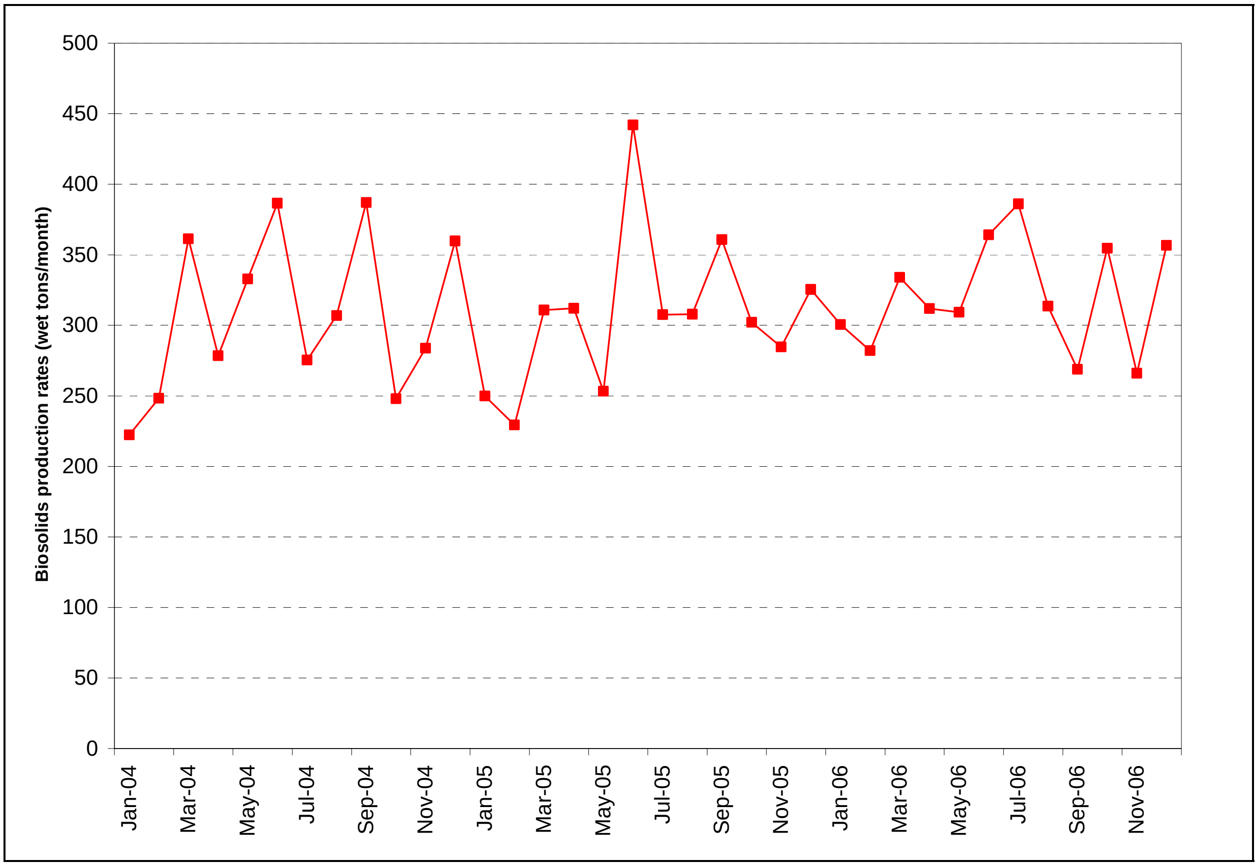

Figure 4-9. Monthly Biosolids Production Rates from 2004 to 2006

4.2.3 Unit Process Summary

Each of the CKWWTP unit processes and related systems is discussed in the following sections. A brief description is given, followed by a statement about current performance and physical condition.

4.2.3.1 Liquid Stream Processes

4.2.3.1.1 Headworks

Description. Raw sewage is conveyed to the plant via a north and south force main, which combine and enter the plant influent structure. The headworks structure includes three parallel channels. Two channels include grit sumps followed by comminutors; the third channel has a manually raked bar screen. The comminutors are no longer operational and all influent flow currently passes through the manually raked bar screen.

The flow can then be divided between two parallel process trains, designated as east and west. Flow through each process train is modulated by a 36-inch channel butterfly gate, followed by an 18-inch Parshall flume. Each flume has a maximum capacity of 8.4 mgd. The east channel flows to the east primary clarifier and the west channel to the west primary clarifier. A refrigerated composite sampler is provided for influent flow sampling.

Performance. The headworks facility can handle the existing flows hydraulically, but has limited provisions for flow measurement and solids handling. The influent force mains cannot be isolated from the headworks or from each other. Repair on one force main requires both force mains to be shut down. Plant recycle flows, such as thickener overflow and digester supernatant, enter the flow stream downstream of the Parshall flumes. There is no provision for sampling or direct measurement of these streams. There is no high water monitoring at the influent sump, which has only 9-1/2 inches of freeboard above the slide gates. The grit sump is ineffective. Because the comminutors are no longer operational, all screenings must be removed manually from the bar rack. This process incurs significant operational effort and contributes to odors. The wide spacing between bars (greater than 1 inch) allows many debris items to enter the treatment process, impacting downstream equipment and biosolids quality.

Condition . Corrosion of metals and controls in the headworks is severe. Odor is also a problem in this area. The composite sampler is reliable, although replacement parts have been hard to obtain when needed. The grit sump upstream of the comminutors requires manual cleaning. This maintenance is labor intensive and causes excessive grit to be discharged into the plant drain system. Since the level measurement at the Parshall flumes was converted to a conductance probe, the unused stilling wells have become a collection point for scum and debris. The comminutor units are no longer useable.

4.2.3.1.2 Primary Clarifiers

Description. From each Parshall flume, the raw sewage is routed to its respective 65-foot-diameter center-feed primary clarifier. Effluent from the clarifiers passes under a scum baffle and over a peripheral weir into a collection launder, and then to the activated sludge basins. Each clarifier is hosed down daily and scrubbed once a week for odor control.

Primary sludge is collected using a rotating rake mechanism and withdrawn through a 6-inch-diameter sludge line. Two new primary sludge pumps were installed as part of the Contract I improvements. The two new pumps replaced the old pump, and were cross-connected to allow one to be removed from service. The new pumps are located in the existing utilidor between the aeration tanks. Primary sludge is pumped to the cyclone degritters next to the gravity thickeners. During normal operation, each pump is connected to one of the clarifiers, but piping was installed to allow either pump to operate with either clarifier. The two pumps pump primary sludge continuously to the cyclone degritters.

Floating scum is collected with a skimming mechanism and withdrawn from a separate 6-inch line and routed to the thickener and digester. Chlorinated effluent is used as process water to spray surfaces and assist in scum removal. Two 140-gpm piston pumps are used for pumping primary scum.

The effluent launder is covered, and foul air is conveyed to a small, nearby biofilter installed by the County.

Performance. Operation of the primary clarifiers has been adequate at the average and peak flow rates experienced thus far. However, their shallow circular design limits solids removal capabilities at higher loadings. Measurements of dissolved oxygen (DO) concentrations in grab samples collected along the liquids-stream treatment train suggested that waterfall effect of the effluent overflowing the peripheral weirs into the launder resulted in DO entrainment, which had a negative impact on the downstream anoxic selector in the aeration basins.

Condition. Two new primary sludge pumps were installed as part of the Contract I improvements. The two new pumps replaced the old pump, and were cross-connected to allow one to be removed from service.

4.2.3.1.3 Activated Sludge Secondary Treatment

Description. Primary effluent is routed to the four activated sludge aeration cells, each of which has a volume of 412,500 gallons. The plant was originally designed to operate in a number of activated sludge process modes, including complete mix, extended aeration, step-feed, and contact stabilization. Flow can be routed through the basins in a number of configurations using a network of hydraulic channels and slide gates. The plant was designed with a configuration that created an east and west series of process tankage that operates in parallel.

Each of the basins is equipped with inlet/outlet slide gates on three sides to facilitate the various operating modes, with an effluent weir on the fourth side from which mixed liquor is routed to the secondary clarifiers. Sludge that settles in the secondary clarifiers is returned as return activated sludge (RAS) and mixed with primary effluent in the aeration tanks. Sludge is wasted from the secondary system either as mixed liquor from the aeration basins or as RAS from the inlet pipe to the RAS pumps. Waste activated sludge (WAS) is pumped to the solids stream processes for further treatment.

Oxygen transfer to each of the four basins was originally by two fixed, mechanical mixer-aerators, each equipped with two-speed, 60-hp motors. Hydraulic channels were aerated with coarse bubble diffused air along their length.

Contract I included replacement of the aerators with fine bubble diffused aeration equipment. Three new blowers were also installed in the new Power/Blower Building. A new aeration air distribution pipe network connects the Power/Blower Building to the aeration tanks. This distribution system runs underground from the Power/Blower Building to the south side of the existing aeration tanks and then extends above the walkway areas on the aeration tanks.

In Contract I, a baffle was added in the southwest and the southeast basins to create an anaerobic selector cell in each process train. In Contract IIC, two floating mechanical mixers were added in each anaerobic selector cell to allow mixing of the mixed liquor without aeration.

Between the east and west basins is an underground utilidor, which contains the primary clarifier sludge pumps, secondary sludge return and waste pumps, the scum pumps, blowers for the channel air diffusers, and all associated electrical equipment. Above the utilidor are the main basin influent channels and two mixing basins. The utilidor is equipped with a sump pump for drainage and equipment protection.

Performance. As described above, the activated sludge system has considerable flexibility. The plant currently typically operates with the two west basins in series in anaerobic selector mode. Under higher flow conditions, the plant can switch to step feed or contact stabilization mode, which reduces solids loadings to the secondary clarifiers and the potential for solids washout.

Oxygen transfer efficiency of the existing membrane diffusers, installed in 1996 as part of the Contract I upgrade, has deteriorated significantly over the years due to the aging membranes. The system at times has been unable to maintain adequate DO concentration in the aeration basin. The pressure requirement for the diffuser system has also increased due to the deteriorated diffuser membranes, exceeding the original design pressure for the aeration blowers.

Condition. The physical condition of the aeration basins is good, with very little evidence of corrosion noted. The foam suppression sprays have been found to be unnecessary, and may be removed by plant staff because of freezing problems. The channel air blowers also appear to be in good condition.

4.2.3.1.4 Secondary Clarifiers

Description. Mixed liquor from the aeration basins is routed through hydraulic channels and pipelines to the two 90-foot-diameter, 11.5-foot-deep secondary clarifiers. The original design provided for essentially equal flow distribution between the two clarifiers, with flow from the west aeration basin train going to the west clarifier, and likewise for the east side. Influent flows to a center feed well, and effluent flows under a scum baffle and over a peripheral weir into a collection channel. The launder discharges into a pipe that conveys the secondary effluent to the ultraviolet (UV) disinfection system. Solids are withdrawn for return to the aeration tanks using a Tow-bro collector.

Separate pumps are provided for pumping both RAS and WAS. RAS is pumped from a 16-inch diameter line using two variable-speed pumps for each clarifier. One constant-speed centrifugal pump is provided as a standby unit and can service either of the two clarifiers. Each pump has a nominal capacity of 900 gpm at 22 feet of total dynamic head (TDH). WAS is withdrawn from the RAS line on a variable-timed basis and pumped using two variable-speed driven centrifugal pumps, each rated at 200/500 gpm at maximum pump speed. Sonic-type flow meters are provided for measuring both waste and return sludge streams. Sludge can also be wasted from the aeration basins as waste mixed liquor (WML).

Scum is captured and collected on the clarifier surface by a skimming device attached to the sludge collector mechanism. Scum collection is aided by use of spray nozzles (utilizing process water), which are attached to the clarifier bridge. The clarifier is either drained by gravity drains or through the WAS pumping systems.

Performance. The activated sludge system has occasionally experienced bulking problems, which reduce performance of the secondary clarifiers and increase effluent concentrations. The average sludge volume index (SVI), which is often used as an indicator of the settling capability of the mixed liquor, is about 230 milliliters per gram (mL/g) based on 2003 to 2006 data, and at times exceeds 350 mL/g. The occasional poor settling sludge was likely at least partly attributable to oxygen poisoning of the anaerobic selector.

Condition. The clarifiers are hosed down daily and scrubbed each week, and are maintained in good condition. Both the RAS and WAS sonic flow meters have been a continuing maintenance problem. The meters are no longer supported by the manufacturers and need frequent adjustments.

4.2.3.1.5 Disinfection

Description. Two UV channels and connecting inlet and outlet channeling were constructed east of the secondary clarifiers during Contract I. The two channels each contain 60 medium-pressure UV lamps, divided into two banks per channel. The outlet channel from the UV channels is connected to a new 72-inch-diameter effluent pipeline and conveyed to the original outfall. Both the inlet and outlet channels to the UV system were designed to accommodate one additional UV channel, should it be required at a later date.

Performance. As shown by the data in Table 4-5, the UV system provides sufficient disinfection of the secondary effluent, with effluent fecal coliform numbers consistently below the NPDES limit.

4.2.3.2 Solids Stream Processes

4.2.3.2.1 Septage Handling Facilities

Description. Septage and sludge from Kitsap County's wastewater treatment plants in Manchester, Suquamish, and Kingston arrive at the plant in tank trucks. Each truckload undergoes preliminary testing prior to discharge. For all deliveries, the pH is measured and a sample is visually inspected by plant staff. Septage is accepted only from haulers registered with the County, and a plant operator must be present during delivery. If the pH is less than 6, the hauler is allowed to add lime to raise the pH. Sludge from the other treatment plants is transported by County staff. Haulers discharge at very frequent intervals between the hours of 8 am and 5 pm, Monday through Friday.

Septage and sludge are discharged by gravity through a bar screen and into a 4,500-gallon pit. One 50 gpm Muffin Monster grinds rags and other solids, and transfers the influent to a 10,000-gallon sludge dilution tank. Process water is pumped into the dilution tank to dilute the solids concentration from approximately 2.75 to 0.5 percent. Aeration is provided in the dilution tank to reduce the septicity of this stream. Spent air is passed through a carbon filter prior to discharge to the atmosphere. The diluted sludge/septage is pumped to the gravity thickener control structure, where it is degritted by cyclone separators. The stream is then pumped to the thickener splitter box where it combines with the primary sludge and WAS and enters one of the gravity thickeners.

The amount of septage and liquid sludge hauled to the plant averaged 25,000 gpd in 1991, and currently averages closer to 12,000 gpd because much of the sludge from the other plants is now thickened. The existing quantity of septage and sludge received at CKWWTP represents approximately 50 percent of the solids loading to the plant. The average concentration of solids in the septage is 2 percent. Sludge from Kingston and Manchester has an average concentration ranging between 3 and 4 percent solids. Sludge from Suquamish averages about 2 percent solids. In 2006, the average monthly solids loading from sludge and septage combined was approximately 60,000 pounds per month.

Performance. In general, the existing septage receiving station and associated facilities are inadequate to meet the current needs of CKWWTP. This process has the following specific disadvantages:

- The station is under capacity. The capacity limitations are associated with the transfer of septage from the receiving pit to the sludge dilution tank. The existing 50 gpm Muffin Monster is undersized for the amount of septage being delivered in a given tank load, up to 200 gpm. With only one unit, no redundancy is available for maintenance.
- The process requires considerable maintenance. Solids accumulate in the receiving pit at a rapid rate. Solids accumulation necessitates weekly cleaning. Approximately 2 cubic yards of grit and debris are removed manually or by vactor truck, if available, each week. Between 35 and 50 cubic yards of solid material are manually removed from the sludge dilution tank each year. This high frequency and intensity of cleaning is time consuming for plant staff.
- Odors from this area are severe. Discharge onto the bar screen exposes septage to the atmosphere under turbulent flow conditions. As a result, odor problems are significant.
- The process does not effectively remove debris. The existing septage receiving station does not provide adequate facilities for screening. Comminuted rags and other stringy material present in septage tend to accumulate in downstream processes, increasing wear on solids handling pumps and labor costs associated with more frequent cleaning and repair. Rags, plastic, and other debris are not removed by the existing process. These materials ultimately end up in the sludge, lessening the aesthetic appeal of a future composted product.
- The septage receiving station is poorly located. A steady stream of haulers arrive at CKWWTP and await their turn to discharge. The trucks form a queue on the main asphalt pad between the Sludge Processing and Vehicle Maintenance Buildings, and along the central access road. Haulers must back into the discharge location, which blocks the south end of the "drive-through" truck bay of the Sludge Processing Building. In general, the line up and movement of these tank trucks interfere with plant operations.

Condition. Facilities at the receiving station are in fair condition. The large volumes of septage received at CKWWTP are largely responsible for odor and corrosion problems associated with the gravity thickening process.

4.2.3.2.2 Scum Handling

Description. Scum from the primary and secondary clarifiers and and the gravity thickeners is collected in sumps at each facility. The scum from the primary and secondary sumps is pumped directly to the digesters by a Marlo double-piston pump followed by a grinder. The thickener scum sumps operate in a similar manner, being serviced by two Moyno pumps and a grinder, one pump being a redundant pump, and pumping directly to the digesters. The primary and secondary scum sumps are pumped at least once per day.

Performance. The scum handling system is working well. There are periods when the primary and secondary clarifier scum sumps can become overloaded. More frequent scum pumping is used to mitigate those conditions rather than increasing the size of the sump.

Condition. The scum collection in general is in good working order and condition. By modifying operations to the current model, odors from the facility have been reduced relative to the original design.

4.2.3.2.3 Sludge Thickening

Description. Primary sludge is withdrawn from the primary clarifiers at a rate to maintain a concentration of less than 1 percent solids for optimum operation of the degritting equipment. The sludge is pumped with variable-speed primary sludge pumps in the aeration basin utilidor. Primary sludge is pumped to the cyclone degritter/classifier located between the two sludge thickeners. Degritted sludge is then injected with sodium hypochlorite for odor control (optional), and flows by gravity to the thickener control structure. Grit is washed and collected in a grit hopper for off-site disposal. The wash stream is routed back to the plant headworks.

Degritted primary sludge is combined with degritted septage sludge and mixed liquor, from the secondary process, at the thickener control structure, where sludge can be routed to either or both thickeners by gravity. The 45-foot-diameter thickeners operate in similar fashion to the main process clarifiers.

Thickener supernatant (effluent) is returned to the plant headworks downstream of the Parshall flumes. Provisions for scum removal are provided. The thickener mechanism speed is somewhat faster than clarifier operation, and the rakes extend a greater distance into the sludge blanket. The sludge withdrawal line is equipped with a sonic-type density meter and sludge grinder on the suction to the progressing cavity thickened sludge pumps. These 7.5-hp pumps are rated at 150 gpm capacity, and are located on the lower level of the Digester Control Building. The sludge grinders are similar to the scum grinder, and provide a uniform consistency to the digester feed. The thickeners are provided with fiberglass covers and a ventilation system, which sends the foul air to the biofilter to reduce odors.

Performance. The sludge thickening system has performed as well as can be expected for gravity thickeners, producing thickened sludge at an average concentration of 3.1 percent solids. The system is currently near capacity and would be easily overloaded by large increases of grit arriving at the plant during the first few storms of the winter. This condition can lead to unacceptable amounts of grit entering the digesters.

Condition. The gravity thickeners are operating at or near capacity, which has lead to deterioration in the thickening performance. The reduction in the hydraulic load to the system should allow continued future operation and extend the service life of the gravity thickeners at the facility.

4.2.3.2.4 Sludge Digestion

Description. The plant has two 65-foot-diameter, fixed-cover digesters with a side water depth of 26 feet. They provide anaerobic digestion of an average of 22,000 to 44,000 gpd thickened sludge to reduce the volatile solids (VS) concentration of the sludge to such that Class B biosolids requirements are met for both pathogen reduction and vector attraction. Current average solids loading to the digestion system is approximately 9,335 pounds VS per day. The digesters are designed such that they can be run either in series or in parallel, with the current operation being parallel.

Thickened combined sludge of approximately 3.1 percent solids is withdrawn from the gravity thickeners by two 150 gpm progressing cavity pumps. The raw solids are loaded to the east and west digesters. Piping flexibility is provided to allow sludge to be fed to or withdrawn from the digesters at various levels. Another pair of 150 gpm progressing cavity pumps is provided in the Digester Building to transfer solids from to the centrifuge for dewatering.

A high volume internal mixing system is provided in the digesters, using centrifugal recirculation pumps rated at 4,400 gpm capacity to keep digester contents in uniform suspension. These pumps take suction from a central draft tube at mid level and discharge through two nozzles located opposite each other and about 5 feet above the digester floor. An additional nozzle is located near the top of the digester to assist in breaking/preventing scum blanket formation.

Digester gas resulting from anaerobic decomposition is currently all flared in the waste gas burner. The digesters and plant hot water system are heated by the boilers, which are fired using fuel oil.

The digesters are maintained at mesophilic temperatures, about 95º F, as part of the Class B biosolids requirements. The digesters are heated by hot water from the boiler system by circulating sludge through spiral heat exchangers using recessed-impeller centrifugal pumps rated at 250 gpm capacity. Hot water for the digester heat exchangers and plant space heating is supplied by two low pressure boilers on the upper level of the Digester Building. The boilers are normally fueled with fuel oil.

Under parallel operation, the digesters have an average solids detention time of 34 to 37 days. This mode of operation is used to provide sufficient detention time without hydraulically overloading the digester.

Performance. The anaerobic digesters are currently operating near capacity. The system is limited by its hydraulic capacity, and taking one unit out of service for cleaning or maintenance is not possible during all times of the year unless liquid sludge is hauled from the facility for disposal. Each digester currently treats an average of 21,000 to 22,000 gpd of thickened raw sludge, resulting in an average sludge retention time (SRT) of 34 to 37 days. Although these current operating conditions meet the requirements for Class B biosolids, they limit process flexibility. If one unit is taken out service, the average SRT will decrease to 16 to 17 days, just above the EPA minimum for Class B biosolids (15 days without mandatory coliform testing).

Under current operating conditions the digesters on average reduced the volatile solids concentration by 57 to 65 percent. The reduction in volatile solids results in an average biogas production of 105,800 cubic feet per day, with an average biogas composition of 33 percent carbon dioxide and 66 percent methane.

The digesters have experience some foaming/scum events that penetrated the oakum seal around the fixed cover, resulting in a loss of material. Retrofits or replacement of the oakum seal will be investigated at a future date to provide a better seal on the fixed-cover digesters.

Condition. Overall, the digesters are in adequate physical and operating condition. The leakage from the oakum seals on the fixed cover will need to be addressed to improve odor control and ease of operation. The boiler system needs to be replaced so that biogas can be used as fuel rather than heating oil, which should significantly reduce the operating costs of the facility. The waste gas burner was recently replaced and is in satisfactory working order.

4.2.3.2.5 Sludge Dewatering

Description. Digested sludge is pumped to the Sludge Processing Building, where it is prepared for dewatering by first grinding, then conditioned by the addition of a polymer (which aids in the removal of water). The conditioned sludge is then fed to the centrifuge for dewatering. The dewatered cake exits the centrifuge through a shoot to a truck located in the bay below. The plate and frame press remains in place, but is not used because centrifugal dewatering is much more efficient. The plate and frame press essentially serves as a redundant dewatering unit should the centrifuge be taken out of service for a significant period of time.

Performance. The centrifuge is a relatively new unit and is in very good operating and physical condition. The performance of the centrifuge is such that another unit will replace the plate and frame press in the future.

Condition. The centrifuge is in good operating and physical condition and is currently meeting the dewatering requirements of the plant. The plate and frame press currently serves as a redundant dewatering unit for the facility. However, the age of the unit and the fact that the unit is no longer made by the manufacturer and parts are hard to find is liability of that unit. The plate and frame press will be replaced in the future by another centrifuge as loadings dictate.

4.2.3.2.6 Grit Removal Facilities

Description . Two sets of cyclone separators and classifiers are used to remove grit from the primary sludge and septage. The degritting facilities are located in the gravity thickener control structure between the gravity thickeners. Each of the cyclones has a capacity of 200 gpm. A total of approximately 5 cubic yards of grit are removed from these process streams each week and collected in the plant waste dumpster.

Performance . The grit removal equipment is performing adequately. No maintenance concerns were expressed by plant staff. The grit is not washed prior to collection and disposal. This condition may contribute to odor problems near the plant dumpster. Odor is a major problem at the sludge junction structure near the thickeners.

Condition.The grit removal equipment is approximately 15 years old. The cyclone and classifier for septage degritting are in relatively good condition. However, the cyclone and classifier for sludge degritting are severely corroded and should be replaced.

4.2.3.3 Ancillary Plant Systems

4.2.3.3.1 Instrumentation and Controls

Description. The existing plant control system is comprised of two different programmatic logic controllers (PLC) types: Allen-Bradley SLC 500 Series and Texas Instruments (Siemens) 505/545 Series. Each main controller (designated PLC 7105 and 2984, respectively) has a series of input/output (IO) modules and remote IO (RIO) connected, and the controllers are connected to each other using hardwired interlocks.

Remote IO for PLC 7105 is distributed throughout the Sludge Processing Building motor control centers (MCCs) and PLC 2984 has RIO distributed throughout the Blower and Digester Buildings. Additional hardwire interlocks to PLC 3000 (Ultra Violet System), and centrifuge and polymer systems complete the integration of the plant controllers.

Interfacing the controllers with the plant operators, the HMI computers running Wonderware's Intouch software are located in the Sludge Processing Building on the first and second floors. The second floor serves as the main plant control room, with a supervisory control and data acquisition (SCADA) master database residing on the workstation. The second floor is also the physical location of the pump station telemetry system. The HMI computers are comprised of several customized screens used for monitoring and controlling equipment connected to the PLCs.

The SCADA network is a multi-tiered, multi-protocol network used to gather information from each PLC and RIO drop, and pass the information to the Master Human Machine Interface (HMI). Most of the network is comprised of copper wiring; however, a short run is three-pair multi-mode fiber from the Point-of-Presence (POP) of the County network in a closet adjacent to the East Laboratory, to the second floor in the Process Building. This protocol is Ethernet/TCP. The other networks are: Ethernet to PLC 7105, RS-232, RS-422, and Allen-Bradley's proprietary Data Highway Plus (DH+). In addition to these networks, PLC 2984 has a proprietary network presently in use for communication to its RIO.

Distributed throughout the plant are a variety of instruments, motor controllers, valves, and other miscellaneous items. Many of these are connected to the PLCs in one form or another, and they allow the system to intelligently control the flow and treatment of wastewater through the plant. Some motors have variable frequency drives (VFDs) connected to them to allow finer control of motor outputs, which allows pressures or flows to be more precisely set. These drives also allow motors to operate more efficiently, using only the amount of power needed to accomplish the equipment's function under varying load conditions.

Condition. The existing SCADA system has deficiencies requiring repair, and is currently exposed to internet and internal hackers through the existing connection to the County network. Upgrades to the existing system are recommended because equipment having reached end-of-life is prone to unexpected failure and could cause loss of data or plant control. As an example, if the HMI workstation fails, which is common in computers of that era, the entire control system is only operable in manual mode until the workstation can be restored to operation. The cost impact of not implementing these upgrades could be thousands of dollars in unexpected overtime and emergency equipment expenditures.

4.2.3.3.2 Potable Water

Potable water is supplied to the plant from the North Perry Water District through an 8-inch diameter water line that enters the plant near the northeast corner. The supply is metered, passed through a reduced pressure backflow preventer, then split to two plant fire hydrants and a circulation loop to the plant buildings.

4.2.3.3.3 Process Water

The process water system supplies chlorinated secondary effluent throughout the plant for hose bibs, irrigation, aeration basin foam sprays, and similar uses. A portion of the secondary effluent from the UV effluent structure is injected with sodium hypochlorite and then conveyed to the utilidor, where the process water pumps are located. Process water is pumped using three pumps, two constant-speed pumps and one with a VFD. The VFD pump is dedicated to the sludge filter press feed pumps, and the other two pumps serve the remaining facilities at the plant. Each pump is rated at 350 gpm. The pump discharge is equipped with automatic self-cleaning strainers and a 6-inch diameter propeller meter.

4.2.3.3.4 Communications

A new intercom system was installed in 1993. The plant operators generally use portable radios for most site communications.

4.2.3.3.5 Electrical System

The plant receives its primary electrical supply from Puget Sound Energy. The plant is served by a 12.47/7.2-kilovolt (kV) line, which enters the plant adjacent to its entrance and Route 303. Power is metered by Puget Sound Energy at the 12.47-kV primary service level at a metering pedestal located at the plant entrance. The incoming 12.47-kV service conductor is routed to the plant service entrance equipment located on the north side of the Administration and Laboratory Building. The service entrance equipment consists of two fused load interrupter switches. One switch serves a 112-kilovolt-Ampere (kVA) transformer for the Administration and Laboratory Building. The other switch is for a feeder to switchgear (SWGR 2950) located north of the standby power generators. SWGR 2950 consists of two fused load interrupter switches that supply a pair of 2,000-kVA transformers. These transformers supply a switchboard (SWBD 2960) that provides 480-volt power distribution to the rest of the plant facilities. From SWBD 2960, power is distributed to plant MCCs in the Power Blower, Sludge Processing, and Digester Buildings.

Backup for the Puget Sound Energy supply is provided by 500- and 600-kilowatt (kW) diesel-powered, standby generators. These generators have sufficient capacity to meet the primary power needs of the existing essential plant components. Automatic transfer circuit breakers contained within SWBD 2960 transfer the power supply between the utility and standby generators during power interruptions. Plant loads are presently controlled to automatically sequence on line following a power outage in a manner that allows ramping of load onto the generators. This sequential loading is accomplished through the SCADA/PLC system. The history of power outages indicates that the plant experiences an average of four 4-hour power outages per year, and one 24-hour outage approximately every 2 years. In 1990, the plant was operated on standby power for 1 week as a result of a high wind storm that affected the entire central Kitsap area. The plant more recently operated for an extended period on standby power after a December 2006 storm.

A dual-feed power distribution system is provided for supplying SWBD 2960 and all of the MCCs from SWBD 2960. SWBD 2960 is configured with a normally open tie breaker, which divides the switchboard. The automatic transfer circuit breakers can be manually configured to have either of the 2,000-kVA transformers supply the entire switchboard. When utility power is not available, the tie breaker is normally open, and one standby generator is connected to each side of the switchboard. In the event that one of the standby generators is not able to operate, the transfer circuit breakers and tie breaker can be manually configured to have either of the standby generators supply the entire switchboard. When the tie breaker is closed, caution must be exercised to ensure that the transformer or standby generator supplying the entire switchboard is not overloaded. Each MCC fed from SWBD 2960 is supplied with a feeder from one side of the switchboard and has a secondary supply from an MCC that is fed from the other side of the switchboard, resulting in a dual feed for each MCC. The dual-feed power distribution system allows the distribution of power to continue during routine maintenance and inspection of electrical equipment as well as in the event of equipment failure.

The Administration and Laboratory Building is normally powered from the 112-kVA transformer located in the service entrance switchgear, SWGR 1. A limited capacity standby power feed from MCC 2972 in the Power/Blower Building is routed to the manual transfer switch at the Administration and Laboratory Building. In the event of a utility power loss, the manual transfer switch can be used to switch standby power to the Administration and Laboratory Building distribution panels.

The CKWWTP has nine MCCs located throughout the plant. MCC 2 is located in the Digester Building. MCCs 2981, 2982, 2983, and 2984 are located in the Sludge Process Building and serve that location. MCC 2971 and MCC 2972 are located in the Power/Blower Building and serve the aeration, utilidor, and secondary clarifiers. MCC 2973 and MCC 2974 are located in the Power/Blower Building and serve the UV system and heating, ventilation, and air conditioning (HVAC) loads.

4.2.3.3.6 Heating, Ventilating and Air Conditioning Systems

Plant heating is provided through a hot water circulation system, with heat supplied by boilers in the Digester Building. Hot water is circulated to the plant buildings by eight circulation pumps, ranging in capacity from 8 to 250 gpm. All of the buildings are equipped with separate space heaters and thermostats.

Ventilation is provided by exhaust fans in the Digester and Sludge Processing Buildings. A forced air heat recovery unit is provided in the Administration and Laboratory Building.

4.2.4 Overall Plant Assessment

The CKWWTP is currently operating within its NPDES discharge permit limitations. Effluent quality has been satisfactory. Currently, the most pressing capacity and/or operational issues are related to the deteriorated performance of the aeration diffusers, the limited capacity of the anaerobic digesters, and the need to identify a long-term biosolids disposal option.

Table 4-6 compares the existing plant design values against the 2006 actual flows and loads. The analysis suggests that while the plant may have a reasonable amount of excess hydraulic capacity, its current loadings are approaching the design capacities. A more detailed evaluation of the unit process capacities will be conducted to determine the potential maximum plant loading capacity and the expansion needs to increase plant capacity.

Table 4-6. Central Kitsap WWTP Estimated Plant Remaining Capacity

Process Element	Units	Existing Design Value[a]	2006 Value	Remaining Capacity
Raw Sewage Flow				
Average daily (AAF)	mgd	4.6	3.9	0.7
Average design (ADF)	mgd	6.0	5.1	0.9
Peak design (hour) (PDF)[b]	mgd	15.0	11.8	3.2
Raw Sewage BOD Loadings				
Annual average	ppd	8,403	8,738	-335
Average peak month	ppd	14,100	9,877	4,223
Raw Sewage TSS Loadings				
Annual average	ppd	8,844	7,430	1,414
Average peak month	ppd	11,4 00	9,080	2,320

[a] Existing design values correspond to Contract 1 flows and loads, except for peak month TSS and BOD loadings, which correspond to the design loadings shown in the current NPDES permit.

[b] Instantaneous flows are recorded on circular pen charts. The maximum recordable flow rate is 11.8 mgd. Any actual flow rates that exceed 11.8 mgd are recorded as 11.8 mgd. From 2002 to 2006, peak flow rates were at or above 11.8 mgd for an hour or longer on five occasions.

4.3 Outfall and Diffuser

A 36-inch-diameter outfall pipeline conveys treated effluent approximately 3,500 feet from the CKWWTP to a 30-inch-diameter submarine pipeline and diffuser section. The submarine portion of the outfall is comprised of a 3,170-foot section of 30-inch-diameter ductile iron pipe with Class 50 Tyton fittings. The discharge location is approximately 3,170 feet off shore in the northern section of Port Orchard Passage. The diffuser section is 120 feet in length and 30 inches in diameter. Discharge occurs at a depth ranging from 41.2 feet at mean lower low water (MLLW) to 52.9 feet at mean higher high water (MHHW), with an average depth of 47.8 feet at mean tide level (MTL). The diffuser is oriented perpendicular to the prevailing north-south currents, at latitude 47° 40'35", longitude 122° 36'05", with the centerline of the diffuser oriented at about 65 degrees (true north). The diffuser has 13 5-inch-diameter ports, 6 on each side located 20 feet on center, and 1 at the end.

The Water Quality Standards for Surface Waters of the State of Washington (WAC 173-201A) discusses the requirements for discharge of treated wastewater. The geometry of the chronic and acute mixing zones is specified by Ecology in the NPDES permit as 602 feet by 482 feet, and 168 feet, and 48 feet, respectively. Concentrations of priority pollutants and toxics are to be diluted to or below WAC 173-201A standards outside these mixing zone boundaries.

An outfall evaluation was conducted in 1996 and summarized in *Central Kitsap Wastewater Treatment Plant Outfall Evaluation Report* (Brown and Caldwell, December 1996). A more recent evaluation was conducted in 2006 to reflect current design flows (as shown in Table 4-3) and modified requirements from Ecology, summarized in the letter report titled *Central Kitsap WWTP Dilution Analysis, October 2006*. The 1996 study recommended inspection of the on-land and offshore portions of the outfall to ensure structural integrity (e.g., restrained joints on marine section) and that minor modifications be made to the diffuser to improve dilution for the future (Contract II) design flows. The 2006 evaluation predicted the worst case effluent dilution ratios of 47:1 and 84:1 at the acute and chronic mixing zone boundaries, respectively, based on aquatic life criteria. The worst-case dilution ratio based on human health (carcinogen) criteria was predicted to be 91:1. The results of this study were incorporated into the current NPDES permit. Based on the results of the dilution study and reasonable potential calculations performed by Ecology, no contaminant approached the maximum allowable limit at the current design flows.

The land-based portion of the outfall at the treatment plant site was identified in the 1994 Facilities Plan to have hydraulic limitations to handle future flows. Results of the 1996 outfall evaluation indicated that the diffuser and outfall have adequate hydraulic capacity to convey the peak design flow of 29.3 mgd. However, depending on the exact location of the new digester to be constructed in Phase III and future digesters in subsequent phases of plant expansion, the existing 36-inch-diameter pipe located south of the existing digesters may need to be replaced, along with a new effluent junction structure. If this 36-inch-diameter pipe is to be replaced, it will be made larger (72 inches in diameter) than the existing pipe to accommodate future flows. This new 72-inch-diameter outfall pipe segment would connect to an existing 72-inch-diameter pipe stub located east of the UV channels.

CHAPTER 5

5. PERMITS AND REGULATIONS

Numerous federal, state, and local regulations, laws, plans, policies, and programs may affect the design, construction, and operation of wastewater facilities in Kitsap County. This chapter describes the various laws and regulatory agencies that are related to wastewater planning for the plan. This evaluation represents the major laws, plans, and policies applicable to wastewater planning, and is not intended to be an exhaustive list.

Kitsap County, in conjunction with Consultants, has developed this Compliance Plan to meet applicable laws, plans, and policies. It should be noted that the laws and regulations are subject to change over time. The evaluations in this chapter are based on those in effect at the publication of this Plan.

5.1 Federal

Several federal laws and regulations affect wastewater planning in Kitsap County. This section identifies the federal laws and agencies concerning the planning, design, and construction of a domestic wastewater collection and treatment facility. Some of the federal programs and permits have been delegated to state agencies, which are discussed later in this chapter.

5.1.1 Clean Water Act

The Federal Water Pollution Control Act Amendments were enacted in 1972. As amended in 1977, this law became known commonly as the Clean Water Act. The Act established the basic structure for regulating discharges of pollutants into the waters of the United States. It gave EPA the authority to implement pollution control programs such as setting wastewater standards. The Act also continued requirements to set water quality standards for all contaminants in surface waters.

The Clean Water Act made it unlawful for any person to discharge any pollutant from a point source into navigable waters unless a permit was obtained. The Act also funded the construction of sewage treatment plants under the construction grants program, and recognized the need for planning to address the critical problems posed by nonpoint source pollution. Changes in 1987 phased out the construction grants program, replacing it with the State Water Pollution Control Revolving Fund, more commonly known as the Clean Water State Revolving Fund. This new funding strategy addresses water quality needs by building on EPA-state partnerships.

EPA is the primary administrator of policies and programs developed under the Clean Water Act. In Washington, much of the EPA's responsibilities for review and approval of wastewater facility plans and for issuance of permits have been delegated to Ecology.

5.1.2 National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires federal agencies to consider the environmental consequences of an action prior to making a decision on that action. Agencies are expected to identify alternatives and mitigation that avoid or otherwise minimize the environmental impacts, while still accomplishing the purpose and need of the proposal. NEPA applies to all major federal actions and projects, to any project requiring a federal permit or located on federal land, and to any proposal receiving federal funding.

The federal agency that grants a permit or approves funding generally would be the lead agency under NEPA. Each federal agency has adopted its own procedures to meet the requirements and intent of NEPA. NEPA review includes both preparing the environmental document and conducting a public review process. The public will usually have an opportunity to review and comment on the proposal and the environmental analysis.

Generally, the NEPA process begins with a determination of whether a categorical exclusion applies. A categorical exclusion requires no further NEPA review. If an exclusion does not apply, the lead agency will prepare an environmental assessment (EA). The EA contains information about the proposal, alternatives considered, and the likely environmental consequences. The lead agency can then use this information to decide whether to prepare a Finding of No Significant Impact (FONSI) or an environmental impact statement (EIS). An EIS would be required if the proposal is likely to have a significant environmental impact.

If a federal permit were required, capital facilities in the plan would undergo NEPA review when applying for that permit. NEPA review also would be required to obtain federal funding for any facility in the plan. Some facilities may require review under both NEPA and the Washington State Environmental Policy Act (SEPA), which is described later in this chapter. The NEPA and SEPA processes may be combined and a joint document can be prepared.

5.1.3 Endangered Species Act (ESA)

The federal Endangered Species Act (ESA) directs the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) Fisheries to promulgate a list of endangered and threatened species and to designate critical habitat for these species. The ESA also regulates the "take" of a listed species, which can include any act that kills or injures a species and may include habitat modification. Federally related projects that would likely affect an ESA-listed species may require consultation with USFWS or NOAA Fisheries.

In addition to the federal ESA listings, several Washington state agencies maintain lists of rare or endangered plants and animal species and habitat. The Washington Department of Fish and Wildlife (WDFW) publishes a Priority Habitats and Species (PHS) list and a Species of Concern (SOC) list. The PHS list is a catalog of habitats and species considered to be priorities for conservation and management. The SOC list includes all state-listed endangered, threatened, sensitive, and candidate species, and well as federally ESA-listed fish stocks. The Washington Department of Natural Resources (DNR) lists rare plants and endangered ecosystems under the Natural Heritage Program.

Several federal and state threatened or endangered species, candidate species, and species of concern are known to occur or potentially occur in Kitsap County. The fish and wildlife species include the bald eagle, marbled murrelet, killer whale, humpback whale, Chinook Salmon, Steller sea line, bull trout, coho salmon, Hood Canal chum salmon, and steelhead trout. The DNR Natural Heritage Program has identified eight species of rare plants occurring in Kitsap County. And the WDFW has documented six priority habitat types in Kitsap County. Other state priority species in Kitsap County include the bald eagle, great blue heron, pileated woodpecker, peregrine falcon, and western pond turtle (Kitsap County, 2006).

Individual projects proposed under the plan could adversely affect federal and state listed species or habitat. Kitsap County would determine if listed species and habitats of concern are present during future environmental review and permitting of individual wastewater facilities. Proposed facilities would be located and designed to avoid impacts on listed species and habitats, where possible, and could include site-specific mitigation. Kitsap County would coordinate individual projects with appropriate agencies and tribes that regulate endangered species to identify mitigation measures and obtain required permits and approvals.

5.1.4 Joint Aquatic Resources Permit Application

Potential activities within regulated waters could require multiple federal, state, and local permits and approvals. To streamline the environmental permitting process, regulatory agencies have created one application to apply for more than one permit at a time. The Joint Aquatic Resources Permit Application (JARPA) can be used to apply for several federal, state, and local permits and approvals in Washington. Agencies participating in the JARPA process include the U.S. Army Corps of Engineers, U.S. Coast Guard, Ecology, WDFW, DNR, and the local agency with shoreline jurisdiction. The individual permits and approvals are described in this chapter.

5.1.5 Corps of Engineers Permits

Section 404 of the Clean Water Act regulates the discharge of dredge or fill material in waters of the United States, including special aquatic sites such as wetlands. Wetlands generally include swamps, marshes, and bogs. Section 404 is administered by the U.S. Army Corps of Engineers (Corps). The Corps' Seattle District is responsible for issuing Section 404 permits in Kitsap County.

Wastewater facilities that involve filling or work in wetlands under Corps jurisdiction may require one of several types of Section 404 Permits. An individual permit is generally required for more substantial projects with the potential for adverse impacts on water quality, habitat, or ESA-listed species. Other activities can be authorized by letters-of-permission, nationwide permits, or regional permits. Capital improvement projects that involve filling or work in small areas of wetlands may be permitted under a nationwide general permit.

The Corps also is responsible for Section 10 of the Rivers and Harbor Act of 1899. A Corps Section 10 Permit may be required for work in, over, or under navigable waters of the United States. Typical activities potentially requiring Section 10 Permits include piers, outfall pipes, pipeline crossings, and dredging and excavation. The Corps can authorize activities under Section 10 by a standard individual permit, letter-of-permission, nationwide permit, or regional permit.

The expansion of the Kitsap treatment plant may require a Section 404 Permit because wetlands may occur within the overall site. New and modified pipelines across rivers and/or wetlands also could require Section 404 Permits. The effluent discharge line and outfall are not expected to be physically changed under the plan; therefore, a Corps permit likely would not be required for the outfall.

The proposed facilities in the plan should be located and designed to avoid wetlands, where possible. If construction of a facility were to discharge dredged or fill material into wetlands under Corps jurisdiction, then the appropriate Section 404 Permit would be obtained. Site-specific mitigation and potential wetland compensation would be evaluated during future Corps review of individual wastewater facilities. One goal of wetlands protection is to avoid the net loss of wetlands, and therefore enhancement of existing wetlands or creation of new wetlands may be required to mitigate for facilities that involve wetland fill.

The application for an individual Corps Section 10 or Section 404 Permit is part of the JARPA. If a proposed facility might affect ESA-listed species or their designated critical habitat, the Corps must consult with NOAA Fisheries or USFWS before it makes a permit decision.

5.2 State and Regional

This section describes Washington state agencies with jurisdiction for planning, design, and construction of a wastewater collection and treatment facility. Ecology has been delegated much of EPA's responsibilities under the Clean Water Act.

5.2.1 Ecology Review of Central Kitsap Wastewater Facilities Plan

According to RCW 90.48, all engineering reports, plans, and specifications for new construction, improvements, or extensions of existing sewerage systems, sewage treatment, or disposal plants or systems shall be submitted to and approved by Ecology before construction may begin. In general, the review is intended to ensure that facilities proposed to be designed, constructed, operated, and maintained will meet the applicable state requirements to prevent and/or control pollution of state waters.

This plan will first be approved by Kitsap County as part of the capital facilities element of its Comprehensive Plan. The Kitsap County Comprehensive Plan is discussed later in this chapter. The ultimate and final Central Kitsap Wastewater Facilities Plan must comply with Ecology regulations for facilities plans (WAC 173-240-060). Ecology is expected to review the final plan in 2009.

Ecology administers the primary funding programs for planning, design, and construction of domestic wastewater facilities. These two programs are the Centennial Clean Water Fund Program (Centennial) and the Washington State Water Pollution Control Revolving Fund Program (SRF).

5.2.2 NPDES Permit

In general, the discharge of any wastewater, except domestic wastewater going to a municipal treatment plant, requires a wastewater discharge permit. The discharge of pollutants into the state's surface waters requires an NPDES Permit. Discharges to groundwater and industrial discharges to a municipal treatment plant require a state wastewater permit. A discharge permit also may be required for stormwater from industrial and construction sites and some municipal sites.

EPA has authorized Ecology to administer the wastewater discharge program in Washington. Chapter 90.48 RCW defines Ecology's authority and obligations in administering the wastewater discharge permit program. The regulations adopted by Washington State include procedures for issuing permits (Chapter 173-220 WAC), technical criteria for discharges from municipal wastewater treatment facilities (Chapter 173-221 WAC), water quality criteria for surface and ground waters (Chapters 173-201A and 200 WAC), and sediment management standards (Chapter 173-204 WAC). These regulations establish the NPDES Permit system and are the basis for effluent limitations and other requirements to be included in the permit.

An individual NPDES Permit from Ecology is required for wastewater discharges to surface waters from a municipal sewage treatment plant. An NPDES Permit typically places limits on the quantity and concentration of pollutants that may be discharged. An NPDES Permit also includes monitoring schedules and reporting to verify that the treatment process is functioning correctly and the effluent limitations are being achieved. The NPDES process includes public review and comment on a draft permit before the final permit can be issued.

The CKWWTP is a conventional activated sludge-type, secondary treatment system. The disinfected secondary-treated effluent is discharged to Port Orchard Bay of Puget Sound. Port Orchard Bay is designated as a Class AA Marine Water in the vicinity of the outfall. An NPDES Permit is required for discharge into Port Orchard Bay.

The dewatered sludge from the CKWWTP is transported by truck to Soil Key in Tenino, Washington, for composting into Class A biosolids. The CKWWTP currently has no discharge to ground and therefore no limitations are required based on potential effects to groundwater.

The existing NPDES Permit for the CKWWTP expired on June 30, 2006. An application for permit renewal was received by Ecology on December 30, 2005. Ecology issued NPDES Permit No. WA-003052-0 on May 31, 2007. Its effective date is June 1, 2007, and its expiration date is May 31, 2012.

The current NPDES Permit is the basis for the design in this GMA Compliance Plan and is shown in Appendix F. The current effluent limitations in the NPDES Permit are provided in Table 4-4.

As shown in Table 5-1, the current NPDES Permit for the CKWWTP does not include any limitations on ammonia. In the future, Ecology may limit ammonia because of potential Total Maximum Daily Load (TMDL) requirements. The TMDL is the maximum amount of the pollutant that can be discharged to the water body without violating the water quality standard for that pollutant. TMDLs can be implemented through NPDES Permits for discharges to that water body. Potential limitations on ammonia for the CKWWTP, if any, likely would occur in the future NPDES Permit cycle, possibly starting in 2017.

The NPDES Permit is based on the flow or waste loadings at the treatment plant. The flows for the CKWWTP shall not exceed the loading shown in Table 4-4.

An NPDES Permit may include both general and special conditions. Special conditions are specific to the site and the treatment plant, and consider the water quality of the receiving waters. The key conditions in the NPDES Permit for the CKWWTP are briefly identified below:

- Discharge Limitations. The effluent limitations are provided in Table 4-4. The discharge limitations also specify the dilution ratios and maximum boundaries of the mixing zones.
- Monitoring Requirements. The NPDES Permit includes the monitoring schedule and sampling and analytical procedures.
- Reporting and Recording Requirements. Kitsap County is required to monitor and report in accordance with the conditions in the permit. Monitoring results shall be submitted monthly on Ecology's Discharge Monitoring Report Form.
- Facility Loading. The flows or waste loading for the CKWWTP are shown in Table 4-4 above.
- Operation and Maintenance. Kitsap County must institute an adequate operation and maintenance (O&M) program for the entire sewage system. The O&M Program includes operator certification, adequate laboratory controls, appropriate quality assurance procedures, and operation of backup or auxiliary facilities.
- Residual Solids. Kitsap County must store and handle all residual solids in a manner to prevent their entry into state ground or surface waters. The Permittee shall not discharge leachate from residual solids to state surface or ground waters.
- Pretreatment. All commercial and industrial users of the CKWWTP must be in compliance with the pretreatment regulations and obtain applicable discharge permits. The plant receives discharges of pretreated industrial waste water from the Kitsap Naval Base and Naval Undersea Warfare Center, both of which are regulated under State Waste Discharge Permits issued by Ecology.
- Acute Toxicity. The effluent limit for acute toxicity is no acute toxicity detected in a test concentration representing the acute critical effluent concentration (ACEC). The NPDES Permit also includes monitoring and reporting requirements for acute toxicity.
- Chronic Toxicity. The final effluent must be tested twice during the permit term. The NPDES Permit specifies the species and protocols for the chronic toxicity tests.

- Sediment Monitoring (Marine). The permit conditions include a sediment sampling and analysis plan for sediment monitoring in the vicinity of the discharge location. The purpose of the plan is to recharacterize the nature and extent of biological toxicity and/or chemical contamination in the vicinity of the discharge location.
- Outfall Evaluation. Kitsap County must inspect, once during the year 2011, the submerged portion of the outfall line and diffuser to document its integrity and continued function.

5.2.3 State Waste Discharge Permit

Discharges to groundwater and industrial discharges to a municipal treatment plant require a State Waste Discharge (SWD) Permit. Ecology issues SWD Permits according to Chapter 173-216 WAC. The SWD program also regulates the use of reclaimed water. SWD Permits are issued on a five-year cycle and include information such as discharge limits, monitoring schedule, and general and special conditions.

Instances where a SWD Permit would be required for wastewater treatment facilities are where the effluent is discharged into ground water or the effluent from the treatment plant is reused. The CKWWTP currently does not discharge into groundwater, and a SWD Permit has not been required.

Kitsap County may be considering the alternative of reclaimed water percolation into local aquifers. Future discharge of reclaimed water into the ground would require an SWD Permit. Water reclamation and land application systems would be required to obtain Ecology review and approval and to meet applicable groundwater quality standards. The evaluation of reclaimed water would require analysis of groundwater conditions in Kitsap County.

5.2.4 Hydraulic Project Approval (HPA)

Any form of work that uses, diverts, obstructs, or changes the natural flow or bed of any fresh water or saltwater of the state, requires a Hydraulic Project Approval (HPA) from the Washington State Department of Fish and Wildlife (WDFW). The HPA typically specifies how construction projects are designed, managed, sequenced, and conducted to minimize adverse effects on fish and shellfish.

The application for an HPA is part of the Joint Aquatic Resources Permit Application (JARPA). State Environmental Policy Act (SEPA) compliance must be completed prior to issuance of the HPA by WDFW. The WDFW would consider any state-listed endangered species and priority habitats when issuing an HPA.

An HPA could be required for wastewater facilities typically for stream crossings and in-water construction at the outfall. If affecting state waters, facilities recommended in the Plan may require an HPA prior to construction. The effluent discharge line and outfall are not expected to be physically changed under the Wastewater Central Kitsap Wastewater Facilities Plan; therefore an HPA likely would not be required for the outfall.

5.2.5 Section 401 Water Quality Certification

Applicants for a federal permit or license, such as a Section 404 Permit, could require a Section 401 Water Quality Certification (401 Certification) from Ecology. A 401 Certification must be obtained for any activity that might result in a discharge of dredge or fill material into water or non-isolated wetlands, or for excavation in water or non-isolated wetlands. The application for a 401 Certification would be part of the Joint Aquatic Resources Permit Application (JARPA) for a project.

Issuance of a certification means that Ecology anticipates that the applicant’s project would comply with state water quality standards and other aquatic resource protection requirements under Ecology's authority. The

401 Certification can cover both the construction and operation of the proposed project. Conditions of the 401 Certification become conditions of the Federal permit or license.

Activities typically requiring a 401 Certification, which are related to construction or wastewater facilities, include underwater pipeline crossings and outfalls. Facilities in the plan could require a 401 Certification from Ecology, although the effluent discharge line and outfall are not expected to be physically changed under the Central Kitsap Wastewater Facilities Plan.

5.2.6 Archaeological and Cultural Coordination

Environmental laws and review processes at the federal, state, and local levels require that consideration be given to protecting significant historic, archaeological, and traditional cultural sites from damage or loss during development. Environmental laws such as the National Historic Preservation Act and the State Environmental Policy Act (SEPA) require that impacts on cultural resources be considered during the public environmental review process. The Washington Department of Archaeology and Historic Preservation (DAHP) works with agencies, tribes, private citizens, and developers to identify and develop protection strategies to assure that Washington's cultural heritage is not lost.

DAHP is the agency with technical expertise in regard to cultural resources, and provides formal opinions to local governments and other state agencies on a site's significance and the impact of proposed projects upon such sites. Recommendations in the Wastewater Facilities Plan should avoid adverse impacts on identified archaeological, cultural, and historic sites. Development of capital improvement projects would be coordinated with DAHP and the local tribes.

5.2.7 Aquatic Use Authorization (Aquatic Lease)

The Department of Natural Resources (DNR) has approval authority for the use of state-owned aquatic lands (beds of saltwater bodies and beds of navigable rivers). Many outfalls in marine waters are constructed in tidelands and aquatic lands managed by the DNR. A lease is required from the DNR for new and existing outfalls located on these lands. DNR would issue an Authorization to use State-Owned Aquatic Lands. The Aquatic Use Authorization process can be part of the Joint Aquatic Resources Permit Application (JARPA).

5.2.8 Air Quality Notice of Construction

The Puget Sound Clean Air Agency (PSCAA) is responsible for regulating air pollution in Kitsap County. A municipal treatment plant may require a PSCAA permit before constructing a new facility, or before installing or modifying equipment that generates or emits air pollution. The application for an individual permit is called a Notice of Construction. The biggest potential source of air pollutants from the Kitsap treatment plant would be the combustion of anaerobic digester gas. Regulatory requirements may include emission limits; work practice standards; and monitoring, reporting, and recordkeeping conditions. In addition, the PSCAA should be notified if demolition or renovation of a structure could involve asbestos.

5.3 Local

Development of wastewater facilities must meet various Kitsap County regulations and may require County permits and approvals. Kitsap County requirements are related to comprehensive land use planning, shoreline development, zoning, critical areas, building and fire codes, noise control, and local development regulations.

5.3.1 Comprehensive Plan and Growth Management Act (GMA)

Washington's Growth Management Act (GMA) establishes goals for land use planning, and directs local governments of fast-growing counties and cities to establish comprehensive plans, urban growth areas (UGAs), and development regulations. As required under GMA, Kitsap County developed its *Comprehensive Plan*, which was first approved in 1998 and recently updated in December 2006.

The GMA identifies 14 planning goals that are diverse and sometimes competing, such as containing sprawl, providing affordable housing, retaining open space, encouraging economic development, ensuring public facilities, and protecting the environment. The GMA goals that directly apply to wastewater management are to focus urban growth in urban areas, to ensure adequate public facilities and services to support development, to encourage citizen participation, and to protect the environment. Kitsap County has developed this GMA Compliance Plan to meet the overall GMA planning goals applicable to wastewater management.

The GMA requires planning documents, including wastewater facility plans, to be internally consistent with the policies and future land use map in the *Comprehensive Plan*. Facility plans should be coordinated with the County's ongoing land use and GMA planning efforts. Kitsap County has developed this Central Kitsap Wastewater GMA Compliance Plan to be consistent with the GMA, *Comprehensive Plan*, and other County land use planning. In particular, the modeling for wastewater flows in the Compliance Plan has been based on future land uses in the *Comprehensive Plan*.

The GMA requires comprehensive plans to include a capital facilities plan element. The capital facility plan element applies to planning and construction of wastewater collection and treatment facilities. This Central Kitsap Wastewater GMA Compliance Plan has been prepared to be consistent with the capital facilities element of the *Comprehensive Plan*. The GMA Compliance Plan includes an inventory of existing capital facilities, projections of wastewater flows based on adopted County land uses, and recommendations for new or expanded capital facilities.

The GMA also requires local jurisdictions to plan for urban growth within the designated UGAs. GMA specifies that local governments must provide adequate public facilities and services, including wastewater collection and treatment. Concurrency under GMA requires public facilities and services to support planned growth at the time development occurs, without decreasing current service levels below County standards. This GMA Compliance Plan includes recommendations for wastewater facilities to support planned growth in unincorporated Kitsap County. Adoption of this plan will allow Kitsap County to meet the concurrency requirements of the GMA.

5.3.2 Shoreline Master Program and Shoreline Management Act

The Washington Shoreline Management Act (SMA) regulates all marine waters, larger streams and lakes, associated wetlands and floodplains, and uplands within 200 feet from the edge of these waters. Kitsap County has adopted its Shoreline Management Master Program (KCC Title 22), which guides future development of the shorelines in Kitsap County in a manner consistent with the SMA. Kitsap County could issue a shoreline substantial development permit, a conditional use permit, or a variance permit. The application for a shoreline permit could be part of the Joint Aquatic Resources Permit Application (JARPA).

If located within regulated shorelines, then facilities recommended in the plan should be consistent with the policies of the state SMA and with the requirements of the Kitsap County Shoreline Management Master Program. Potential wastewater facilities may require the applicable shoreline permit at the time individual projects are designed and approved.

5.3.3 Critical Areas Ordinance

The Growth Management Act (GMA) requires Kitsap County to designate critical areas and to adopt regulations to protect these areas. The Kitsap County Critical Areas Ordinance regulates land uses or development that would alter the condition of a critical area or its required buffer (KCC Title 19). The critical areas are wetlands, fish and wildlife habitat conservation areas, geologically hazardous areas, frequently flooded areas, and aquifer recharge areas.

Wastewater facilities recommended in the plan should be located and designed to avoid critical areas, where possible. If a facility were located in or adjacent to a designated critical area, then the project would comply with the Critical Areas Ordinance and obtain applicable critical areas approvals. The presence of a critical area(s) and any site-specific mitigation for individual facilities would be determined during future review under the Critical Areas Ordinance.

5.3.4 Land Use, Zoning, and Development Regulations

Potential facilities evaluated under the plan could affect land uses regulated by Kitsap County. Development of individual wastewater facilities must be consistent with adopted County land use policies, zoning designations, and development regulations. The Kitsap County Zoning Ordinance is codified in Title 17 of the Kitsap County Code.

The plan should ensure that wastewater facilities are located and designed to be consistent with the site-specific land use and zoning designations. Depending on the site's underlying zoning, a project may be permitted outright or could require a conditional use or variance. Individual wastewater facilities would obtain applicable zoning permits and approvals at the time they are designed and approved.

Other Kitsap County permits and approvals may be applicable to new or expanded wastewater facilities. A Site Development Activity Permit (SDAP) provides a mechanism to ensure stormwater quantity and quality concerns are addressed prior to site development (Title 12, Kitsap County Code). A new driveway access should meet Kitsap County Road Standards and may require a Road Approach Permit.

5.3.5 Building and Fire Code

The Kitsap County Building and Fire Code regulates construction and/or development of site work within the unincorporated boundaries of Kitsap County (KCC Title 14). The Code regulates site improvement work, plumbing and sanitation, water conservation, heating, air conditioning, ventilation, energy efficiency, fire suppression systems, alarm systems, and fire department access. The Kitsap County Department of Community Development is charged with the administration and enforcement of the Code. A building permit may be required for construction of permanent buildings or additions to existing buildings recommended under the plan.

5.3.6 Noise Ordinance

Kitsap County has a noise ordinance that limits noise levels at the property lines of neighboring properties (KCC Chapter 10.28). When such a local ordinance is in effect, the State of Washington does not enforce Ecology's similar noise regulations (WAC Chapter 173-60).

The Kitsap County noise ordinance could apply to construction activities and to operation of noise-generating sources adjacent to sensitive land uses, while vehicle noise from public roadways is exempt. Potential noise sources could include generators, air compressors, ventilation equipment, centrifuges, blowers, and pumps. The design of treatment facilities, pump stations, and related pipelines should consider construction techniques and mitigation measures to reduce noise levels at sensitive land uses.

5.3.7 SEPA Regulations

The State Environmental Policy Act (SEPA) provides a way to identify possible environmental impacts that may result from governmental actions. These decisions may be related to issuing permits for private projects, constructing public facilities, or adopting regulations, policies, or plans. SEPA review is not a permit, but is a process that helps agency decision-makers, applicants, and the public understand how a proposal would affect the environment. This information can be used to change a proposal to reduce potential impacts or to condition or deny a proposal when adverse environmental impacts are identified.

SEPA applies to all levels of state and local government. Kitsap County has adopted its own SEPA regulations in Chapter 18.04 of the Kitsap County Code, which generally follows the Ecology SEPA regulations in Chapter 197-11 of the Washington Administrative Code. For most projects proposed by the County under the Central Kitsap Wastewater Facilities Plan, Kitsap County would be the lead agency under SEPA and would be responsible for completing SEPA review under the County SEPA policies and regulations.

Any proposal that requires a local agency to license, fund, or undertake a project, or the proposed adoption of a policy, plan, or program, could trigger environmental review under SEPA. A proposal with potential significant adverse environmental impacts could require an environmental impacts statement (EIS). Proposals without significant impacts likely would require a determination of non-significance (DNS) and accompanying environmental checklist. SEPA review includes both preparing environmental documents and public review, the extent of which depends on the location, magnitude, and potential impacts of the proposal. The overall SEPA process is similar to environmental review under the National Environmental Policy Act (NEPA).

Adoption of the Central Kitsap Wastewater Facilities Plan itself will require SEPA review by Kitsap County prior to its approval by Ecology. The plan would be a nonproject action under SEPA, and a non-project or programmatic SEPA document will be prepared concurrently with the plan. Individual capital improvement projects prescribed in the plan would undergo SEPA review at the time they are designed and permitted. If federal funding or permits were required, review under NEPA also may be required.

All projects financed through the federal Clean Water Act State Revolving Fund program administered by Ecology are subject to the State Environmental Review Process (SERP). Ecology has developed a SERP process for the State of Washington that has been approved by EPA. Both NEPA and SEPA are satisfied for State Revolving Fund projects if a project proponent meets the requirements of SERP.

CHAPTER 6

6. DESIGN AND EVALUATION CRITERIA

6.1 Introduction

The design and evaluation criteria for wastewater treatment and conveyance facility projects typically have many common approaches and components. Design and evaluation criteria are established as a basis for defining and evaluating alternative projects to select a specific preferred approach. Alternative projects may be evaluated and specific projects defined.

In the case of the Central Kitsap Interim Wastewater Facility Plan, however, the planning approach for conveyance facilities differs from that used for planning wastewater treatment projects. For the collection and conveyance facilities, design criteria and concepts are established and used to prepare a long-term conceptual plan for sewer service to the entire area. This plan identifies the core infrastructure that will be required to receive wastewater conveyed from unsewered areas during the planning horizon. The core infrastructure consists of the existing primary lift stations (larger that 1,000 gpm) and the associated conveyance facilities. The Central Kitsap Wastewater GMA Compliance Plan evaluates alternatives and identifies specific projects necessary to maintain the core infrastructure as a priority. This document also presents a conceptual sewage collection and conveyance system to serve areas beyond the existing core infrastructure. The following detailed design and evaluation criteria relative to conveyance systems will be used to prepare the final Central Kitsap Wastewater Facilities Plan

In developing alternative projects designed to perform a given function, each project must be laid out in sufficient detail to permit comparisons of performance and cost, for both construction and operation. To make such layouts and evaluations, it is first necessary to develop criteria applicable to the preliminary design of all major wastewater facilities and, second, to develop the basis of cost estimating.

In evaluating alternatives, it is necessary to identify the criteria against which they are to be compared. The alternatives are compared in terms of each criterion, and one alternative is selected for implementation.

This chapter presents the criteria to accomplish both the layouts and evaluations of the alternatives or projects, which are developed in Chapters 8 and 9. These criteria are identified in five groups:

Design Criteria. Design criteria address technical issues important to the design and construction of facilities.

Cost Criteria. These criteria examine monetary and resource costs (e.g., energy, materials, and staffing).

Performance Criteria. Performance criteria address the reliability, flexibility, and effectiveness of alternatives.

Environmental Criteria. These criteria address odor, aesthetics, water quality, siting, and adjacent land use concerns.

Implementation Criteria. Implementation criteria include regulatory compliance, financing, constructability, and public acceptance.

Each of these five general criteria groups is described, and specific factors within each group are applied in evaluating the Central Kitsap alternatives or projects.

6.2 Goals for Future Facilities

1. Three general goals were (or will be) adhered to in developing the conveyance and treatment alternatives presented in Chapters 8 and 9. The goals are briefly stated here.
2. Service to Saturation-level Populations. All the alternatives were (or will be) developed using the 2025 populations likely to occur in the Central Kitsap County study area.
3. Attention to Critical Improvements. While servicing saturation-level population was considered a key goal in this analysis, attention was also given (or will be) to areas the County has identified as needing immediate improvements.
4. Minimize Construction and Operation and Maintenance (O&M) Costs. Implicit in the selection of the recommended conveyance and treatment alternatives is the goal to minimize costs.
5. Maximize Use of Existing Facilities, Property, and Accessways Wherever Logical. Locations for future sewers and pumping stations were chosen to coincide with existing alignments and property. Use of the existing Central Kitsap Wastewater Treatment Plant facilities was maximized.

6.3 Design Criteria

General technical aspects of alternatives are addressed in this section. Design criteria for conveyance systems are presented. General site evaluation and treatment objectives are also presented. The reader is referred to Chapter 9 for design criteria specific to a given treatment process unit.

6.3.1 Preliminary and Conceptual Layouts

Design criteria and basic cost data presented herein apply to preliminary design of wastewater treatment facilities or conceptual layouts for conveyance facilities. In preliminary design, detailed construction drawings and specifications are not required. Instead, it is necessary only that a reasonably close approximation of the size, location, route, and cost of the various facilities is developed, and that this information is given in sufficient detail to permit comparisons between alternative plans. Therefore, relocation and resizing of some of the treatment facilities may be required at a later date as a result of detailed engineering analyses during preparation of construction drawings and specifications.

For collection facilities, core infrastructure needs are identified and future new facilities are conceptualized.

6.3.2 Planning Period

All alternative plans, or projects, were laid out to serve the 20-year planning period. The 2025 populations established by the Kitsap County Department of Community Development (DCD) are the basis for the future densities modeled for tributary areas. Depending on the actual growth rate over time, the projected 2025 population may occur sooner or well into the future. Within the study area, some tributary areas may develop to DCD-estimated densities much sooner than others. This study deals with the average overall density without respect to time.

Although the conceptual plan shown in Chapter 7 was laid out to serve entire study area, it does not follow that all facilities will be constructed, nor that all facilities will be constructed by the County.

In Chapter 7, the collection and conveyance system was developed conceptually. In Chapter 8, costs were approximated using flows estimated for the 20-year density. This plan then provides the County with a "blue-print" by which to guide the development of its wastewater system.

In Chapters 9 and 10, the comparative analysis for the wastewater treatment plant was based on a 20-year projection of flows and loadings for the service area, with an overview of how the layout would be expanded to meet capacity needs at saturation. The treatment plant cost comparisons were made using the 20-year horizon in order to allow for the changing nature of governing legislation and policies, changes in treatment technology, and the modular nature of treatment process units.

In this manner, cost-effective treatment alternatives were identified based upon current, available technology, while anticipating space needs for future expansion.

6.3.3 Use of Existing Facilities

The capacities and condition of the existing facilities were evaluated with regard to their incorporation in the final recommended plan. In general, most of the existing facilities have been incorporated into the final plan. However, where existing facilities cannot be expanded easily, are significantly insufficient in meeting current regulatory design and safety requirements, or are improperly located, they have been (or will be) recommended to be replaced, removed, or inactivated. Since most of the treatment facilities are relatively new, it is expected that the existing system will remain primarily intact, with additions for increasing capacity or reliability.

6.3.4 Conveyance-System

A conceptual plan for new future lift stations and downstream conveyance was prepared as a basis for determining the downstream impacts for the 20-year horizon. To accommodate the anticipated wastewater flows, existing core infrastructure improvements have been identified. These include lift station and the associated downstream conveyance. A conceptual plan for future new gravity collectors was also prepared.

6.3.4.1 Gravity Sewers.

In general, trunk and interceptor sewers were preliminarily sized to provide a minimum velocity of 2 feet per second (fps) when flowing full and were sized to carry peak flow without surcharge. Diameters of pipes for sewer replacement projects were determined by means of Manning's pipe-friction formula using a roughness coefficient (n) of 0.013.

6.3.4.2 Lift Stations.

Hydraulic design of lift stations will, of course, be compatible with the capacity of associated pipelines. Although pumping units may be installed incrementally as required by growing demand, structures should be designed to accommodate pumping equipment for wastewater flows anticipated beyond the initial construction phase. The useful life has been estimated to be 20 years for pumping equipment and 50 years for structures.

Pumping units for major stations will be centrifugal wastewater pumps with variable-speed drives to minimize wet well size and reduce odor problems. Pumping station superstructures are normally constructed of reinforced concrete or masonry and are designed to blend architecturally with the surrounding area. Standby power units will be provided. Lift station costs have been approximated accordingly.

The majority of the County's lift stations are prefabricated, factory-built pumping stations. This type of lift station is often referred to as a "canned" station because the dry well consists of a narrow metal cylinder. These confined space entry units are difficult to properly ventilate and are nearing the end of their service life. They should be give higher priority in future replacement projects.

6.3.4.3 Force Mains and Low-Pressure Gravity Sewers.

Force mains, unlike gravity sewers, always flow full and must be designed with proper velocities to prevent deposition of solids. Force mains and low pressure gravity sewers (also known as inverted siphons) are normally constructed of concrete-lined and coated welded-steel pipe, or cast-iron or ductile-iron pipe. The most suitable material for a specific installation must be determined during design. Diameters of force mains were preliminarily sized by assuming a velocity of 5 fps at the 20-year design flow.

Hydraulic transients—caused by constant-speed pumping stations turning off, sudden pump failure, or shutdown—may result in damage to the force main, lift station, or both. While an analysis of these phenomena is not within the scope of this planning study, hydraulic transients are mentioned here because they often affect the design (and thereby the cost) of pipelines and lift stations. In general, techniques for controlling problems associated with hydraulic transients include limiting peak pipeline velocities, sloping force mains continuously upward to their discharge ends, incorporating pressure-relief or vacuum-breaker valves in force mains, and providing flywheels on pumping units.

Odor control and corrosion control also need to be considered. In wastewater systems, odors and corrosion are usually associated with hydrogen-sulfide generation. The potential for odor- and corrosion-control problems is greater during the initial years of the planning period when force main velocities are low. In those instances, in which initial force main velocities would not reach 2 to 3 fps at least once a day at the beginning of the planning period, facilities for pipeline pigging and chemical addition should be incorporated into the pump stations. Systems for removing odors from air evacuated from pump station wet wells and force main discharge manholes may also be considered during final design.

6.3.5 Treatment Process Alternatives

All of the process alternatives analyzed are capable of meeting an effluent requirement of 25 milligrams per liter (mg/L) for 5-day biological oxygen demand ($CBOD_5$) and 30 mg/L for total suspended solids. Design criteria specific to the operation and performance of treatment plant processes are detailed in Chapters 9 and 10. For each process, treatment units were sized for the year 2026 so that estimates of capital and annual costs could be prepared.

The treatment plant alternatives were initially screened with respect to the following criteria:

- Compatibility with existing system
- Land requirements
- Energy and chemical demands
- Complexity of operation and maintenance
- Suitability for expansion

6.4 Cost Criteria

Cost criteria include capital and operating costs as well as other resource factors such as energy, chemical and materials use, and staffing. Monetary cost criteria can be aggregated by calculation of total annual costs or present worth.

6.4.1 Basis of Cost Estimates

Construction and O&M costs cited in this report are based on preliminary layouts of the proposed alternatives. In considering the estimates, it is important to realize that changes during final design and future changes in the cost of materials, labor, and equipment will cause changes in costs provided herein. However, since the relative economy of alternative projects can be expected to change only slightly with respect to each other, decisions based on present comparison should remain valid.

6.4.2 Precision of Cost Estimates and Construction Contingency

Cost estimating is an evaluation of the cost of all elements of a well-defined project. Generally speaking, there are four levels of cost estimating. These include the ball park estimate, the planning level estimate, the budget level estimate, and the definitive estimate. Each one has some degree of precision, or accuracy, associated with it that reflects the amount of detail evaluated, not only in the design of the facility, but also in the method used for estimating.

The level of accuracy generally considered acceptable for these types of estimates are as follows:

1. Ball Park Estimate—This type of estimate is based on the bare essentials of a project, with little or no knowledge other than the approximate size of a facility. This type of estimate has no range of accuracy associated with it. It generally approximates the decimal place in a number, and is an educated guess based upon experience and judgment.
2. Planning Estimate—This estimate, also referred to an "order of magnitude" estimate, is made without detailed engineering data. It may use cost capacity curves, scale-up/scale-down factors, and/or approximate ratio relationships. The range of accuracy normally associated with this estimate is from +50 percent to -30 percent.
3. Budget Estimate—A budget estimate, generally prepared at the 15 to 20 percent design point, is normally determined with the use of process diagrams, project layouts, and some definition of major equipment items. The range of accuracy normally associated with this estimate is from +30 percent to -15 percent.
4. Definitive Estimate—This estimate is prepared from nearly completed, well-defined engineering documents that include plot plans and elevations, piping and instrumentation diagrams, one-line electrical diagrams, equipment data sheets and quotations, structural drawings, soil data and drawings of major foundations, building drawings, and a complete set of specifications. The range of accuracy normally associated with this estimate is from +15 percent to -5 percent.

The degree of accuracy should not be confused with the contingency applied to the project. The range of accuracy reflects the cost estimating method used as well as the amount of detail available.

The contingency is an allowance for undefined items. This allowance covers items of work that will have to be performed, or other elements of cost that will be incurred, that were not explicitly foreseen at the time of the estimate because of lack of complete, accurate, and detailed information.

The contingency is not intended to cover some potential additions to the scope of the work, nor any act of God, unusual economic situations, or strikes, nor to compensate for any inaccuracy of the estimate. Since the contingency is required to cover costs that are almost certain to be incurred, it is an integral part of the estimate. Construction contingencies used in this project are discussed below in more detail. The degree of accuracy applies to the total construction cost, which includes the construction contingency.

Also, estimating ranges are not meant to be absolute limits, but instead imply that there is a high probability that the final costs will fall within that range. The range of individual contractor's bids often falls outside of these ranges. The cost estimate focuses on predicting the selected lowest bid. Therefore, a range of cost estimates are presented in the report as "low," "high," and "most probable" costs.

The costs provided in the recommendations chapters reflect the probable range of cost and the "most probable" cost. The most probable cost is used in the final chapter to discuss the rate impacts of the recommended improvements.

6.4.3 Capital Costs

The capital cost, or total project cost, of future facilities includes the estimated total construction cost (which includes an allowance to cover contingencies, plus Washington State sales tax, administrative, engineering, financial and legal costs). The assumptions for these allowances are presented below.

6.4.4 Total Construction Cost

The construction cost estimate consists of costs the contractor is expected to charge the County for building the future facilities. The total construction cost includes the cost of the labor, materials, equipment, subcontractors, mobilization, overhead and profit, contingencies, and Washington State sales tax.

Two different costing techniques were utilized in preparing construction cost estimates for this wastewater treatment. These included "order of magnitude" estimating for alternatives comparisons, and a more sophisticated computer-based cost estimating system for the recommended facilities.

This latter refinement of the costs was implemented to assure a higher degree of accuracy for the final facilities that become part of the capital improvement program.

6.4.5 Alternatives Analysis for CKWWTP

Planning-level cost estimates are considered adequate for alternative comparisons. Prices of comparable work were obtained from cost data developed by EPA and by Brown and Caldwell, where available, and from costing systems such as Mean's and Richardson's construction estimating publications. Where estimates were derived by more detailed cost breakdowns, 44 percent has been added for contractor's overhead and profit, general conditions, startup and training, earthquake insurance, builders risk and other insurance, performance bond, payment bond, and anticipated change orders. Additionally, costs are escalated to the mid-point of construction. Using this approach, an additional uniform contingency of 35 percent was applied to all types of construction projects. As stated above, the confidence level of costs generated under this approach is from +50 percent to -30 percent.

6.4.6 Recommended Facilities for CKWWTP

After the alternatives were evaluated and ranked, the recommended alternatives were further defined, as described in Chapter 9, and construction and project costs were estimated.

The recommended facilities were further developed using engineering experience and judgment to make assumptions about the conditions of construction and the key components of the facilities being proposed. Therefore, more detail was available from which to estimate quantities and prepare a more precise and detailed estimate.

When using these methods of cost estimating, the construction contingency is estimated by a methodical evaluation of the variables that identify the level of definition of the project. Table 6-1 describes the variables considered and the range of contingency percentages associated with each.

6.4.7 Sales Tax

Total construction costs also include the Washington State sales tax the contractor would charge. A sales tax rate of 8.6 percent has been used.

6.4.8 Cost Index

Construction costs can be expected to undergo long-term changes in keeping with corresponding changes in the national and local economy. One of the most common, available indices of these changes has been the Engineering News Record Construction Cost Index (ENR-CCI), which is computed from prices of construction materials and labor and is based on a value of 100 in the year 1913. It is believed that the ENR-CCI in the Seattle area is representative of the construction cost in Kitsap County. The costs presented for the recommended facilities are based on December 2007 dollars. The Seattle ENR-CCI for December 2007 is 8618. Costs used in Chapter 11 have been projected based on an average inflation rate of 4 percent.

Table 6-1. Contingency Definitions Based [a] on Degree of Wastewater Treatment Project Definition

Description	High – Low, Percent
Level of plot plan development Complete and final locations of items within the project boundaries, i.e. structure and equipment locations, piping/electrical run locations.	0 - 10
Level of P&ID development Complete and final process and instrument diagrams with equipment and pipe sizes.	0 – 10
Site conditions Level of sloped site terrain conditions, interface of existing structures and processes, or level of project site congestion.	0 - 5
Major equipment confidence Level of confidence in size and type of equipment to be used.	0 – 10
Layout details Degree of detail shown on drawings (i.e., structural details shown and piping layout completion).	0 – 10
Unlisted items Items needed for the project either not shown or shown but not identified or sized.	0 - 5
Labor resources Uncertainty regarding availability of labor within the project region, weather conditions affecting labor productivity, or location of project site in relation to labor resource area.	0 – 15
Pricing techniques Methods by which project costs were established (i.e., lump sum pricing versus detail unit cost pricing, firm equipment cost pricing).	0 – 5
Schedule compressions Normal project schedule sequencing versus fast track schedule sequencing	0 - 10

[a] *The contingency allowed for in this estimate is based on a detailed evaluation of the above factors*

6.4.9 Administrative, Engineering, Financial, and Legal Costs

Cost of engineering services may include special investigations, surveys, foundation explorations, location of interfering utilities, detailed design, preparation of contract drawings and specifications, general construction assistance, detailed on-site construction inspection, materials testing, final inspection of the completed work, pumping-station start-up services, operator training, and preparation of as-built drawings. Total engineering costs for design and construction assistance can vary from 12 to 30 percent of the total construction cost, depending on the complexity of the project. The lower percentage applies to projects relatively simple or repetitive in nature. The higher percentage applies to projects that require a great deal of preliminary investigation work, require substantial permitting, or involve considerable remodel work to existing facilities.

Other costs directly associated with the cost of constructing facilities include administrative, financial, and legal services; costs associated with bond sales; and interest on money borrowed during the construction period. Administrative and legal proceedings could represent a significant expenditure for the formation of special utility districts, for preparation of inter-agency agreements, and for O&M contracts. Based on experience, allowances for administrative, financial, and legal costs have varied from 5 to 10 percent of total construction costs.

This report utilizes a combined approximate cost for administrative, engineering, financial, and legal services of 30 percent of the total construction cost (base construction cost plus contingency and sales tax).

6.4.10 Total Project Costs

The total project costs, or the capital-cost estimates, following the sequential application of the above allied costs, represent 191 percent of the base construction costs, as shown in Table 6-2.

Table 6-2. Capital-Cost Estimates

Item	Percent
Construction plus Escalation	100
Contingency	35
Washington State Sales Tax	8.6
Total Construction Cost	147
Engineering, Legal, and Administrative	30
Total Project Cost	191

6.4.11 Operation-and-Maintenance Costs for CKWWTP

Operation and maintenance includes all costs for labor, materials and supplies, energy, and chemicals related to each major system component and an allowance for major equipment repair. For cost analysis purposes, the annual O&M costs are based on the projected flows and loadings for the midpoint of the planning period. Costs are inflated at 4 percent to this point, then converted back to present worth using the EPA discount rate. The present-worth timeframe is identified in each cost table. A 35 percent contingency allowance is applied to account for uncertainties in the project costs of labor, materials and supplies, energy, and chemicals.

6.4.12 Equivalent Uniform Annual Cost (EUAC)

The equivalent uniform annual cost (EUAC) is one method of presenting cost information. The EUAC represents the amount paid each year over a 20-year period. Its value is equivalent to paying the total present worth cost in one lump sum today. The equivalent uniform annual cost is used as an expression of the true economic burden of a project and, thus, the local rate impacts. For the discount rate and rate of inflation assumed in this study, the EUAC equals the total present worth times an amortization factor of 0.1057.

6.4.13 Present-Worth Analysis

A present-worth analysis converts all future costs and credits into present-day dollars and then adds them to the initial capital costs to compare alternatives. Table 6-3 summarizes the present-worth criteria used in the wastewater treatment portion of the Central Kitsap Wastewater GMA Compliance Plan.

Table 6-3. Summary of Present-Worth Criteria	
Item	Planning Criteria
Basis for cost projections	
Year	December 2007
ENR-CCI Index (Seattle)	8618
Amortization Factor (EUAC)	0.1057
Inflation Rates	
Construction	4 percent
Energy	4 percent
O&M	4 percent
Land Appreciation	4 percent
Discount Rate	6 percent
Useful Life (years)	
Land	Permanent
Sewers and Pipelines	50 years
Treatment Plant, Pump Station, or Storage Structures	50 years
Process Equipment	20 years
Transportation Equipment	10 years
Energy Purchase	
Electricity	$0.068/kw-hr
Labor Rate	$40/hr

6.5 Performance Criteria for CKWWTP

Similar performance criteria for the collection and conveyance facilities will be developed and applied to the on-going Wastewater Facilities Plan preparation.

Performance criteria generally relate to the way each alternative achieves objectives of the project and how well each alternative is expected to function. Performance factors include effectiveness, reliability, flexibility, reclamation potential, and public health protection.

6.5.1 Effectiveness

National Pollutant Discharge Elimination System (NPDES) Permit compliance is the primary factor to be evaluated under effectiveness. The relative ease of achieving compliance is a primary consideration; however, the ratio of expected performance to total cost also enters into this part of the evaluation.

6.5.2 Reliability

Assurance of design performance is the overall screening consideration under the reliability criterion. The evaluation will consider relative risk of process or mechanical failures, susceptibility of the alternative to disruption from natural catastrophes, and consequences of functional system failures, regardless of cause.

6.5.3 Flexibility

This criterion is an evaluation of how each alternative adapts to flexible considerations and constraints of existing and future conditions. Flexibility particularly concerns possible future constraints such as revised effluent limits, modified disposal methods, resource scarcities, or technological advancement. Flexibility evaluations should also consider responsiveness to new land use plans, development patterns, and lifestyle changes, such as water and energy conservation.

6.5.4 Reclamation Potential

Each alternative is evaluated in terms of its ability to serve reclaimed water or sludges to industrial, agricultural, forestry, or other potential markets such as parkland development. This evaluation also considers the relative compatibility of effluent and sludge quality produced by each alternative to various uses and the location of potential reuse sites or markets.

6.5.6 Public Health Protection

Each alternative is evaluated in terms of potential public health risks. Water-contact recreation, shellfish harvesting, and sludge- or effluent-disposal/reuse impacts on water quality, soil, or crops are given particular emphasis in the evaluation.

6.6 Environmental Criteria

Environmental criteria for the collection and conveyance facilities will be developed and applied to the on-going Wastewater Facilities Plan preparation. Environmental criteria have been selected from topics generally covered in SEPA checklists and environmental impact assessments dealing with wastewater facilities and pipeline layouts. Seven environmental criteria considered important to the Central Kitsap facility planning effort are identified below.

6.6.1 Air Quality

There is always some odor risk near wastewater treatment facilities. Important factors include number, character, and location of sensitive receptors; climate; and degree of odor control provided. Different treatment processes have different degrees of odor generation potential and hence varied risk of producing measurable odor at the treatment plant boundary.

6.6.2 Water Quality

Water quality can be rated considering pollutant loads and locations, receiving water quality, and sediment quality.

6.6.3 Noise Impact

Noise concerns are associated with both construction and facility operations. Construction will cause noise impacts at treatment sites as well as in areas of sewer construction. Noise from treatment facility operations is generally at low or background levels. Noise from truck traffic associated with facility operations would include chemical delivery and sludge hauling activities.

6.6.4 Traffic

Construction disruption and construction vehicles, operations traffic, sludge trucks, and street closures are the primary traffic-related concerns.

6.6.5 Aesthetics/Visual

Visual impacts are evaluated in terms of impact on the surrounding community. Facilities located in industrial areas have much less visual impact on the surrounding community than those located in a residential community. Architectural and layout mitigating measures are included in the evaluation.

6.6.6 Land Use Compatibility

Plans involving treatment facilities and pipe alignments in or near shorelines, wetlands, residential areas, or parks are considered less compatible with existing land use due to the industrial character of these facilities.

6.6.7 Recreational Uses

Plans that adversely affect park or playfield uses or restrict or disrupt access to shorelines and beaches are rated lower than plans that do not have such impacts.

6.7 Implementation Criteria

Implementation criteria for the collection and conveyance facilities will be developed and applied to the on-going Facilities Plan preparation. The ability to implement a plan or project is the single most important consideration in evaluating alternatives. It is also the factor least susceptible to engineering analysis. Key aspects of implementation include the overall acceptability of the preferred plan to County officials, the public, and governmental agencies. Acceptability by the public can depend on financial impacts on rate payers. Acceptability to governmental agencies will depend on the consistency of the selected plan relative to regulations, individual agency priorities, and availability of essential public services such as power or transportation corridors.

Factors such as constructability and permitting potential, public acceptance, and compliance with regulatory agency requirements are considered in the evaluation of implementability of each Central Kitsap alternative. These criteria may override all others if serious difficulties are discovered that cannot be resolved in the time available for implementing the plan. Implementation criteria selected for evaluation of the Central Kitsap Facility Plan are listed below.

6.7.1 Acceptability

Overall acceptability of an alternative is, in a sense, a measure of political reaction to each proposal. This factor is finally determined by regulatory agency review, actions by elected officials, and potentially public vote at a bond election.

6.7.2 Constructability

Construction considerations include such factors as size and complexity of structures, soil and groundwater constraints, utility interferences, and need to keep existing treatment plants operating during construction periods. Permit issues may also affect constructability, particularly where construction is planned in a shoreline zone.

6.7.3 Financial Impacts on Rate Payers

The impacts of the capital improvement program on user rates were taken into account during the preparation of this Plan. First, the capital improvements needed to support existing and projected growth were identified, costed, and scheduled. The impacts to the rates were estimated through a sewer rate model currently being developed for the entire Kitsap County under a separate contract. Proposed capital improvements were phased, where practical, to keep user rates within the range of other Puget Sound communities, to utilize the existing facilities to their greatest extent possible, and to defer capital improvement costs as far into the future as possible, thereby allowing them to be spread over an increasing customer base, keeping future rates down.

6.8 Summary of Evaluation Criteria

A total of 18 criteria are identified under the four topical groups described in the preceding pages. These are listed in Table 6-4. These criteria are used to describe the positive and negative effects of each conveyance, treatment, and disposal alternative. The application of these criteria is in many cases subjective and in other cases objective. Kitsap County must determine, in any case, which factors are most important, and apply those factors to the developed alternatives.

Table 6-4. CKWWTP Facility Plan Evaluation Criteria

Cost	Performance	Environmental	Implementation
Capital Cost	Effectiveness	Air Quality	Acceptability
Operations and Maintenance cost	Reliability	Water Quality	Constructability
Present Worth	Flexibility	Noise	Financial Impacts
	Reclamation Potential	Traffic	
	Public Health Protection	Aesthetic/Visual	
		Land-Use Compatibility	
		Recreational Uses	

CHAPTER 7

7. CONVEYANCE SYSTEM EVALUATION AND MODELING

This Central Kitsap Wastewater GMA Compliance Plan evaluates the existing conveyance system to identify potential future infrastructure needs for the central Kitsap and Silverdale Urban Growth Areas (UGAs). Conveyance system modeling is utilized to analyze the existing facilities and evaluate their capacity and effectiveness to convey flows generated by the current population. The projected populations and their distributions are the basis for establishing future system requirements.

7.1 Modeling and Analysis Approach

The SewerGEMS hydraulic model by Bentley System, Inc. was selected for use in modeling the Central Kitsap collection and conveyance system. SewerGEMS V8XM is a fully dynamic model designed specifically for modeling urban sanitary and combined sewers systems. The current version is interoperable and may be used stand-alone or interactive with AutoCAD or ArcGIS (ArcMap).

For this plan, modeling using a spreadsheet analysis was conducted to evaluate existing lift stations and sizing of future lift stations and force mains. The SewerGEMS hydraulic model will be developed further to include a more refined analysis of lift stations and the results provided as part of the final Central Kitsap Wastewater Facilities Plan.

Because this Plan is primarily focused on the Southern Service Area, the Northern Service Area conveyance system is not being modeled at this time.

7.2 Model Input Parameters

The SewerGEMS model relies on user generated, as well as, automatically generated parameters to perform a range of calculations for various flow scenarios. System details such as daily flow patterns, peaking factors, and infrastructure characteristics are used by the model in conjunction with wastewater flow information to provide an evaluation of the existing and future system requirements. Automatically generated parameters such as pipe slope, friction losses, and pumping head rely on the user input data along with model-based algorithms.

7.2.1 Daily Flow Pattern

A diurnal curve, based on measured hourly flow rates at Aeration Station No. 1, was developed to represent a typical daily flow rate pattern for the Southern Service Area. The diurnal curve represents the variation in flow over time as a fraction of the average daily flow. The diurnal curve provides a peaking factor to the time component of the analysis.

7.2.2 Existing Facilities

Existing facilities must be modeled and evaluated as a basis for developing future system needs. The existing collection and conveyance system is inventoried; physical properties of the infrastructure are tabulated; sewerage basins are defined; and sewered and unsewered properties are identified and input into the analytic computer model. Once inputted, flows are generated from the sewered parcels and wastewater is "conveyed" throughout the model. Flow patterns and results are calibrated against known flow data and are ultimately applied to future flows.

7.2.2.1 Infrastructure

Kitsap County maintains a database of sewer mapping in graphical information system (GIS) format. The database contains a very complete and comprehensive data set, including elevations of rims and inverts of manholes, manhole and pipe numbering, pipe diameters and materials, and documentation of pipe conditions. Pumping facilities information stored in the database includes details of the lift station wet or dry well, known operational characteristics based on facilities testing, and pump curves and motor controls (constant speed versus variable speed). Conveyance system piping is defined as either force mains or gravity pipes. The database of physical attributes of the existing conveyance facilities was incorporated into the SewerGEMS modeling software to create a base model. The model uses these attributes to determine the appropriate equations, friction factors, headlosses, and pumping capacities under a range of flows to "model" the system and identify its capabilities and limitations.

For the Southern Service Area, the model is divided into two major conveyance system sections that are generally based on the Central Kitsap and Silverdale UGAs. In order to expedite the modeling effort, the two systems were modeled separately for this plan. Flows from the two areas are part of a low pressure system and combine into a single pressure line. This part of the system is evaluated below based on known system hydraulic conditions and will ultimately be evaluated using the SewerGEMS model.

7.2.2.2 Delineation of Existing Lift Station Basins

Delineation of the lift station basins that serve existing pump stations is described in Chapter 4. The drainage basins illustrated on Figures 4-3 to 4-6 were incorporated into the model to define the area that contributes to each lift station.

7.2.2.3 Loading of Existing Flows

One of the key elements in developing a wastewater system model is the method used to tell the model the quantity of flows and the location where they enter the system. This is referred to as "loading" the model. In this case, flow loading was based on parcel-level sewer user data. The County GIS data set, referred to as "Sewer Permits," was utilized to define and distribute flow loading from each sewered parcel to the appropriate node in the model. In this case, a node typically represents a manhole in the conveyance system.

The Sewer Permits dataset identified the number of ERUs (as defined in Section 2.6, "Equivalent Sewered and Unsewered Populations") that were attributed to each parcel both for residential and non-residential users. Prior to loading the model, the data were manually prepared so that the model could make use of the parcel-based data. Each ERU in the dataset was converted to an "equivalent population." Historical wastewater flow data resulted in an average annual flow (AAF) for the Central Kitsap and Silverdale UGAs of 76 gallons of wastewater per capita, per day (gpcd).

Thus, the load for each parcel was calculated in the model by applying the average annual flow of 76 gallons per day (gpd) to each equivalent population assigned to each sewered parcel. The loading from each parcel was distributed to the node representing the manhole physically closest to that parcel within the defined lift station basin.

7.2.2.4 Model Execution for Existing Conditions

The SewerGEMS model is a continuous model that allows flows to be dynamically routed through the system over time. In this case, the model was run to represent a period of 24 hours. The daily flow totals produced by the population are introduced to and routed through the system over a typical 24-hour period using the diurnal curve presented in the previous section.

As commonly seen and anticipated in the modeling process, the first few model runs resulted in a range of errors and incongruities that required investigation and debugging. The Kitsap system, with its hilly terrain, 44 lift stations, pressure piping with manholes, and large-diameter pipes emptying into smaller pipes caused excessive iterations and unresolved calculations for the model as well as extended simulation times. The model was debugged as much a possible and divided into two sections: the Central Kitsap UGA and the Silverdale UGA. This dividing point was a reasonable solution and eliminated (at least for this report) the modeling effort for the transitions from force main to gravity and gravity to low pressure in the interceptors from each UGA to the CKWWTP, as described in Chapter 4. The hydraulic capacities and future capacity requirements for these interceptors, are, nonetheless, addressed at the end of this section. Once the model was divided, successful results for the existing collection and conveyance system were attained.

7.2.2.5 Model Calibration

The existing condition model was calibrated against actual historical data for AAF and average design flow (ADF) per capita. Average values for 5 years were used to compare flows output by the model. The total flow results were within 5 percent of the anticipated results for Central Kitsap and 10 percent for Silverdale. In both cases the model generated flows that were above the average historical flows. Since this difference was considered conservative, the model was not adjusted.

7.2.3 Future Wastewater Conveyance System Facilities

Once the model of the existing infrastructure is completed and calibrated, future conditions are represented conceptually by loading the model with wastewater flows that would be generated by future populations. Once the future flows are generated, the modeler identifies and tabulates the infrastructure requirements to convey the future flows to CKWWTP.

7.2.3.1 Delineation of Potential Future Lift Station Basins

In order to estimate future flow loading on the existing facilities, unsewered land within the Central Kitsap and Silverdale UGAs was divided into sewer sub-basins. These are conceptually illustrated on Figures 7-1 through 7-4. Based on topography, the basins were delineated as either an area that could flow strictly by gravity to an existing lift station (e.g., Basin 7A may be sewered by gravity flow into the LS-7 collection system) or as an area that would require pumping to an existing lift station (e.g., Basin 7.1 represents an area that may be sewered using a pumping modality to deliver flows to the LS-7 system). For basins requiring pumping, a hypothetical lift station was located at a topographical low point of the basin. Again, based on topography as well as the most convenient flow routing, flows from the lift stations were routed either directly to an existing lift station or routed through a second lift station. Future lift stations are not intended to establish site locations of the facilities; rather, they are provided as a mechanism to approximate the future system requirements on a more global level. Locations are identified only as a means for tallying flows at a reasonable location to approximate lift station sizes for the system.

Future basin delineations and future lift station locations may (and will likely) vary from those provided in this conceptual interim planning document. In some basins or areas within basins, alternative conveyance modalities may be more appropriate than traditional pumping stations. The nature of each facility is not evaluated here, but could include grinder pumps and small-diameter conveyance pipe (individual pumps), vacuum systems (good for shorelines), or step systems (combination of septic and conveyance to treatment plant).

7.2.3.2 Loading Future Flows

Flow projections were developed for the future conditions similar to the flow estimates for the existing condition. Parcel-based ERUs were assigned to the unserved and developable parcels within the UGA in accordance with the Kitsap County Department of Community Development (DCD) population allocations and Land Capacity Analysis as described in Chapter 2 of this Central Kitsap Wastewater GMA Compliance Plan. ERUs were converted to equivalent populations and input into the model assigned to their respective parcels. For the future situation, the per capita flows were assigned at a rate of 100 gpcd and the average diurnal curve described previously. This is a commonly used literature reference value for future flow estimates. The model was run at this loading and verified to be generating the anticipated flows within 10 percent.

The SewerGems model was "loaded" with future wastewater flows on the basis of total future populations within each future basin. Because no actual collection facilities exist in future basins, flow loading could not be assigned to local infrastructure (i.e., manholes). Rather, the model's ability to interact with the GIS data allowed it to read the future populations for each respective parcel, aggregate the flows within each "future" basin, and assign the totals to the associated existing or future lift station. The wastewater flows from the future basins were assigned into the existing system at the nearest available entry point (manhole or cleanout).

A critical design parameter for wastewater collection and conveyance infrastructure is the projected peak hour flow. A peaking factor was synthetically generated and incorporated into the diurnal curve, replacing the average daily peak hour with an empirical peak hour flow. For the total plant flow projection (BHC Consultants, 2007 *DRAFT Central Kitsap Wastewater Facilities Plan Flow Projections*, BHC, October 2007), a peaking factor of 3.3 was used to simulate the attenuation of peaks typically seen at downstream locations in large systems (such as the treatment plant). The resulting values provided appropriate guidance for CKWWTP hydraulic capacity. When evaluating conveyance requirements from smaller contributing areas the peaking factors are higher; therefore, in the case of the model run for the planning for conveyance system infrastructure (lift stations, and conveyance piping); a peaking factor of four was used. This is more representative of the higher peaks typically seen from smaller, local contributing areas.

7.3 Model Execution and Analysis Results

The modeling effort and data set described above were developed to determine the infrastructure requirements to provide adequate sewer service to the projected 2025 population within the Central Kitsap and Silverdale UGAs as defined by the County in the 10-year Update to the County's Comprehensive Plan, dated December 2006.

An initial review of existing lift stations is included in Chapter 4, which summarizes the age and hydraulic capacity of each station. This evaluation was expanded in this chapter to include the projected future flows to each station and determine if the existing capacity was adequate for future flows or if expansion of the pump station may be necessary.

When the model was run using the peaking factor of 3.3 and 4.0 to represent peak hour flows to the plant and to the lift stations, respectively, the effects of the future flows on the system could be analyzed. As expected, the influx of new flows could not be handled in the nearest downstream facilities, thus requiring lift station and piping improvements in the model to allow those flows to proceed to the next downstream facility. In the modeling, this phase of the effort is usually an iterative process of designing appropriate future lift stations and associated piping, installing that infrastructure into the model, rerunning, analyzing the results, and responding with additional infrastructure.

In order to expedite this analysis, future flows could be estimated more quickly by returning to the parcel-based population data and sorting it by basin to determine the flow requirements for each one. The results were then summed to approximate the additive effects downstream. This method likely results in conservatively high flows because the model's flow routing results in attenuations that dampen peak flows, whereas the calculated flows did not. With this estimate, the model iterations were bypassed and the model was adjusted by inputting future pipe sizing as well as lift station requirements. These results, a summary of the basin loadings and the estimated future lift station requirements for both existing and future new facilities, are provided in the spreadsheet tabulation in Appendix G (G-1, Lift Station Capacity Requirements Based on Populations).

Figure 7-5 is a schematic diagram that shows the relationship of new and existing lift stations and includes the projected future pumping capacity requirements. Based on the projected flows and pumping requirements for each basin, estimates of conveyance infrastructure requirements for 2025 were developed. Existing facilities were evaluated for revision requirements and future new facilities were also defined. These approaches are explained below and followed up with more detail and cost information in Chapter 8.

7.3.1 Revisions to Existing Facilities to Accommodate 2025 Projected Flows

Capacity requirements to accommodate future flows were then assessed relative to the existing infrastructure to determine which facilities would need to be upgraded or replaced. For existing lift stations and related discharge piping, existing and future requirements are presented in Appendix G (G-2, Evaluation of Future Revisions to Existing Lift Stations and Conveyance Piping). This evaluation also includes the horsepower requirements for each facility. Horsepower and force main sizes were determined using the flows and a calculated total dynamic head (TDH). The TDH is a summation of the known static head (the elevation difference between the lift station and its discharge to a wet well or manhole) and the friction losses in the system. Since a range of conveyance modalities could actually be used in the future, flows and horsepower requirements were selected as a general means for cost estimation because they offer a means of comparison with other conveyance system approaches.

Replacement force mains and gravity sewers are shown on Plate 1, Central Kitsap UGA Conceptual Plan for Wastewater Conveyance, and Plate 2, Silverdale UGA Conceptual Plan for Wastewater Conveyance, which are provided in map pockets at the end of this Central Kitsap Wastewater GMA Compliance Plan.

7.3.2 Future New Conveyance Facilities to Accommodate 2025 Projected Flows

Future new conveyance facilities were sized according to the 2025 flow requirements in Table G-1 and the calculated TDH for each facility. Using the variables, force main sizes and lift station horsepowers were determined. The evaluations for each UGA are provided in Appendix G (Table G-3, Silverdale New Lift Stations and Force Main Projects, and Table G-4, Central Kitsap New Lift Stations and Force Main Projects).

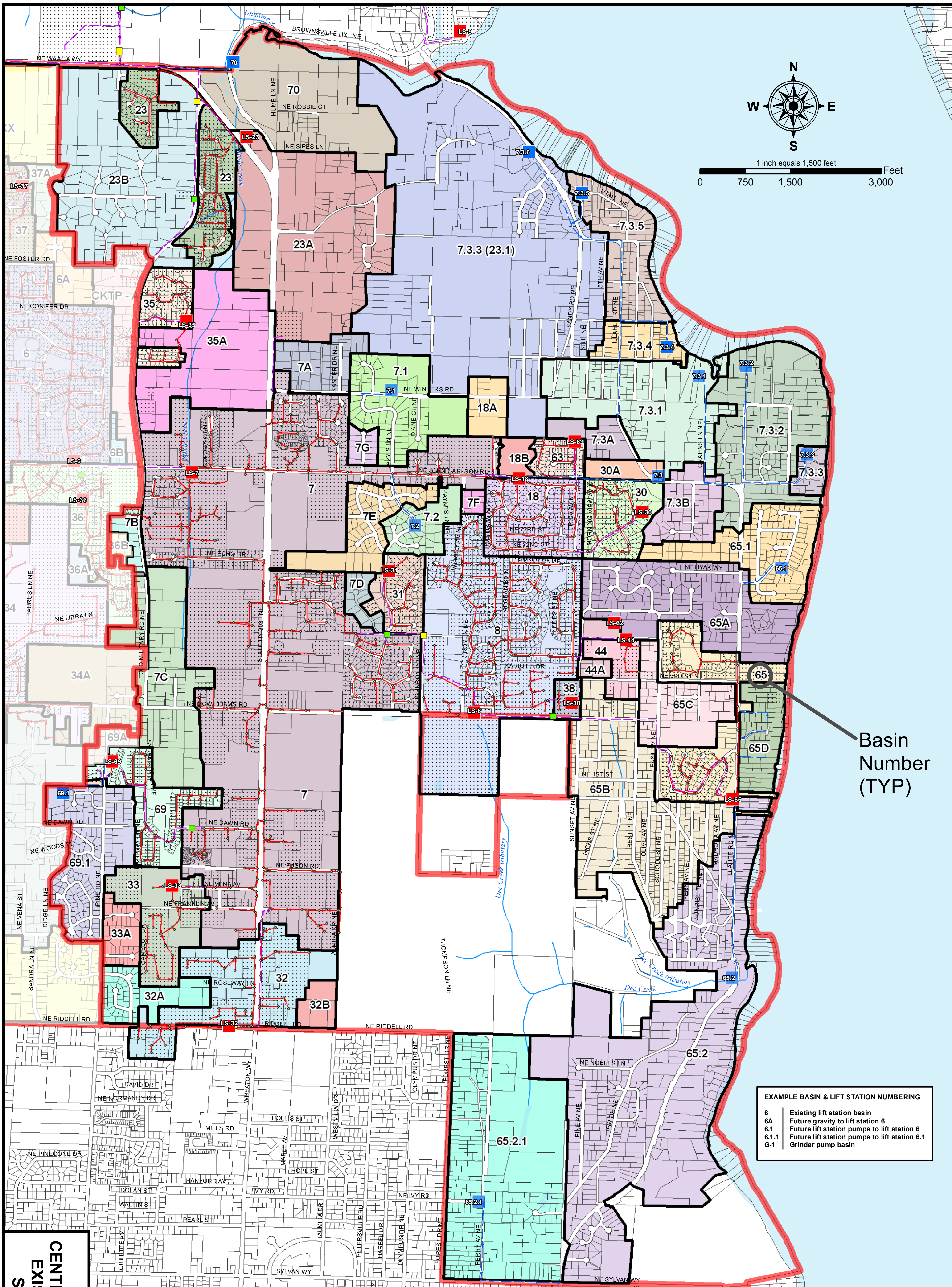

FIGURE 7-1
CENTRAL KITSAP - EAST EXISTING & FUTURE SEWER BASINS

LEGEND

- Treatment Plant
- Lift Stations
- Air Vac
- Gate Valve
- Manhole
- Forcemain
- Gravity
- Outfall
- Permits - Sept 2007
- Future Lift Station
- Future Manhole
- Future Force Main
- Silverdale UGA
- Central Kitsap UGA
- Parcels - All Kitsap Co June 07
- Water Bodies
- Rivers & Streams

Data sources supplied by Kitsap County 2007, and may not reflect actual or current conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

MAP DATE: JANUARY 2007

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KITSAP COUNTY PUBLIC WORKS

CENTRAL KITSAP WASTEWATER GMA COMPLIANCE PLAN

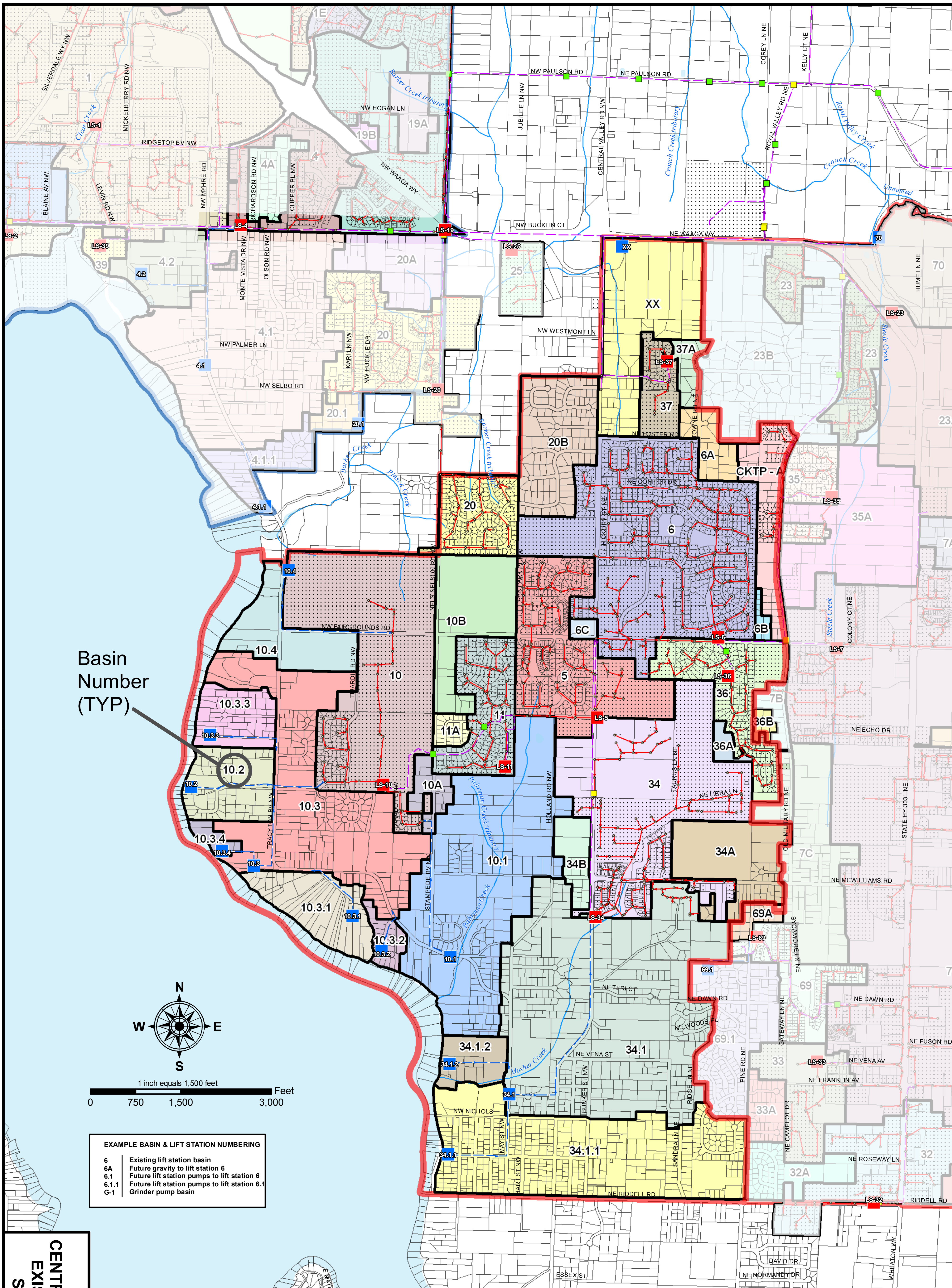

FIGURE 7-2
CENTRAL KITSAP - WEST EXISTING & FUTURE SEWER BASINS

LEGEND

- Treatment Plant
- Lift Stations
- Air Vac
- Gate Valve
- Manhole
- Forcemain
- Gravity
- Outfall
- Permits - Sept 2007
- Future Lift Station
- Future Manhole
- Future Force Main
- Silverdale UGA
- Central Kitsap UGA
- Parcels - All Kitsap Co June 07
- Water Bodies
- Rivers & Streams

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KITSAP COUNTY PUBLIC WORKS

CENTRAL KITSAP WASTEWATER GMA COMPLIANCE PLAN

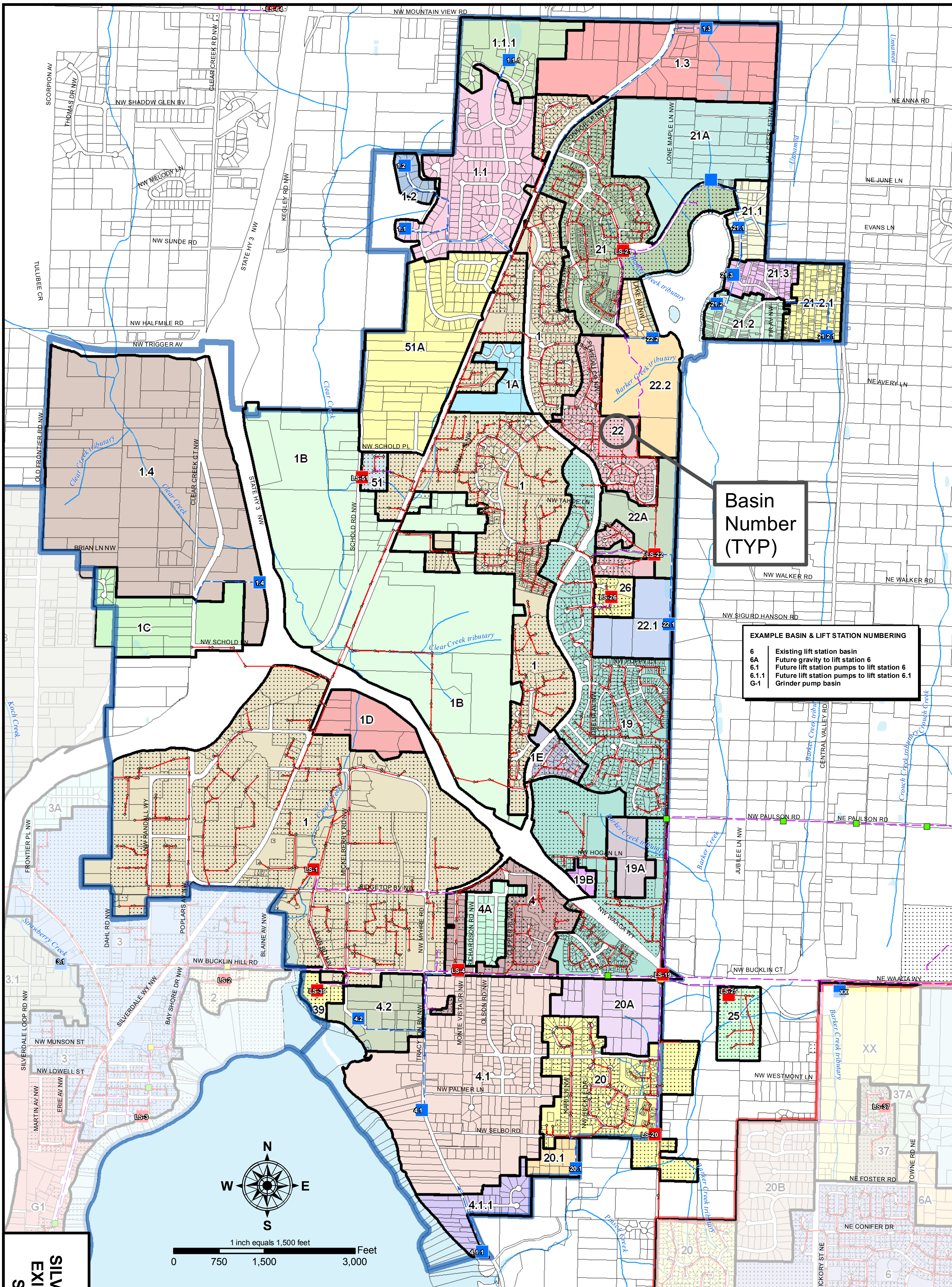

FIGURE 7-3
SILVERDALE - NORTH EXISTING & FUTURE SEWER BASINS

LEGEND

- Treatment Plant
- Lift Stations
- Air Vac
- Gate Valve
- Manhole
- Forcemain
- Gravity
- Outfall
- Permits - Sept 2007
- Future Lift Station
- Future Manhole
- Future Force Main
- Silverdale UGA
- Central Kitsap UGA
- Parcels - All Kitsap Co June 07
- Water Bodies
- Rivers & Streams

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MAP DATE: JANUARY 2007

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KITSAP COUNTY PUBLIC WORKS

CENTRAL KITSAP WASTEWATER GMA COMPLIANCE PLAN

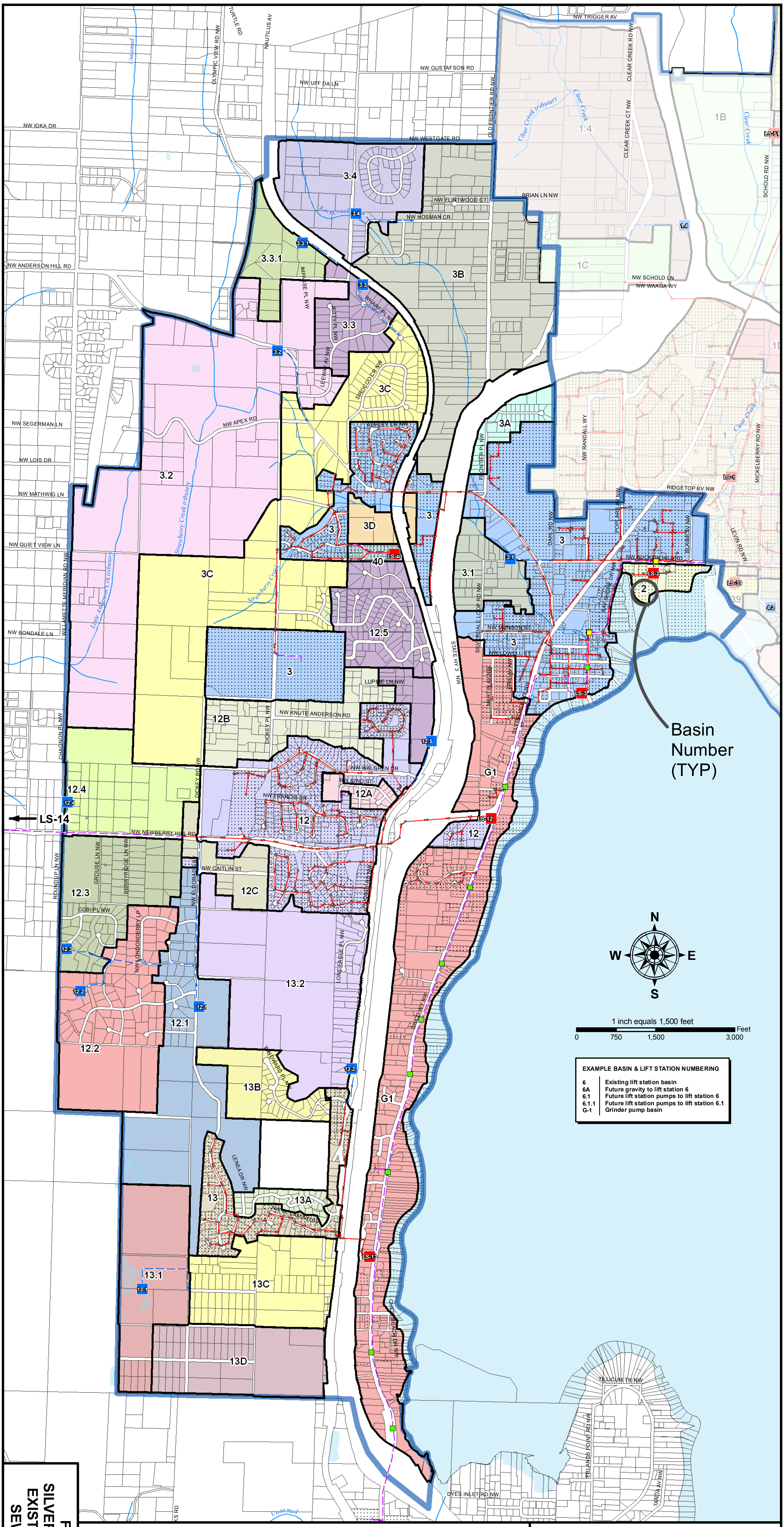

FIGURE 7-4
SILVERDALE - SOUTH EXISTING & FUTURE SEWER BASINS

LEGEND

Treatment Plant	Forcemain	Future Lift Station	Silverdale UGA
Lift Stations	Gravity	Future Manhole	Central Kitsap UGA
Air Vac	Outfall	Future Force Main	Parcels - All Kitsap Co June 07
Gate Valve			Water Bodies
Manhole			Rivers & Streams

Data sources supplied by Kitsap County 2007, and may not reflect actual or current conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

MAP DATE: JANUARY 2007

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KITSAP COUNTY PUBLIC WORKS

CENTRAL KITSAP WASTEWATER GMA COMPLIANCE PLAN

FILE NAME (UPDATED BY)	PLOT DATE & TIME
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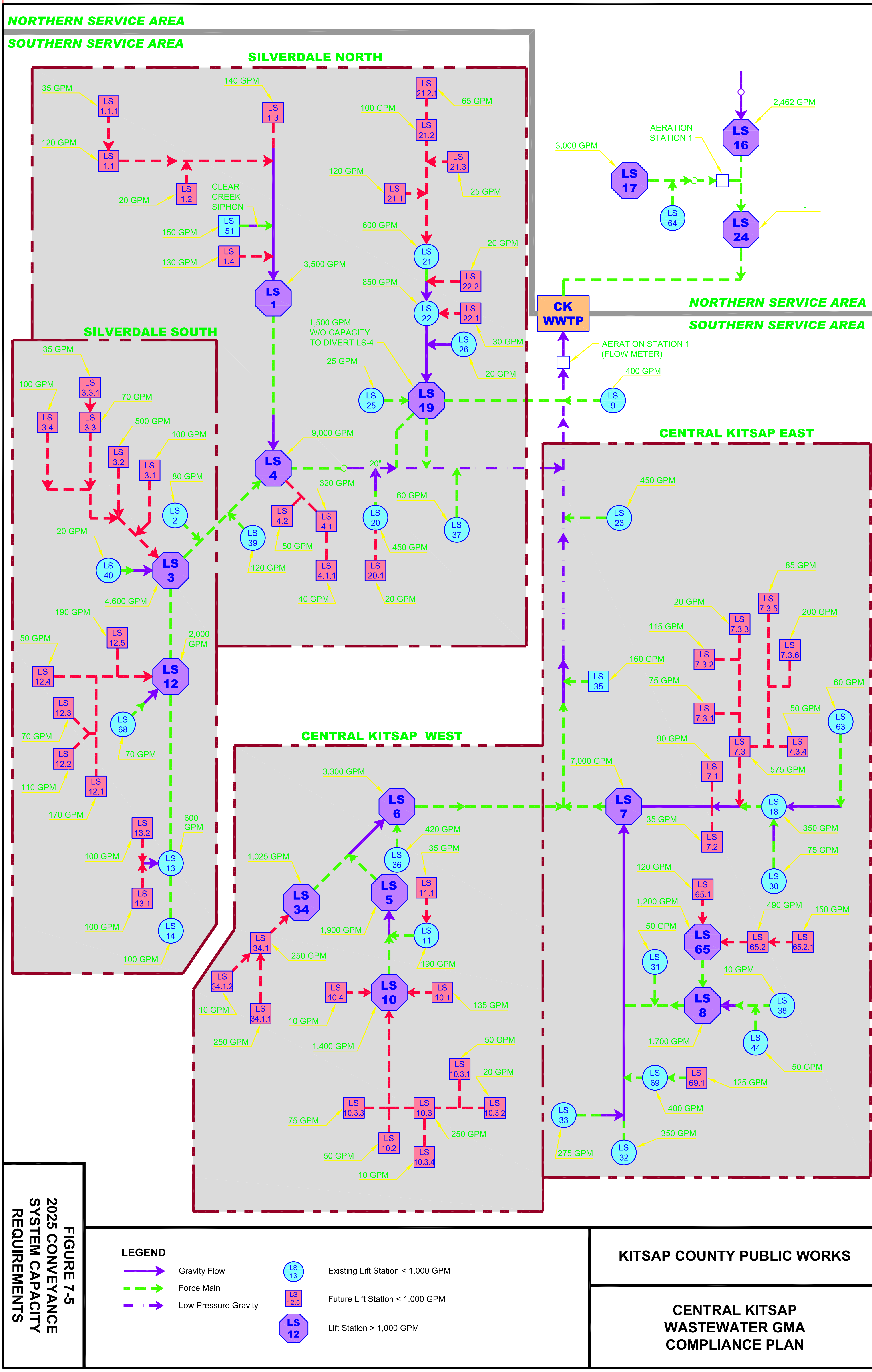


FIGURE 7-5
2025 CONVEYANCE SYSTEM CAPACITY REQUIREMENTS

KITSAP COUNTY PUBLIC WORKS

CENTRAL KITSAP WASTEWATER GMA COMPLIANCE PLAN

7.4 Silverdale and Central Kitsap Low Pressure Gravity Interceptors to CKWWTP

As described in Chapter 4, wastewater flows from Central Kitsap and Silverdale are delivered to the CKWWTP by means of a system of low pressure gravity lines. The lines clearly do not have adequate capacity to convey the projected flows from their respective areas and, therefore must be considered in this Plan.

The 1994 Facility Plan included an analysis of the existing capacity of the interceptors that deliver wastewater from Central Kitsap and from Silverdale to the CKWWTP. Excerpts of the analysis are provided below followed by discussion of the future capacity requirements:

> "…wastewater flows generated in the southern service area makes its final approach to the CKWWTP by gravity through a system of low-pressure lines. These lines essentially make up a system of branching single-barrel inverted siphons. The system of low-pressure lines flow through a topographic "bowl" roughly defined by high points in Old Military Road (Central Kitsap Interceptor from LS-6 and LS 7), in Bucklin Hill Road (Silverdale Interceptor from LS-4 that picks up LS 19), and near the CKWWTP headworks. The low point of the bowl is located near the intersection of Old Military Road and Wagga Way in the vicinity of Steele Creek. The energy available to drive flows to the CKWWTP through the siphons is entirely determined by the high points of the bowl."

Water surface elevations at the gravity breaks in the interceptors determine the head available to drive Southern Service Area flows to the treatment plant. Since the flows from the two areas combine in a low pressure system, the hydraulics interact, making the available capacity of one line dependent upon the flows from the other and vice versa. If no flow is coming from Central Kitsap in the 16-inch-diameter line, the available capacity (per 1994 Plan) for Silverdale in the 20-inch-diameter line would be 6.5 million gallons per day (mgd). Conversely, if Silverdale flows ceased, the capacity of the 16-inch-interceptor for Central Kitsap would be 4.5 mgd.

> "… in the existing system, flow is conveyed through both the 16-inch force main and the 20-inch force mains. Therefore, the capacity of these pipelines and all tributary force mains are interdependent.
>
> "…The total maximum possible capacity of the line entering the CKWWTP from the south is 9 mgd. This maximum occurs when flow through the 16-inch line from Old Military Road equals approximately 3.4 mgd and flow through the 20-inch line from Bucklin Hill Road equals approximately 5.6 mgd."

Based on BHC's Flow Technical Memorandum (BHC, 2006), 2025 peak hour flows from each of these areas exceeds 12 mgd. The existing conveyance system from the air break on the Silverdale 20-inch line (downstream of Lift Station 4 near the top of Bucklin Hill) and from the air break on the Central Kitsap 16-inch-diameter line to the plant cannot handle the projected flows and will require a detailed modeling effort and alternatives analysis to determine the most appropriate course of action.

7.5 Lift Station 19 Alternative Flow Routing

It should be noted that, while this analysis provides an evaluation of the future system requirements, in the case of the alternative flow routing from Lift Station 19 to the CKWWTP influent interceptor, the required improvements exclude modifications that would allow this routing option to continue. Flows from Lift Station 19 normally pump into the 20-inch-diameter line from Lift Station 4 on Bucklin Hill Road. However, an alternative flow routing option is currently available to operators. A flow-splitter valve can divert flow from Lift Station 4 into Lift Station 19 through an alternative 14-inch-diameter line. In this case, flows from the entire Silverdale UGA may be pumped by Lift Station 19 through the alternative 14-inch-diameter force main to an intersection point on the Southern Service Area force main, just south of Aeration Station No. 1. In order for this alternative to remain plausible, Lift Station 19 (3,264 gpm existing capacity with a 1,500 gpm future requirement) would need to be upgraded to increase its capacity to carry future flows of 9,000 gpm from Lift Station 4. While not included in future upgrades at this time, the alternate 14-inch-diameter conveyance line may be considered useful as it is part of the low pressure gravity system that delivers Southern Service Area flows to the CKWWTP.

7.6 Conceptual Plan for Gravity Collectors

During the course of the 20-year planning period it is likely that many resources will be utilized to develop improvements or additions to the existing collection and conveyance infrastructure. The layouts for collection system piping will vary depending on the timing and the available resources for construction. This interim plan provides a snapshot of the general conceptual locations of future gravity collector piping for the future sewer basins for the purposes of evaluation of potential future infrastructure requirements.

The conceptual plan for gravity sewers was prepared based on topography and the basin delineations and future lift stations identified herein. Plate 1, Central Kitsap UGA Interim Facility Plan Conceptual Plan for Wastewater Conveyance, and Plate 2, Silverdale UGA Interim Facility Plan Conceptual Plan for Wastewater Conveyance, are provided in map pockets at the end of this GMA Compliance Plan. The maps show general locations and flow directions for collectors in the future sewer basins. It is anticipated that the piping shown will range in size from 8 to 12 inches in diameter. The length of the gravity collectors shown in each basin is tabulated in Appendix G (Table G-5, Silverdale Conceptual Gravity Collectors, and Table G-6, Central Kitsap Conceptual Gravity Collectors).

CHAPTER 8

8. FUTURE CONVEYANCE SYSTEMS

Future conveyance system improvements have been identified for existing facilities based on their ability to convey future projected peak flows and for new facilities to serve growth within the Silverdale Urban Growth Area (UGA) and Central Kitsap UGA. These facilities include lift stations, force mains, and gravity sewers for each UGA as presented in the following sections. The improvements described in this chapter have been developed based on preliminary modeling evaluations and other considerations. Thus, the recommended improvements have been developed to a planning level of detail, which is sufficient to generally define the major hydraulic characteristics of the improvements and to prepare planning level project costs. Appendix G, Table G-7 (Silverdale) and Table G-8 (Central Kitsap) provide cost information for replacements of existing lift stations and, where necessary, their associated force mains. Similarly, Appendix G, Table G-9 (Silverdale) and Table G-10 (Central Kitsap) provide cost information for replacements of existing gravity sewers as identified in the system model.

It is important to note that many of the lift stations in the conveyance system were constructed in the 1970s and 1980s. Many lift stations that were determined to have adequate capacity for future flows will likely require significant equipment replacement and modernization due to their age. These improvements have not been identified in this analysis, but should be quantified and funded as part of the capital improvements program.

It must be recognized that there may be alternative sets of improvements that may achieve the same level of service more effectively and with potentially fewer impacts. Other alternatives will be investigated in more detail during continuing planning efforts and the design development phase for the recommended improvements. Other related investigations will also be undertaken during the subsequent evaluations, including potential environmental impact and mitigation measures, land acquisition, and rights-of-way requirements. These more detailed considerations may result in substantial changes to the recommended improvements. Nevertheless, the improvements described in this chapter will result in a system that is capable of providing sewer services for the planning period through 2025 and provides a basis to estimate future project costs.

8.1 Existing Conveyance System Improvements

As described in Chapter 4, the existing Central Kitsap County sewer system consists of 44 lift stations, over 12 miles of force mains, and 103 miles of gravity sewers. Much of the existing system is adequately sized hydraulically for future flows. However, based on the modeling investigation and other analysis methodologies, sewer system hydraulic conveyance deficiencies were identified for the existing system as well as the needs for future conveyance systems to serve future growth. The following sections describe required improvements needed to correct the deficiencies of the existing sewer system and to serve future growth within the UGAs. An evaluation of all existing lift stations is presented in Appendix G, Table G-1.

8.1.1 Silverdale UGA

Six existing lift stations were determined to have inadequate hydraulic capacity to convey future projected flows and are listed in Table 8-1. The associated lift station and discharge piping analysis is provided in Appendix G, Table G-2. Lift Stations 3 and 4 will convey large flows in the future and become major pumping facilities with pumping requirements exceeding 350 horsepower. The three other pump stations will be much smaller, with pump sizes of 25 horsepower or less.

Table 8-1. Existing Lift Stations in Silverdale UGA Requiring Capacity Extension				
Lift station number	Future capacity (gpm)	Future hp	Discharge piping (in.)	
			Force main	Gravity sewer
3	4100	350	18	-
4	8000	360	27/30	-
12	2000	25	15	-
13	600	10	10	-
21	600	25	10	12
22	850	50	10	8

Lift Station 3: The improvements for LS-3 are required due to a pumping capacity increase from the current 1,800 gallons per minute (gpm) to a future design flow of 4,100 gpm. The existing 7,300 feet of 14-inch-diameter force main must be replaced with 18-inch force main.

Lift Station 4: The improvements for LS-4 are required due to increased pumping requirements from 2,865 to 8,000 gpm. The pump station discharges to a 14-inch-diameter force main that then discharges to a 20-inch-diameter force main. The existing 1,575 feet of 14-inch-diameter force main must be replaced with 27-inch-diameter force main and the 1,800 feet of 20-inch-diameter force main must be replaced with 30-inch-diameter force main

Lift Station 12: The improvements for LS-12 are required due to increased pumping requirements from 250 to 2,000 gpm. The pump station currently discharges to 1,900 feet of 12-inch-diameter force main that must be replaced with 15-inch-diameter pipe.

Lift Station 13: LS-13 pumping requirements are projected to be 600 gpm relative to the design capacity of 400 gpm. The existing 1,600 feet of 8-inch-diameter force main must be replaced with 10-inch-diameter force main.

Lift Station 21: LS-21 pumping requirements are projected to be 600 gpm relative to the existing design capacity of 240 gpm. The existing discharge piping of 2,650 feet of 8-inch-diameter force main must be replaced with 10-inch-diameter pipe followed by 550 feet of 8-inch-diameter gravity line replaced with 12-inch-diameter pipe.

Lift Station 22: Projected flows are 850 gpm compared to the current design capacity of 380 gpm. The existing discharge piping may provide adequate capacity to convey future flows.

Projects involving upgrades to existing gravity sewers in the Silverdale UGA are listed in Table 8-2. These eight projects amount to about 7,100 feet of gravity sewer, most of which is 8-inch diameter. The largest projects serve the Anderson Hill area. Gravity replacements identified in the model are detailed in Appendix G, Table G-9.

Table 8-2. Summary of Gravity Sewer Projects in Silverdale UGA

Project	Location	Description	Length (ft)	Diameter (in.)
1	Anderson Hill Rd	Provost Rd to Silverdale Loop Rd	2,700	8
2	Silverdale Way NW	NW Anderson Hill Rd to McConnell Ave NW	1,200	8
3	Washington Way NW	Bayshore Dr. to Alley south of Byron	1,000	8
4	LS2 Influent Line	Bucklin Hill Rd to LS2	250	8
5	Silverdale Way NW	400 Ft south of NW Misty Ridge Ln. to Clear Creek	700	8
6	Silverdale Way NW	LS-51 FM to NW Misty Ridge Ln	550 250	8 10
7	Provost Rd NW	60 ft north of NW Bernard St to 180 ft south of NW Bernard St.	300	8
8	NW Newberry Rd	Provost Rd to Hwy 3	200	8

8.1.2 Central Kitsap UGA

Ten existing lift stations must be expanded to convey future flows projected for the Central Kitsap UGA (Table 8-3). The associated analysis is provided in Appendix G, Table G-2. Lift Stations 6 and 7 will continue to be the largest and major pumping facilities serving the area, with future capacities exceeding 3,200 and 7,000 gpm, respectively, and horsepower requirements exceeding 100 HP. LS-5, LS-8, LS 10, and LS-65 will also become major pumping facilities. The remaining four existing lift stations are smaller, with pumping requirements of 500 gpm and 25 HP or less.

Table 8-3. Existing Lift Stations in Central Kitsap UGA Requiring Capacity Expansion

Lift Station Number	Future Capacity (gpm)	Future HP	Discharge Piping (in.) Force Main
5	1900	100	12
6	3200	115	18
7	7000	400	24
8	1700	40	15
10	1400	75	12
32	350	10	-
33	275	10	-
36	420	20	-
65	1200	175	12
69	400	25	8

Lift Station 5: LS-5 improvements are due to the projected capacity of 1,900 gpm relative to existing design capacity of 530 gpm. The discharge piping consists of 1,800 feet of 8-inch-diameter force main that must be replaced with 12-inch-diameter pipe. (Alternatively, LS-34 may be considered to carry this flow; however, the cost by horsepower approach is intended to provide planning level costs that are somewhat independent of the routing.)

Lift Station 6: LS-6 has a current design capacity of 1,200 gpm, which is inadequate for the projected future flows of 3,200 gpm. In addition to the lift station expansion, the existing 3,275 feet of 10-inch-diameter force main that connects with the discharge piping from LS-7 must be replaced with 18-inch-diameter force main.

Lift Station 7: LS-7 flows are projected to be 7,000 gpm in the future relative to the recently upgraded pumping capacity of 4,200 gpm. The 850 feet of 14-inch-diameter force main from LS-7 to the connection with the force main from LS-6 must be replaced with 24-inch-diameter pipe.

Lift Station 8: Projected flows for LS-8 are 1,700 gpm relative to the existing design capacity of 300 gpm. The 3,000 feet of 8-inch-diameter force main from the lift station must be replaced with 15-inch-diameter pipe. The existing force main discharges to 1,400 feet of 8-inch-diameter gravity sewer, which will be at 112 percent of design capacity and is considered adequate.

Lift Station 10: Flows for LS-10 are projected to increase from the 270 gpm existing capacity to 1,400 gpm in the future. This station serves the Kitsap County Fairgrounds and includes a future flow estimate of 600 gpm for the facility. The existing discharge piping consists of 3,000 feet of 6-inch-diameter force main followed by 1,150 feet of 10-inch-diameter gravity line. The force main must be replaced with 12-inch-diameter pipe; the existing gravity line has adequate capacity.

Lift Station 32: Projected flows for LS-32 are 350 gpm relative to the existing design capacity of 165 gpm. The existing discharge piping appears to be adequate for future flows, so the improvements may only consist of new pumping equipment and related piping at the lift station.

Lift Station 33: LS-33 flows are also projected to increase significantly to 275 gpm relative to the current design capacity of 90 gpm. The existing 8-inch-diameter force main appears to be adequate for future flows.

Lift Station 36: Future flows for LS-36 are projected to increase to 420 gpm relative to the existing design capacity of 150 gpm. The existing 4-inch-diameter force main may be adequate for the future flows, so the lift station improvements would consist of new pumping equipment and related piping at the lift station.

Lift Station 65: LS-65 will become a major lift station in the service area. Future flows are projected to be 1,200 gpm compared to the existing design capacity of 300 gpm. In addition to the lift station expansion required, the existing 5,950 feet of 8-inch-diameter force main must be replaced with 12-inch-diameter pipe.

Lift Station 69: Improvements to LS-69 are required due to the projected future flows of 400 gpm relative to the existing design capacity of 160 gpm. The existing discharge piping consists of 2,700 feet of 6-inch-diameter force main, which must be replaced with 8-inch-diameter pipe, and 1,100 feet of 8-inch-diameter gravity sewer, which has adequate capacity.

Four improvement projects for existing gravity sewers in the Central Kitsap UGA were identified as a result of the modeling investigations and are summarized in Table 8-4. A total of about 2 miles of gravity sewers must be replaced with larger sewers to convey projected future flows. The largest projects involve replacement of about 1.3 miles of sewers along Fairgrounds Road upstream of LS-6 and LS-7. Gravity replacements identified in the model are detailed in Appendix G, Table G-10.

Table 8-4. Summary of Existing Gravity Sewer Upgrades Required in CK UGA

Project	Location	Length (ft)	Existing Diameter (in.)	Required Diameter (in.)
1	East of LS-7 along Fairgrounds Road	4,800	8	12
2	South of LS-7	3,200	12 and 15	18
3	West of LS-6 along Fairgrounds Road	2,100	8 and 10	12 and 18
4	East of LS-33	900	8	12

8.1.3 Interceptors to the Wastewater Treatment Plant

Low pressure interceptors from Silverdale and Central Kitsap to the plant are described in Chapter 4 along with discussions of other existing facilities. Their current and future required hydraulic capacities were reviewed in Chapter 7. Given the system limitations and anticipated future needs, the associated infrastructure requirements will be significant. In the 1994/1999 Facility Plan, the recommended solution was to locate a new lift station near a low point in the system at Wagga Way. The lift station requirements were based on future flows of 25 million gallons per day (mgd) from Central Kitsap and Silverdale. Today's estimated peak hour flows are relatively comparable at 12.4 mgd for Central Kitsap and 12.1 mgd for Silverdale (BHC, 2006)

Alternatively, the County may prefer to consider a parallel construction of an additional conveyance along the route of the 24- and 30-inch-diameter downstream portion, thus allowing for the flows from Central Kitsap and Silverdale to be conveyed separately. Upstream portions of the low pressure lines would also need to be upsized considerably.

The preliminary design level of analyses that is appropriate to evaluate the alternatives is beyond the scope of this planning effort; however, a placeholder for estimated cost for the improvements of $5 million has been included. Alternatives will be analyzed in more detail during continuing planning efforts.

8.2 Future Collectors and Conveyance Systems

Future new collection and conveyance systems to serve growth in the Silverdale and Central Kitsap UGAs will consist of local gravity collector sewers discharging to local lift stations that will connect to the existing Kitsap County sewer system. Over 50 new lift stations will be required to serve future growth in the planning area as shown schematically in Figure 7-5 and summarized in Table 8-5. As a result, the number of lift stations in the Kitsap County sewer system will more than double in the future relative to the existing system. The relationship of future lift stations with the existing sewer system are illustrated in Figures 7-1 through 7-4. Analysis and details on each of the new lift stations and force mains are provided in the Appendix G, Tables G-3 and G-4. Future new gravity collectors are listed by basin in Appendix G, Tables G-4 and G-5.

Table 8-5. Summary of Future New Collectors, Lift Stations and Force Mains Required

UGA	Gravity Collectors (miles)	Number of New Stations	Range in Capacity (gpm)	Range in Pump Size (HP)	Total FM Length (Miles)
Silverdale	33	28	20-500	1-12	7.2
Central Kitsap	19	24	20-575	1-55	11.3

8.2.1 Silverdale UGA

The new lift stations required to provide sewer service in the Silverdale UGA are located throughout the area west and northwest of the Silverdale commercial core. The lift stations are in a small range, with design flow capacities generally less than or equal to 500 gpm and pump sizes generally less than 30 HP. The largest new lift stations are LS-3.2, LS-4.1, and LS-12.5, which will serve areas northwest of Anderson Hill, north of Barker Creek abutting Dyes Inlet, and Chico, respectively. LS-3.2 will serve roughly 450 acres and require upgrades to LS-3. LS-12.5 is sized to accommodate grinder pump contributions along the western shoreline of Dyes Inlet. All of the new force mains from the lift stations are 6 inches or less in diameter, with the exception of LS-1.3 and LS-4.1.

Other new gravity sewers in the Silverdale UGA will consist of local collector sewers to convey wastewater from developed areas to the existing (and upgraded) system or to the new lift stations.

8.2.2 Central Kitsap UGA

The new lift stations required in the Central Kitsap UGA will be located throughout the service area. As in the Silverdale UGA, the new lift stations in the Central Kitsap UGA will be in a small to medium-sized range with design flow capacities less than 600 gpm and pump sizes of 55 HP or less. The largest new lift stations are LS-7.3, LS-65.2, and LS-10.3. Lift Station 7.3 will act as a booster station, receiving flows from as many as six smaller coastal stations in the north east section of Central Kitsap. LS-65.2 will serve areas north and south of Illahee. LS-10.3 is sized to serve a large unsewered basin east of Central Valley Road to Dyes Inlet. The new force mains from the lift stations are 6 inches or less in diameter, with the exception of LS-7.3.

New gravity sewers in the Central Kitsap UGA will consist of local sewers delivering flows from gravity basins to their associated existing lift stations, gravity collectors within basins, and the improvements to the existing gravity sewers described above.

8.3 Estimated Project Costs

Planning level project costs have been developed for the improvements based on the estimated hydraulic capacity requirements of the facilities and generalized cost factors. It must be recognized that the estimated costs have a high range associated with them due to the conceptual level of analysis completed to identify the hydraulic requirements and to other related factors that are difficult to evaluate at the project planning level. Consequently, actual project costs may range from 50 percent less to 100 percent more than the costs presented in this section.

The following generalized cost factors were used to estimate project costs:

- Lift station costs are estimated using $20,000 per horsepower for lift stations having pumping capacity less than 200 HP and $10,000 for lift stations with pumping capacity greater than 200 HP. These factors are average construction cost determined for several new lift station projects designed or constructed in the past few years. The new lift stations consisted of pumps and piping, emergency power, SCADA, and buildings.
- Force main construction costs are estimated using $12.00 per inch diameter-length in feet. This factor is based on a mean cost used by King County for open-cut force main base construction costs in 2001. The King County factor was based on an ENR Seattle Construction Cost Index of 7,000 which was updated to 8,618 for this planning effort. This cost factor should be increased for extraordinary project conditions such as extensive dewatering, multiple conflicts with utilities, extensive unsuitable soils, and major environmental mitigation requirements.
- Gravity sewer replacement construction costs are estimated using $15.00 per inch diameter-length in feet. This factor is also an update to ENR Seattle CCI of 8,618 of a King County cost factor for open-cut gravity sewer construction used in 2001. The factor should be increased for extraordinary project conditions as discussed for the force main cost factor.
- The conceptual plan for the future new gravity collector piping is useful for estimating the general locations and lengths of collector sewers. The sizes will range between 8 and 12 inches in diameter and are estimated to cost roughly $200 per foot.
- Project costs are estimated by increasing the estimated construction costs by 50 percent. This increase is intended to cover a nominal construction cost contingency and other typical project-related costs such as

project administration, engineering, and construction management. Project costs for items as extraordinary site dewatering, special construction methods, land acquisition, rights-of-way, environmental investigations, and resulting mitigation measures are excluded in this factor. These additional costs can be substantial and would be added to the project costs when the specific project requirements are identified in more detail during the design development phase.

The estimated project cost for collection and conveyance system improvement costs to serve the Silverdale and Central Kitsap UGAs is $130 million (Table 8-6). As discussed above, there is a high degree of uncertainty with these planning level costs. It may appropriate to increase these costs to $175 million, in today's dollars to provide some contingency for these uncertainties. As the requirements for the conveyance systems become better defined through continuing planning efforts and the design process, the project cost estimates will improve and the contingency can be reduced.

Table 8-6. Estimated Project Costs for Future Collection and Conveyance Systems ($mil)

	Existing System Replacements			Future Conveyance System		Total
UGA	Lift station and discharge pipe	Gravity sewer	Siphon	Lift stations and force main	Gravity sewer	
Silverdale	20.0	1.5		5.5	35	62
Central Kitsap	28.0	4.0	5.0	11.0	20	68
Total	48.0	5.5	5.0	16.5	55	130

Roughly 45 percent of the cost is due to the expansion and upgrade of existing lift stations and force mains to convey future wastewater flows projected for the two UGAs. About 55 percent of the cost is for new conveyance facilities extending beyond the current Kitsap County sewer system. The total costs for all conveyance system improvements for facilities within the Central Kitsap UGA are slightly more that the costs for improvements in the Silverdale UGA, with the split being 52 and 48 percent, respectively.

As stated at the beginning of this chapter, the existing sewer system has been in service since the 1970s. While several lift stations were identified as needing expansion in this evaluation, most of the remaining existing lift stations are nearing the end of their service life and will likely require significant equipment replacement and modernization during the planning period. The cost of these improvements has not been identified in this report, but will be quantified in continuing planning efforts for future funding.

CHAPTER 9

9. DEVELOPMENT OF TREATMENT PLANT ALTERNATIVES

9.1 Introduction

This chapter summarizes the flows and loadings used as the basis of design, and reviews alternatives for liquid and solid stream processes for wastewater treatment. Where reasonable choices exist for the treatment plant expansion, they are identified as process alternatives.

Process alternatives are identified for the headworks, primary clarifiers, biological treatment facilities, secondary clarifiers, septage handling facilities, sludge thickening, and sludge digestion. A brief description is provided of each of the alternative processes, and how each would affect the existing plant operations. Planning level cost estimates for each of the alternatives are presented to establish an economic basis of comparison.

The alternatives are also evaluated for performance, reliability, ease of operations, flexibility for future needs, ability to handle storm flows, plant site layout, and environmental impacts such as odor, noise, and traffic. From the results of alternatives evaluation, alternatives are selected for further development during predesign. The selected alternatives and other facilities necessary to meet the design flows are incorporated into the recommended facilities discussed in Chapter 10.

9.2 Basis of Design

In evaluating the wastewater treatment processes, the selection and sizing of alternative facilities were based upon common flow and loading characteristics. In Chapter 3, the existing values are established, and future values then estimated for different time periods.

A 20-year design period for wastewater treatment plant expansions is typical in that it provides service for the flows anticipated to occur within a 20-year bond repayment period. The 20-year design was based upon flows projected for the year 2025. However, the saturation-level flows and loadings were also considered to provide an overview of the land that should be reserved for facilities that will be required at a more distant point in time.

Table 9-1 presents the projected 2025 flows and loadings to be used as the basis of comparison in this report.

Table 9-1. Basis of Design for Future CKWWTP Facilities

Parameter	Values
Raw Influent:	
Average Annual Flow (AAF), mgd	8.5
Average Dry Weather Flow (ADWF), mgd	7.7
Average Peak Month Flow (ADF), mgd	10.6
Maximum Day Flow (MDF), mgd	17.2
Peak Design (Hour) Flow (PDF), mgd	29.3
Annual Average TSS, ppd	17,000

Table 9-1. Basis of Design for Future CKWWTP Facilities	
Parameter	Values
Average Peak Month TSS, ppd	20,600
Peak Day TSS, ppd	29,000
Annual Average BOD, ppd	19,900
Average Peak Month BOD, ppd	22,500
Peak Day BOD, ppd	26,600
Potential Effluent Concentration Limits (monthly average):	
CBOD5 (mg/L)	25
TSS (mg/L)	30
NH3-N (mg/L)	1

Also listed in Table 9-1 are the potential future effluent concentration limits. Currently, the plant does not have any ammonia limits. However, as mentioned in Chapter 5, in order to comply with the total maximum daily load (TMDL) requirements, an effluent ammonia limit may be added in the future. For the purpose of the alternative evaluation, it was assumed that the 2025 plant will need to fully nitrify year-round.

9.3 Headworks

The existing headworks contains comminution and manual bar screens. The comminutors are no longer operational and the manually raked bar screen is not effective at removing large solids from the flowstream. Consideration was given to grinders and to self-cleaning bar screens.

Grinders macerate rags and other large solids to facilitate settling and eliminate clogging in pumps and pipelines. However, this material tends to be stringy and often re-agglomerates into balls that can create significant maintenance problems. The extent of rag accumulation in the digesters is testament to this situation.

Self-cleaning bar screens take up more space; however, they are simple, and are effective at removing problem rags, sticks, plastics, and stringy material from the waste stream. Screenings can be dewatered and directly disposed of along with grit at the sanitary landfill. Based on the problems experienced with ragging in the digesters and elsewhere, self-cleaning bar screens are proposed for the new headworks.

Two general types of self-cleaning screens are available: traditional bar screens with parallel bars and perforated plate screens with small perforations for openings. Bar screens are available with openings (slots) ranging from 4 millimeters (mm) to 18 mm. The perforated plate screen is available with openings as small as 1 mm. The advantage of screens with smaller openings is that less debris passes to downstream processes. This is particularly important if membrane bioreactors (MBR) are used in the secondary process. The disadvantages of the finer screens include higher capital cost, higher operational cost in handling the greater quantity of screenings, and greater tendency to clog or blind.

Several types of screens were evaluated for the CKWWTP, including perforated plate types and bar types. Because MBRs are not likely to be installed at this plant, the finer perforated plate type screens were deemed unnecessary. A multiple rake bar screen with 4.5 mm openings was recommended. The 4.5 mm slots in the recommended screen are smaller than the typical opening size for bar screens at other wastewater treatment plants. The relatively small slot size would remove most recognizable solids, resulting in better quality biosolids. The screenings would be conveyed to a compactor to reduce the volume of screenings and reduce the water content to an acceptable level for most landfills.

Parshall flumes downstream of the screens are proposed to serve two functions: flow measurement and regulation of the water depth through the bar screens. Regulation of the water depth ensures that the water velocity through the screen does not become excessive.

The CKWWTP currently has no grit removal system at the head end of the plant. Grit is removed from the primary sludge using a cyclone separator and auger-type classifier. Allowing grit to pass into the primary sedimentation process results in accelerated wear from abrasion on the primary clarifier sludge collectors and sludge pumps. To reduce this wear, an aerated grit removal system is proposed as part of the headworks. The screening effluent collector channel would serve as the influent channel to the rectangular grit removal tanks. The effluent from the grit tanks would flow directly into the primary clarifier influent channel. The grit pumps and blowers would be housed in a subterranean equipment gallery that would also service the primary clarifiers.

The new headworks is located south of the sludge processing to provide room for the proposed and future primary clarifiers, and to avoid interference with future expansion of the secondary treatment facilities. The treatment and disposal of screenings and grit removed at the headworks is discussed in a later section entitled "Grit and Screenings Processing Facilities."

9.4 Primary Treatment Alternatives

Additional primary clarification will be necessary for the 2025 design flows. The existing primary clarifiers are circular. Their existing design surface overflow rates (SORs) are 909 gallons per day per square foot (gpd/sf) at average design flow (ADF) and 2,260 gpd/sf at peak design (hour) flow (PDF). To treat the 2025 peak flows, the addition of two new circular tanks the same size as the existing tanks (65 feet in diameter, 10.5 feet deep) would suffice.

Rectangular primary clarifiers were considered and ultimately recommended in the 1994 Facilities Plan because they can be loaded at higher rates, require less site area, provide ease for expansion, and are generally less expensive to construct than circular units. The Washington Department of Ecology (Ecology) recommends loading primary clarifiers at 800 to 1,200 gpd/sf under ADF condition and 2,000 to 3,000 gpd/sf under PDF condition, without distinguishing between different clarifier configurations. Based on Brown and Caldwell's experience at South Plant in Renton, WA, rectangular primary clarifiers can handle loadings at 2,500 to 4,000 gpd/sq ft. Assuming a maximum SOR of 3,500 gpd/sf, a minimum of 8,370 square feet of surface area would be needed for the projected peak hour flow in 2025. Three 130-foot-long by 21-foot-wide by 11-foot-deep tanks would provide 8,400 square feet of surface area.

9.5 Biological Treatment Alternatives

A plant capacity study conducted in 1998 determined that the secondary treatment system has a maximum capacity of 7.0 mgd expressed as maximum month flow. Therefore, to accommodate a 2025 projected maximum month flow (same as ADF) of 10.6 mgd and also to achieve year-round nitrification, the system capacity will need to be expanded. There are several alternatives for increasing the secondary system capacity. These include the following:

1. **Same configuration as existing conventional activated sludge (CAS) system.** In this case, the capacity of the secondary system will be increased by adding two new aeration basins and two new secondary clarifiers that have the same configuration and dimensions as the existing units. The new clarifiers will be deeper than the existing clarifiers to provide better performance than the existing shallow clarifiers. The system will be operated to achieve year-round nitrification. The existing anaerobic selector

will be converted to anoxic selector by operating at higher solids retention time (SRTs) to allow nitrification and addition of internal mixed liquor recycle (IMLR) pumps to pump nitrified mixed liquor from the end of the aeration basins to the anoxic selector.

2. **CAS system with same aeration basin size but larger new clarifier.** This is similar to Alternative 1, except that instead of two new clarifiers with the same dimensions as the existing units, one larger and deeper clarifier will be added and will be able to handle more flows and loads than each of the existing units. Similar to Alternative 1, the existing anaerobic selector will be converted to anoxic selector, with addition of the IMLR pumps.
3. **Convert existing system to a membrane bioreactor system.** The existing conventional activated sludge system (with anaerobic selector) can be converted to an MBR system. Figure 9-1 shows a schematic of an MBR system. New membrane tanks, typically about 30 to 90 percent of the volume of the aeration tanks, depending on the membrane configuration, will be constructed. Alternatively, the existing clarifiers may be converted into membrane tanks. The system will operate at higher SRTs (and thus also higher mixed liquor suspended solids [MLSS] concentrations) than the existing activated sludge system. Additional aeration tanks will likely not be needed to treat the 2025 projected flows and loads; however, a new equipment gallery or building may be required to house the mechanical equipment associated with the MBR system (permeate pumps, scour air blowers, etc.). Because MBR systems are typically operated to achieve full nitrification, it will be compatible with the potential need to produce a low ammonia effluent. MBRs also produce Class A reclaimed water quality, thus allowing the plant to implement water reuse at the same time without installing an additional effluent filtration system.

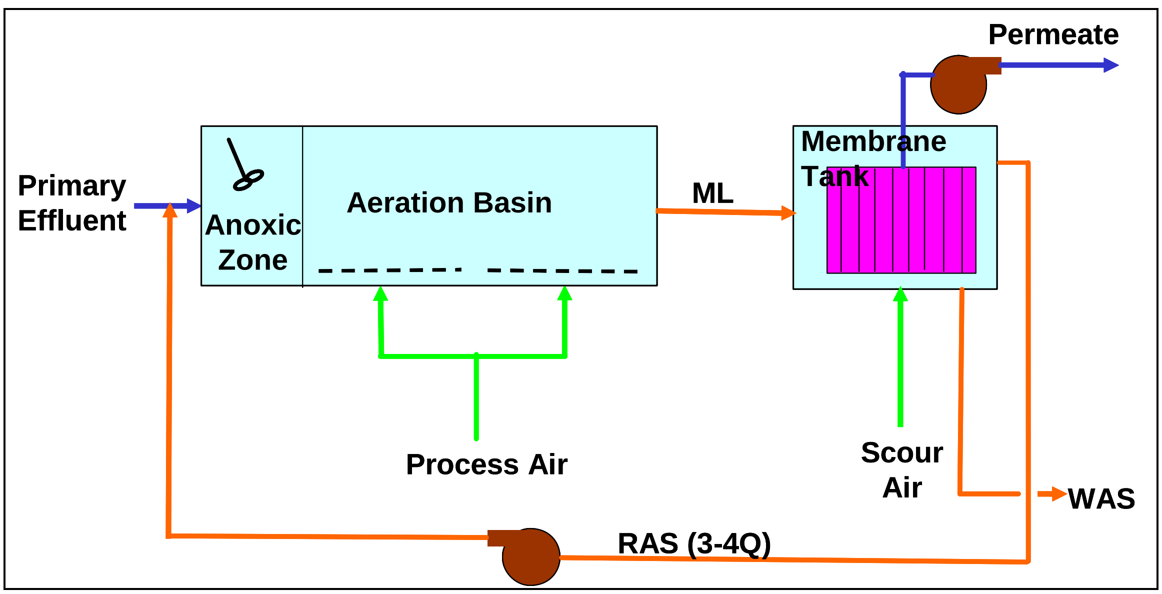


Figure 9-1. Membrane Bioreactors Process Schematic

9.5.1 Evaluation of Biological-Treatment Alternatives

Table 9-2 lists the advantages and disadvantages of the three biological system alternatives. Because a viable water reclamation program has not been identified, for this Central Kitsap Wastewater GMA Compliance Plan, the existing CAS system modified for year-round nitrification was recommended, mainly due to the higher capital and operational costs expected for an MBR system.

Table 9-2. Comparison of Biological System Alternatives			
	Alternative 1: CAS – two new secondary clarifiers (same size as existing)	Alternative 2: CAS – one new secondary clarifier (larger than existing)	Alternative 3: Convert to MBR System
Advantages	• Staff familiarity • Minimal chemical requirements (for bulking control only)	• Lowest capital costs • Minimal chemical requirements (for bulking control only)	• Highest effluent quality (produces reclaimed water without additional treatment) • Lowest footprint requirement • Potential for reducing UV requirements • Least operator attention
Disadvantages	• Require uneven flow split among clarifiers • Highest footprint requirement • Does not produce reclaimed water quality • Susceptible to filamentous bulking	• Require uneven flow split among clarifiers • Loss of more clarifier capacity when the new, larger clarifier is out of service • Does not produce reclaimed water quality • Susceptible to filamentous bulking	• Highest capital cost • Staff need to learn new process • Highest energy requirements • Highest chemical requirements (for membrane cleaning)

9.6 Solids Processing

Solids loading is derived from three main sources at the CKWWTP: influent solids, influent biochemical oxygen demand (BOD), and septage. In addition, sludge from the Kingston, Suquamish, and Manchester plants are expected to continue to be received in the future. Table 9-3 summarizes the projected solids loads in 2025 and at saturation.

Table 9-3. Future Solids Loading		
	2025 solids, ppd	
	Average Annual	Peak Month
Influent		
Wastewater	17,000	20,600
Septage	1,400	2,200
Other sludge[a]	1,200	1,600
Process streams		
Primary sludge	9,300	10,300
Waste activated sludge	9,800	13,800
Screened septage	1,400	2,200
Other sludge (a)	1,200	1,600
Total solids to thickening and digestion	21,700	26,900

[a] *Includes sludge from Kingston, Suquamish, and Manchester wastewater treatment plants.*

9.6.1 Septage Handling Facilities

The amount of septage hauled to the plant currently averages approximately 8,100 gpd. In the year 2025, the volume of septage is projected to be an average of 8,300 gpd, with a peak month of 13,000 gpd. The projected peak month loads are 1,560 ppd of TSS and 300 ppd of BOD. Two alternatives can be identified to deal with this issue.

1. The existing location (southwest corner of the Sludge Processing Building): Upgrade the old receiving station with higher capacity equipment and odor control.
2. The hill behind the Vehicle Maintenance Building: Construct a new receiving station with odor control at this location.

The second location, on the hill southeast of the shop and Equipment Maintenance Building, is preferable for several reasons. It would remove the daily backlog of septic hauling trucks from the main operations area of the plant site. This location would free up the truck bay under the Sludge Processing Building for drive-through access (one end is blocked by septage haul trucks during the hours of 8 a.m. to 5 p.m. Monday through Saturday). In addition, more space is available in this area to construct a dual-bay receiving station, which will be necessary to handle the large volume of traffic efficiently.

Therefore, a new septage receiving station is recommended to be constructed on the hill southeast of the Equipment Maintenance Building. Figure 9-2 shows the proposed location of the septage receiving station. A new on-site road and restricted access gate will be required to access this area from the main entrance road. The gate will be kept locked during night hours or when staff at CKWWTP is unavailable to monitor the station from the plant control room.

The new septage receiving station will resemble a petroleum re-filling station with two parallel drive-up unloading stations. It will include packaged septage receiving equipment that provides fine screening of the septage as well as flow measurement, pH measurement, automated access, and account tracking. The new station will provide facilities that expedite hauler traffic, septage discharge, and transfer of septage from the receiving station to the treatment facilities. Flexibility will be provided to allow septage to be routed to the thickeners via degritting, the digesters, or the headworks at operator discretion. Normally the screened septage will be routed to the existing septage degritting equipment in the gravity thickener control structure as it is now. The degritted septage will flow to the gravity thickeners. Odor control will be provided at the new station. The station should also include a dumpster to dispose of debris trapped by the rock catchers, and process water for cleaning and maintenance.

To reduce labor costs associated with supervising the septage receiving operations, a remote card key reader identification and billing system, and video monitoring will be provided. With a card key system, CKWWTP will be able to pre-approve septage haulers and automatically generate billing statements for dischargers. Video cameras will be used to monitor the receiving station from the plant control room.

9.6.2 Grit and Screenings Processing Facilities

New grit processing facilities will be necessary at CKWWTP for several reasons. Primary sludge is degritted at the gravity thickener flow split structure. The existing primary sludge degritting equipment is very corroded and needs to be replaced. In addition, grit removal from primary sludge will no longer be necessary with the new aerated grit system in service.

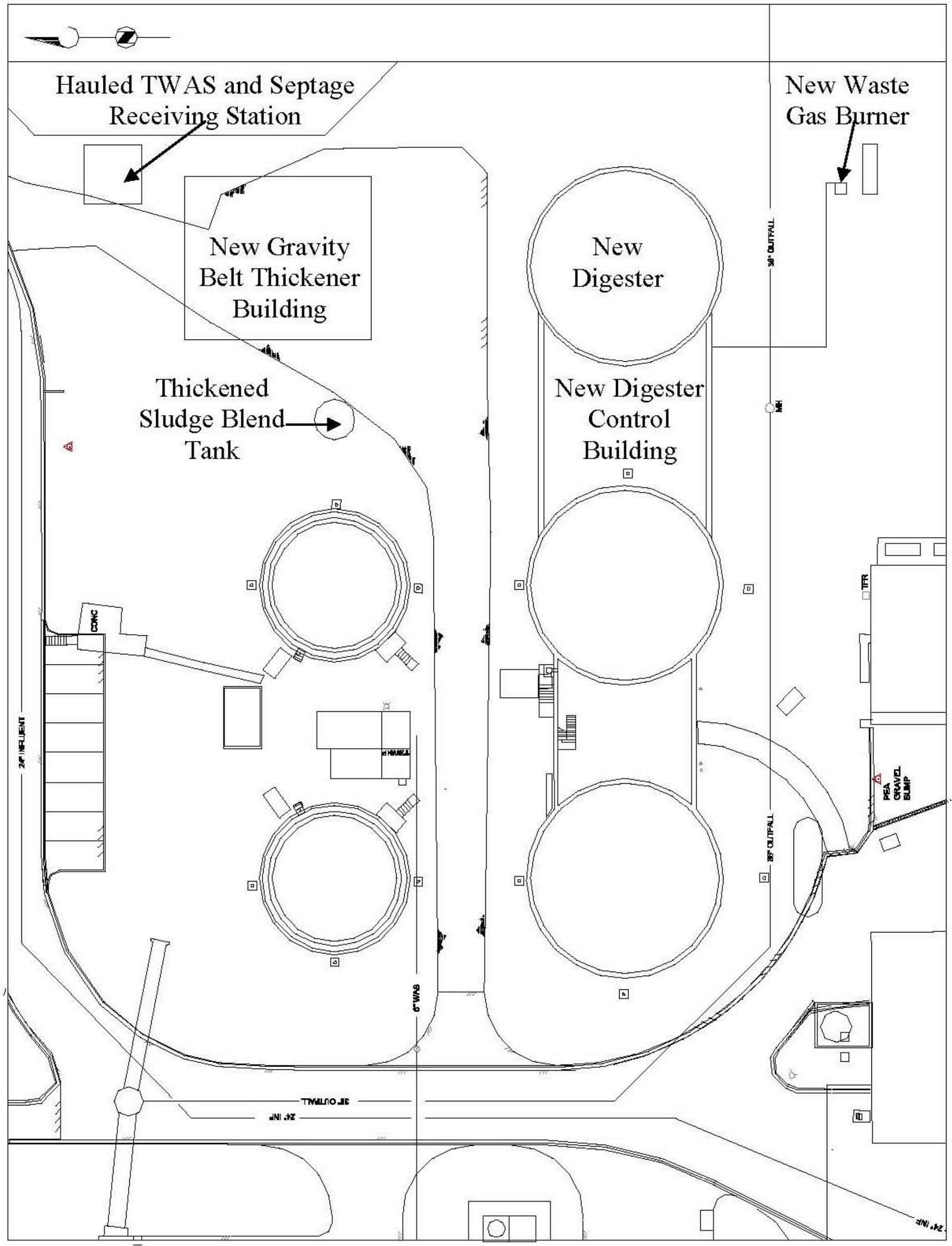


Figure 9-2. Location of New Solids Processing Units

A new grit and screenings handling structure will be constructed adjacent to the new headworks. This facility provides a centralized location for both grit and screenings pickup and removal. The structure will house the new grit separation and dewatering equipment as well as the grit and screenings collection boxes. For ease of grit and screenings disposal, the collection boxes will be housed in a truck bay underneath the grit and screenings handling equipment area.

The building housing the grit handling equipment will require an odor scrubbing system. Since odor scrubbing will already be required at the headworks for the screening channels, providing additional scrubbing for the grit handling facility will be straightforward.

Septage will be degritted at the gravity thickener control structure and then conveyed along with primary sludge septage to the gravity thickeners. Grit and screenings removed at the headworks will be dewatered and collected for disposal at the headworks.

9.6.3 Sludge Thickening

Primary sludge, waste activated sludge, septage, and waste activated sludge from the other Kitsap County plants comprise the solids digested at the CKWWTP, the quantities of which are given in Table 9-3. Table 9-4 summarizes the 2025 loadings to the existing gravity thickeners if no additional thickening capacity is added.

The solids loading to the two operating gravity thickeners in 2025 is within the prescribed WDOE limits for combine primary sludge and secondary sludge. However, the hydraulic loading to the gravity thickeners is higher than that recommended by Ecology. The load to the thickeners is approximately 50 percent by mass secondary sludge and will be impacted by the high hydraulic loading rate, resulting in poor thickener performance. The thickener currently generates solids with an approximate concentration of 3.1 percent; increased hydraulic load will likely result in a thinner sludge further reducing digester capacity.

Table 9-4. Future Solids Loading

	Existing gravity thickeners	
	Average	Peak
Number of units	2	
Diameter, feet	45	
Surface area, each, sq ft	10	
WDOE Recommended Overflow Rate Primary Solids Only, gpd/sq ft Secondary Sludge Only, gpd/sq ft	 600 96	 792 192
2025 Combined Solids Overflow Rate[a], gpd/sq ft (both units operating)	383	535
Ecology-Recommended Solids Loading Rate, ppd/sq ft	4.8	16.8
2025 Combined Solids Load, ppd/sq ft	6.8	9.0

[a] *WAS is wasted directly from the aeration basin.*

The concentration of the solids generated in the underflow of the gravity thickeners has a direct impact on the retention time or capacity of the digester which receive the solids. Table 9-5 shows how solids retention time changes when the digesters are operated in parallel at different solids concentrations. At the 2025 condition and a solids concentration of 3 percent, close to current performance, there would only be 11 days

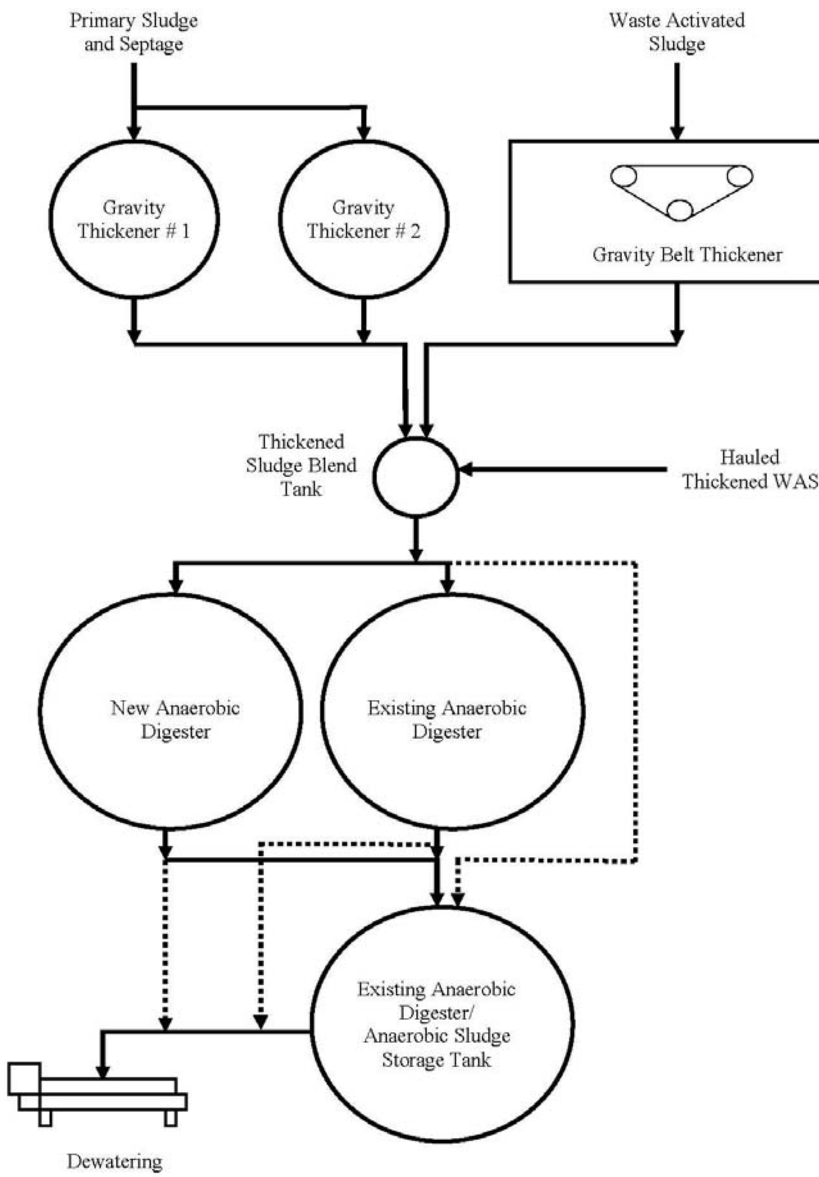


Figure 9-3. Flow Schematic of Solids Treatment at CKWWTP at 2025 Buildout

of retention time in the digesters. This is well below the minimum of 15 days prescribed by the United State Environmental Protection Agency (EPA) for mesophilic processes, which do not require constant monitoring for pathogen destruction. Table 9-5 also demonstrates that additional digester capacity will be required for the 2025 loads even if the thickened sludge reaches a concentration of 6 percent. Under no condition would the facility be able to take one digester out of service and maintain an adequate SRT without adding a third digester.

Table 9-5. Thickener Effluent Solids Concentration versus Digester Residence Time [a, b]

Solids concentration in 2025 flow to digester (percent)	Digester SRT, parallel operation (days)	Digester SRT, one unit out of service (days)
2.5	9	5
3	11	6
3.5	13	7
4	15	7
4.5	17	8
5	19	9

[a] Each of the digesters at CKWWTP has a capacity of 86,280 cu ft (643,280 gallons).

[b] Solids loading at Peak 14 Day flow and load.

Based on the information in Tables 9-4 and 9-5, there is insufficient thickening and digestion capacity at the CKWWTP to meet the projected flows and load under the 2025 condition. Construction of two additional gravity thickeners, the same size as the existing units, would reduce the loading to the existing units. However, continued production of thickened sludge at approximately 3.0 percent solids (under peak 14 day conditions) would also necessitate construction of 109 percent more digestion capacity than currently is present at the CKWWTP, essentially two or more digesters of similar size to the current units. Increasing the solids concentration to 5.0 or 5.5 percent would require only the construction of one additional digester of equivalent size to the current digesters.

Rather than construct additional gravity thickeners and at least two additional digesters, it is recommended that the existing gravity thickeners be augmented with a gravity belt thickener (GBT). The existing gravity thickeners will be used to thicken both the primary sludge and septage, for which they are reported to be effective for. The GBT will thicken the secondary solids that do not settle and compact well in the gravity thickeners. By splitting out the secondary sludge from the primary sludge and septage, the overall concentration of solids to the digester will increase. As a result, fewer digesters will need to be constructed to meet the 2025 condition, leaving a greater facility footprint available for the ultimate build-out condition.

To meet the loading requirements for 2025, one 3-meter GBT will be required. The building to house the GBT will be sized such that any additional footprint will be made available for a second 3-meter unit.

In general GBTs are preferable for the CKWWTP because:

1. Process Enhancement: WAS is not well thickened in gravity thickeners. The use of a GBT will allow solids concentrations of WAS to meet or exceed 5 percent. Similar concentrations can be achieved with primary sludge only in gravity thickeners. This should provide the CKWWTP with considerably more digester capacity.
2. Cost: GBTs and the associated building are a relatively inexpensive alternative when compared to other suitable thickening technologies, such as dissolved air floatation. The cost of continued combined

thickening with new gravity thickeners and two or more additional digesters would be considerably greater than one digester and the GBT facility.

3. Process Familiarity: Kitsap County operates gravity belt thickeners at its other facilities to thicken solids for transport to the CKWWTP. Therefore, County staff have a high degree of process familiarity with the GBT, and thus implementing the technology at the CKWWTP should be easier than another technology.

In summary, it is proposed to construct a facility to house one new and one future GBT and to continue to utilize the gravity thickeners to thicken primary sludge and septage prior to digestion. The thickened solids will be recombined and mixed in the blend tank prior to introduction to the digesters. The hauled thickened sludge from other facilities will also be introduced to the solids system at the blend tank. Figure 9-3 shows the location proposed for the new GBT facility. Figure 9-2 shows the process flow schematic for solids thickening, digestion, and storage.

9.7 Digesters

Parallel operation of the digesters will continue following the expansion to meet 2025 flows and loads. Two primary digesters will operate to reduce solids and pathogen loads, increase solids stability, and generate biogas. The third digester will be operated as a storage tank, receiving the waste solids from the two primary digesters. The storage digester will serve also as a redundant digester, having all of the necessary equipment to operate in place of one of the primary digesters.

Solids from the storage digester will be sent to the centrifuge for dewatering and ultimate disposal. In the event that the storage tank is in service as a digester, dewatering will follow the current standard operating procedures.

To further augment process stability, a sludge blend tank will be located prior to the two primary digesters. This tank will combine the thickened WAS, primary sludge, septage, and WAS from other Kitsap County facilities and homogenize it. This should equilibrate process performance between the primary digesters, resulting in an easier to use monitoring and control system. Also, by providing a blend tank, the thickened sludge from the other Kitsap County facilities can be directly introduced to the digesters because it typically has a solids concentration of 6 percent. This will reduce the load to the gravity thickeners and reduce operator time associated with re-thickening the solids, as is currently done now.

Operating the two existing digesters in parallel rather than in series is recommended. Construction of a third digester, equivalent in size to the existing units, will be required. Parallel operation of the expanded digestion system will result in an SRT of 19 days at a solids concentration of 5 percent, under peak 14-day loading. Operating the digesters at a temperature of 35°C should provide a 50 to 60 percent reduction in volatile solids. Table 9-6 shows the design criteria for digestion.

Table 9-6. Design Criteria for Digestion		
Parameter	Existing digesters	New digester
Number of units	2	1
Diameter, ft	65	65
Depth, ft	26	26
Volume each, cu ft	86,200	86,200
WDOE recommended loading, ppd VSS/1,000 cu ft (completely mixed systems)	30-300	30-300
WDOE recommended detention time, days (completely mixed systems)	20-Oct	20-Oct
2025 detention time, days[a,c]	19	19
2025 loading (all units operating), ppd VSS/1,000 cu ft[c]	143	143
2025 loading (new unit out), ppd VSS/1,000 cu ft[b,c]	143	--
2025 detention time (new unit out), days[a,b,c]	19	--

[a] *Assumes thickened sludge with 5.0 percent solids produced from new GBT and existing GT*

[b] *Assumes storage tank moved to digester operation and parallel operation continues*

[c] *Assumes peak 14 day loading condition, and one existing digester operating as a storage tank*

9.8 Alternative Treatment Technologies

The treatment alternatives and process configurations described in this chapter are an extension of the plant expansion concepts defined in several past studies. Basically, this plant is currently planned to continue with basic primary treatment followed by activated sludge and ultraviolet light (UV) radiation disinfection for liquid stream secondary treatment, coupled with anaerobic digestion and dewatering for biosolids stabilization and handling. The current plant, built in the 1970s, was originally configured with this type of general treatment, and the site is large enough to permit the County to retain this type of treatment for the foreseeable future.

The adoption of newer treatment technologies and alternative methods to utilize or dispose of the plant's major product streams (liquid effluent and biosolids) is logically dictated by various forces and drivers. Chief among them are changing economic realities that can shift the County to newer and better alternatives that can meet the level of treatment requirements imposed by regulations. Other drivers for change can also affect the decision to adopt different technologies, such as: 1) stricter regulations governing effluent discharge standards and biosolids quality standards, 2) regulatory and regional concerns about the fate of overall surface and groundwater balances in the County, and 3) changing policy directions and environmental ethics to find more sustainable methods to treat and use wastewater treatment plant effluent and biosolids.

The planning process to provide a pathway to update the County's treatment facility must provide for a flexible outcome to adapt to future changes in the way wastewater is treated and disposed of. At this time, at least two different technologies need to be contemplated in this study to ensure the County can react to economic, policy, and environmental changes discussed above. One technology involves the creation of reclaimed water and the other involves the drying of biosolids. Both of these technology alternatives are discussed below.

9.8.1 Water Reclamation

At the CKWWTP, water reuse is currently limited to in-plant process uses such as elutriation water for the gravity thickeners (for odor control), scum spray water at the primary and secondary clarifiers, and flushing and polymer dilution water for the centrifuge. Because UV disinfection is used for effluent disinfection, sodium hypochlorite addition is included as part of the process water system to provide a chlorine residual in the plant effluent re-used at the plant.

There are several newer and broader potential applications for reclaimed water in the vicinity of the CKWWTP and within the Central Kitsap UGA. Reclaimed water can be produced at the CKWTTP (using tertiary filtration processes) and then distributed to reuse sites for irrigation uses, groundwater recharge, stream flow augmentation, etc. Alternatively, raw sewage can be diverted within the County's collection system and routed to dispersed satellite reclamation plants (scalping plants) to create reclaimed water locally with respect to where it is needed. Satellite treatment plants have been recently installed in several communities, using the latest MBR technology to achieve a very high quality effluent. These concepts are further described in Appendix D.

For the purposes of this document, the proposed expansion recommendations for the CKWWTP do take these potential reclaimed water opportunities into account at this time. All proposed plant expansion recommendations will not preclude the County from developing reclamation facilities at the CKWWP or constructing collection system satellite plants. The design recommendations made in this document will preserve the County's ability to shift to producing reclaimed water when that new direction is better defined in the future.

9.8.2 Biosolids Drying

The solids treatment train at the CKWWTP consists of two gravity thickeners, two anaerobic digesters, and a dewatering centrifuge. Primary sludge, WAS, septage, and other sludges hauled from the treatment plants at Kingston, Manchester, and Suquamish are pumped to the two gravity thickeners. Thickened sludge is pumped to the anaerobic digesters, which are currently operated in parallel to provide adequate residence time. Digested sludge is dewatered in a centrifuge, and the dewatered biosolids are then hauled to a composting facility in Yakima, Washington. The CKWWTP currently produces Class B biosolids.

An alternative process to handling biosolids includes the use of sludge drying technology to reduce the water content of biosolids prior to hauling and to also produce a Class A biosolids product. The drying technology uses a fuel source (either heating oil or digester gas at the CKWWTP) to elevate the temperature of the biosolids, drive off excess water, and essentially pasteurize the biosolids. This technology has been proven; however, a local market for a Class A product has not been clearly identified at this time and the economics for conversion to a sludge dryer are currently not favorable to the County. As with the water reclamation option described above, the current proposed recommendations will not preclude the County from installing a sludge dryer in the future, nor will it strand any new capital investment currently proposed for the treatment plant. Additional information on these topics is shown in Appendix H-1 and H-2.

9.9 Satellite Treatment Plants

Besides the various treatment process alternatives discussed in this chapter, another alternative treatment approach is to construct satellite treatment plants in outlying low-density areas of the service area. Satellite plants can be constructed along the collection system and operate as scalping plants. This would reduce the flows and loads sent to the main treatment plant (CKWWTP in this case), sometimes referred to as the "mothership" plant in this type treatment scheme. The benefits of satellite treatment plants include the following:

- Increasing reserve capacity at the main treatment plant (or delaying expansion) by diverting flows to the satellite plants.
- Delaying the need to upgrade or install parallel pipes to serve future flows by re-directing flows from an interceptor operating at full or nearly full capacity. The treatment capacity is thus added to serve the area with a more urgent need.
- Since effluent from satellite plants is typically reclaimed, reducing marine discharge and thus the need for outfall modifications or expansion.
- Reducing costs associated with reclaimed water conveyance by locating the satellite plants close to reuse sites.

Several criteria are typically considered when assessing the feasibility and siting of satellite treatment plants, as follows:

- Close proximity to reuse sites.
- Adequacy of flow available for diversion from a nearby forcemain or pump station. There should also be sufficient flow left in the forcemain after diversion to carry the waste sludge from the satellite plants to the main treatment plant for solids processing.
- Limited space for expansion at the main treatment plant
- Limited impact of inflow/infiltration (I/I) on wastewater being diverted to the satellite plant, thus minimizing variations in flows and/or loadings to the plant. Satellite plants, as scalping plants, work best as base loaded plants. The more the influent flows and loadings fluctuate, the less cost-effective the plant would become.

As indicated above, construction of satellite plants is closely tied to the potential for water reclamation in the County. If water reclamation is not implemented in the County, then construction of satellite plants is not likely an attractive option unless the Central Kitsap WWTP is severely constrained by space availability for plant expansion or the outfall becomes hydraulically limited due to receiving water quality considerations. In general, the farther the reuse sites are from the main treatment plant, the more cost-effective it is to build the satellite plants near the reuse sites than to reclaim the effluent at the main plant and convey the reclaimed water to the reuse sites, providing that there is adequate flow from a nearby forcemain or pump station for flow diversion to the satellite plant.

Further evaluation of satellite plants, including potential sites, capacity and treatment technology, will be presented in the Final Facilities Plan.

9.10 Summary

This chapter presented alternatives to expand the CKWWTP capacity and treatment capabilities to meet the 20-year projected flows. Each of the presented alternatives was evaluated with respect to process performance, cost, and environmental criteria. Based on this evaluation, the following major facilities were selected for inclusion in plant expansion for the 20-year planning period:

1. New headworks with screening and grit removal, and a screenings and grit handling facility
2. Three rectangular primary clarifiers
3. Two new aeration basins with fine bubble diffused air
4. Two additional secondary clarifiers
5. Mixed liquor distribution channel (aerated)
6. New septage receiving station
7. One gravity belt thickener

8. One new anaerobic digester

Yard piping, in-plant pumping stations, and electrical and instrumentation will be required in association with these major facilities. The need for the following other support facilities or modifications were also identified:

1. Replace membranes on existing fine bubble membranes diffusers
2. Add internal mixed liquor recycle pumps in aeration basins
3. Additional process water pumping capacity and associated yard piping
4. Add sludge dryer system (when dried Class A biosolids market becomes more viable in Kitsap County and a sludge dryer system becomes a more cost-effective biosolids management approach)

10. RECOMMENDED TREATMENT PLANT FACILITIES

Alternatives for expanding facilities at the CKWWTP are presented and evaluated in Chapter 9. Chapter 10 provides an approach to constructing all of the facilities resulting from the evaluation in Chapter 9, and other facilities for which alternatives were not identified. The basic components of the treatment plant expansion are described, budget-level costs are summarized, and a proposed schedule for implementing overall improvements is presented. A plan for financing this project is presented in Chapter 11.

The facilities recommended in this chapter will meet the design flows and loadings expected for the next 20 years, until 2025. Facilities have been detailed sufficiently to generally address capacity and operational concerns, and to provide a basis for budget-level cost estimates. This information provides guidance to serve as the basis of engineering design. The recommended facilities must be more fully developed and analyzed during pre-design.

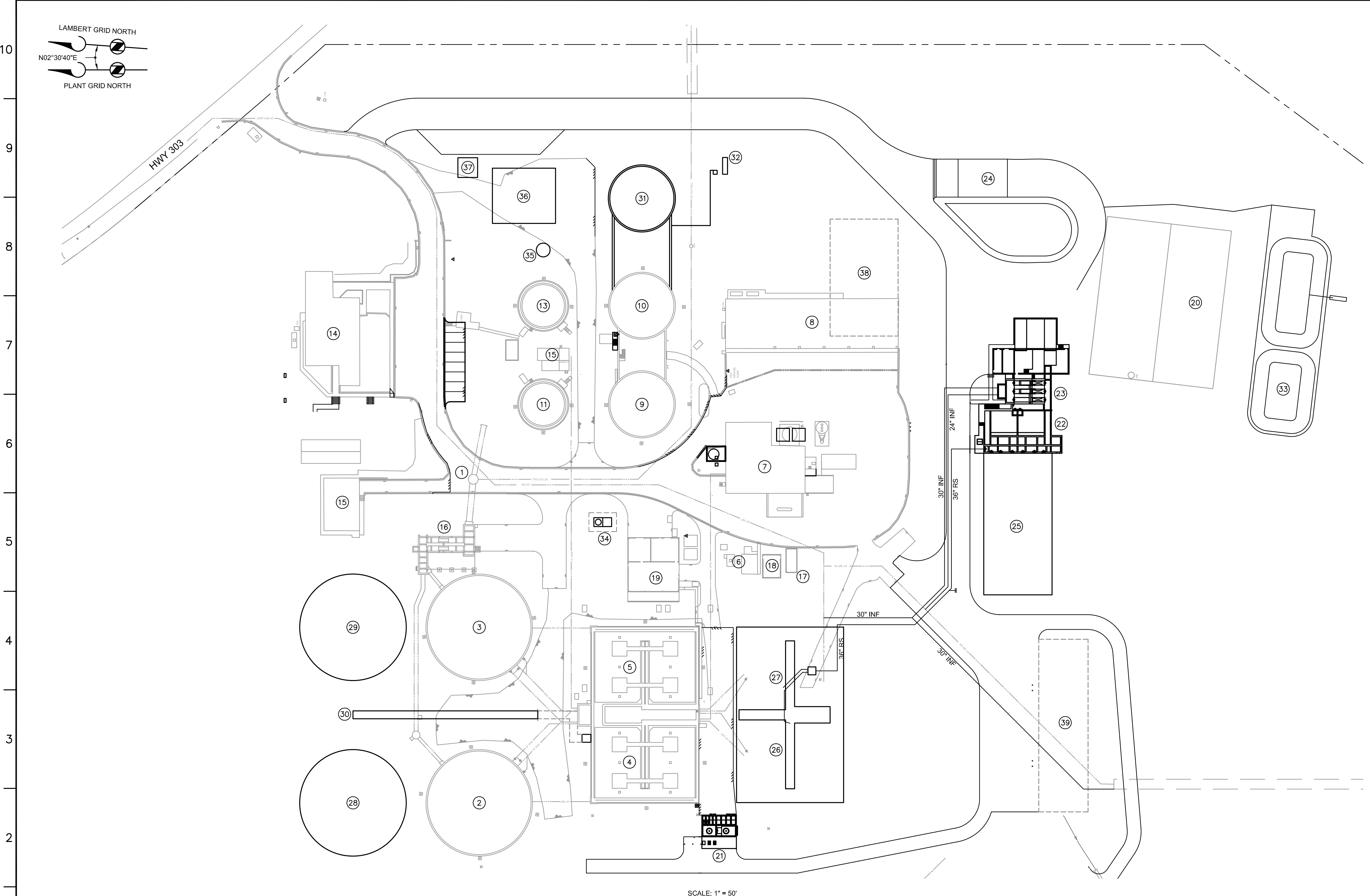
Based on assessment of the existing systems described in Chapter 4 and treatment alternatives evaluation described in Chapter 9, the recommended treatment plant upgrades to accommodate the 2025 design flows and loadings include the following:

- New Junction Structure (as part of new headworks)
- Headworks with mechanical bar screens, influent flow measurement, and aerated grit tanks
- Grit and screenings removal facilities
- Three new primary clarifiers and gallery
- Two new aeration basins
- Upgraded aeration system
- New internal mixed liquor recycle pumps
- Two new secondary clarifiers
- New septage receiving station
- One new gravity belt thickener (GBT)
- One new anaerobic digester
- Upgraded process water system

The next section of this chapter describes the recommended CKWWTP facilities in more detail.

Figure 10-1 shows the layout of the recommended facilities. Figure 10-2 shows the flow schematic for treatment of both the liquid and solid streams at the plant. These figures should be consulted as the descriptions for each process are presented.

Table 10-1 lists the design criteria for the facilities recommended for the treatment plant expansion. All of the new unit processes are sized for the 2025 flows.



KEY LEGEND:

EXISTING FACILITIES

1. MANHOLE B
2. SECONDARY CLARIFIER 1
3. SECONDARY CLARIFIER 2
4. AERATION TANK 1
5. AERATION TANK 2
6. GENERATOR BUILDING
7. SLUDGE PROCESSING BUILDING AND SEPTAGE RECEIVING STATION
8. SHOP AND EQUIPMENT MAINTENANCE BUILDING
9. DIGESTER 1 NEW SLUDGE STORAGE TANK
10. DIGESTER 2 NEW DIGESTER 1
11. SLUDGE THICKENER 1
12. GRAVITY THICKENER CONTROL STRUCTURE
13. SLUDGE THICKENER 2
14. ADMINISTRATION AND LABORATORY BUILDING
15. CHLORINATION BUILDING
16. UV DISINFECTION CHANNEL
17. FUEL STORAGE TANK
18. GENERATOR BUILDING
19. POWER/BLOWER BUILDING
20. VACTOR DECANT FACILITY

NEW FACILITIES

21. RAS MIXING BOX
22. HEADWORKS
23. GRIT / SCREENING COLLECTION
24. SEPTAGE RECEIVING STATION
25. PRIMARY CLARIFIERS
26. AERATION TANK 3
27. AERATION TANK 4
28. SECONDARY CLARIFIER 3
29. SECONDARY CLARIFIER 4
30. ML CHANNEL
31. DIGESTER 2
32. WASTE GAS BURNER
33. BIOFILTER AND BIOFILTER SUMP
34. PLANT WASTEWATER PUMP STATION
35. THICKENED SLUDGE BLEND TANK
36. GBT BUILDING
37. HAULED WAS RECEIVING STATION
38. POTENTIAL FUTURE SLUDGE DRYING FACILITY
39. FUTURE STORGAE SHED

BROWN AND CALDWELL
CONSULTANTS
SEATTLE, WASHINGTON

SUBMITTED: ______ PROJECT MANAGER DATE: ______
APPROVED: ______ BROWN AND CALDWELL DATE: ______
APPROVED: ______ DATE: ______

FILE 132857–FIG10–1
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CHECKED

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

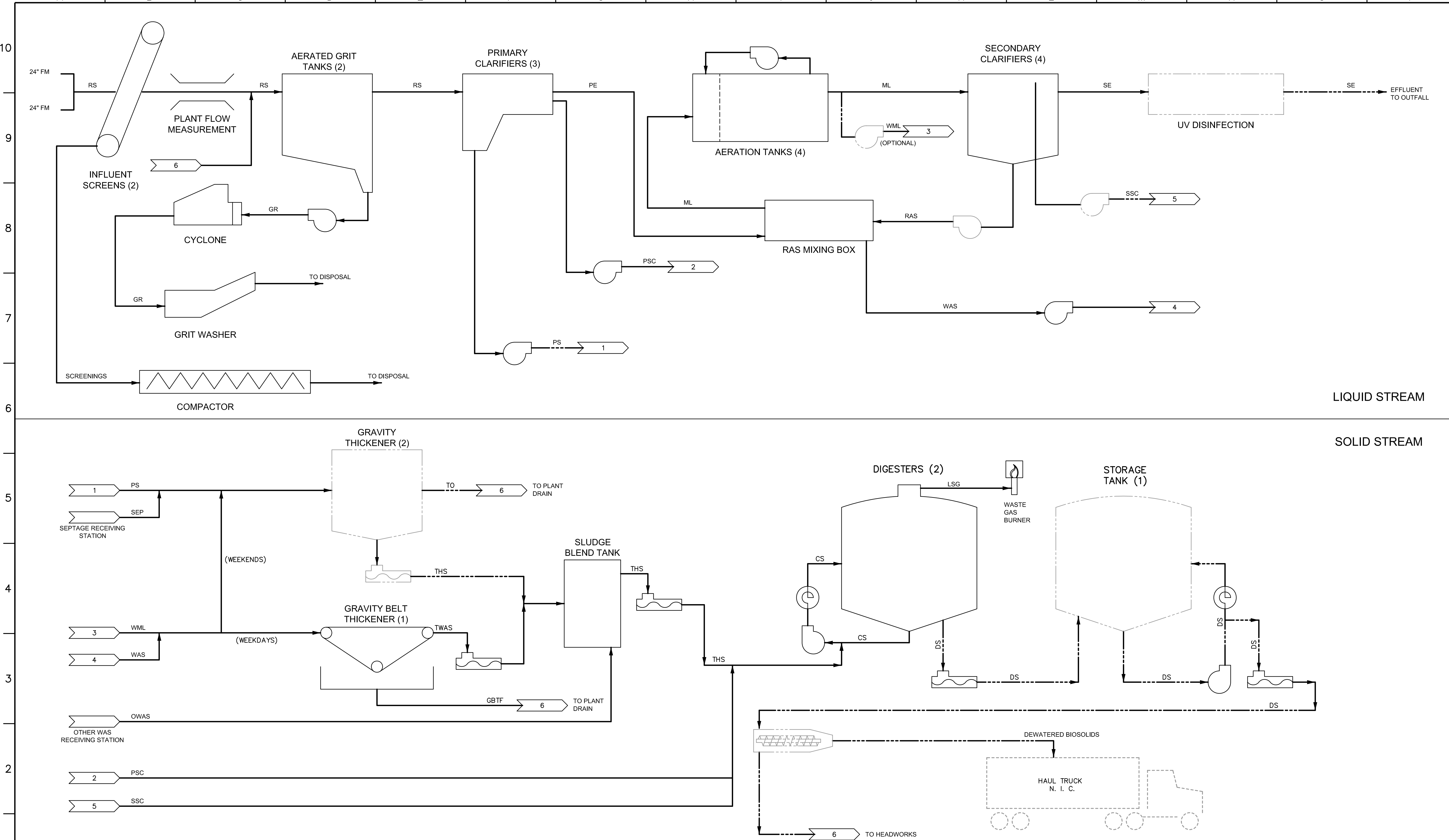
REVISIONS

KITSAP COUNTY

CENTRAL KITSAP COUNTY WASTEWATER FACILITY PLAN

FIGURE 10–1
SITE PLAN
FOR RECOMMENDED CKWWTP FACILITIES

JAN 2008
DRAWING NUMBER
FIG 10–1
SHEET NUMBER



BROWN AND CALDWELL
CONSULTANTS
SEATTLE, WASHINGTON

SUBMITTED: ____________ DATE: ________
PROJECT MANAGER
APPROVED: ____________ DATE: ________
BROWN AND CALDWELL
APPROVED: ____________ DATE: ________

LINE IS 2 INCHES AT FULL SIZE
(IF NOT 2"–SCALE ACCORDINGLY)

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ZONE	REV.	DESCRIPTION	BY	DATE	APP.

REVISIONS

KITSAP COUNTY

CENTRAL KITSAP COUNTY
WASTEWATER FACILITY
PLAN

FIGURE 10–2
2026 CKWWTP
PROCESS FLOW SCHEMATIC

JAN 2008

DRAWING NUMBER
FIG 10–2
SHEET NUMBER

132857–FIG10–2 1–8–08 1=1 WMC

Table 10-1. Central Kitsap WWTP Recommended Plant Expansion Design Criteria

Parameter	Unit	2025 Plant
Raw Sewage Flow		
Average Annual (AAF)	mgd	8.5
Average Dry Weather (ADWF)	mgd	7.7
Average Peak Month (ADF)	mgd	10.6
Max Day (MDF)	mgd	17.2
Peak Design (Hour) (PDF)	Mgd	29.3
Raw Sewage Loadings		
Annual Average BOD	ppd	19,940
Average Peak Month BOD	ppd	22,540
Annual Average TSS	ppd	16,980
Average Peak Month TSS	ppd	20,550
Bar screens		
Number, mechanical		2
Number, manual		1
Peak hydraulic capacity, each	mgd	30
Aerated grit tanks		
Number		2
Volume, each	gal	56,000
Detention time		
@ ADF	min	15
@ PDF	min	5.5
Grit dewatering system		
Number of cyclones		4
Total cyclone capacity	gpm	1,000
Number of classifiers		2
Total classifier capacity	tpd	36
Primary clarifiers		
Number		3
Length	ft	130
Width	ft	21.5
Depth	ft	10.5
Total surface area	sq ft	8,385
Overflow rate		
@ ADF	gpd/sq ft	1,264
@ PDF	gpd/sq ft	3,494
Detention time		
@ ADF	hrs	1.6
@ PDF	hrs	0.6
Primary sludge pumps		
Number		6
Capacity, each	gpm	100
Activated sludge basins		
Number		2
Volume, total	Mgal	1.62
Depth	ft	15.4
Hydraulic detention time @ ADF	hrs	7.4
Mixed liquor suspended solids (MLSS)	mg/l	2,000 – 3,500
Sludge retention time (SRT)	days	4 - 8

Table 10-1. Central Kitsap WWTP Recommended Plant Expansion Design Criteria

Parameter	Unit	2025 Plant
RAS to influent flow ratio	%	50 - 100
Aeration blowers		
Number, firm/total		4/5
Capacity, each	scfm	4,200
Total air flow, firm capacity	scfm	16,800
Existing secondary clarifiers		
Number		2
Diameter	ft	104
Depth	ft	11.5
Total surface area	sq ft	16,990
Overflow rate[a]		
@ ADF	gpd/sq ft	250
@ PDF	gpd/sq ft	690
New secondary clarifiers		
Number		2
Diameter	ft	100
Depth	ft	18
Total surface area	sq ft	15,708
Overflow rate[a]		
@ ADF	gpd/sq ft	405
@ PDF	gpd/sq ft	1,119
UV channels		
Number		2
Length	ft	36
Width	ft	4.58
Depth	in	52
Design flow per channel	mgd	17
Design transmissivity		
Average	%	62
Minimum	%	55
Septage receiving station		
Number of receiving tanks		2
Volume, each	gal	25,000
Transfer capacity, each	gpm	250
Gravity Thickeners		
Number		2
Diameter	ft	45
Depth	ft	10
Solids loading rate		
Annual average	ppd/sq ft	5.4
Peak month	ppd/sq ft	7.5
Gravity Belt Thickeners		
Number		1
Length	m	3.1
	ft	10
Solids loading rate		
Annual average	ppd/m	5.4
Peak month	ppd/m	7.5
Anaerobic Digesters		
Number (digester/storage tanks)		2/1
Diameter	ft	65

Table 10-1. Central Kitsap WWTP Recommended Plant Expansion Design Criteria

Parameter	Unit	2025 Plant
Depth	ft	26
Volume, each	cu ft	86,280
Annual average loadings		
Total solids feed	ppd TS	28,675
Volatile solids feed	ppd VS	24,632
Volatile solids loading	ppd VS /1000 cu ft	143
Detention time	days	19
Sludge dewatering		
Plate and frame press[b]		
Number		1
Filtration area	sq ft	2,800
Number/size of plates	m	55/1.5 x 2
Capacity	pph	---[b]
Centrifuges		
Number		1
Capacity, each	gpm	186[c]

Notes:

[a] Assumes a flow split of 40 percent to the existing clarifiers and 60 percent to the new clarifiers under all flow conditions.

[b] Plate and frame press is currently not operable.

[c] Capacity based on 7 hours per day, 5 days per week dewatering at average annual sludge

10.1 Influent Junction Structure

A new influent junction structure will be included as part of the headworks. The structure will consist of separate boxes into which each of the two influent force mains discharge. The flow will pass over a weir from each box to the screen channels. The structure will isolate each force main so that if there is a break in either line, the flow from the other line is prevented from reversing direction into the broken line. A crossover connection with a valve will be provided to allow work in either box without shutting down the associated force main, except for a brief shutdown to allow insertion of a plug into the discharge end of the force main.

10.2 Headworks

The existing headworks has sufficient capacity for flows through 1998. A new headworks facility should be constructed in association with construction of the new primary clarifiers. The new headworks should be located so that it will not conflict with plans for future facilities. Figure 10-1 shows the new and future headworks proposed for the area southwest of the Vehicle Maintenance Building. This location will not conflict with future expansion of the primary clarifiers or secondary treatment units.

The new headworks should be designed to accommodate hydraulic isolation of each force main, three self-cleaning mechanical bar screens with a bypass channel, and isolation gates. A common effluent channel should convey the screened wastewater to the aerated grit tanks. A bypass channel would provide conveyance directly to the primary clarifiers if the grit tanks were out of service. The installation of mechanical bar screens will significantly reduce the current problem of rag accumulation in the digesters. Screened solid material will be automatically discharged from the mechanical bar screens into a screw conveyor and conveyed to a washer/compactor. The washer/compactor will discharge the compacted screenings into a collection box for disposal.

Two aerated grit tanks will be provided downstream of the bar screens. Each grit tank will be divided into two stages by a center baffle. Most of the grit will be removed in the first stage. The second stage will receive little grit, except during storm flows. A spiral flow pattern through the tank will be developed by positioning the inlet and outlet ports, providing strategically located baffles and encouraging the spiral motion with agitation air. The spiral velocity will be high enough to keep organic materials in suspension, but low enough to let the more dense grit particles settle. The air flow rate will be adjustable. At the optimum air flow rate, organic materials will stay in suspension while grit particles settle in the hoppers.

Each grit tank stage will have a steeply sloped hopper for collecting settled grit. A dedicated grit pump will serve each hopper. The operation of all four grit pumps will be controlled automatically. During automatic operation, each time a pump starts, controlled agitation air and water will be injected near the pump suction pipe to loosen and re-suspend compacted grit, allowing it to flow into the pump suction pipe.

Each grit pump will be paired with a dedicated cyclone-type separator that will concentrate the grit slurry by a factor of about 15. The degritted water from the cyclone will be returned to the primary clarifier inlet channel, and the grit-containing underflow will be discharged to a screw classifier for additional dewatering and separation of remaining organic materials. Two cyclones (one paired with a first stage pump from one tank and one paired with a second stage pump from the other tank) will share each classifier. This arrangement will ensure that at least one stage of each grit tank is operational, even if one of the classifiers is out of service. The classifiers will discharge dewatered grit to a grit roll-off container. Overflow from the classifiers will be returned to the primary clarifier inlet channel.

The grit pumps, agitation air blowers, and solenoid valves for the air and water system used to resuspend compacted grit in the hoppers will be located in a below-grade gallery between the grit tanks and the primary clarifiers. The grit pumps will be located adjacent to the grit tank hoppers to minimize the length of suction piping. The cyclones and classifiers will be enclosed in a building.

Grit causes wear on piping regardless of the piping material or coatings selected. Grit piping will therefore be designed for ease of replacement. Grit piping can also be subject to plugging. Flushing and draining connections will be provided. The capability to physically disassemble the pipe is recommended. Buried or encased grit piping should be avoided.

To mitigate odors associated with screening and grit removal, odor control providing 20 air exchanges per hour should be included at the new headworks. This odor control system should be designed to also accommodate the grit handling facilities described later in this chapter. Several odor control systems are currently available, including activated carbon packed towers, chemical scrubbers (using sodium hypochlorite and sodium hydroxide), and bulk media biofilters. For purposes of this study, an activated carbon system was included for odor control. Detailed evaluation should be performed during predesign to determine which odor control system is most appropriate for the CKWWTP.

10.3 Primary Sedimentation (Clarification)

Additional primary clarification will be needed for the 2025 flows. It is recommended that the existing circular clarifiers be replaced with rectangular units. The existing clarifiers will be decommissioned and removed to allow for additional activated sludge tankage (see next subsection).

Design overflow rates for the primary clarifiers are shown in Table 10-1. The new rectangular primary clarifiers should be designed to achieve at least 50 percent suspended solids removal and 30 percent biochemical oxygen demand (BOD) removal at an average design overflow rate of 1,300 gallons per day per square foot (gpd/sq ft). Based on performance data of similar clarifier design at the South Plant in Renton, average daily flow (ADF) and peak design flow (PDF) rated capacities of 1,300 gpd/sq ft and 3,500 gpd/sq ft are reasonable for CKWWTP.

Figure 10-1 shows the proposed location for the new primary clarifiers in the area immediately west of the new headworks. An equipment gallery will be located under the influent channel to the new primary clarifiers. Scum and primary sludge pumps for the new settling tanks will be located in this gallery. Flows will be divided between three clarifiers. Wastewater from the headworks will enter a primary influent channel, designed for eventual extension to the south as future primary tanks are added. Flow balancing between the three primary tanks will be accomplished by weir gates in this channel. Effluent from the rectangular primary tanks will collect in an effluent channel and be conveyed through a 36-inch diameter pipeline to the aeration tanks. As with the influent channel, the primary effluent channel will be designed for future extension to the south to accommodate future primary tanks.

10.4 Activated Sludge

Based on the alternatives evaluation in Chapter 9, activated sludge (AS) has been selected over membrane bioreactor (MBR) for secondary treatment. The operational mode will include an anoxic selector to improve sludge settleability and allow CKWWTP to meet a potential future ammonia-nitrogen limitation. To accomplish treatment objectives, four additional 0.41 milligram (mg) AS tanks or two trains of two tanks in series (the same size as the existing tanks) will be constructed for the 2025 flows. The new tanks will be constructed south of the existing tanks, at the same location of the existing circular primary clarifiers, which will be demolished. This will increase the total aeration basin volume to 3.26 million gallons. The new basins will be equipped with fine bubble diffused aeration (FBDA) equipment for process aeration. To increase the air delivery capacity, two new aeration blowers will be added.

The planned changes will improve operator control of the secondary system. Flow routing will be altered to provide plug flow conditions by dividing each aeration basin train into six passes (three passes in each tank), with the first pass serving as an anoxic selector. An internal mixed liquor recycle pump will be added in each aeration basin train to return nitrified mixed liquor to the anoxic selector for denitrification. The recommended design will allow CKWWTP to produce a nitrified effluent if required in the future. With construction of the additional secondary clarifiers and mixed liquor suspended solids (MLSS) channel (see subsequent section), MLSS from the east and west sides of the plant can be combined prior to secondary clarification. Return activated sludge (RAS) from the secondary clarifiers will be combined in a RAS mixing box prior to entering the AS system. During the wet weather season the AS system can operate in sludge reaeration mode, with primary effluent bypassing the first aerated tank and entering the second on both sides of the plant.

Flow routing is shown in Figure 10-2. Flow from the primary clarifiers will be combined and divided equally between the four aeration basin trains. For each train, primary effluent first enters the anoxic zone. Then the flow path proceeds through the remaining passes, which are to be kept aerated. Nitrified mixed liquor is pumped from the last pass to the anoxic selector, and RAS is pumped to the RAS mixing box.

During wet weather conditions the AS system could be operated in sludge reaeration mode. Under these conditions the first pass is aerated and the internal mixed liquor recycle pumps are shut off. To allow flexibility for sludge reaeration, FBDA will also be installed in all of the new tankage.

This AS system described above will allow the CKWWTP flexibility to meet the current National Pollution Discharge Elimination System (NPDES) limits and accommodate seasonal variations in flows and loadings. To anticipate future regulatory changes, the AS system can be operated with longer solids residence times (SRTs) to accomplish nitrification. If an ammonia-nitrogen limit is not required in the future, the system can be operated with less aeration and shorter SRTs to reduce operating costs.

10.5 Mixed Liquor Channel

To convey mixed liquor to the new secondary clarifiers and to future clarifiers (see next section), the construction of a new mixed-liquor channel is recommended. A channel is preferable over a pipeline for mixed liquor conveyance because it can be kept aerated, is easier to maintain, and will have lower headlosses. The channel should be approximately 300 feet long, 10 feet wide, and 10 feet deep, and should extend from the center of the existing aeration basin pipe and equipment gallery to the proximity of the new final clarifier. The mixed liquor channel will be aerated and covered with grating. This channel will be designed to permit future extension when clarifiers are added farther to the north. Mixed liquor from the last pass of each aeration basin train will be combined in the new mixed liquor channel. The recommended location for the mixed liquor channel is shown in Figure 10-1.

10.6 Secondary Clarification

To provide capacity for the projected 2025 flows, two new clarifiers 100 feet in diameter (inside) and 18 feet deep will be necessary. Table 10-1 lists the 2025 design criteria for the existing and new secondary clarifiers.

While the plant has the capability to waste either mixed liquor or RAS, the recommended design is to normally waste the thicker RAS to maximize the sludge thickening capacity of the gravity belt thickener.

The two new secondary clarifiers, with an 18-foot sidewater depth, will be deeper than the existing clarifiers. This will increase the solids loading capacity of the clarifiers. Because of this, the design criteria in Table 10-1 assumes that the two new clarifiers will process a larger portion of the mixed liquor flow (60 percent). The new clarifiers will be located in the area directly north of the existing clarifiers.

10.7 Disinfection

Disinfection will continue to be provided by the ultraviolet (UV) system. The UV system, installed as part of the Contract I expansion, was designed to provide a total capacity of 34 million gallons per day (mgd). Therefore, no expansion of the UV system is required to treat the projected 2025 flows.

10.8 Outfall and Diffuser

Treated secondary effluent from the CKWWTP leaves the plant site through an existing 36-inch gravity outfall attached to a 30-inch diameter submarine diffuser. Previous hydraulic evaluation indicated that the diffuser and outfall have sufficient hydraulic capacity to convey the projected 2025 peak hour flow. Based on the results of a recent dilution study and reasonable potential calculations performed by the Washington State Department of Ecology (Ecology), no contaminant approached the maximum allowable limit at the current design flows. Dilution ratios for the 2025 projected flows need to be calculated to determine any needed modification of the diffuser.

10.9 Solids Handling

The solids stream at the CKWWTP includes septage handling, grit handling, and sludge thickening, digestion, storage, and disposal. Recommendations to improve and increase the capacity of these operations are identified in this section.

10.9.1 Septage Handling Facilities

The existing septage handling facilities are inadequate to handle the current volume of flow and extent of septage hauler traffic. Construction of a new septage receiving station is recommended.

Figure 10-1 shows the proposed location for the new septage receiving station on the hill southeast of the Vehicle Maintenance Building. This location was selected because it will remove the daily backlog of septic hauling trucks from the main operations area of the plant site, free up the truck bay under the Sludge Processing Building for drive-through access, and allow construction of a dual-bay receiving station. The new station should include the following features:

- A new on-site road and restricted access gate to access this area from the main entrance road.
- A dual-bay receiving area to allow two haulers to discharge simultaneously.
- Vendor package septage receiving units that include a card reader and automatic billing software, pH monitoring, flow measurement, a rock trap, and fine screening.
- Two 25,000-gallon buried septage holding tanks. Concrete aprons will slope drainage to an opening in the top of the tank, which will be covered by rock catchers. Also, the tanks will be cross-connected to minimize the possibility of overfilling.
- Solids handling pumps for transferring septage from one tank to another and pumping it to the septage grit removal system.
- An air handling unit (e.g., carbon filter, biofilter) to scrub odors produced as the receiving tanks are filled.
- Plumbing to allow septage to be routed at operator discretion to either the thickeners, the digesters, or the headworks.
- A dumpster to collect rags and other debris collected by the rock catchers.
- Process water wash facilities for maintenance.
- Three fixed-position video cameras to allowing site monitoring from the control room.

Septage will normally be pumped to the existing septage degritting facility in the gravity thickener control structure. The degritted septage will then be pumped to the gravity thickeners. To increase flexibility, options will be provided for pumping septage to the headworks and directly to the digesters. The existing septage receiving pit should be decommissioned and the mechanical equipment put to other use.

Grit will also be removed on a regular basis from the new septage receiving station storage tanks.

10.9.2 Sludge Thickening

One new gravity belt thickener, 3.1 meters (m), is recommended to augment the existing gravity thickeners (GTs). The new GBT will serve to thicken the WAS generated at the CKWWTP only. The existing GTs will remain in service to thicken the primary sludge and the septage. Hauled WAS from the County's other facilities will be directly introduced to the sludge blend tank prior to the digesters. This will reduce the hydraulic load to the GTs and keep the poor settling WAS out of these units. All thickened sludge streams will be combined and homogenized in the sludge blend tank prior to digestion.

The separation of WAS from the primary sludge should increase the concentration of the thickened solids from the gravity thickeners. Thus, the overall thickness of the solids sent to the digester should increase, resulting in an overall increase in the hydraulic capacity of the digesters.

The existing 45-foot-diameter GTs are estimated to each receive an average solids loading of 3.6 pounds per day (ppd)/sq ft per unit at 2025 under average annual conditions. The GBT is to be loaded at a rate of 4,435 ppd/m under average annual conditions. The proposed location for the new GBT building is east of the existing gravity thickeners, as shown in Figure 10-1.

10.9.3 Digesters

One new digester providing approximately 86,200 cubic feet of capacity is required for the projected 2025 solids loads. Table 10-1 lists the design criteria for the existing and new digesters. Only one additional digester is required for the 20-year design, provided that CKWWTP continues parallel operation of at least two digesters. Parallel digester operation will ensure that minimum SRTs are achieved, and having the third digester will allow for routine maintenance and cleanings to occur. Two digesters will be maintained in parallel operation at all times, with the third serving as either a digester or a storage tank as maintenance demands dictate.

For the projected 2025 solids loads, the increased digester capacity at the plant will provide for a 19-day SRT in all digesters at the peak 14-day condition and 30 days at average annual conditions. A minimum of 15 days SRT in each digester is desired so that the process can significantly reduce pathogens and mandatory pathogen monitoring is not required. Providing adequate residence time to achieve at least 38 percent reduction in volatile solids will meet the vector attraction requirements for Class B biosolids, when operated at 35°C.

The saturation-level development will require one additional digester. It is recommended that this future digester be constructed at a location south of the existing digesters in a linear layout, allowing for a central digester control and equipment building.

10.9.4 Sludge Disposal Facilities

Improvements to sludge storage, dewatering, composting, and ultimate disposal are necessary as the CKWWTP service expands. Each is discussed below.

10.9.4.1 Digested Sludge Storage

The third digester will serve in dual roles, primarily as a digested sludge storage tank prior to dewatering and secondarily as a digester when needed. While operating as a storage tank, the digester will serve as a sludge reservoir to the centrifuges rather than the operating digester, which is currently done. This mode of operation should provide more consistent liquid level control in the primary digesters.

Transient gas storage can be achieved in the storage digester by drawing down the liquid level through dewatering. Providing gas storage can reduce energy costs by having additional gas on hand for heating operations. However, using fixed-cover digesters for gas storage is not the most effective means. To mitigate the inefficiencies inherent in using a fixed-cover system, a dual fuel boiler system will be associated with the digestion system. During periods of insufficient gas production or high storage tank liquid levels, the boilers can be switched from biogas to fuel oil to generate heat. While there is an inherent cost associated with using fuel oil and the installation of a dual fuel source system, this approach avoids the cost of removing the cover from the storage tank and replacing it with a flexible membrane or floating cover system. Expansion of the facility beyond the 2025 construction period may warrant revisiting gas storage due to the possible addition of a fourth and fifth digester and/or sludge drying facility.

10.9.4.2 Sludge Dewatering

The existing dewatering facilities include a plate and frame filter press capable of dewatering sludge up to 25 percent solids content, and a newer centrifuge that serves as the primary means of dewatering all of the digested solids at the CKWWTP. The consistent performance of the centrifuge has relegated the plate and frame press to standby status. While this will significantly increase the life of the plate and frame press, the slow and labor-intensive nature of the equipment and the declining availability of parts suggest that it should eventually be replaced. Replacement will not only increase the reliability of the redundant unit, but also reduce labor costs through commonality of parts and process familiarity. Design criteria for the centrifuge and plate and frame press are listed in Table 10-1.

It is recommended to locate the replacement centrifuge in the location currently occupied by the plate and frame press: on the second floor of the Sludge Processing Building, alongside the existing centrifuge. Both the new and the existing centrifuges will be provided with ventilation hoods with air scrubbing capability.

10.9.4.3 Composting or Sludge Drying

The CKWWTP currently produces a Class B biosolids product through mesophilic anaerobic digestion. The County has contracted with several disposal sites over the years and has been able to dispose of its biosolids. In the event that regulatory or market conditions change, contingencies for either sludge drying or County- or contract-operated composting facilities should be provided in order to achieve a Class A biosolids product. The Class A product is much less restrictive to dispose of, especially if it meets the requirement of exceptional quality.

A dryer facility can be sited at the existing plant, south of the digesters, but would require construction of a new maintenance building and demolition of the existing maintenance building. The composting facility and the dryer should be further investigated to determine if they could serve as a regional facility servicing Kitsap County and surrounding communities. The type and magnitude of either regional facility should be thoroughly investigated to determine if the interest is there and if a regional (rather than local or contract-operated) facility for composting makes economic sense at the time of implementation.

The current climate would suggest that a plan providing maximum process flexibility is needed. At this time no single technology stands above the rest in determining which is appropriate for the County. Rather, a suite of technologies should be further evaluated to ensure that the County is in the best possible position to economically dispose of its biosolids in the future.

10.10 Odor Control

Odor control is currently provided at the gravity thickeners and the Solids Processing Building. In the future, foul air will be collected from the new headworks, the GBT building, and the septage receiving station, and treated with two new biofilters.

10.11 Cost Estimate for CKWWTP Facilities

Two separate construction projects are envisioned to construct all the new facilities required at the CKWWTP. The first project is called the Phase III Project and the subsequent project is called the Phase IV Project. The scheduling and sequencing of the Phase III Project are driven by rectifying existing deficiencies at the plant. The Phase IV Project is geared toward enabling the plant to provide capacity as future flows and loads increase.

Total project costs for the recommended improvements are summarized in Tables 10-2 and 10-3. Costs are presented in December 2007 dollars. A plan for financing these projects is presented in Chapter 11.

Table 10-2. CKWWTP Phase III Upgrade
Preliminary Capital Costs (2007$)

Major Design Elements	Cost Allocation[a]
Headworks	$2,811,508
Modify primary clarifier launders	$16,800
Modify aeration tankage (baffles, pumps, foam removal)	$723,256
RAS mixing box and new WAS pumps	$323,358
New septage receiving station	$428,170
GBT & building	$1,111,143
New anaerobic digester/existing digester modifications	$4,032,332
Odor control/biofilters	$419,706
Plant wastewater sump pumps	$110,000
Subtotal Construction Cost	$9,976,273
Demolition and abandonment	$164,669
Civil site work and yard piping	$2,889,252
Electrical	$3,864,750
I&C	$950,000
Base Construction Cost	$17,844,944
Contractor overall markups, general conditions[b]	$4,014,071
Escalation to midpoint construction[c]	$2,740,213
Subtotal	$24,599,227
Startup, training, and O&M (2%)	$491,985
Subtotal	$25,091,212
Construction contingency (35%)	$8,781,924
Subtotal	$33,873,136
Earthquake insurance (0.10%)	$33,873
Subtotal	$33,907,009
Bldg risk, liability, auto insurance (2.85%)	$966,350
Subtotal	$34,873,359
Performance bond (1%)	$348,734
Subtotal	$35,222,093
Payment bond (1%)	$352,221
Subtotal	$35,574,313
Construction change orders (5%)	$1,695,350
Subtotal	$37,269,664
Sales tax (8.6%)	$3,205,191
Total Construction Cost	$40,474,855
Engineering, Legal, Administration (30%)	$12,142,457
TOTAL PROJECT COST	$52,617,312

[a] Based on cost estimate by Brown and Caldwell dated October 8, 2007, with updates made to the costs of the aeration basin modifications and digester modifications, and estimated costs for the GBT and building (GBT cost per vendor quote).

[b] Includes labor markup (18%), material markup (15%), subcontractor markup (5%), equipment markup (15%), material shipping & handling (4%), workers travel and subsistence (1%), and contractor general conditions (12%).

[c] Includes escalation to midpoint construction for labor (11.7%), for material (21.3%), and for subs and equipment (11.7%).

Table 10-3. CKWWTP Phase IV Upgrade Preliminary Capital Costs (2007$)	
Major Design Elements	Cost Allocation[a,d,e]
New primary clarifiers	$2,724,226
New blower	$118,445
Mixed liquor channel	$507,620
New secondary clarifiers (2)	$2,876,512
One new GBT-not needed for 2025	$0
New digesters (2)-not needed for 2025	$0
One new centrifuge	$1,167,526
Expand process water system	$135,365
Upgrade lab, build new Admin. Bldg and new Storage Bldg.	$3,045,719
Subtotal Construction Cost	$10,575,412
Demolition and abandonment	$174,558
Civil site work and yard piping	$3,062,770
Electrical	$4,096,853
I&C	$1,007,054
Base Construction Cost	$18,916,648
Contractor overall markups, general conditions[b]	$4,255,141
Escalation to midpoint construction[c]	$2,904,780
Subtotal	$26,076,569
Startup, training and O&M (2%)	$521,531
Subtotal	$26,598,101
Construction contingency (35%)	$9,309,335
Subtotal	$35,907,436
Earthquake insurance (0.10%)	$35,907
Subtotal	$35,943,343
Bldg risk, liability, auto insurance (2.85%)	$1,024,385
Subtotal	$36,967,729
Performance bond (1%)	$369,677
Subtotal	$37,337,406
Payment bond (1%)	$373,374
Subtotal	$37,710,780
Construction change orders (5%)	$1,797,167
Subtotal	$39,507,947
Sales tax (8.6%)	$3,397,683
Total Contruction Cost	$42,905,631
Engineering, Legal, Administration (30%)	$12,871,689
TOTAL PROJECT COST	$55,777,320

[a] Based on cost estimate by Brown and Caldwell dated October 8, 2007, with updates made to the costs of the aeration basin modifications and digester modifications, and estimated costs for the GBT and building (GBT cost per vendor quote).

[b] Includes labor markup (18%), material markup (15%), subcontractor markup (5%),equipment markup (15%), material shipping & handling (4%), workers travel and subsistence (1%), and contractor general conditions (12%).

[c] Includes escalation to midpoint construction for labor (11.7%), for material (21.3%), and for subs and equipment (11.7%).

[d.] Based on Seattle ENR of 8618 (December 2007).

[e.] Additional factor to multiply old ENR indicies by is 1.25.

10.12 Schedule For Recommended Facilities

A schedule for expansion of CKWWTP facilities and a summary of costs are provided in Table 10-4. The estimated duration for predesign, design, and construction for each of the CKWWTP contracts is also summarized. Three months is expected for contractor bidding for each contract.

Table 10-4. Summary of CKWWTP Contracts

Contract number	Project description	Start date	End date	Date of midpoint	Project costs, December 2007[a]
III	Plant Upgrade				$52,620,000.00
	Predesign[c]	-	-	-	
	Design	Mar 2008	Aug 2009	Dec 2008	
	Construction	Dec 2009	Dec 2011	Dec 2010	
IV	Plant Expansion				$55,780,000.00
	Predesign	May 2010	Jan 2011	Oct 2010	
	Design	Mar 2011	Sep 2012	Dec 2011	
	Construction	Dec 2012	Dec 2014	Dec 2013	

[a] *Present value for ENR = 8618 for December 2007.*

[b] *Future value determined assuming 5 percent annual inflation rate.*

[c] *Predesign is complete.*

11. POTENTIAL FUNDING STRATEGIES

Existing funding mechanisms for wastewater improvements are limited, but many opportunities are available or can be made available. Table 11-1 summarizes a number of these existing opportunities and includes a description, maximum possible funding, requirements for voter approval, whether they are currently utilized, and any specific issues with their usage. Implementation of these strategies could raise additional revenue, but some would affect land use and zoning designations. These funding strategies are analyzed at a planning-level and will allow Kitsap County to achieve a balance between land use, wastewater finance, and level-of-service standards.

Table 11-1. Potential Revenue Sources

Funding Option	Description	Maximum Funding (over 20 years)[a]	Voter Approval Required?	Currently Utilized?	Usage Issues
Reallocation of Existing Revenues					
General Fund	Move funding from other departments to fund wastewater projects.	Unknown	No	No	Requires significant cuts in other departments and programs and level-of service.
Wastewater Improvement Fund	Move funding within the Capital Facilities Plan (CFP) to fund specific projects.	$5.4M [A]	No	Yes	Funds are collected from Newcomer's Assessments to expand treatment capacity for new users.
Wastewater Construction Fund	Move funding within the CFP to fund specific projects.	$15.3M [A]	No	Yes	Funds are collected from operating transfers, Improvement Funds, loan proceeds, and a portion of other sewer service revenues.
Real Estate Excise Tax (REET)	Dedicate some portion of future funding from this revenue stream to wastewater projects.	$8.7M - $15.4M [A]	No	No	REET funding is currently used for a wide number of facility projects. The low end of the range is based upon Board of County Commissioner policy of maintaining a surplus equal to the previous year's bonding obligations. The high end of the range would require that policy to be discontinued.

Table 11-1. Potential Revenue Sources

Funding Option	Description	Maximum Funding (over 20 years)[a]	Voter Approval Required?	Currently Utilized?	Usage Issues
Tax Increases					
Utility Local Improvement District (ULID)	The maximum amount of a ULID is unlimited with funding coming from voter-approved assessments on properties within specified district.	Dependent on specific capacity project costs	Yes	Yes	Requires majority vote from property owners representing 60% of the assessed value within specified district.
Other Mechanisms					
Federal Grants	Grant funding from the federal government. Programs include: ▪ USDA Water & Waste Disposal Grant ▪ EPA Public Works Construction Grant ▪ HUD Brownfields Economic Development Initiative ▪ State and Tribal Assistance Grants	Variable by program and eligibility criteria. Average community grant eligibility is roughly $600,000 per project, with limit typically $1M per project	No	No	These are competitive, and decision criteria often require declared environmental hazard and/or depressed economic conditions.
State Grants/Loans	Grant funding from Washington State. Programs include: ▪ Centennial Clean Water Fund ▪ Public Works Trust Fund ▪ Clean Water Revolving Fund ▪ Reclaimed Water Grants ▪ Budget Earmarks	CCWF – Limit $5M per project, 0-100% Grant. SRF – Loan limit 50% of Fund to any one Applicant. FY2008 program is $45.2M. PWTF – Up to $1M for design and $10M for construction loans per biennium.	No	Yes	Many are competitive with many jurisdictions seeking the same funding. Grants are comparatively small, and programs are primarily low interest rate loans. Greater hardship results in lower interest rate or lower matching funds requirement.
Land Use Measures – Reduce UGA Size	Urban growth areas (UGAs) could be contracted to reduce required capacity improvements.	Dependant on land use model	No	No	Requires amendment to Countywide planning policies, Countywide Comprehensive Plan, and environmental impact statement.

Table 11-1. Potential Revenue Sources

Funding Option	Description	Maximum Funding (over 20 years)[a]	Voter Approval Required?	Currently Utilized?	Usage Issues
City annexations / Incorporation	Much of the proposed UGA boundaries are expected to be incorporated during the 20-year planning period. As these wastewater systems leave County jurisdiction, the responsibility for their funding moves to the respective city.	Dependant on projected costs for UGA specific collection system	No	Yes	Requires property owner majority approval of annexation/ incorporation.
Developer Extensions	Extension and improvements to the wastewater conveyance system would be borne upon developments.	Dependent on specific capacity project costs.	No	Yes	Expensive and requires the ability and mechanisms to achieve higher density in the UGAs.
Connection Fees	Extension and improvements to the wastewater conveyance and treatment system would be borne by fees charged to properties connecting to the system.	Dependent on specific project costs.	No	Yes	Funds are collected as properties are developed which reimburses original source of capital.

[aA]*Gross estimates in 2007 Dollars.*

This document plans for the installation of additional wastewater conveyance infrastructure to serve the Silverdale and Central Kitsap UGAs. When implemented, the additional pump stations and force mains will facilitate the installation of conveyance systems into currently unsewered areas and will reduce the costs of those conveyance systems. In accordance with Comprehensive Plan policies, Kitsap County will continue to explore funding options to implement the plans set forth in this document and extend public sewer throughout the UGAs.

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APPENDIX A – GLOSSARY OF TERMS

GLOSSARY OF TERMS

Anaerobic: An environment devoid of oxygen and nitrate.

Anoxic: An environment devoid of oxygen where nitrate acts as the electron acceptor.

Aquiclude: A geologic formation which, although porous and capable of absorbing water slowly, will not transmit it rapidly enough to furnish an appreciable supply for a well or spring. The permeability is so low that, for all practical purposes, water movement is precluded or severely restricted.

Aquifer: A porous, water-bearing geologic formation. Generally restricted to materials capable of yielding an appreciable supply of water.

Average Design Flow (ADF): The average monthly flow of the maximum month, estimated for the design year of the wastewater facility. The ADF typically occurs during wet weather.

Average Dry Weather Flow (ADWF): Average dry weather flow is the monthly average 24-hour flow during a dry weather flow period.

Biochemical Oxygen Demand (BOD_5): The quantity of oxygen required to support biological oxidation of the organic matter contained in wastewater. Usually referred to as BOD, this characteristic defines the strength of a wastewater and often determines the type and degree of treatment which must be provided to produce a required effluent quality. BOD is commonly expressed as the amount of oxygen utilized in the oxidization of organic matter over a five-day period at 20 degrees C.

Carbonaceous Biochemical Oxygen Demand (CBOD): Similar to biochemical oxygen demand, except that nitrification is excluded, typically by using inhibiting agents.

CKWWTP: Central Kitsap Wastewater Treatment Plant.

Combined Sewer: A sewer which receives both wastewater and storm or surface water.

Commercial Wastewater: Wastewater generated in predominantly business or commercial districts, including both sanitary wastes and wastes from the commercial activities. Typically, commercial wastewater includes wastes from restaurants, laundromats, and service stations.

Denitrification: Removal of nitrogen from wastewater by convection of nitrate into nitrogen gas under anoxic conditions.

DOE: See "WDOE."

Domestic Wastewater: Wastewater principally derived from the sanitary conveniences of residences or produced by normal residential activities.

Dry Weather Flow: Wastewater flow during periods of little or no rainfall. Rates of flow exhibit hourly, daily, and seasonal variations. A certain amount of infiltration may also be present. See also "Average Dry Weather Flow" and "Peak Dry Weather Flow."

EPA: The United States Environmental Protection Agency.

gpcd: Gallons per capita per day.

Hydrogen Sulfide: A potentially toxic and lethal gas (chemical symbol H2S) produced in sewers and digesters by anaerobic decomposition. Detectable in low (<0.01 percent) concentrations by its characteristic "rotten egg" odor, it deadens the sense of smell in higher concentrations or after prolonged exposure. Respiratory paralysis and death may occur quickly at concentrations as low as 0.07 percent by volume in air.

Infiltration: The quantity of ground water that leaks into the wastewater collection system from the surrounding soil. Common points of entry include broken pipes and defective joints in the pipe or in walls of manholes. Infiltration may result from sewers being laid below the ground water table or from saturation of the soil by rain or irrigation water.

Inflow: Rainwater which enters the collection system through roof drain connections, catch basin connections, and holes in the tops of manhole covers in flooded streets. Inflow is generally distinguished from infiltration by the rapidity with which inflow begins and ends after a period of rainfall. Infiltration, on the other hand, may persist for an extended period after a rainfall.

Interceptor: A sewer that receives flow from a number of main or trunk sewers, force mains, etc. Minimum peak design flow should be not less than 250 percent of the average day wet weather design flow.

Lateral: A sewer that has no other common sewers discharging into it. Minimum peak design flow should be not less than 400 percent of the average day wet weather design flow.

Main: A sewer that receives flow from one or more submains. Also referred to as "trunk." Minimum peak design flow should be not less than 250 percent of the average day wet weather design flow.

Maximum Daily Flow (MDF): The largest estimated flowrate sustained over a 24-hour period in the design year of the wastewater facility.

mgd: Million gallons per day.

mg/l: Milligrams per liter. See also "ppm."

Nitrification: The process of converting organic and ammonia-nitrogen into nitrate nitrogen by nitrifying autotrophic bacteria.

Nitrogen: An essential nutrient that is often present in wastewater as ammonia, nitrate, nitrite, and organic nitrogen. The concentrations of each form and the sum, total nitrogen, are expressed as mg/l elemental nitrogen. Also present in some ground water as nitrate and in some polluted ground water in other forms.

Peak Design Flow (PDF): The largest estimated flow rate sustained over a 60-minute period in the design year of the wastewater facility. The PDF is, therefore, the PWWF in the design year.

Peak Dry Weather Flow (PDWF): Peak dry weather flow is the rate of flow during the peak hour during a dry weather flow day.

Peak Wet Weather Flow (PWWF): The rate of flow during the peak hour of a wet weather day. Also referred to as the peak design flow.

pH: A measure of the hydrogen-ion concentration in a solution, expressed as the logarithm (base ten) of the reciprocal of the hydrogen-ion concentration in gram moles per liter. On the pH scale (0-14), a value of 7 at 25°C represents a neutral condition. Decreasing values, below 7, indicate increasing acidity; increasing values, above 7, indicate increasing alkalinity.

Phosphorus: An essential chemical element and nutrient for all life forms. Occurs in orthophosphate, pyrophosphate, tripolyphosphate, and organic phosphate forms. Each of these forms is expressed as mg/l elemental phosphorus.

ppm: Parts per million.

Revised Code of Washington (RCW): Document which consists of laws passed by the State legislature.

Sewerage: A complete system of piping, pumps, basins, tanks, unit processes, and appurtenances for the collection, transporting, treating, and discharging of wastewater. Term is declining in use, generally being replaced by sewer system or wastewater facilities.

Submain: A sewer that receives flow from one or more lateral sewers. Minimum peak design flow should be not less than 400 percent of the average day wet weather design flow.

Suspended Solids: The suspended material transported in wastewater. The quantity of suspended material removed during treatment varies with the type and degree of treatment and has an important bearing on the size of many mechanical and process units. Also referred to as "Total Suspended Solids (TSS).

Total Suspended Solids (TSS): See "Suspended Solids."

Trunk: A sewer that receives flow from one or more submains. Also referred to as "main." Minimum peak design flow should be not less than 250 percent of the average day wet weather design flow.

Volatile Suspended Solids (VSS): The organic portion of the total suspended solids which will oxidize and be driven off as a gas at 600°C. VSS typically represents 75 to 85 percent of the TSS for digested and undigested sludge.

Washington Administrative Code (WAC): Document which consists of regulations adopted by the state to carry out the RCW.

Wastewater: Water-carried wastes from residences, businesses, institutions, and industrial establishments, together with such ground and storm waters as may be present.

Wastewater Treatment Plant (WWTP): A water pollution control facility engineered and constructed to remove pollutants from wastewater. Also referred to as a sewage treatment plant.

WDOE: The Washington State Department of Ecology.

Wet Weather Flow: Wastewater flow during or following periods of moderate to heavy rainfall. Inflow may increase the wet weather flow to a rate many times greater than the dry weather flow, and unless provided for in sewerage design, can produce hydraulic overloads resulting in wastewater overflows to streets or water courses.

APPENDIX B – GEOLOGY, GROUNDWATER AND SOILS CHARACTERIZATION

APPENDIX B

GEOLOGY, GROUND WATER, AND SOILS CHARACTERIZATION

Geology

Geologic formations, particularly those near the surface, as well as the surface soils themselves, are significant factors in the design and construction of pipelines, structures, and submarine outfalls. They are also factors relevant to the suitability of on-site and land application waste disposal alternatives.

The geologic information presented herein is based on four principal documents: "Soil Survey of Kitsap County Area, Washington," by the National Cooperative Soil Survey, 1977; "Kitsap County Ground Water Management Plan" (Kitsap County GWMP), Kitsap County Ground Water Advisory Committee, 1989; "Quaternary Geology And Stratigraphy of Kitsap County, Washington" (Masters Thesis, 1979), by Jerald D. Deeter; and "Proposed Revision of Nomenclature for the Pleistocene Stratigraphy of Coastal Pierce County, Washington," by John B. Noble, February 1990.

The Kitsap planning area is located in the Puget Sound Lowland Between the Olympic Mountains on the west, and the Cascades Mountains on the East. This area is part of a large glacial drift plain developed by repeated glaciations during the past 1.5 million years (Pleistocene epoch). At least five continental ice sheets occupied the Puget Lowland. The youngest of these, The Vashon Lobe of the Fraser Glaciation, receded approximately 15,000 years ago.

Each glacier was responsible for depositing varying assortments of till, (hardpan), outwash sand and gravel, and glacial lake sediments. The glacial cycles were separated by long periods of non-glacial alluvial and fluvial deposition. Consequently a very complex sequence of unconsolidated sediments was deposited in the Kitsap planning area. These Pleistocene unconsolidated deposits range from a few feet to over 3600 feet in thickness and overlay an irregular bedrock surface.

The glacial deposits have been divided into four major stratigraphic units:

- Vashon Drift
- Possession Drift
- Whidbey Formation
- Double Bluff Drift

The underlying bedrock, or non-glacial units, include:

- Tertiary Sedimentary Rock--Blakeley Formation
- Tertiary Volcanic Rock--Crescent Formation

Not all units are present at all locations in the planning area and there is disagreement as to exact identification/correlation of some or parts of these units. Figure 1 is a generalized geologic map indicating the surficial distribution of the major units in the Kitsap planning area. Table 1 provides geologic names and correlations for the map units shown on Figure 1.

Vashon Drift. The most extensive unit exposed in the planning area, the Vashon Drift is composed of three distinct sub-units:

- Vashon Recessional Outwash
- Vashon Till
- Vashon Advance Outwash (Colvos Sand)

The recessional outwash is composed of sand, silt and gravel. These deposits, which average only ten feet thick, are found at scattered locations throughout the planning area.

Exposed at the surface throughout most of the planning area and underlying the Vashon recessional outwash, where present, is the Vashon till (hardpan). It consists of very dense, poorly sorted clay, silt, sand and gravel. This till averages about 40 feet in thickness but may be as much as 80 feet thick in some locations. It is an important unit because it is often the first barrier to the downward movement of ground water and contaminants.

Below the till is the Colvos Sand member of the Vashon Drift. It consists of loose, well sorted sand with occasional gravel beds. In some areas it includes a distinctive basal clay layer. The Colvos has an average thickness of about 60 feet but can range from a few feet to over 200 feet thick. This extensive unit is usually the first significant aquifer encountered.

Discovery nonglacial unit. This layer consists of gravels deposited during the Olympia interglacial period (Noble 1990), interspersed with thin lenses of discontinuous silt and clay. These gravels are oxidized from orange to a dark red and are frequently cemented. Thickness varies from 10 to 100 feet.

Possession Drift. Underlying the deposits of the Discovery nonglacial unit (Olympia Interglacial Deposits) are the compact, nonsorted, nonstratified till and glacial marine deposits of the Possession Drift. The deposits consist mainly of oxidized sand and gravel but also include thin, discontinuous layers of interbedded silt, fine-grained sand, and peat. Thickness ranges from 10 feet to over 150 feet. The sand and gravel deposits yield minor amounts of groundwater.

Whidbey Formation. The Whidbey Formation stratigraphically underlies the Possession Drift but is not continuous over the entire planning area. It is primarily a finely laminated silt and clay with occasional peat beds. The formation is normally of low permeability and acts as a protective barrier between the upper and lower aquifers. It yields no groundwater. Average thickness of the unit is 65 feet and in some areas is over 150 feet thick.

Double Bluff Drift. This formation underlies the Whidbey Formation and is composed primarily of stratified sand and gravel but may contain some silt, clay, and till layers. It has an average thickness of 50 feet but can be more than 150 feet in some areas. This unit yields good quantities of ground water, often under artesian pressure.

Tertiary Sedimentary Rock-Blakeley Formation. The Blakeley Formation is a steeply dipping collection of consolidated conglomerate, sandstone and shale of marine and non-marine origin. The formation is highly fractured and jointed with weathering common at the surface. Surface exposure is limited to the southern portions of Kitsap County. The formation has a maximum thickness of about 300 feet.

Tertiary Volcanic Rock-Crescent Formation. Volcanic rock, mainly fine grained basaltic lava flows and coarse grained diorite and gabbro intrusions underlie the Blakeley Formation. These rocks correlate to The Crescent Formation found on the Olympic Peninsula. Like the Blakeley Formation, surface exposure occurs in the southern portion of the county. The formations thickness is unknown.

Ground Water

The presence and location of ground water and surface water have an impact both on the suitability of land for drainfields, and on the construction of wastewater conveyance structures and pipelines. Since minimum separation of drainfields from ground-water tables must be observed, a high ground-water table can prevent or greatly increase the cost of constructing on-site disposal systems for wastewater. At present, Kitsap County Health Department utilizes the EPA Design Manual, "Onsite Wastewater Treatment and Disposal Systems," which requires a minimum of two to four feet of separation between the ground-water table and the bottom of the drainfield.

A high ground-water level can also add significant costs for underground construction of structures and pipelines. This is due to expensive dewatering, shoring, and waterproofing requirements that might not otherwise be required.

A geological survey of the Kitsap Peninsula, (U.S. Department of Interior, 1980) and the Kitsap County GWMP, 1989, identified ground water in both unconsolidated deposits and consolidated rock. In the Kitsap planning area, only the unconsolidated deposits contain significant ground-water resources. These unconsolidated deposits may be as much as 3,000 feet deep and are divided into glacial and nonglacial units. Local precipitation is considered to be the source of most of this water.

Hydrostratigraphic Units

The term hydrostratigraphic unit refers to a grouping of sediments, both vertically and horizontally, deposited at approximately the same time, in a similar environment, and exhibiting the same physical and hydrological characteristics. When these deposits are permeable and yield useable quantities of water when tapped by a well they can be classified as an aquifer. On the other hand, when they have low permeability, and impede the flow of water, they can by classified as an aquitard.

It is desirable to protect aquifers, particularly those used as drinking water sources, from contamination from subsurface disposal of wastewater. Generally, the aquifers near the surface are most susceptible to this type of contamination. Deeper aquifers are generally protected by aquitards layered between aquifers. Sections A through D show the stratigraphic layers and their relationship to the hydrostatic units described below.

Thirteen units having similar water bearing characteristics were identified and assigned a stratigraphic symbol in the Kitsap County GWMP. The use of geologic unit names (i.e. Vashon Till) were avoided due to "the uncertain state of the stratigraphic nomenclature at this time" However, a tentative correlation with published nomenclature is provided in Table 1. In the Kitsap planning area twelve units have been identified and illustrated as aquifers and aquitards in cross-sections, Figures 2 to 5. Refer to Figure 6 for location of cross-sections. Refer to Table 1 for name and correlation of hydrostratigraphic units.

It is important to note that, because of the complex nature of the deposits, some units described in Table 1 can contain both aquifers and aquitards. The following are the hydrostratigraphic units in the GWMP for the Kitsap planning area:

Unit Qgl (Aquifer/Aquitard). This unit is Vashon glacial drift and is found as a veneer of till throughout the county and covers the largest land area of all the various units. Thickness varies considerably up to 200 feet. Included in this unit are the Vashon recessional deposits and all younger deposits. Minor amounts of ground water are found in perched aquifers in this unit and some recent alluvium in valley floors. (GWMP,1989)

Unit Qg1a (Aquifer). This unit was deposited during the last (Vashon) glaciation by meltwaters from the advancing ice sheet. It is up to 250 feet thick, and comprised of sand, and sand and gravel. It correlates with the Colvos and Esperance Sands.

Unit Qn2 (Aquitard). This interglacial deposit is fine grained with a thickness up to 150 feet. This unit has been designated as the Discovery formation by Noble (1990). This unit is generally an aquitard.

Unit Qg2 (Aquifer/Aquitard). This formation is a poorly sorted deposit of sand, gravel, silt and clay. It is generally found at an elevation of 100 to 300 feet above sea level and a thickness of up to 150 feet. The unit is not very extensive but found sporadically throughout the study area. Some times identified as the Mid-Cliff Drift, it likely correlates to the Possession Drift (Easterbrook and others, 1967). This unit produces a minor amount of ground water.

Unit Qn3 (Aquitard). This interglacial deposit, up to 300 feet thick, is comprised of fine grained sand, silt, clay, and some peat. It is found intermittently throughout the county. It is likely correlated to the Kitsap and Whidbey formations, to the south and north.

Unit Qg3 (Aquifer). This very extensive unit is composed of sand, sand and gravel, and till of the third oldest glacial episode. The unit is up to 200 feet thick and found between 200 feet above and below sea level. It is tentatively correlated with the Double Bluff Drift formation to the north. It contains the Kitsap planning area's primary water supply source.

Unit Qn4 (Aquitard). This nonglacial unit represents the deposits of the third interglacial period. This unit is extensive, fine grained, and up to 200 feet thick. It is correlated, (Noble, 1989), to the Clover Park formation. This unit does not produce significant ground water.

Unit Qg4 (Aquifer/Aquitard). This unit is a complex mixture of sand and gravel interbedded with fine grained glacial lake deposits. The unit is up to 150 feet thick and found throughout the county area. It is associated with the fourth oldest glacial event. This unit produces moderate amounts of ground water. Interbedded within this unit is a significant marine or glaciomarine deposit with a thickness of up to 100 feet. It is designated as Qg4m.

Unit Qn5 (Aquitard). This formation is fine grained, consisting of silt and clay with occasional peat and wood fragments. The unit is thought to be up to 600 feet thick. It is designated as the fourth interglacial deposit. It is generally not a productive source of ground water.

Unit Qg5 (Aquifer). This unit, located 600 to 800 feet below sea level is the oldest glacial unit in the planning area. The areal extent is unknown and has a maximum thickness of 100 feet. This unit is very productive and a major ground-water source.

Unit Tb (Aquitard). This unit is the Blakely Formation and consists of a thick sequence of marine and non-marine sedimentary rock. This unit is not a source of significant ground water.

Ground-Water Occurrence

Shallow and perched ground water could limit on-site disposal options and create dewatering problems for facility and pipe line construction. In the Kitsap planning area, ground water could possibly occur in shallow excavations in unit Qg1 containing perched aquifers, and in very deep excavations into unit Qg1a. The extent of the water-supply aquifers shown on Figure 6 are defined based on current ground-water production and may not represent the actual extent of the aquifers in the subsurface. Information about the location and extent of shallow and perched aquifers is not available and must be addressed on a site-specific basis.

In or near the project area, 11 primary water-supply ground-water systems (aquifers) have been identified. The location of these aquifers are shown on Figure 6.

The Bangor Aquifer System is the largest system in Kitsap County. It is a two aquifer system. The shallow aquifer is found at an elevation approximately 25 feet above sea level to 25 feet below sea level and is within units Qg3 and Qn2. The Qn2 unit is much coarser grained in this section of the county and yields significant quantities of ground water to wells. The deeper aquifer is located within unit Qg4 at an elevation between 50 and 250 feet below sea level. The system boundaries are well defined to the east, but not defined to the north and south.

The Big Beef Aquifer System, in western Kitsap County, is described as one of the most productive and least exploited aquifers in the county (Kitsap Co. GWMP, 1989). The aquifer is encountered between 100 and 250 feet below sea level in unit Qg4. The lateral extent of this aquifer is poorly defined and may extent a much greater distance to the south.

The Bucklin Hill Aquifer is a deep system encountered in the silty sand and gravels of unit Qg5. The system is found between elevations of 400 and 700 feet below sea level. The boundaries are well defined to the north and east but poorly defined else where.

The Edgewater Aquifer System is located in sand and gravel deposits of unit Qg3 and occurs between an elevation of 150 feet below sea level to 200 feet above sea level. Productivity of the Edgewater aquifer varies from moderate to high. The areal extent is relatively small and the boundaries are not well defined and may be a continuation of the upper Bangor aquifer to the south.

The Island Lake Aquifer is a small system encountered in the sand and gravel of unit Qg3. It generally occurs between sea level and 150 feet above sea level. Wells in the Island Lake aquifer are very productive. The areal extent of the system is controlled by topography with topographic lows to the north and south and probably to the east and west as well.

The Keyport Aquifer System is encountered in the sand and gravel deposits of units Qq5 and Qn6 at a depth of 675 to 800 feet below sea level. Because of the greater depth of this system, the areal extent is not well-defined. Wells that do penetrate into the aquifer are very productive.

The Poulsbo Aquifer system is encountered in the sands and gravels deposit of unit Qg2. It generally occurs between 175 feet above sea level and sea level. The boundaries of the aquifer are not well defined to the north and appear to be controlled by topographic lows to the south and east, and to the southeast by subsurface changes in the geology.

The Silverdale Aquifer System is a moderately productive system generally encountered between sea level and 250 feet below sea level. This system is contained within unit Qg4. The lateral extent is poorly defined.

The Suquamish-Miller Bay Aquifer System occurs in unit Qg3 near sea level to approximately 300 feet below sea level and should not be a factor in facility construction. The Aquifer is characterized as being variable in thickness and productivity. The East-West boundaries are well defined from well log information while the North-South boundaries are less clear.

The Gilberton-Fletcher is a two aquifer system in eastern Kitsap county. The upper aquifer is generally encountered between 300 and 475 feet below sea level within unit Qg4. The deeper aquifer is encountered within unit Qg5, 575 to 650 feet below sea level. The deeper aquifer is the most productive of the two. Because of the lack of deep wells in the area, the boundaries of the system are not well defined.

The Manette-Bremerton North Aquifer system is a relatively large aquifer in the south eastern section of the project area. It is generally encountered in sand and gravel of unit Qg3 from sea level to 250 feet below sea level. The boundaries are not well defined.

Ground-Water Flow Systems

Ground-water recharge is principally in the topographic highlands and results from infiltration of precipitation. Discharge is to surface-water bodies, i.e. Puget Sound, Hood Canal, Dyes Inlet and Liberty Bay. A ground-water-elevation contour map for the project planning area, (Kitsap County GWMP,1989), is presented in Figure 6. Shown in this map is the general water level elevations and direction of ground-water flow in the primary supply aquifer. This flow is generally consistent with surface topography.

Ground-water flow data are not available for any shallow or perched aquifers. However, flow is typically from topographic high to topographic low areas.

Ground-Water Quality

A water quality analysis was conducted on a large number of wells for the portion of Kitsap county located in the project area (Kitsap County GWMP,1989). No significant trends were calculated for any of the indicator parameters. These tests however did not include biologic indicators. Iron and manganese levels were found to be higher than secondary standards in several of the wells and one well was found to contain higher levels of arsenic.

An impact on water quality in the shallow or perched aquifers of units Qgl and Qgla could be possible due to facility construction and operation or on-site waste disposal systems. Because of the extensive protection provided by unit Qn2 and Qn3, it is unlikely that any significant impact would occur to the primary water-supply aquifers.

Generally, recharge potential and aquifer vulnerability for most of the project study area is ranked low to medium. (Kitsap County GWMP,1989). This is due to lower precipitation and/or low soil permeability. Areas in the project with higher soil permeability may require further study and monitoring. See Table 2 for soil permeability information and Figure 8 for soil infiltration characteristics.

Geotechnical Suitability

Figure 7 provides a generalized map outlining the geotechnical suitability of the soils with regards to the potential for differential settlement, relative slope stability, and seismic hazard. The criteria for ranking in each category are as follows:

Relative Potential for Differential Settlement.

1	LOW	Usually includes areas of till or areas of dense sand, gravel, silt or clay.
2	MODERATE	Usually includes areas of Recessional outwash.
3	HIGH	Usually includes areas of recent alluvium, swamps, and artificial fill.

Relative Slope Stability.

1	STABLE	Slopes generally less than 15 percent, surface often underlain by glacial till.
2	MODERATE	Stable slopes generally greater than 15 percent, surface often underlain by well drained sand and gravel.
3	UNSTABLE	Slopes usually greater than 15 percent, surface often underlain by saturated sand on top of impermeable layer. Includes areas of recent and past landslides.

Seismic Hazard.

1	LOW	Generally includes areas of dense gravel or till.
2	MODERATE	Generally includes areas of medium dense sand, gravel, or silt and/or clay.
3	HIGH	Generally includes areas of loose sand or gravel, peat, artificial fill and landslide material.

Waste-water facilities located in moderate-to-high/unstable-ranked areas will typically require more extensive site investigation and cost more for construction.

<u>Surface Soils</u>

Perhaps one of the most important factors in considering facilities planning for sewerage is the type and distribution of the various soils in the project area. In mapping Kitsap County, the SCS identified 28 soils series divided into 63 soils types or phases based on slope, wetness, stoniness, salinity, degree of erosion, permeability, hydrologic group, and other characteristics that affect their use. These characterizations are for soils at depths of 6 to 8 feet from the ground surface.

Ground slope affects the suitability of an area for subsurface disposal of wastewater. Generally, very flat areas are susceptible to low runoff rates and ponding of stormwater, thereby saturating soils and restricting their treatment capacity.

Soils that exhibit very high or very low permeability rates limit the use of subsurface disposal of wastewater. High permeability soils allow septic tank effluent to rapidly infiltrate towards the ground-water table, minimizing filtering and effective treatment of surface soils and minimizing surface evaporation. Low permeability soils tend to cause septic effluent to accumulate and to saturate soils, thereby reducing treatment effectiveness.

The hydrologic soil groups refer to their runoff/ infiltration characteristics and are based on the soil's inherent capacity, irrespective of vegetation, to permit infiltration. Figure 8 shows the hydrologic groups for the project area. The soils listed are assigned to four groups, Group A to Group D.

Group A soils have a high infiltration rate and are mainly deep, well drained, and sandy or gravelly. These soils could present a high risk to ground-water contamination if pipeline or facility leaks or spills should occur. These areas are generally unsuitable for subsurface disposal of sewage, since the rapid infiltration of rainwater would tend to flush effluent through the soils.

On the low end are Group D soils. They have a very slow infiltration rate, generally have a claypan or clay layer near the surface, and/or have a permanent high water table. These soils are generally unsuitable for subsurface disposal of wastewater and are a prime factor in failing septic systems due to surfacing effluent.

Table 2 provides a brief description of each soil type, the underlying geologic association, permeability, hydrologic grouping and general soil suitability information for septic tank fields and building site development for these soils. In Table 2, limitations are considered "slight", "moderate", or "severe" depending on the favorability of the soil properties, site features and construction cost considerations. Special feasibility studies may be required where the soil limitations are severe. This table also lists the major restrictive soil features for each application.

TABLE 1

NOMENCLATURE AND REGIONAL CORRELATION OF STRATIGRAPHY

UNIT	HYDROSTRATIGRAPHIC DESCRIPTION	GEOLOGIC MAP UNIT(s)	REGIONAL CORRELATION
Qn1	Recent alluvium and peat deposits	Qa1,Qa2,Qps Qb,Qt	Quaternary alluvium
Qg1	glacial till	Qvr,Qvrs,Qvrg Qvrd,Qvi, Qvt	Vashon till
Qg1a	advance deposits	Qve2,Qve1 Qvad,Qvl	Colvos sand,Esperance sand
Qn2	First interglacial deposits	Qs	Discovery nonglacial unit (Noble 1990)
Qg2	Second glacial deposits	Qp	Possession Drift
Qn3	Second interglacial deposits	Qw	Whidbey Formation/Kitsap Formation
Qg3	Third glacial deposits	Qdb	Double Bluff Formation
Qn4	Third interglacial deposits	Not Mapped	Uncertain
Qg4	Fourth glacial deposits	Not Mapped	Uncertain
Qn5	Fourth interglacial deposits	Not Mapped	Uncertain
Qg5	Fifth glacial deposits	Not Mapped	Uncertain
Tb	Tertiary sedimentary rock	Tb	Blakeley Formation

TABLE 2 SOILS DESCRIPTION AND SUITABILITY

Soils Series Type	Underlying Geologic Association	Soil Description	Hydrologic Group	Permeability (In/Hr)	Septic Tank Absorption Field	Shallow Excavation	Small Commercial Building	Local Roads and Streets
Alderwood 1,2,3	Glacial till	Very gravelly sandy loam. Slope 0-30 percent. Moderately well drained.	C	2.0-6.0 Moderately rapid	Severe: cemented pan wetness	Moderate to Severe: cemented pan, wetness, slope	Slight to Severe: slope.	Slight to Severe: slope.
Belfast 5	Stratified alluvium	Loam. Slope 0-2 percent well drained.	B	0.6-2.0 Moderate	Severe: floods, wetness	Severe: cutbanks cave.	Severe: floods.	Severe: floods.
Bellingham 6	Alluvium.	Silty clay loam. Slope 0-2 percent. Poorly drained.	C	.06-0.2 Slow	Severe: ponding. percs slowly	Severe: Ponding.	Severe: Ponding Shrink-Swell	Severe: low strength, ponding.
Cathcart 7,8,9	Glacial drift	Silt loam. Slope 2-30 percent. Moderately well drained.	C	0.6-2.0 Moderate	Moderate: percs slowly	Slight to Severe: slope.	Moderate to Severe: slope	Slight to Severe: slope.
Dystric Xerothents 10	Glacial till Valley sidewalls	Very gravelly sandy loam. Slope 45-70 percent. Well drained.	- - -	- - -	- - -	Severe: Slope.	Severe: Slope.	Severe: Slope.
Grove 11,12,13	Glacial outwash	Very gravelly sandy loam. Slope 0-30 percent. Excessively drained.	A	6.0-20.0 Rapid	Severe: poor filter slope	Slight to Severe: slope.	Slight to Severe: slope.	Moderate to Severe: slope
Harstine 14,15,16,17	Sandy glacial till	Gravelly sandy loam. Slope 0-45 percent.Moderately well drained.	C	0.6-2.0 Moderate	Severe: cemented pan wetness	Moderate to Severe: wetness, slope	Moderate to Severe: slope.	Moderate to Severe: wetness, slope
Indianola 18,19,20	Glacial outwash.	Loamy sand. Slope 0-45 percent. Excessively drained.	A	6.0-20.0 Rapid	Severe: poor filter	Severe: cutbanks cave, slope.	Slight to Severe: slope.	Slight to Severe: slope.
Indianola-Kitsap 21	Glacial outwash and glacial lake sediments.	Loamy sand to silt loam. Slope 45-75 percent. Well drained.	A/C	0.6-2.0 Moderate	Severe: poor filter slope	Severe: cutbanks cave, slope.	Severe: slope.	Severe: low strength, slope.
Kapowsin 22,23	Glacial till.	Gravelly loam. Slope 0-15 percent. Moderately well drained	C	0.6-2.0 Moderate	Severe: cemented pan wetness	Severe: wetness.	Severe: wetness.	Severe: wetness.
Kapowsin Variant 24	Lacustrine sediments over glacial till.	Gravelly clay loam. Slope 0-5 percent. Moderately well drained.	C	0.2-0.6 Moderately slow	Severe: cemented pan wetness	Severe: wetness.	Moderate: wetness, shrink-swell	Severe: low strength.
Kilchis 25,26	Balsalt ridge crests and slopes	Very gravelly sandy loam. Slope 15-70 percent. Well drained.	C	2.0-6.0 Moderately rapid	Severe: Depth to rock.	Severe: Depth to rock.	Severe: Depth to rock.	Severe: Depth to rock.
Kilchis-Shelton 27	Basalt and glacial till	Complex of Shelton, Kilchis and Schneider soils. Slope 30-50 percent. Well drained.	C	6.0-20.0 Rapid	Severe: Depth to rock.	Severe: Depth to rock. wetness,slope	Severe: Depth to rock. wetness,slope	Severe: Depth to rock. wetness,slope

TABLE 2 SOILS DESCRIPTION AND SUITABILITY

Soils Series Type	Underlying Geologic Association	Soil Description	Hydrologic Group	Permeability (In/Hr)	Septic Tank Absorption Field	Shallow Excavation	Small Commercial Building	Local Roads and Streets
Kitsap 28,29,30,31	Glacial lake sediments.	Silt loam. Slope 2-45 percent. Moderately well drained.	C	0.6-2.0 Moderate	Severe: wetness, percs slowly, slope.	Severe: ponding.	Moderate: wetness, shrink-swell	Severe: low strength.
McKenna 32	Glacial Till	Gravelly loam. Slope 0-6 percent. Poorly drained.	C/D	0.06-.02 Slow	Severe: ponding. percs slowly	Severe: excess humus, ponding.	Severe: ponding.	Severe: ponding.
Muckilteo 33	Upland and valley depressions.	Peat. Slope 0-1 percent. Very poorly drained.	D	0.6-2.0 Moderate	Severe: ponding.	Severe: cutbanks cave, ponding.	Severe: low strength, ponding.	Severe: ponding.
Neilton 34,35,36	Glacial outwash	Gravelly loamy sand Slope 8-25 percent. Excessively drained.	A	6.0-20.0 Rapid	Severe: poor filter slope	Severe: cutbanks cave, slope.	Severe: slope.	Moderate to Severe: slope.
Norma 37	Alluvium	Fine sandy loam. Slope 0-3 percent. Poorly drained.	B/D	2.0-6.0 Moderately Rapid	Severe: ponding.	Severe: wetness.	Severe: ponding.	Severe: ponding.
Poulsbo 39,40,41	Glacial till	Gravelly sandy loam. Slope 0-30 percent. Well drained.	C	2.0-6.0 Moderately Rapid	Severe: cemented pan wetness, slope.	Severe: cutbanks cave, wetness.	Severe: wetness, slope.	Moderate to Severe: wetness, slope.
Poulsbo-Ragnar 42,43	Glacial till and outwash	Fine sandy loam to gravelly sandy loam. Slope 15-30 percent. Moderately well drained	C	2.0-6.0 Moderately Rapid	Severe: cemented pan wetness, poor filter	Severe: cut banks cave, slope.	Slight to Severe: wetness.	Slight to Moderate: wetness.
Ragnar 45,46	Glacial outwash	Fine sandy loam to gravelly sandy loam. Slope 15-30 percent. Well drained.	A	2.0-6.0 Moderately Rapid	Severe: poor filter slope	Severe: slope.	Moderate to Severe: slope.	Moderate to Severe: slope.
Ragnar-Poulsbo 47	Glacial till and glacial outwash.	Fine sandy loam to gravelly sandy loam. Slope 15-30 percent. Well drained.	A/C	2.0-6.0 Moderately Rapid	Severe: poor filter slope.	Severe: slope.	Severe: slope.	Severe: slope.
Schneider 48	Basalt colluvium	Very gravelly loam. Slope 45-70 percent. Well Drained.	B	0.6-2.0 . Moderate	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Semiahmoo 49	Flood plain backwater areas	Muck-decaying organic material. Slope 0-1 percent. Very poorly drained.	D	0.2-0.6 Moderately slow	Severe: ponding. percs slowly	Severe: excess humus, ponding.	Severe: low strength, ponding.	Severe: ponding.
Shalcar 50	Backwater depressions.	Muck. Slope 0-1 percent. Very poorly drained.	D	0.2-0.6 Moderately slow	Severe: ponding. percs slowly	Severe: excess humus, ponding.	Severe: low strength, ponding.	Severe: ponding.

TABLE 2 SOILS DESCRIPTION AND SUITABILITY

Soils Series Type	Underlying Geologic Association	Soil Description	Hydrologic Group	Permeability (In/Hr)	Septic Tank Absorption Field	Shallow Excavation	Small Commercial Building	Local Roads and Streets
Shelton 51,52,53,54,55 56,57	Morains and till plains	Very gravelly to extremely gravelly sandy loam. Slope 0-45 percent. Well drained.	C	6.0-20.0 Rapid	Severe: cemented pan wetness, poor filter.	Severe: wetness, slope.	Moderate to Severe: wetness, slope.	Moderate to Severe: wetness, slope.
Sinclair 59,60,61	Glacial till.	Very gravelly sandy loam. Slope 2-30 percent. Moderately well drained.	C	2.0-6.0 Moderately Rapid	Severe: cemented pan wetness, slope.	Severe: wetness, slope.	Moderate to Severe: wetness, slope.	Moderate to Severe: wetness, slope.
Tacoma 62	Alluvium	Silt loam. Slope 0-1 percent. Very poorly drained.	D	0.2-0.6 Moderately slow	Severe: wetness, floods percs slowly.	Severe; cutbanks cave, wetness.	Severe: wetness, floods.	Severe: wetness, floods.

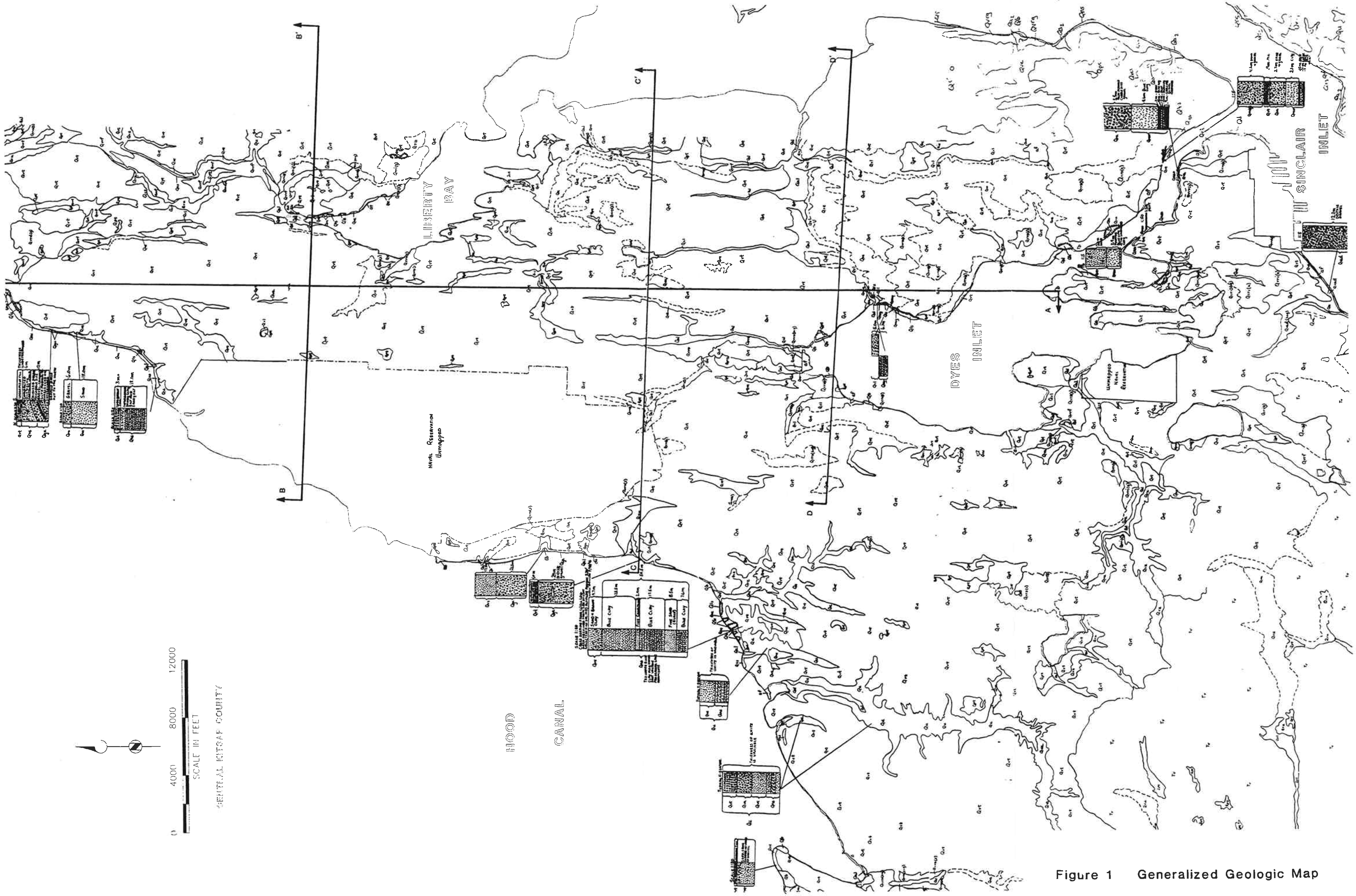

Figure 1 Generalized Geologic Map

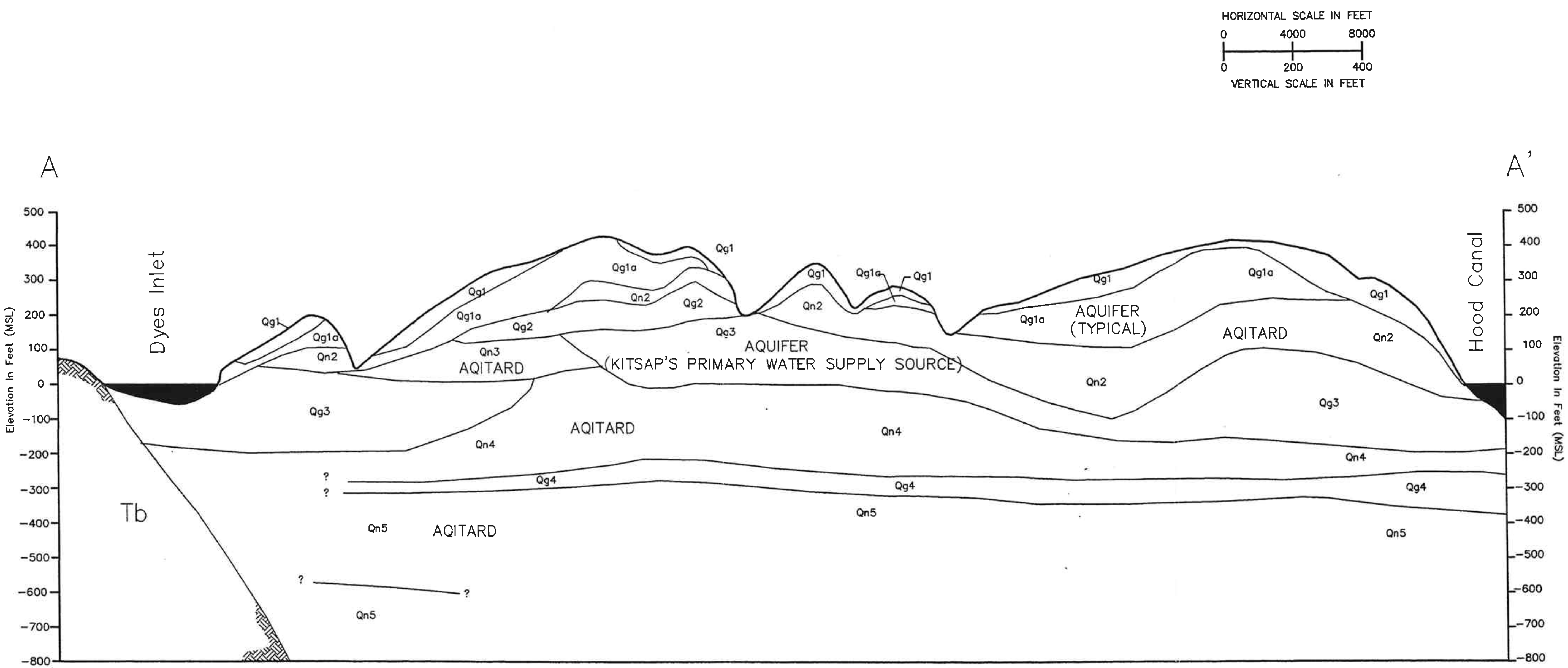

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Figure 2 Geologic Cross Section A-A'

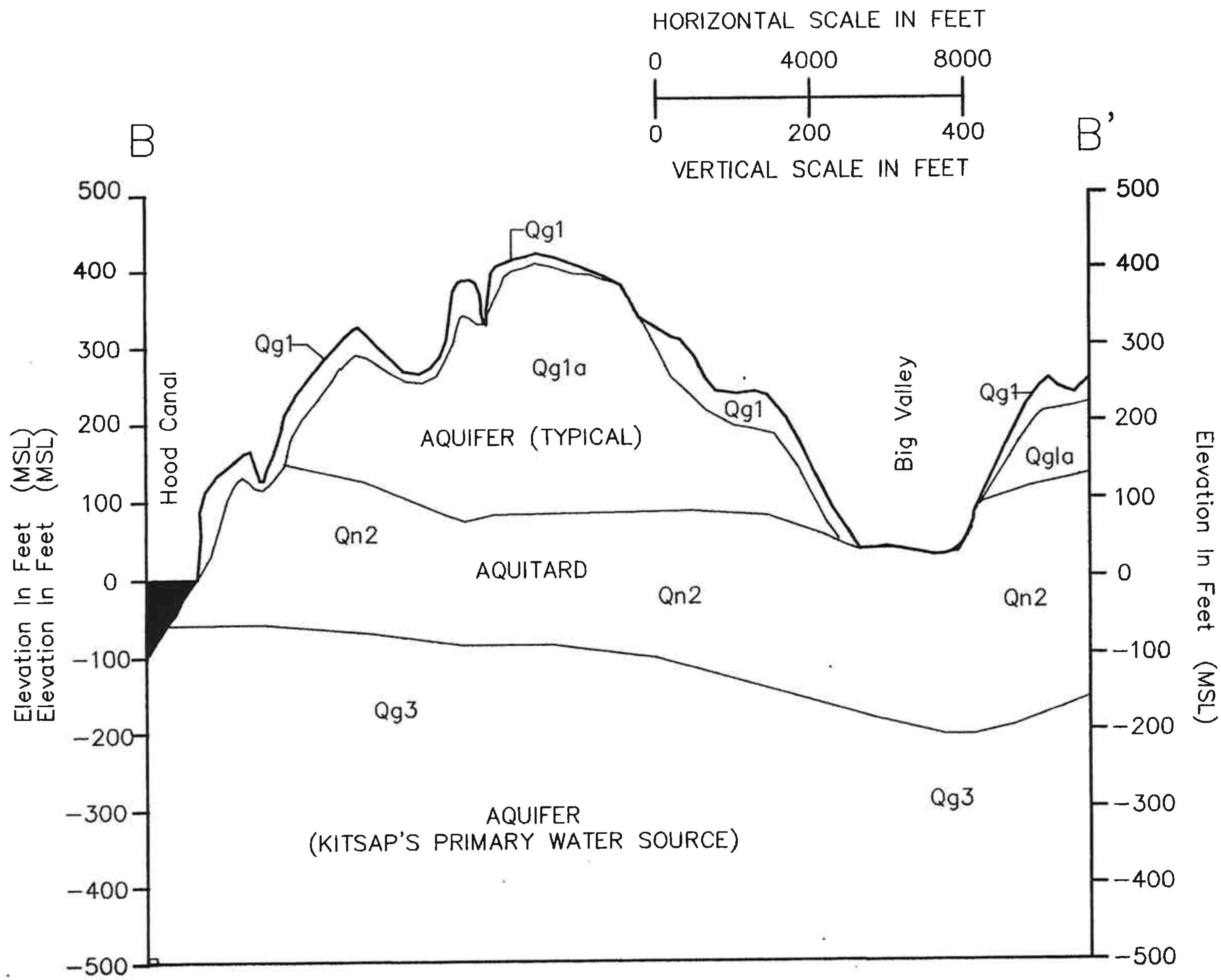

Figure 3 Geologic Cross Section B-B'

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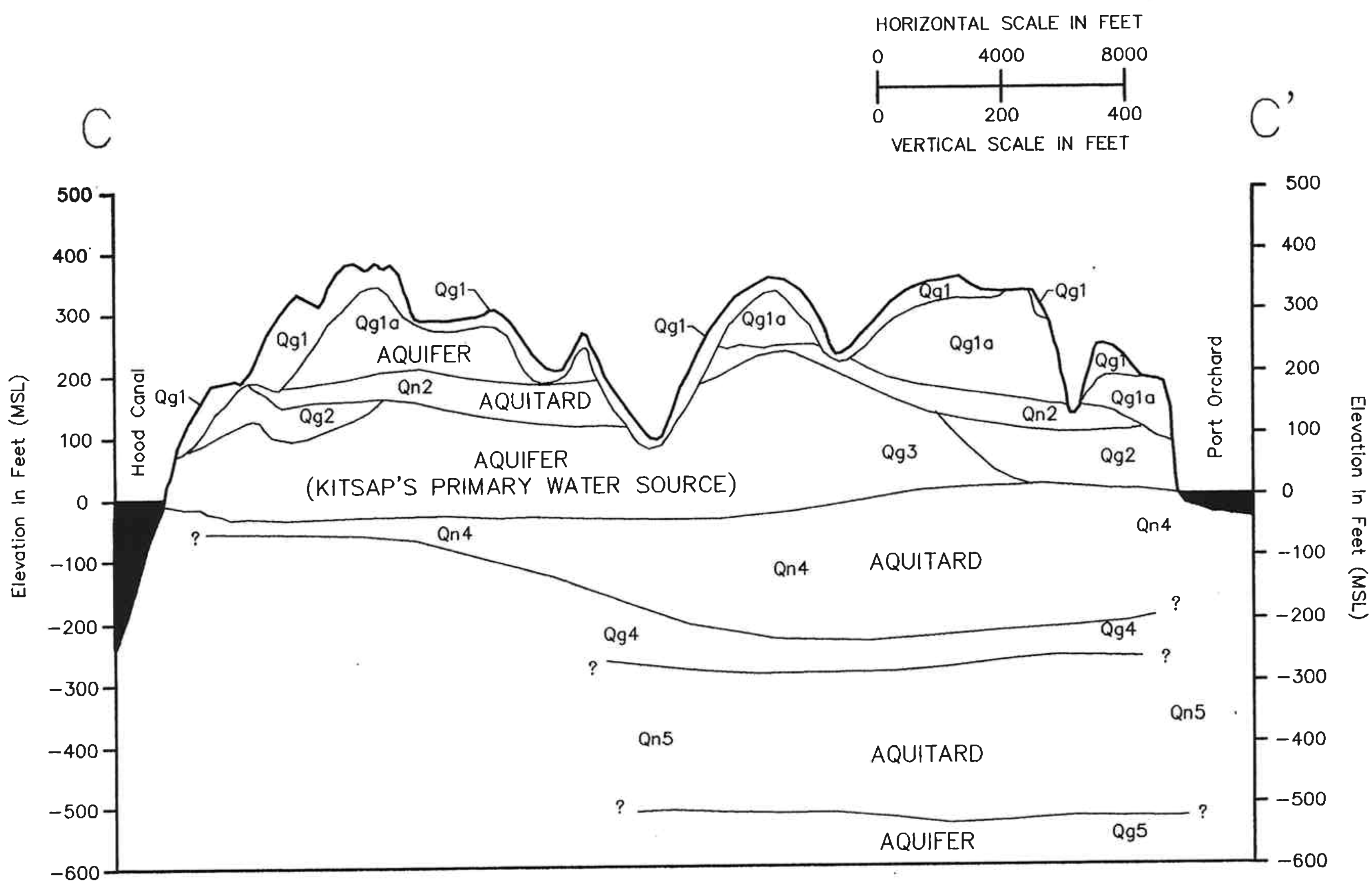

Figure 4 Geologic Cross Section C-C'

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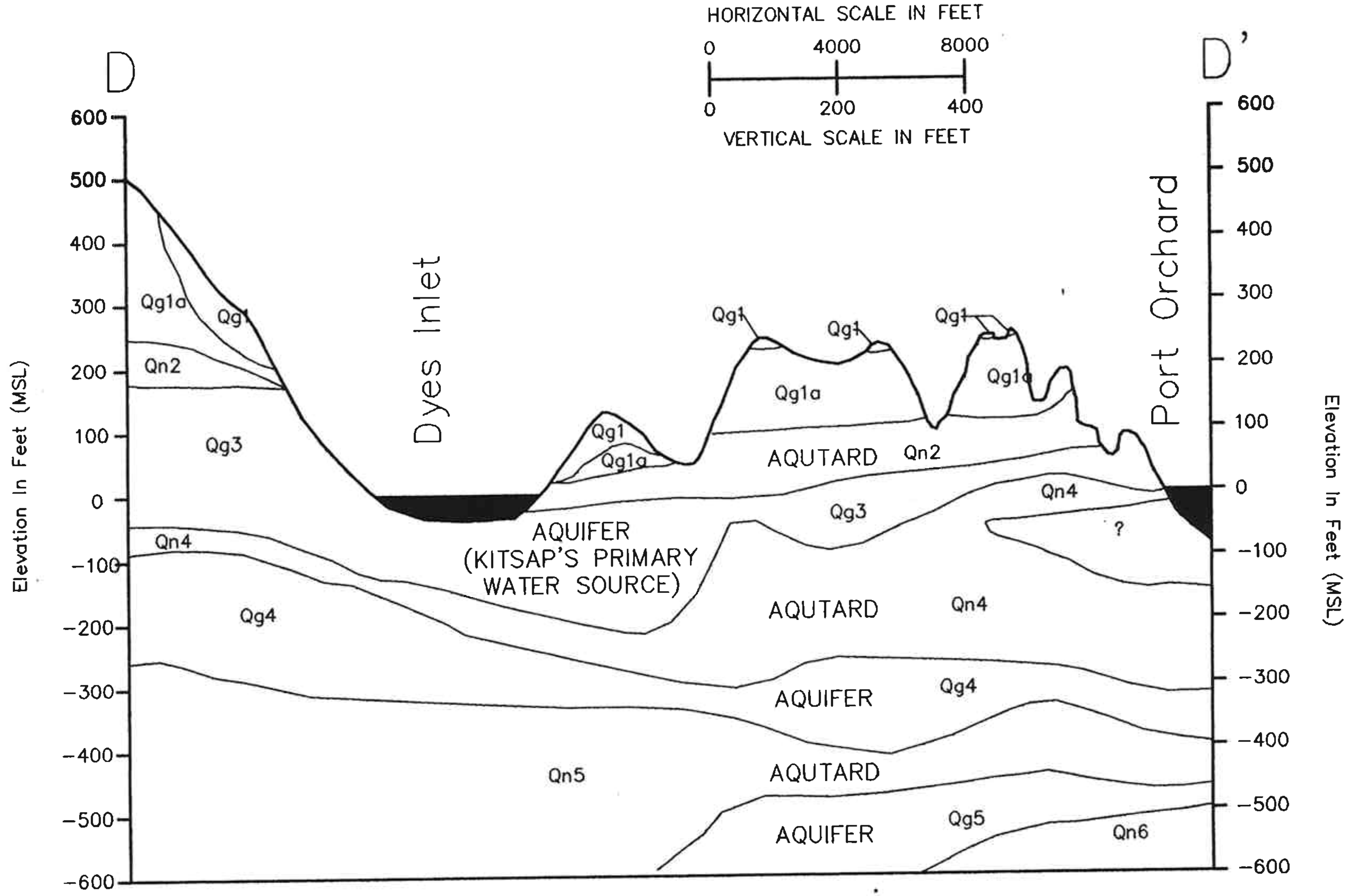


Figure 5 Geologic Cross Section D-D'

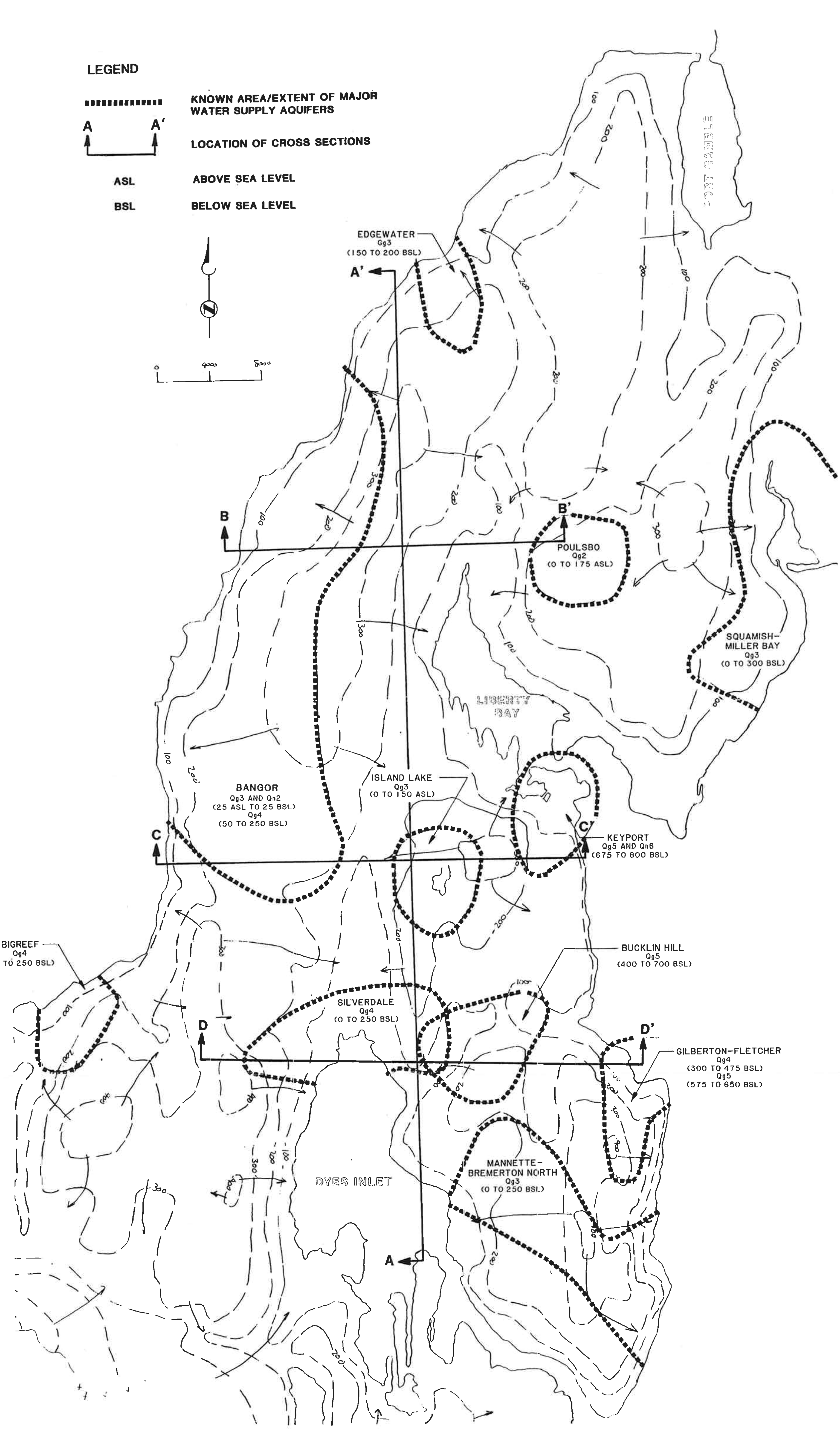


Figure 6 Aquifers and Groundwater Flow Systems

Figure 7 Geotechnical Suitability

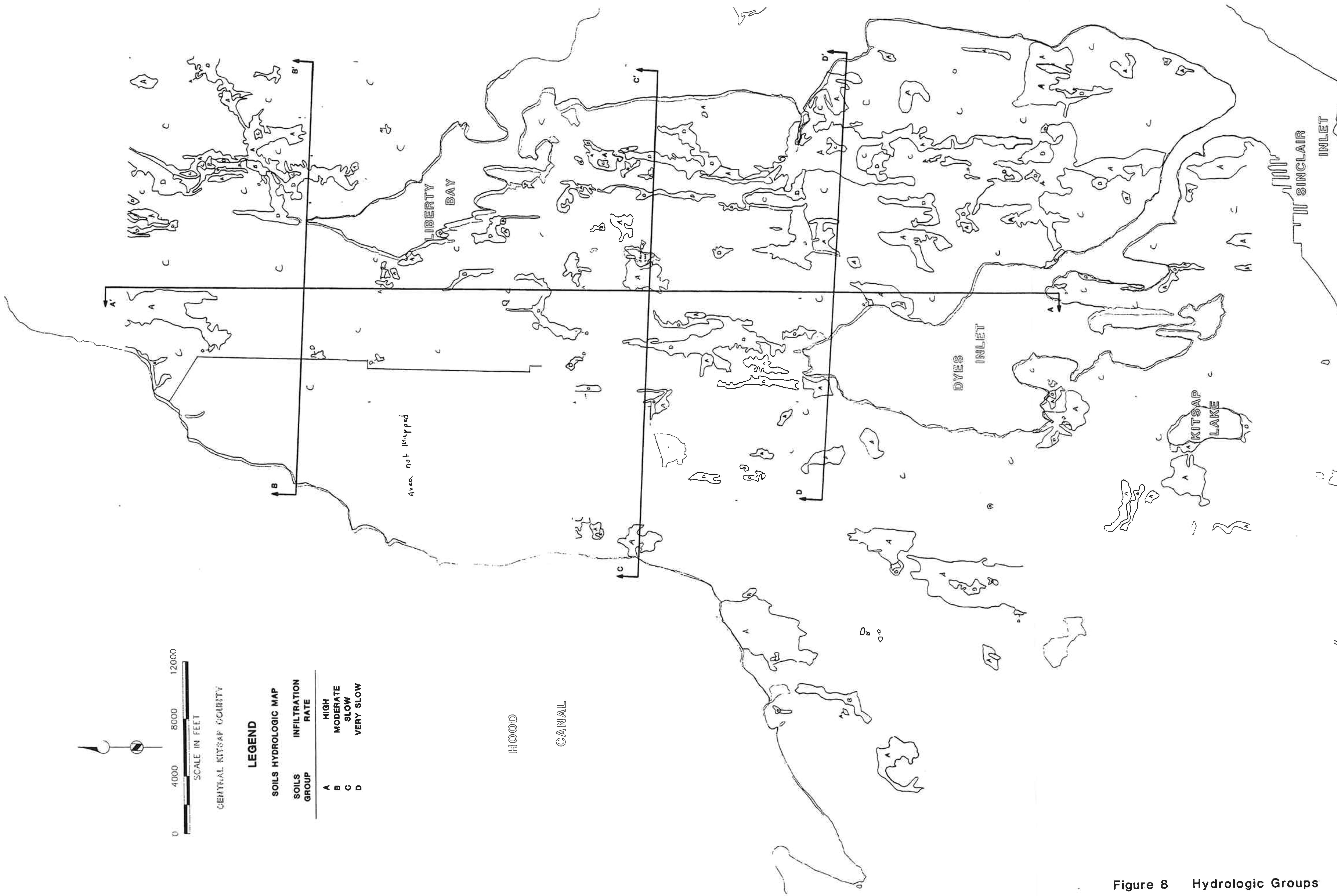


Figure 8 Hydrologic Groups

APPENDIX C – TECHNICAL MEMORANDUM: PRELIMINARY WATER QUALITY ISSUES

TECHNICAL MEMORANDUM

Date: June 23, 2006

To: Barbara Zaroff, PE - Kitsap County Department of Public Works

From: Martin Harper, Ph.D, PE – BHC Consultants, LLC

CC: Bill Persich, PE – Brown and Caldwell

Subject: **Central Kitsap County Wastewater Facilities Development Strategy Plan Preliminary Water Quality Issues**

INTRODUCTION

This Technical Memorandum identifies water quality-related issues that are recommended for consideration as part of the development of the Central Kitsap Wastewater Facility Plan. There has been significant effort expended in Kitsap County during the past several years focused on ground and surface water quality conditions. Many of these efforts have investigated the relationship of non-point sources of pollution and receiving water quality.

Several reports have been prepared to document these activities and a comprehensive review of all of the reports is beyond the scope of this Memorandum. Rather, readily available and significant reports were reviewed to identify potential water quality-related issues that should be considered during subsequent Facility Plan activities. The review was limited to streams located within Kitsap County, including those that originate in Kitsap County yet flow through the City of Poulsbo before discharging to marine waters. Recommendations are made for follow-up Facility Plan activity and will be the basis for scoping subsequent Facility Plan tasks.

Degraded water quality conditions in marine waters were also identified in several of the reports that were reviewed. Although several pollution sources were identified, the degraded conditions were generally related to the elevated fecal coliform bacteria concentrations of the creeks discharging to the marine waters. The potential for degraded water quality caused by other sources, such as wastewater treatment plant effluent discharges to marine waters, will be addressed in another technical memorandum.

2006 Priority Area Work List for the Pollution Identification and Correction Program (January 2006)

The Kitsap County Health District, Environmental Health Division, Water Quality Program developed a 2006 Priority Area Work List based on a review of 58 water bodies having water quality problems within Kitsap County. The evaluation used monitoring data collected in 2004-

2005. A ranking procedure was used to prioritize the water bodies based on existing water quality problems, potential for public exposure, on-site sewage system failure history, fecal coliform pathways and watershed ranking. This ranking along with other special circumstances were the factors considered in development of the annual priority work list.

The ranking procedure may provide useful information for prioritization of facility needs in the Central Kitsap Facility Plan study area. The ranking is based on current conditions for the water bodies. The ranking procedure could be used in the Facility Plan effort with expansion to consider the following:

- The investigations included surface water bodies; **ground water conditions were not addressed**. Other studies have considered ground water quality impacts from on-site systems and are reviewed below.

- Current (2004-2005) data was used in the analysis. Existing high density development or agricultural activity within 100 feet of a shoreline was considered in the fecal coliform pathway assessment; however, the potential for future degradation of water quality conditions due to failing on-site sewage systems was not considered. **The expansion of this analysis to include existing zoning and land use is recommended.**

- The ranking procedure utilized a weighting system that should be reviewed for the Facility Plan. Based on comments received during facility plan development, it may be appropriate to revise the weighting factors to reflect the **potential for future water quality degradation due to future development**.

- There appear to be several creeks outside of, yet close to, the existing Central Kitsap Facility Plan study area that have been designated as having high priority for the Health District's Pollution Identification and Correction (PIC) Program. **Daniels Creek**, for example is scheduled to have the PIC project completed in 2006. It is located outside of the northern UGA boundary and west of Keyport. The Health District program should be monitored and it may be appropriate to expand the Facility Plan study boundary to include this area.

- There are other areas within the Central Kitsap Facility Plan study area that have been identified for future PIC programs. These include **Strawberry Creek, Barker Creek and Clear Creek.** These areas may be considered high priority for analysis during development of the Facility Plan. At a minimum, the future Health District programs should be monitored and coordinated with the Facility Plan.

It is recommended that these issues be reviewed by the Technical Advisory Committee formed to review and provide guidance during development of the Facility Plan.

Kitsap County Ground Water Management Plan, Volume IV, Appendix 2, Issue Paper: Septic Systems (May 20. 1997)

This issue paper was prepared to discuss water quality issues related to on-site sewage disposal system use in Kitsap County. On-site sewage systems served approximately 50% of all single family residences within the County at the time of the study or about 50,000 systems. Kitsap County statistics indicated that the reported failure rate for on-site systems was less than ½ of 1%, or less than 250 systems per year. Approximately 95% of all failed systems were installed prior to 1974 when on-site sewage regulations were first approved and implemented in Kitsap County.

Ground water quality impacts from failed on-site sewage systems were discussed in terms of nitrates and bacteria. Based on a comprehensive monitoring program conducted in 1992 and 1993, there was no evidence that suggested ground water degradation from failed on-site systems. Approximately three-tenths of 1% of the samples tested positive for fecal coliform in distribution systems or reservoirs, and not at the water source, which raised doubt on any impacts from failed on-site systems. Moreover, nitrate samples for public water systems never exceeded the Maximum Contaminate Level of 10 mg/L and 99.7% of all samples taken fell within a range of 0.2 to 0.6 mg/L. Proper operation and maintenance was identified as key to the successful long-term performance of on-site systems.

The importance for potential ground water recharge was emphasized in the issue paper. It was estimated that the 50,000 on-site systems represented a potential annual recharge rate of 2.5 billion gallons to Kitsap County aquifers. As a result, several recommendations were made that are relevant to the Central Kitsap Facility Plan:

- The Facility Plan should give full consideration to the **impacts** which may occur to the **region's groundwater** whenever a new or expanded sewer system is planned.

- The Health District and Kitsap County Public Works Department should develop a wastewater plan for both **on-site and sewer systems** for the county.

- The County's comprehensive plan should **encourage the use of septic systems** over the development of sewer systems, whenever possible.

- **An educational program** should be developed which explains on-site systems and their impacts on both ground and surface waters.

In summary, it appeared that ground water quality issues related to failing on-site sewage systems were not significant in Kitsap County at that time. Rather, it was recognized that aquifer recharge from on-site systems was significant. This recognition is important to the Central Kitsap Facility Plan in terms of wastewater reclamation and reuse alternatives and effluent disposal for CKTP and satellite treatment facilities.

Kitsap Watershed (WRIA 15) Water Quality Technical Assessment (June 30, 2003)

This water quality assessment reviewed both surface water and groundwater quality in the Kitsap Watershed. Surface water quality conditions were reviewed based primarily on the 1998 Ecology listing of waterbodies under section 303(d) of the Clean Water Act. Groundwater quality conditions were evaluated based on information available from the Washington Department of Health and the Kitsap Public Utilities District.

Fecal coliform (FC) bacteria was found to be the predominant impaired water quality parameter for surface water bodies. The most common causes of FC pollution was identified as agricultural/livestock waste, septic systems, pet waste and stormwater runoff. Three freshwater bodies having FC violations were identified within the Central Kitsap Facility Plan study area: **Barker Creek, Clear Creek and Dogfish Creek**. Barker Creek and Clear Creek discharge to Dyes Inlet while Dogfish Creek discharges to Liberty Bay.

Groundwater quality was evaluated in more detail and focused on aquifer susceptibility and saline intrusion as indicated by nitrate and chloride information. It was assumed that the primary source of nitrate in groundwater was septic systems. The major findings relative to the nitrate data analysis are:

- Naturally occurring nitrate concentrations are less than 1 mg/L (expressed as nitrogen).

- The historical record in drinking water wells showed an average increase in nitrate concentration of 0.7 mg/L in the six year period ending in 2002.

- Nitrate concentrations were less than 2.5 mg/L (the concentration used by KCHD to trigger additional monitoring in drinking water sources) in about 90% of the public water system wells.

- **Six wells north of Dyes Inlet** had increasing nitrate concentrations. Wells analyzed and completed in the shallow aquifer (up to 120 feet deep) had concentrations above 5 mg/L while those in the deep aquifer had concentrations below 5 mg/L.

- Nitrate concentrations greater than 2.5 mg/L typically occurred in the shallow aquifer and in areas with **population density of 500 people per square mile** or greater, which represents 3.2 homes/acre.

Washington State's Water Quality Assessment for 2004

The 2004 Water Quality Assessment prepared by Ecology expanded on the 1998 listing for 303(d) waterbodies referenced above. The 2004 listing of 303(d) waterbodies placed within the Category 5 List included 9 creeks within the Central Kitsap Facility Plan study area, five of which had FC standards violations. The Category 5 listing means that Ecology will require a Total Maximum Daily Load (TMDL) analysis for each waterbody to formulate a plan to bring water quality conditions back into compliance with standards.

The listed creeks were:
- Barker Creek and Strawberry Creek discharging to Dyes Inlet.
- Big Scandia Creek and Johnson Creek discharging to Liberty Bay.
- Illahee Creek discharging to Port Orchard Bay.

Kitsap County Health District 2004-2005 Water Quality Monitoring Report

The 2004-2005 Water Quality Monitoring Report summarizes stream, lake and marine water quality data collected by the Kitsap County Health District for 2005 water year. Fecal coliform bacteria, E. coli bacteria, dissolved oxygen, pH, and temperature data were collected for 55 streams, 17 lakes and marine waters in Kitsap County. Watershed reports were prepared that include information about each stream in the watershed and the watershed's overall marine water quality.

Three reports for the Port Orchard / Burke Bay watershed; Dyes Inlet watershed; and Liberty Bay / Miller Bay watershed, all within the Central Kitsap Facility Plan study area, are summarized below concerning waterbodies having poor water quality conditions. The assessment of water quality conditions was based on the ability to meet the Washington State Surface Water Quality

Standards for Extraordinary Primary Contact. Plate 1 identifies streams that fail to meet the standard and shows 2005 UGA boundaries that are related to the Central Kitsap Facilities Plan.

- Port Orchard / Burke Bay Watershed: **Steele Creek, Illahee Creek and Illahee State Park Creek** have poor water quality relative to the fecal coliform standard. Both Steele Creek and Illahee State Park Creek failed to meet the standard in 10 years of monitoring. Illahee Creek has met the standard for two of the 10 years of monitoring. Because of the high bacterial concentrations, a public health advisory has been posted for no contact in Steele Creek. Conditions in all three creeks appear to be stable, however.

- Dyes Inlet Watershed: Water Quality conditions are poor in **Barker Creek, Clear Creek, Mosher Creek, Parmann Creek and Strawberry Creek**. The fecal coliform standard has been met once in ten years of monitoring in Clear Creek and due to the high concentrations, the Health District advises against public contact. A Pollution Identification and Correction (PIC) Project is underway to determine the fecal coliform bacteria causes and sources.

  Fecal coliform standards have not been met in 10 years of monitoring in Barker Creek. Mosher Creek has met the standard 3 times in 10 years, Parmann Creek failed to meet the standard in 5 years, and Strawberry Creek met the standard twice in 10 years. A PIC project is underway for Barker Creek while further investigations into bacterial sources in Mosher Creek and Parmann Creek watersheds are warranted. Conditions in all five creeks appear to be stationary.

- Liberty Bay / Miller Bay Watershed: Water quality conditions were found to be poor due to high fecal coliform bacteria in **Big Scandia Creek, Daniels Creek, Dogfish Creek, Dogfish Creek (South Fork), and Johnson Creek.** Fecal coliform bacteria concentrations failed to meet water quality standards in all of these creeks in 10 years of monitoring, except for Johnson Creek which met the standard twice in 10 years. Daniels Creek has been posted with a public health advisory for no contact due to its high fecal coliform concentrations. Conditions appear to be stationary in Big Scandia Creek, Daniels Creek, and Johnson Creek. Improving trends are noted for Dogfish Creek and Dogfish Creek (South Fork) and are attributed to cleanup projects in their watersheds.

Recommendations for Central Kitsap Facility Plan Activities

Based on the preceding review, the following recommendations are made for work scope tasks for the development of the Central Kitsap Facility Plan:

- Expand the Health District ranking procedure to include ground water quality, zoning and land use for use in identifying potential areas that may be sewered and for prioritizing future Facility Plan projects.

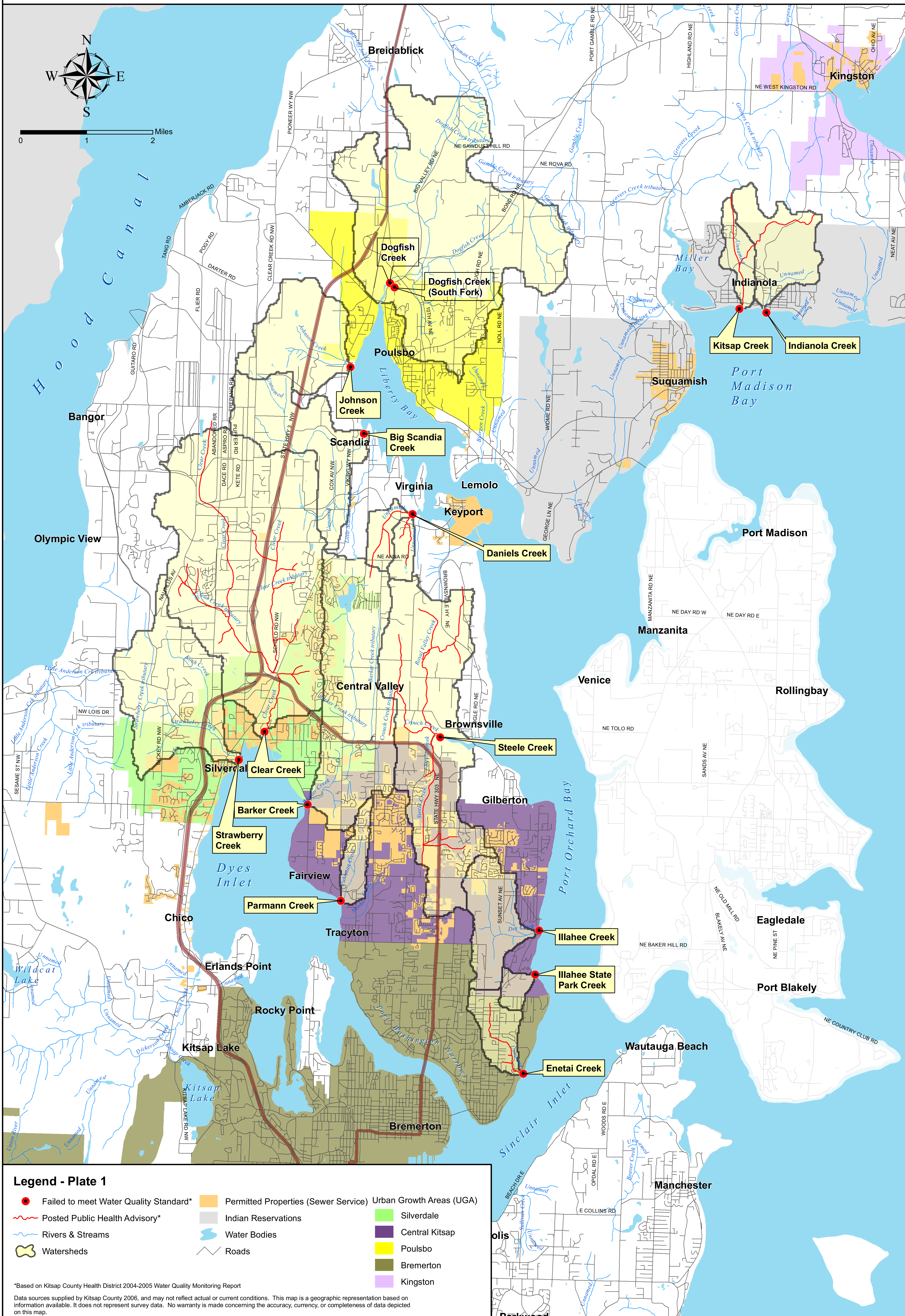
- Coordinate the Facility Plan investigations for provision of future sewer service with the future PIC Programs and possibly in other watersheds having creeks with poor water quality conditions.

- On-site systems are recognized as appropriate for wastewater treatment and disposal provided future population densities are less than 500 people per square mile (3.2 homes/acre). Sewer service or regional satellite treatment facilities should be investigated to serve areas having future population densities are greater than 500 people per square mile.

- Significant technical expertise and local knowledge about existing water quality conditions in the Central Kitsap Facility Plan study area exists within the Kitsap County agencies. It is recommended that staff from the Kitsap County Health District and Surface and Storm Water Management programs be requested to participate on the Technical Advisory Committee. Their input will be valuable in the assessment of existing water quality problems and in the prioritization of potential future Facility Plan projects.

CENTRAL KITSAP FACILITIES DEVELOPMENT STRATEGY PLAN
PRELIMINARY WATER QUALITY ISSUES

KITSAP COUNTY PUBLIC WORKS



Legend - Plate 1

- Failed to meet Water Quality Standard*
- Posted Public Health Advisory*
- Rivers & Streams
- Watersheds
- Permitted Properties (Sewer Service)
- Indian Reservations
- Water Bodies
- Roads

Urban Growth Areas (UGA)

- Silverdale
- Central Kitsap
- Poulsbo
- Bremerton
- Kingston

*Based on Kitsap County Health District 2004-2005 Water Quality Monitoring Report

Data sources supplied by Kitsap County 2006, and may not reflect actual or current conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

MAP DATE: JUNE 23 2006

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APPENDIX D – CENTRAL KITSAP COUNTY WASTEWATER FACILITIES DEVELOPMENT STRATEGY PLAN, WATER REUSE

MEMORANDUM 129651.001

August 23, 2006

TO: BARBARA ZAROFF - KITSAP COUNTY DEPARTMENT OF PUBLIC WORKS

FROM: PATRICIA TAM - BROWN AND CALDWELL
BILL PERSICH – BROWN AND CALDWELL

SUBJECT: CENTRAL KITSAP COUNTY WASTEWATER FACILITIES DEVELOPMENT STRATEGY PLAN – WATER REUSE

INTRODUCTION

The Kitsap County Public Works Department has identified the need to prepare an updated wastewater facility plan for Central Kitsap County. The current facilities plan for this area was prepared in 1994 and updated in 1999. Since the completion of that plan, a number of capital projects identified in the plan have been completed. Additionally, service population growth, service area changes, on-going regional water quality concerns, and the development of newer wastewater treatment technologies have rendered parts of the current plan out of date. The updated facilities plan will be developed in two phases: facilities development strategy plan memorandum (Phase 1) and preparation of the actual final facility plan (Phase 2).

This technical memorandum provides a preliminary assessment of the water reuse options for the Central Kitsap Wastewater Treatment Plant and a methodology for pursuing these options in subsequent planning projects. The assessment will provide the basis for the technical portions of the strategy memorandum and identify issues and alternatives that will be further evaluated in the facility plan. A county-wide water reuse study was recently conducted by Golder Associates (*Kitsap County Water Reuse Implementation Study,* draft report, October 2005). This memorandum summarizes the findings of this past water reuse study that pertains to the CKWWTP and provides guidance and a framework for further investigating reuse opportunities in the Central Kitsap service area.

BACKGROUND

The Central Kitsap Wastewater Treatment Plant (CKWWTP) is an activated sludge plant originally built in 1979. It is currently rated to provide secondary treatment for a maximum month flow of 6.0 mgd, and currently, the annual average flow is about 3.5 mgd. The plant liquid stream facilities include comminutors, primary clarifiers, aeration basins (with anaerobic selector), secondary clarifiers, and ultraviolet (UV) system for effluent disinfection. The plant effluent is discharged into Port Orchard Passage. Water reuse at the plant is currently limited to in-plant process uses, such as elutriation water for the gravity thickener (for odor control), scum spray water at the primary and secondary clarifiers, and flushing and polymer dilution water for the centrifuge.

REUSE SITE OPTIONS

The Central Kitsap WWTP is located in a rural area that does not have significant nearby conventional reuse opportunities such as irrigation (either urban or agricultural) or other commercial and industrial applications. Therefore, all of the reuse options identified in the Golder study are environmental applications, specifically, streamflow augmentation through the use of constructed or natural wetlands or through groundwater recharge. The two sites considered are the headwaters of Steele Creek and Barker Creek, and are shown in Figure 1. The advantages of reusing the effluent by means of streamflow augmentation as opposed to marine discharge (i.e., no reuse) include the following:

- Less discharge of plant effluent into the marine waters would improve water quality in the receiving water body.
- Reclaimed water is used to augment streamflow, thus improving the habitat conditions in the streams.
- Where groundwater recharge is included, the reclaimed effluent indirectly augments the drinking water supply.
- Less marine discharge would extend the life of the outfall.

Steele Creek

Streamflow augmentation of Steele Creek, which is adjacent to the plant (the headwaters are located on the plant property), can be accomplished by restoring approximately 65 acres of the natural wetlands which drains towards Steele Creek. In order to implement reuse of this site, a number of activities are required, including categorization of the existing wetlands, a survey of the physical conditions, characterization of the hydrologic regime of the area, and discussion with current land owners to ensure that either easements or land acquisition would be feasible.

Because regulations may require that delivery of reclaimed water to the wetlands be reduced during the summer dry season to mimic the natural hydrologic regime (e.g., wetting and drying cycle), it was proposed that a complementary, nearby, groundwater recharge site be used in conjunction with the natural wetlands. The groundwater recharge site, south of the wetlands, will provide an alternative discharge point for reclaimed water when delivery to the wetlands is reduced, and integration of the two sites will ensure a backup option if one site needs to be removed from service for any reason.

Preliminary project costs, including capital costs, operation and maintenance (O&M) costs (net present value for a 30-year period), and land purchase cost were estimated to be about $8.4 million (per Golder study conducted in 2005).

Barker Creek

Barker Creek is located approximately 1.2 miles west of CKWWTP. Three sites were identified for receiving reclaimed water: one through constructed wetlands east of the Barker Creek headwaters, one through groundwater recharge in an infiltration area of approximately 5 acres, and the third one through groundwater recharge to an area that drains to Island Lake.

Construction of a wetland site would require clearing much of the forested area and development of a surface connection to existing wetlands along the creek and/or a direct connection to Barker Creek.

Preliminary project costs for the three sites, including capital costs, O&M costs (net present value for a 30-year period), and land purchase costs were estimated to be about $11 million (site 1 – constructed wetlands), $5.4 million (site 2 – groundwater recharge), and $5.3 million (site 3 – groundwater recharge to Island Lake) (per Golder study conducted in 2005).

Other Reuse Options

Besides streamflow augmentation at the Steele Creek and Barker Creek sites, other potential reuse site options for direct non-potable uses should be explored as part of the facility plan. A larger list of options may become developed if a larger geographical area than what might have been considered in the Golder study is used to identify the reuse sites. The Golder study assumed that the reclaimed water would essentially be generated at the CKWWTP. If satellite treatment plants are constructed to reduce the capacity expansion requirements at the CKWWTP, then reclaimed water application at sites further away from the CKWWTP could be implemented in a cost-effective manner.

Generally, direct non-potable water reuse options include irrigation at golf courses, parks, and cemeteries, non-potable uses at industrial facilities, as well as other groundwater recharge and constructed wetlands sites. An inspection of the Central Kitsap County service area indicates a number of these potential reuse sites. These are described in Table 1 and the locations of the sites are shown in Figure 1. Proximity to large sewer pipes and pumps stations is an important criterion for construction of satellite plants near the reuse sites.

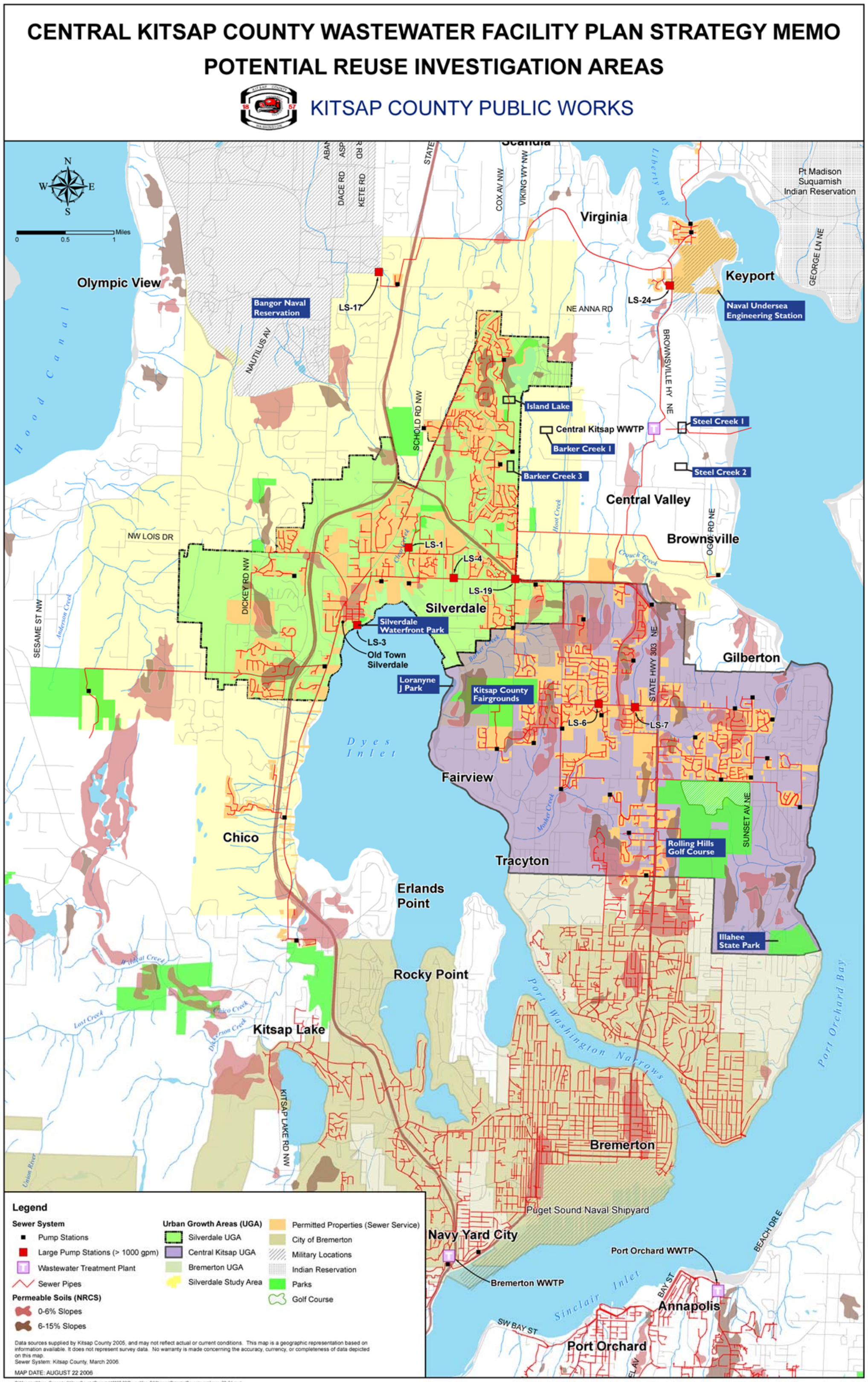

Figure 1. Potential Water Reuse Sites in Central Kitsap County

Table 1. Potential Sites for Non-Potable Water Reuse in Central Kitsap County

Site location	Near Sewer Pipes/ Pump Station?	Comments
Rolling Hills Golf Course	Yes	-
Kitsap County Fairgrounds	Yes	Includes ballfields, rodeo ground
Lorayne J Park	No	Likely not a good candidate to receive reclaimed water from a satellite plant
Silverdale Waterfront Park	Yes	Possibly limited space for satellite plant
Illahee State Park	No	Natural vegetation; no irrigation used, thus not a good candidate for water reuse
Keyport Naval Undersea Engineering Station	Yes	Possibly for any landscape irrigation or other non-potable use
Bangor Naval Reservation	Yes	Possibly for any landscape irrigation or other non-potable use

As an example of efforts in other local areas, King County Department of Natural Resources performed a water reuse study in 2000 that identified potential satellite projects for direct non-potable uses. In this study, information was solicited from various potential reclaimed water users in King County by sending out questionnaires to interested parties to gather information on water use and water rights to determine the potential for using reclaimed water in appropriate non-potable applications. Evaluation criteria were developed to screen potential application sites, and based on the number and/or volume of use for the application sites, the most likely areas able to support a satellite demonstration plant were then identified. Additionally, the King County study also included brief on-site inspection of all significant potential sites to verify the potential likelihood for reclaimed water irrigation. These approaches greatly reduced the candidate application sites to a manageable few, resulting in the creation of a useful “short list” of potential sites worthy of additional future study. A similar approach could be applied to Central Kitsap County to evaluate the potential irrigation reuse sites listed in Table 1 and any others developed as part of the facility plan.

TREATMENT REQUIREMENTS

In order to produce reclaimed water suitable for discharge to wetlands and groundwater recharge, tertiary treatment at the CKWWTP will be required. This would involve effluent filtration to reduce effluent biological oxygen demand (particulate portion) and total suspended solids concentrations as well as turbidity levels, and depending on the discharge requirements for the reuse sites, modification of the secondary treatment system and chemical precipitation to implement nutrient removal. In order to determine the potential effluent limits and thus the treatment requirements for wetlands discharge and groundwater recharge to the various reuse sites discussed above, Kitsap County should initiate discussions with the appropriate regulatory agencies since the permit limits are often developed on a case-by-case basis and, in the case of the natural wetlands, will depend on the baseline loadings.

Effluent Filtration

In the reuse study performed by Golder Associates, effluent filtration using either cloth filters installed at the CKWWTP plant site or slow sand filters installed at the reuse site was considered. Another alternative is upflow continuous backwash filter, which uses deep-bed sand filtration but can operate at hydraulic loading rates much higher than conventional sand filters.

Membrane filtration or membrane bioreactor (MBR) will provide treatment levels that exceed those typically associated with conventional effluent filtration. The former will function like a conventional tertiary treatment system by sending secondary effluent (usually via membrane feed pumps) from the secondary clarifiers to a membrane filtration system. The latter consists of membrane modules immersed directly into the mixed liquor of a membrane tank that follows the aeration basins. The membranes provide solids separation in place of secondary clarifiers, and because the operating mixed liquor solids concentrations in an MBR are typically at least three times higher than in an activated sludge system and the need for clarifiers are eliminated, use of an MBR is especially attractive to reduce overall site footprint while producing Class A reclaimed water quality (less than 2 NTU of turbidity). A variation of the MBR process that may be used for retrofit-type applications such as for the CKWWTP is to send a portion of the mixed liquor leaving the existing aeration basins to a separate membrane tank containing the membrane modules. The membrane tank thus operates as a parallel process to the existing secondary clarifiers and would be sized to produce the required amount of reclaimed water.

At the CKWWTP, use of an MBR process in parallel to or in place of the existing activated sludge system will need to be evaluated in the context of the expansion needs of the existing system (discussed in technical memorandum on wastewater treatment). If satellite plants are constructed to reduce the capacity expansion requirements at the CKWWTP, then an MBR process would be well suited at the satellite plants to produce reclaimed water. A more detailed discussion of satellite plants is included in the technical memorandum on wastewater treatment.

Nitrogen Removal

To achieve any needed nitrogen removal for wetlands discharge and groundwater recharge, the existing activated sludge system will need to be modified. The current system was designed to operate as an anaerobic selector-assisted activated sludge system. The system will first need to be operated at a higher solids retention time to achieve the required level of nitrification. With nitrate generated from nitrification returned to the selector cell via the return activated sludge stream, anoxic denitrification will then take place in the selector cell (now called anoxic selector). To further enhance denitrification, a mixed liquor recycle stream is added that sends mixed liquor from the end of the aeration basins back to the selector cell. If a low effluent nitrate concentration is required, an external carbon source, such as acetic acid or methanol, may be needed if a sufficient amount of readily biodegradable organics is not available in the wastewater to drive denitrification.

Phosphorus Removal

To achieve any needed phosphorus removal for wetlands discharge and groundwater recharge, biological phosphorus removal and/or chemical precipitation would be required. Biological phosphorus removal involves use of an anaerobic cell (typically upstream of the anoxic cell if denitrification is also required) at the front end of the aeration basin. Chemical precipitation involves addition of chemicals (alum), often with dual feed points (at the primary and secondary clarifiers). A combination of biological phosphorus removal and chemical precipitation may be used if a high level of phosphorus removal is required.

IDENTIFICATION OF ISSUES AND ALTERNATIVES DEVELOPMENT

It is recommended that the following issues and alternatives regarding water reuse be further evaluated as part of the facility plan development for Central Kitsap County:

- Explore other potential reuse sites not considered in the reuse study by Golder Associates, as listed in Table 1, including options for satellite treatment plants.
- Initiate discussion with the appropriate regulatory agency (Department of Ecology and/or Department of Health) to assess potential effluent limits for discharge to natural and constructed wetlands and groundwater recharge.
- Evaluate land acquisition needs and zoning and purchase required.
- Integrate any needed WWTP upgrade with level of treatment required for the reuse sites.
- Develop additional data on the hydrologic regime, function, and biology of the Steele Creek wetlands and categorize them under the Washington wetland rating system.
- Develop and compare costs of constructing satellite plants to produce reclaimed water with the costs of expanding the existing CKWWTP capacity and adding tertiary treatment.

APPENDIX E – CENTRAL KITSAP HYDRAULIC PEAKING FACTORS

DESIGN AND CONSTRUCTION OF SANITARY AND STORM SEWERS

PREPARED BY

A JOINT COMMITTEE OF THE

AMERICAN SOCIETY OF CIVIL ENGINEERS

AND THE WATER POLLUTION CONTROL FEDERATION

2002-2006 AAF
2015 AAF
2025 AAF

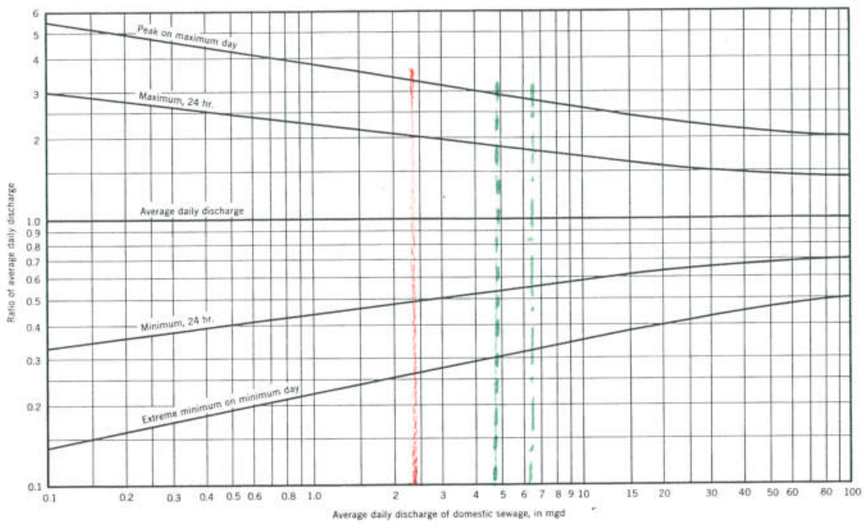

FIGURE 5.—Ratio of extreme flows to average daily flow in New England. (Mgd × 3,785 = cu m/day.)

infiltration or other extraneous flows are present. Also, provision must be made for industrial wastes which are to be transported by the sewers.

(*a*) Fixture-Unit Method of Design. Estimate of peak sewage flows for facilities such as hospitals, hotels, schools, apartment buildings, and office buildings may be made by the "fixture-unit" method (16). For these facilities flows approaching the peak rates often occur during the daylight hours. If the velocities in sewers designed for these flows are adequate for self-cleansing, deposits during the night hours will be resuspended and no nuisance should result. The United States of America Standards Institute National Plumbing Code, USASI A40.8–1955, defines "fixture-unit flow rate" as "the total discharge flow in gallons per minute of a single fixture divided by 7.5 which provides the flow rate of that particular plumbing fixture as a unit of flow. Fixtures are rated as multiples of this unit of flow." It further defines "fixture-unit" as a "quantity in terms of which the load-producing effects on the plumbing system of different kinds of plumbing fixtures are expressed on some arbitrarily chosen scale." From the first of these it can be seen that a fixture-unit is approximately 1 cfm (0.028 cu m/min).

Table X shows the fixture-unit value for various plumbing fixtures and groups of fixtures. Based on these, the discharge rate for the average single-family house or apartment is about 12 fixture units or three per person for a family of four.

Figure 7 shows the probable peak rates of discharge from systems consisting of various numbers of fixture-units, as taken from probability studies by Hunter (16). The probable peak rate of discharge from a system serving 1,000 persons at three fixture-units per person is, for example, about 440 gpm (28 l/sec). This compares to results obtained from Figure 5 for a 1,000-person system at an average daily discharge of

APPENDIX F – NPDES PERMIT

FACT SHEET FOR NPDES PERMIT WA-003052-0
CENTRAL KITSAP WASTEWATER TREATMENT PLANT

SUMMARY

Central Kitsap Wastewater Treatment Plant (CK WWTP) is owned and operated by Kitsap County Public Works Department. This is an activated sludge-type secondary treatment plant. The plant provides sewage service for the cities of Silverdale, Keyport, and Poulsbo; Central Kitsap area; the Naval Base Kitsap (NBK); and the Naval Undersea Warfare Center (NUWC) - Division Keyport. The disinfected secondary treated effluent is discharged to Port Orchard Bay, Puget Sound.

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INTRODUCTION

The Federal Clean Water Act (FCWA, 1972, and later modifications, 1977, 1981, and 1987) established water quality goals for the navigable (surface) waters of the United States. One of the mechanisms for achieving the goals of the Clean Water Act is the National Pollutant Discharge Elimination System of permits (NPDES permits), which is administered by the Environmental Protection Agency (EPA). The EPA has authorized the state of Washington to administer the NPDES permit program. Chapter 90.48 RCW defines the Department of Ecology's authority and obligations in administering the wastewater discharge permit program.

The regulations adopted by Washington State include procedures for issuing permits (chapter 173-220 WAC), technical criteria for discharges from municipal wastewater treatment facilities (chapter 173-221 WAC), water quality criteria for surface and ground waters (chapters 173-201A and 200 WAC), and sediment management standards (chapter 173-204 WAC). These regulations require that a permit be issued before discharge of waste water to waters of the state is allowed. The regulations also establish the basis for effluent limitations and other requirements which are to be included in the permit. One of the requirements (WAC 173-220-060) for issuing a permit under the NPDES permit program is the preparation of a draft permit and an accompanying fact sheet. Public notice of the availability of the draft permit is required at least thirty (30) days before the permit is issued (WAC 173-220-050). The fact sheet and draft permit are available for review (see Appendix A—Public Involvement of the fact sheet for more detail on the public notice procedures).

The fact sheet and draft permit have been reviewed by the Permittee. Errors and omissions identified in this review have been corrected before going to public notice. After the public comment period has closed, the Department of Ecology (Department) will summarize the substantive comments and the response to each comment. The summary and response to comments will become part of the file on the permit and parties submitting comments will receive a copy of the Department's response. The fact sheet will not be revised. Comments and the resultant changes to the permit will be summarized in Appendix G—Response to Comments.

GENERAL INFORMATION	
Applicant	Kitsap County public Works
Facility Name and Address	Central Kitsap Wastewater Treatment Plant 12351 Brownsville Highway NE Poulsbo, WA 98370
Type of Treatment	Conventional Activated Sludge (Secondary Treatment) System
Discharge Location	Port Orchard Bay, Puget Sound Latitude: 47° 40' 35" N Longitude: 122° 36' 05" W
Waterbody ID Number	1224819475188

BACKGROUND INFORMATION

DESCRIPTION OF THE FACILITY

HISTORY

Central Kitsap Wastewater Treatment Plant (CK WWTP) is a regional treatment plant designed to serve the central portion of Kitsap County. The WWTP began operating in 1979 as a conventional activated sludge - secondary treatment facility. The plant provides sewage service for the cities of Silverdale, Keyport, and Poulsbo; Central Kitsap area; the Naval Base Kitsap (NBK); and the Naval Undersea Warfare Center (NUWC) - Division Keyport.

Primary sources of waste water to the treatment plant are domestic waste water from residential and commercial activities, and pretreated process waste water from the NBK and the NUWC. The discharges of pretreated industrial waste water to the CK WWTP from both these facilities are regulated under State Waste Discharge Permits issued by the Department.

TREATMENT PROCESSES

The liquid stream treatment at the plant includes two communitors, a backup bar screen, two Parshall flumes, two primary clarifiers, four conventional activated sludge treatment basins with fine bubble air diffusers, two secondary clarifiers, and two ultraviolet (UV) light channels for disinfection.

The influent flow to the plant enters the headworks through one of the two communitors, where large solids get shredded and reenter the liquid waste stream. When the communitors are not operational, the influent flow to the plant enters the headworks through a backup bar screen where large solids get removed. The flow then gets divided into two Parshall flume channels with ultrasonic flow measuring device for influent flow measurement. Flow from each individual channel then enters the two circular primary clarifiers for settling of primarily (heavy) inorganic solids (primary sedimentation). Primary clarifier effluent travels to the aeration basins equipped with fine bubble air diffusers for biological treatment of waste water. Effluent from the aeration basins (mixed liquor) then splits equally and travels to the two secondary clarifiers for settling of solids generated in the aeration basins. The secondary clarifier effluent then flows to the two channels with ultraviolet (UV) light system for disinfection. The secondary treated and disinfected waste water is discharged to Port Orchard Bay, Puget Sound.

The solids stream treatment at the plant includes two sludge degritters, two gravity thickeners, two anaerobic digesters, and a centrifuge. The scum collected from the surface of the primary and secondary clarifiers is removed and sent to the anaerobic digesters for treatment. Primary sludge (solids settled in the primary clarifiers) is pumped to the degritters for grit removal. The degritted primary sludge, as well as the waste activated sludge (WAS) from the secondary clarifiers, is pumped to the gravity thickeners for thickening. The thickened sludge is pumped to the anaerobic digesters for digestion and stabilization. The digested sludge is then dewatered in a centrifuge to approximately 20 to 23 percent total solids concentration. The CK WWTP serves as a septage receiving and treatment facility for Kitsap County. In addition, secondary sludge from three other Kitsap County wastewater treatment plants is treated at this plant. The septage, and the sludge from three other County's plants are treated, stabilized, and dewatered with the solids generated at this plant. The dewatered sludge is transported by truck to Soil Key in Tenino, Washington, for composting into Class A biosolids.

Grit collected in the sludge degritting units and screenings collected in the backup bar screen (when in use) are transported to a transfer station and eventually disposed of at a local landfill.

Backup power is provided by two diesel generators, which can fully power the plant for an extended time period.

A diagram showing treatment plant process flow schematic is included in Appendix C.

DISCHARGE OUTFALL

Secondary treated and disinfected effluent from the plant is discharged to Port Orchard Bay, Puget Sound. The effluent is discharged approximately 3170 feet offshore at a depth of approximately 41 feet below mean lower low water, via a 36-inch outfall line with a diffuser. The diffuser consists of a 30-inch diameter, 120-foot long ductile iron pipeline with twelve 5-inch diameter diffuser ports. The port spacing is 10 feet, with consecutive ports facing opposite direction.

A map showing outfall discharge location is included in Appendix C.

RESIDUAL SOLIDS

Grit collected in the sludge degritting units and the screenings collected in the backup bar screen (when in use) are transported to a transfer station and eventually disposed of at a local landfill. The dewatered sludge is transported by truck to Soil Key in Tenino, Washington, for composting into Class A biosolids.

PERMIT STATUS

The existing permit for the plant expired on June 30, 2006. An application for permit renewal was received by the Department on December 30, 2005, and accepted by the Department on March 9, 2006. Since the permit could not be renewed by the expiration date, it was extended by the Department via a letter dated June 9, 2006. The plant is currently operating under the terms and conditions of the extended permit.

SUMMARY OF INSPECTIONS

The last Class I inspection of the plant was conducted on August 16, 2004. In addition, a Class II inspection of the plant was conducted on May 21, 2004. The plant effluent looked clear at the time of these inspections. The inspection reports are filed in the records section at the Northwest Regional Office of the Department.

EXISTING EFFLUENT LIMITS

The existing permit placed effluent limitations on 5-day Carbonaceous Biochemical Oxygen Demand ($CBOD_5$), Total Suspended Solids (TSS), pH, and Fecal Coliform bacteria. The effluent limitations as stipulated in Condition S1.A of the existing permit are as follows:

EFFLUENT LIMITATIONS[a]: OUTFALL # 001		
Parameter	**Monthly Average**	**Weekly Average**
Carbonaceous Biochemical Oxygen Demand[b] (5-day)	25 mg/L, 1251 lb/day	40 mg/L, 2002 lb/day
Total Suspended Solids[c] (TSS)	30 mg/L, 1501 lb/day	45 mg/L, 2252 lb/day
Fecal Coliform Bacteria	200/100 mL	400/100 mL
pH	Shall not be outside the range of 6.0 - 9.0 standard units.	
[a] The average monthly and weekly effluent limitations are based on the arithmetic mean of the samples taken with the exception of fecal coliform, which is based on the geometric mean.		
[b] The average monthly effluent concentration for $CBOD_5$ shall not exceed 25 mg/L or 15 percent of the monthly average influent concentration, whichever is more stringent.		
[c] The average monthly effluent concentration for TSS shall not exceed 30 mg/L or 15 percent of the monthly average influent concentration, whichever is more stringent.		

SUMMARY OF COMPLIANCE WITH THE EXISTING PERMIT

During the existing permit term, the Permittee has remained in compliance with the effluent limitations, based on Discharge Monitoring Reports (DMRs) submitted to the Department. Also, the treatment plant operated below its influent design criteria for flow and BOD_5. From August 2001 through February 2002, there were five instances when the influent TSS design criterion was exceeded. However, this did not result in any effluent limits violations.

The Permittee submitted *Influent Solids Analysis Report,* Brown and Caldwell, November 21, 2006, to the Department, for approval of a higher influent TSS design criterion for the treatment plant. In February 2007, an addendum to this report was submitted with a revised (lower) value for influent TSS design criterion. The Department approved this report and the addendum on March 6, 2007. The previously approved influent TSS design criterion for the plant was monthly maximum of 10,700 lb/day; the new TSS design criterion is monthly maximum of 11,400 lb/day. Condition S4.A of this permit reflects the new (approved) influent TSS design criterion of 11,400 lb/day.

INFLUENT AND EFFLUENT CHARACTERIZATION

The influent flow and the average daily concentrations of conventional pollutants, ammonia, and metals in the facility effluent as reported in the NPDES application are as follows:

Parameter	Average Daily Value
Flow (Influent)	3.6 MGD
$CBOD_5$	8 mg/L
TSS	16 mg/L
Ammonia	32 mg/L
Antimony	<5.6 µg/L
Arsenic	4.1 µg/L
Beryllium	4.4 µg/L
Cadmium	4.8 µg/L
Chromium	1.7 µg/L
Copper	8.3 µg/L
Lead	5.6 µg/L
Mercury	<0.22 µg/L
Nickel	4.2 µg/L
Selenium	3.2 µg/L
Silver	1.3 µg/L
Thallium	10.8 µg/L
Zinc	36.1 µg/L

PROPOSED PERMIT LIMITATIONS

Federal and state regulations require that effluent limitations set forth in an NPDES permit must be either technology- or water quality-based. Technology-based limitations for municipal discharges are set by regulation (40 CFR 133, and chapters 173-220 and 173-221 WAC). Water quality-based limitations are based upon compliance with the surface water quality standards (chapter 173-201A WAC), ground water standards (chapter 173-200 WAC), sediment quality standards (chapter 173-204 WAC) or the National Toxics Rule (Federal Register, Volume 57, No. 246, Tuesday, December 22, 1992.) The most stringent of these types of limits must be chosen for each of the parameters of concern. Each of these types of limits is described in more detail below.

The limits in this permit are based in part on information received in the application. The effluent constituents in the application were evaluated on a technology- and water quality-basis. The limits necessary to meet the rules and regulations of the state of Washington were determined and included in this permit. Ecology does not develop effluent limits for all pollutants that may be reported on the application as present in the effluent**.** Some pollutants are not treatable at the concentrations reported, are not controllable at the source, are not listed in regulation, and do not have a reasonable potential to cause a water quality violation**.** Effluent limits are not always developed for pollutants that may be in the discharge but not reported as present in the application. In those circumstances the permit does not authorize discharge of the non-reported pollutants. Effluent discharge conditions may change from the conditions reported in the permit application. If significant changes occur in any constituent, as described in 40 CFR 122.42(a), the Permittee is required to notify the Department of Ecology. The Permittee may be in violation of the permit until the permit is modified to reflect additional discharge of pollutants.

DESIGN CRITERIA

In accordance with WAC 173-220-150 (1)(g), flows or waste loadings shall not exceed approved design criteria.

The design criteria for the treatment plant are taken from (i) *Basis of Design Report for Central Kitsap Wastewater Treatment Facilities - Contract 1,* Brown and Caldwell, March 1995, (ii) *Central Kitsap Wastewater Treatment Plant Contract 1 Improvements, Technical Memorandum,* Brown and Caldwell, March 1996, and (iii) *Addendum to Central Kitsap Treatment Plant Influent Solids Loading Analysis,* Brown and Caldwell, February 8, 2007. The design criteria for the treatment plant are as follows:

Parameter	Design Criteria
Monthly average flow (maximum month)	6.0 MGD
Monthly average influent BOD_5 loading (maximum month)	14,100 lb/day
Monthly average influent TSS loading (maximum month)	11,400 lb/day

TECHNOLOGY-BASED EFFLUENT LIMITATIONS

Municipal wastewater treatment plants are a category of discharger for which technology-based effluent limits have been promulgated by federal and state regulations. These effluent limitations are given in the Code of Federal Regulations (CFR) 40 CFR Part 133 (federal) and in chapter 173-221 WAC (state). These regulations are performance standards that constitute all known, available, and reasonable methods of prevention, control, and treatment for municipal waste water.

The following technology-based limits for pH, fecal coliform, $CBOD_5$, and TSS are taken from chapter 173-221 WAC:

Parameter	Limit
pH	Shall be within the range of 6.0 to 9.0 standard units.
Fecal Coliform Bacteria	Monthly Geometric Mean = 200 organisms/100 mL Weekly Geometric Mean = 400 organisms/100 mL
$CBOD_5$ (concentration)	Average Monthly Limit is the most stringent of the following: - 25 mg/L - may not exceed 15% of the average influent concentration Average Weekly Limit = 40 mg/L
TSS (concentration)	Average Monthly Limit is the most stringent of the following: - 30 mg/L - may not exceed 15%of the average influent concentration Average Weekly Limit = 45 mg/L

The following technology-based mass emission limits (lb/day) are based on WAC 173-220-130(3)(b) and 173-221-030(11)(b).

The average monthly effluent mass emission limit (lb/day) for $CBOD_5$ is calculated as the maximum monthly design flow (6.0 MGD) x Concentration limit (25 mg/L) x 8.34 (conversion factor) = 1251 lb/day.

The average monthly effluent mass emission limit (lb/day) for TSS is calculated as the maximum monthly design flow (6.0 MGD) x Concentration limit (30 mg/L) x 8.34 (conversion factor) = 1501 lb/day.

The average weekly effluent mass emission limit (lb/day) for $CBOD_5$ is calculated as the maximum monthly design flow (6.0 MGD) x Concentration limit (40 mg/L) x 8.34 (conversion factor) = 2002 lb/day.

The average weekly effluent mass emission limit (lb/day) for TSS is calculated as 1.5 x monthly mass emission limit = 2252 lb/day.

SURFACE WATER QUALITY-BASED EFFLUENT LIMITATIONS

In order to protect existing water quality and preserve the designated beneficial uses of Washington's surface waters, WAC 173-201A-060 states that waste discharge permits shall be conditioned such that the discharge will meet established surface water quality standards. The Washington State surface water quality standards (chapter 173-201A WAC) is a state regulation designed to protect the beneficial uses of the surface waters of the state. Water quality-based effluent limitations may be based on an individual waste load allocation (WLA) or on a WLA developed during a basin-wide total maximum daily loading study (TMDL).

NUMERICAL CRITERIA FOR THE PROTECTION OF AQUATIC LIFE

"Numerical" water quality criteria are numerical values set forth in the state of Washington's water quality standards for surface waters (chapter 173-201A WAC). They specify the levels of pollutants allowed in a receiving water body while remaining protective of aquatic life. Numerical criteria set forth in the water quality standards are used along with chemical and physical data for the waste water and receiving water to derive the effluent limits in the discharge permit. When surface water quality-based limits are more stringent or potentially more stringent than technology-based limitations, they must be used in a permit.

NUMERICAL CRITERIA FOR THE PROTECTION OF HUMAN HEALTH

The state was issued 91 numeric water quality criteria for the protection of human health by the U.S. EPA (EPA 1992). These criteria are designed to protect humans from cancer and other diseases and are primarily applicable to fish and shellfish consumption and drinking water from surface waters.

NARRATIVE CRITERIA

In addition to numerical criteria, "narrative" water quality criteria (WAC 173-201A-030) limit toxic, radioactive, or deleterious material concentrations below those which have the potential to adversely affect characteristic water uses, cause acute or chronic toxicity to biota, impair aesthetic values, or adversely affect human health. Narrative criteria protect the specific beneficial uses of all fresh (WAC 173-201A-130) and marine (WAC 173-201A-140) waters in the state of Washington.

ANTIDEGRADATION

The state of Washington's Antidegradation Policy requires that discharges into a receiving water body shall not further degrade the existing water quality of the water body. In cases where the natural conditions of a receiving water body are of lower quality than the criteria assigned, the natural conditions shall constitute the water quality criteria. Similarly, when receiving waters are of higher quality than the criteria assigned, the existing water quality shall be protected. More information on the Washington State Antidegradation Policy can be obtained by referring to WAC 173-201A-070.

The Department has reviewed existing records and is unable to determine if ambient water quality is either higher or lower than the designated classification criteria given in chapter 173-201A WAC; therefore, the Department will use the designated classification criteria for this water body in the proposed permit. The discharges authorized by this proposed permit should not cause a loss of beneficial uses.

CRITICAL CONDITIONS

Surface water quality-based limits are derived for the waterbody's critical condition, which represents the receiving water and waste discharge condition with the highest potential for adverse impact on the aquatic biota, human health, and existing or characteristic waterbody uses.

MIXING ZONES

The water quality standards allow the Department of Ecology to authorize mixing zones around a point of discharge in establishing surface water quality-based effluent limits. Both "acute" and "chronic" mixing zones may be authorized for pollutants that can have a toxic effect on the aquatic environment near the point of discharge. The concentration of pollutants at the boundary of these mixing zones may not exceed the numerical criteria for that type of zone. Mixing zones can only be authorized for discharges that are receiving all known, available, and reasonable methods of prevention, control and treatment (AKART) and in accordance with other mixing zone requirements of WAC 173-201A-100.

The National Toxics Rule (EPA, 1992) allows the chronic mixing zone to be used to meet human health criteria.

DESCRIPTION OF THE RECEIVING WATER

The treatment plant effluent is discharged to Port Orchard Bay, Puget Sound, which is designated as a Class AA Marine Water in the vicinity of the outfall. Characteristic uses include the following:

> water supply (domestic, industrial, agricultural); stock watering; fish migration; fish and shellfish rearing, spawning and harvesting; wildlife habitat; primary contact recreation; sport fishing; boating and aesthetic enjoyment; commerce and navigation.

SURFACE WATER QUALITY CRITERIA

Applicable criteria are defined in chapter 173-201A WAC for aquatic biota. In addition, U.S. EPA has promulgated human health criteria for toxic pollutants (EPA 1992). Criteria for this discharge are summarized below:

Parameter	Water Quality Criteria
Fecal Coliforms	14 colonies/100 mL maximum geometric mean
Dissolved Oxygen	7 mg/L minimum
Temperature	13 degrees Celsius maximum
pH	7.0 to 8.5 standard units
Turbidity	Less than 5 NTU above background
Toxics	No toxics in toxic amounts

CONSIDERATION OF SURFACE WATER QUALITY-BASED LIMITS FOR NUMERIC CRITERIA

A. In estuaries, mixing zones, singularly or in combination with other mixing zones, shall:

1. Not extend in any horizontal direction from the discharge port(s) for a distance greater than 200 feet plus the depth of water over the discharge port(s) as measured during mean lower low water; and

2. Not occupy greater than 25 percent of the width of the water body as measured during mean lower low water.

B. In estuarine waters, a zone where acute criteria may be exceeded shall not extend beyond 10 percent of the distance established in (A) above, as measured independently from the discharge port(s).

The vertical limitations for both chronic and acute zones is the depth of water over the discharge port(s) as measured during mean lower low water.

The mixing zone boundaries for the WWTP discharge are described in Condition S1.B of the permit.

The predicted dilution factors of effluent to receiving water that occur within these zones have been determined at the critical condition by the use of EPA Plumes model. The water quality model and results are included in the *Central Kitsap WWTP Dilution Analysis,* Brown and Caldwell, October 26, 2006. The predicted dilution ratios for the WWTP effluent for aquatic life and human health criteria are summarized in the following table:

Criteria	Acute	Chronic
Aquatic Life	47:1	84:1
Human Health, Carcinogen		91:1
Human Health, Non-carcinogen		84:1

Pollutants in an effluent may affect the aquatic environment near the point of discharge (near-field) or at a considerable distance from the point of discharge (far-field). Toxic pollutants, for example, are near-field pollutants—their adverse effects diminish rapidly with mixing in the receiving water. Conversely, a pollutant such as BOD is a far-field pollutant whose adverse effect occurs away from the discharge even after dilution has occurred. Thus, the method of calculating water quality-based effluent limits varies with the point at which the pollutant has its maximum effect.

The derivation of water quality-based limits also takes into account the variability of the pollutant concentrations in both the effluent and the receiving water.

$CBOD_5$—This discharge with technology-based limitations results in a small amount of CBOD loading relative to the large amount of dilution (84:1) occurring in the receiving water at critical conditions. Technology-based limitations will be protective of dissolved oxygen criteria in the receiving water.

Temperature—The impact of the discharge on the temperature of the receiving water was modeled by simple mixing analysis at critical condition, using the dilution ratio of 84:1. Under critical conditions, there is no predicted violation of the water quality standards for surface waters. Therefore, no effluent limitation for temperature was placed in the proposed permit.

pH—Because of the high buffering capacity of marine water, compliance with the technology-based limits of 6.0 to 9.0 will assure compliance with the water quality standards for surface waters.

Fecal Coliform—The numbers of fecal coliform were modeled by simple mixing analysis using the technology-based limit of 400 organisms per 100 ml and a dilution factor of 84:1. Under critical conditions, there is no predicted violation of the water quality standards for surface waters with the technology-based limit. Therefore, the technology-based effluent limitation for fecal coliform bacteria was placed in the proposed permit.

Toxic Pollutants—Federal regulations (40 CFR 122.44) require NPDES permits to contain effluent limits for toxic chemicals in an effluent whenever there is a reasonable potential for those chemicals to exceed the surface water quality criteria. This process occurs concurrently with the derivation of technology-based effluent limits. Facilities with technology-based effluent limits defined in regulation are not exempted from meeting the water quality standards for surface waters or from having surface water quality-based effluent limits.

The toxics determined to be present in the discharge are ammonia and metals. The average daily concentrations of these pollutants detected in the plant effluent are shown in the table in *INFLUENT AND EFFLUENT CHARACTERIZATION* section of this fact sheet. A reasonable potential analysis to exceed the water quality criteria was conducted for these pollutants, to determine whether or not effluent limitations for these parameters would be required in this permit.

The determination of the reasonable potential to exceed the water quality criteria was evaluated with procedures given in EPA, 1991 (Appendix C) at the critical condition in the receiving water. Dilution ratios at the critical condition used in the modeling are (i) acute dilution ratio 47:1 and (ii) chronic dilution ratio 84:1. The reasonable potential analysis is shown in Appendix D of this fact sheet.

Calculations using all applicable data resulted in a determination that there is no reasonable potential for this discharge to cause a violation of water quality standards.

HUMAN HEALTH

Washington's water quality standards now include 91 numeric health-based criteria that must be considered in NPDES permits. These criteria were promulgated for the state by the U.S. EPA in its National Toxics Rule (Federal Register, Volume 57, No. 246, Tuesday, December 22, 1992).

The Department has determined that the effluent contains chemicals of concern for human health. The chemicals of concern present in the discharge are: arsenic, mercury, nickel, selenium, and thallium. The discharger's h'gh priority status is based on the discharger's status as a major discharger, and knowledge of data indicating regulated chemicals occur in the discharge.

A determination of the discharge's potential to cause an exceedance of the water quality standards was conducted as required by 40 CFR 122.44(d). The reasonable potential determination was evaluated with procedures given in the *Technical Support Document for Water Quality-Based Toxics Control* (EPA/505/2-90-001) and the Department's *Permit Writer's Manual* (Ecology Publication 92-109, July 1994). The determination indicated that the discharge has no reasonable potential to cause a violation of water quality standards for human health, thus an effluent limit is not warranted. The reasonable potential analysis is shown in Appendix E of this fact sheet.

WHOLE EFFLUENT TOXICITY

The water quality standards for surface waters require that the effluent not cause toxic effects in the receiving waters. Many toxic pollutants cannot be detected by commonly available detection methods. However, toxicity can be measured directly by exposing living organisms to the waste water in laboratory tests and measuring the response of the organisms. Toxicity tests measure the aggregate toxicity of the whole effluent, and therefore this approach is called whole effluent toxicity (WET) testing. Some WET tests measure acute toxicity and other WET tests measure chronic toxicity.

Acute toxicity tests measure mortality as the significant response to the toxicity of the effluent. Dischargers who monitor their waste water with acute toxicity tests are providing an indication of the potential lethal effect of the effluent to organisms in the receiving environment.

Chronic toxicity tests measure various sublethal toxic responses such as retarded growth or reduced reproduction. Chronic toxicity tests often involve either a complete life cycle test of an organism with an extremely short life cycle or a partial life cycle test on a critical stage of one of a test organism's life cycles. Organism survival is also measured in some chronic toxicity tests.

Accredited WET testing laboratories have the proper WET testing protocols, data requirements, and reporting format. Accredited laboratories are knowledgeable about WET testing and capable of calculating an NOEC, LC_{50}, EC_{50}, IC_{25}, and so on. All accredited labs have been provided the most recent version of the Department of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria,* which is referenced in the permit. Any Permittee interested in receiving a copy of this publication may call the Ecology Publications Distribution Center at (360) 407-7472 for a copy. Ecology recommends that Permittees send a copy of the acute or chronic toxicity sections(s) of their permits to their laboratory of choice.

Acute toxicity was measured during testing in the previous permit term. Acute toxicity was found to be at levels that, in accordance with WAC 173-205-050(2)(a), have a reasonable potential to cause receiving water toxicity. An acute toxicity limit is therefore required. The acute toxicity limit is no statistically significant difference in test organism survival between the acute critical effluent concentration (ACEC), 2.1 percent of the effluent, and the control. Permit Condition S1.A includes the limit for acute toxicity.

The acute toxicity limit is set relative to the zone of acute criteria exceedance (acute mixing zone) established in accordance with WAC 173-201A-100. The acute critical effluent concentration (ACEC) is the concentration of effluent existing at the boundary of the acute mixing zone during critical conditions.

Monitoring for compliance with an acute toxicity limit is accomplished by conducting an acute toxicity test using a sample of effluent diluted to equal the ACEC and comparing test organism survival in the ACEC to survival in nontoxic control water. The Permittee is in compliance with the acute toxicity limit if there is no statistically significant difference in test organism survival between the ACEC and the control.

The WET tests during effluent characterization indicate that no reasonable potential exists to cause receiving water chronic toxicity, and the Permittee will not be given a chronic WET limit, and will only be required to retest the effluent prior to application for permit renewal in order to demonstrate that chronic toxicity has not increased in the effluent.

If the Permittee makes process or material changes which, in the Department's opinion, results in an increased potential for effluent toxicity, then the Department may require additional effluent characterization in a regulatory order, by permit modification, or in the permit renewal. Toxicity is assumed to have increased if WET testing conducted for submission with a permit application fails to meet the performance standards in WAC 173-205-020, "whole effluent toxicity performance standard." The Permittee may demonstrate to the Department that changes have not increased effluent toxicity by performing additional WET testing after the time the process or material changes have been made.

SEDIMENT QUALITY

The Department has promulgated aquatic sediment standards (chapter 173-204 WAC) to protect aquatic biota and human health. These standards state that the Department may require Permittees to evaluate the potential for the discharge to cause a violation of applicable standards (WAC 173-204-400).

As required by the previous permit, the Permittee had submitted a sediment sampling and analysis plan to the Department of Ecology, for review and approval. Following Department's approval of this plan, the Permittee collected and analyzed sediments in the vicinity of the outfall. The results of the sediment sampling and analysis were submitted to the Department in *Central Kitsap WWTP NPDES Sediment Monitoring Report,* Beak Consultants, Inc., May 1999.

The analysis of the sediment chemistry data using SEDQUAL model by the Department's Sediment Management Unit staff identified no sediment quality standards violations. Because no sediment quality standards exceedances were found, there was no need for follow-up bioassay testing by the Permittee.

The sampling and analysis showed elevated sediment conventional parameters, that is, sulfides, oil and grease, and total volatile solids. In particular, elevated sulfides levels were documented at stations near the outfall. The elevated sulfides levels were also documented at stations away from the outfall.

The proposed permit requires additional sediment sampling for further evaluation. Condition S12 of the permit requires the Permitee to conduct sediment bioassays and conventional sediment variables analysis. If the bioassays fail the sediment quality standards, the Permittee is required to conduct analysis for the standard 47 Sediment Management Standards (SMS) sediment chemicals of concern.

OUTFALL EVALUATION

Proposed permit Condition S13 requires the Permittee to conduct an outfall inspection in the year 2011, and submit a report detailing the findings of that inspection. The outfall was last inspected on September 15, 1993. The outfall and diffuser were found to be in good condition during this inspection. The purpose of the inspection required by this permit is to determine the condition of the discharge pipe and diffusers and to determine if sediment is accumulating in the vicinity of the outfall.

GROUNDWATER QUALITY LIMITATIONS

The Department has promulgated groundwater quality standards (chapter 173-200 WAC) to protect uses of ground water. Permits issued by the Department shall be conditioned in such a manner so as not to allow violations of those standards (WAC 173-200-100).

This Permittee has no discharge to ground and therefore no limitations are required based on potential effects to ground water.

COMPARISON OF THE PROPOSED EFFLUENT LIMITS WITH THE EXISTING EFFLUENT LIMITS

Comparison of the proposed and existing effluent limits is shown in the following table. The proposed effluent limits for conventional pollutants (BOD, TSS, fecal coliform bacteria, and pH) are the same as the existing limits. In addition, due to noncompliance with the performance standard for acute toxicity test during the existing permit term, the proposed permit also includes effluent limits for acute toxicity. Due to revised dilution ratios, the acute critical effluent concentration (ACEC) for the acute toxicity limit in the proposed permit is more stringent than the existing permit.

Parameter	Existing Effluent Limits	Proposed Effluent Limits
$CBOD_5$ (average monthly concentration)	25 mg/L	25 mg/L
TSS (average monthly concentration)	30 mg/L	30 mg/L
Fecal Coliform (average monthly concentration)	200/100 mL	200/100 mL
pH	6.0 to 9.0	6.0 to 9.0
Acute Toxicity	No acute toxicity in a whole effluent toxicity (WET) test concentration representing the acute critical effluent concentration (ACEC) of 1.7% effluent.	No acute toxicity in a whole effluent toxicity (WET) test concentration representing the acute critical effluent concentration (ACEC) of 2.1% effluent.

MONITORING REQUIREMENTS

Monitoring, recording, and reporting are required (WAC 173-220-210 and 40 CFR 122.41) to verify the treatment process is functioning correctly and the effluent limitations are being achieved.

The monitoring schedule is detailed in the proposed permit under Condition S2.A. Specified monitoring frequencies take into account the quantity and variability of discharge, the treatment method, past compliance, significance of pollutants, and cost of monitoring. Agency guidance for required monitoring frequencies for wastewater treatment plants is given in the current version of Ecology's *Permit Writer's Manual* (July 2002). The guidance for monitoring frequency for this plant is given in the subsection for A*ctivated Sludge Plants With Greater Than 5 MGD Average Design Flow*.

The suggested monitoring frequencies given in the guidance for CBOD and TSS are 5/week, and daily for fecal coliform. The monitoring frequencies for these parameters in the proposed permit are the same as the existing permit, which are 3/week for CBOD and TSS, and 5/week for fecal coliform. As stated above in the *SUMMARY OF COMPLIANCE WITH THE EXISTING PERMIT* section of this fact sheet, based on the DMRs submitted to the Department, the Permittee has consistently remained in compliance with the effluent limits and there have been no exceedance of influent design criteria since February 2002. Therefore, monitoring of these parameters at the existing frequencies is deemed sufficient.

Priority pollutants and conventional pollutants monitoring is required for reporting in the next permit application. Requirement for metals monitoring has been continued from the previous permit in order to continue monitoring for the influence of industrial discharges.

LAB ACCREDITATION

With the exception of certain parameters, the permit requires all monitoring data to be prepared by a laboratory registered or accredited under the provisions of chapter 173-50 WAC, *Accreditation of Environmental Laboratories*. With the exception of some priority pollutants, and WET testing, the laboratory at this plant is accredited for all of the monitoring parameters in Condition S2.A.

OTHER PERMIT CONDITIONS

REPORTING AND RECORD KEEPING

The conditions of S3 are based on the authority to specify any appropriate reporting and recordkeeping requirements to prevent and control waste discharges (WAC 173-220-210).

PREVENTION OF FACILITY OVERLOADING

Overloading of the treatment plant is a violation of the terms and conditions of the permit. To prevent this from occurring, RCW 90.48.110 and WAC 173-220-150 require the Permittee to take the actions detailed in proposed permit Requirement S4 to plan expansions or modifications before existing capacity is reached and to report and correct conditions that could result in new or increased discharges of pollutants.

OPERATION AND MAINTENANCE (O&M)

The proposed permit contains Condition S5 as authorized under RCW 90.48.110, WAC 173-150, chapter 173-230 WAC, and WAC 173-240-080. It is included to ensure proper operation and regular maintenance of equipment, and to ensure that adequate safeguards are taken so that constructed facilities are used to their optimum potential in terms of pollutant capture and treatment.

RESIDUAL SOLIDS HANDLING

To prevent water quality problems, the Permittee is required in permit Condition S7 to store and handle all residual solids (grit, screenings, scum, sludge, and other solid waste) in accordance with the requirements of RCW 90.48.080 and state water quality standards.

The final use and disposal of sewage sludge from this facility is regulated by U.S. EPA under 40 CFR 503, and by Ecology under chapter 70.95J RCW and chapter 173-308 WAC. The disposal of other solid waste is under the jurisdiction of the Bremerton/Kitsap County Health Department.

PRETREATMENT

Since the pretreatment program has not been delegated to the Permittee, the pretreatment Condition S8 in the permit is a standard condition derived from the Federal Regulation 40 CFR 403.5.

GENERAL CONDITIONS

General conditions are based directly on state and federal law and regulations and have been standardized for all individual municipal NPDES permits issued by the Department.

PERMIT ISSUANCE PROCEDURES

PERMIT MODIFICATIONS

The Department may modify this permit to impose numerical limitations, if necessary, to meet water quality standards, sediment quality standards, or groundwater standards, based on new information obtained from sources such as inspections, effluent monitoring, outfall studies, and effluent mixing studies.

The Department may also modify this permit as a result of new or amended state or federal regulations.

RECOMMENDATION FOR PERMIT ISSUANCE

This proposed permit meets all statutory requirements for authorizing a wastewater discharge, including those limitations and conditions believed necessary to protect human health, aquatic life, and the beneficial uses of waters of the state of Washington. The Department proposes that this permit be issued for the full allowable five (5)-year period.

REFERENCES FOR TEXT AND APPENDICES

Environmental Protection Agency (EPA)

1992. National Toxics Rule. Federal Register, V. 57, No. 246, Tuesday, December 22, 1992.

1991. Technical Support Document for Water Quality-based Toxics Control. EPA/505/2-90-001.

1983. Water Quality Standards Handbook. USEPA Office of Water, Washington, D.C.

Washington State Department of Ecology

Laws and Regulations (http://www.ecy.wa.gov/laws-rules/index.html)

Permit and Wastewater Related Information (http://www.ecy.wa.gov/programs/wq/wastewater/index.html)

1994. Permit Writer's Manual. Publication Number 92-109

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2007. Addendum to Central Kitsap Treatment Plant Influent Solids Analysis, Brown and Caldwell

2006. Central Kitsap Wastewater Treatment Plant Influent Solids Analysis Report, Brown and Caldwell

2006. Central Kitsap Wastewater Treatment Plant Dilution Analysis, Brown and Caldwell

1999. Central Kitsap Wastewater Treatment Plant NPDES Sediment Monitoring Report, Beak Consultants Incorporated

1996. Central Kitsap Wastewater Treatment Plant Contract 1 Improvements, Technical Memorandum, Brown and Caldwell

1995. Basis of Design Report for Central Kitsap Wastewater Treatment Facilities – Contract 1, Brown and Caldwell

APPENDIX A—PUBLIC INVOLVEMENT INFORMATION

The Department has tentatively determined to reissue a permit to the applicant listed on page 1 of this fact sheet. The permit contains conditions and effluent limitations which are described in the rest of this fact sheet.

Public Notice of Application (PNOA) was published on March 10 and 17, 2006, in the *Kitsap Sun* to inform the public that an application had been submitted and to invite comment on the reissuance of this permit.

The Department published a Public Notice of Draft (PNOD) on March 31, 2007, in the *Kitsap Sun* to inform the public that a draft permit and fact sheet were available for review. Interested persons were invited to submit written comments regarding the draft permit. The draft permit, fact sheet, and related documents were available for inspection and copying between the hours of 8:00 a.m. and 5:00 p.m. weekdays, by appointment, at the regional office listed below. Written comments were mailed to:

Water Quality Permit Coordinator
Department of Ecology
Northwest Regional Office
3190 – 160 Avenue SE
Bellevue, WA 98008-5452

Any interested party may comment on the draft permit or request a public hearing on this draft permit within the thirty (30)-day comment period to the address above. The request for a hearing shall indicate the interest of the party and the reasons why the hearing is warranted. The Department will hold a hearing if it determines there is a significant public interest in the draft permit (WAC 173-220-090). Public notice regarding any hearing will be circulated at least thirty (30) days in advance of the hearing. People expressing an interest in this permit will be mailed an individual notice of hearing (WAC 173-220-100).

Comments should reference specific text followed by proposed modification or concern when possible. Comments may address technical issues, accuracy and completeness of information, the scope of the facility's proposed coverage, adequacy of environmental protection, permit conditions, or any other concern that would result from issuance of this permit.

The Department will consider all comments received within thirty (30) days from the date of public notice of draft indicated above, in formulating a final determination to issue, revise, or deny the permit. The Department's response to all significant comments is available upon request and will be mailed directly to people expressing an interest in this permit.

Further information may be obtained from the Department by telephone (425) 649-7201, or by writing to the address above.

APPENDIX B—GLOSSARY

Acute Toxicity—The lethal effect of a pollutant on an organism that occurs within a short period of time, usually 48 to 96 hours.

AKART—An acronym for "all known, available, and reasonable methods of prevention, control, and treatment."

Ambient Water Quality—The existing environmental condition of the water in a receiving water body.

Ammonia—Ammonia is produced by the breakdown of nitrogenous materials in waste water. Ammonia is toxic to aquatic organisms, exerts an oxygen demand, and contributes to eutrophication. It also increases the amount of chlorine needed to disinfect waste water.

Average Monthly Discharge Limitation—The highest allowable average of daily discharges over a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month (except in the case of fecal coliform). The daily discharge is calculated as the average measurement of the pollutant over the day.

Average Weekly Discharge Limitation—The highest allowable average of daily discharges over a calendar week, calculated as the sum of all daily discharges measured during a calendar week divided by the number of daily discharges measured during that week. The daily discharge is calculated as the average measurement of the pollutant over the day.

Best Management Practices (BMPs)—Schedules of activities, prohibitions of practices, maintenance procedures, and other physical, structural and/or managerial practices to prevent or reduce the pollution of waters of the state. BMPs include treatment systems, operating procedures, and practices to control: plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. BMPs may be further categorized as operational, source control, erosion and sediment control, and treatment BMPs.

BOD_5—Determining the Biochemical Oxygen Demand of an effluent is an indirect way of measuring the quantity of organic material present in an effluent that is utilized by bacteria. The BOD_5 is used in modeling to measure the reduction of dissolved oxygen in a receiving water after effluent is discharged. Stress caused by reduced dissolved oxygen levels makes organisms less competitive and less able to sustain their species in the aquatic environment. Although BOD is not a specific compound, it is defined as a conventional pollutant under the federal Clean Water Act.

Bypass—The intentional diversion of waste streams from any portion of a treatment facility.

$CBOD_5$—The quantity of oxygen utilized by a mixed population of microorganisms acting on the nutrients in the sample in an aerobic oxidation for 5 days at a controlled temperature of 20 degrees Celsius, with an inhibitory agent added to prevent the oxidation of nitrogen compounds. The method for determining $CBOD_5$ is given in 40 CFR Part 136.

Chlorine—Chlorine is used to disinfect waste waters of pathogens harmful to human health. It is also extremely toxic to aquatic life.

Chronic Toxicity—The effect of a pollutant on an organism over a relatively long time, often 1/10 of an organism's lifespan or more. Chronic toxicity can measure survival, reproduction or growth rates, or other parameters to measure the toxic effects of a compound or combination of compounds.

Clean Water Act (CWA)—The Federal Water Pollution Control Act enacted by Public Law 92-500, as amended by Public Laws 95-217, 95-576, 96-483, 97-117; USC 1251 et seq.

Combined Sewer Overflow (CSO)—The event during which excess combined sewage flow caused by inflow is discharged from a combined sewer, rather than conveyed to the sewage treatment plant because either the capacity of the treatment plant or the combined sewer is exceeded.

Compliance Inspection – Without Sampling—A site visit for the purpose of determining the compliance of a facility with the terms and conditions of its permit or with applicable statutes and regulations.

Compliance Inspection – With Sampling—A site visit to accomplish the purpose of a Compliance Inspection – Without Sampling and as a minimum, sampling and analysis for all parameters with limits in the permit to ascertain compliance with those limits; and, for municipal facilities, sampling of influent to ascertain compliance with the percent removal requirement. Additional sampling may be conducted.

Composite Sample—A mixture of grab samples collected at the same sampling point at different times, formed either by continuous sampling or by mixing a minimum of four discrete samples. May be "time-composite" (collected at constant time intervals) or "flow-proportional" (collected either as a constant sample volume at time intervals proportional to stream flow, or collected by increasing the volume of each aliquot as the flow increased while maintaining a constant time interval between the aliquots).

Construction Activity—Clearing, grading, excavation, and any other activity which disturbs the surface of the land. Such activities may include road building; construction of residential houses, office buildings, or industrial buildings; and demolition activity.

Continuous Monitoring—Uninterrupted, unless otherwise noted in the permit.

Critical Condition—The time during which the combination of receiving water and waste discharge conditions have the highest potential for causing toxicity in the receiving water environment. This situation usually occurs when the flow within a water body is low, thus, its ability to dilute effluent is reduced.

Dilution Factor—A measure of the amount of mixing of effluent and receiving water that occurs at the boundary of the mixing zone. Expressed as the inverse of the effluent fraction, for example, a dilution factor of 10 means the effluent comprises 10 percent by volume and the receiving water 90 percent.

Engineering Report—A document which thoroughly examines the engineering and administrative aspects of a particular domestic or industrial wastewater facility. The report shall contain the appropriate information required in WAC 173-240-060 or 173-240-130.

Fecal Coliform Bacteria—Fecal coliform bacteria are used as indicators of pathogenic bacteria in the effluent that are harmful to humans. Pathogenic bacteria in wastewater discharges are controlled by disinfecting the waste water. The presence of high numbers of fecal coliform bacteria in a water body can indicate the recent release of untreated waste water and/or the presence of animal feces.

Grab Sample—A single sample or measurement taken at a specific time or over as short a period of time as is feasible.

Industrial User—A discharger of waste water to the sanitary sewer which is not sanitary waste water or is not equivalent to sanitary waste water in character.

Industrial Wastewater—Water or liquid-carried waste from industrial or commercial processes, as distinct from domestic waste water. These wastes may result from any process or activity of industry, manufacture, trade or business; from the development of any natural resource; or from animal operations such as feed lots, poultry houses, or dairies. The term includes contaminated storm water and, also, leachate from solid waste facilities.

Infiltration and Inflow (I/I)—"Infiltration" means the addition of ground water into a sewer through joints, the sewer pipe material, cracks, and other defects. "Inflow" means the addition of precipitation-caused drainage from roof drains, yard drains, basement drains, street catch basins, etc., into a sewer.

Interference—A discharge which, alone or in conjunction with a discharge or discharges from other sources, both:

Inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal; and

Therefore is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or of the prevention of sewage sludge use or disposal in compliance with the following statutory provisions and regulations or permits issued thereunder (or more stringent state or local regulations): Section 405 of the Clean Water Act, the Solid Waste Disposal Act (SWDA) (including Title II, more commonly referred to as the Resource Conservation and Recovery Act [RCRA], and including state regulations contained in any state sludge management plan prepared pursuant to subtitle D of the SWDA), sludge regulations appearing in 40 CFR Part 507, the Clean Air Act, the Toxic Substances Control Act, and the Marine Protection, Research and Sanctuaries Act.

Major Facility—A facility discharging to surface water with an EPA rating score of > 80 points based on such factors as flow volume, toxic pollutant potential, and public health impact.

Maximum Daily Discharge Limitation—The highest allowable daily discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. The daily discharge is calculated as the average measurement of the pollutant over the day.

Method Detection Level (MDL)—The minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is above zero and is determined from analysis of a sample in a given matrix containing the analyte.

Minor Facility—A facility discharging to surface water with an EPA rating score of < 80 points based on such factors as flow volume, toxic pollutant potential, and public health impact.

Mixing Zone—A volume that surrounds an effluent discharge within which water quality criteria may be exceeded. The area of the authorized mixing zone is specified in a facility's permit and follows procedures outlined in state regulations (chapter 173-201A WAC).

National Pollutant Discharge Elimination System (NPDES)—The NPDES (Section 402 of the Clean Water Act) is the federal wastewater permitting system for discharges to navigable waters of the United States. Many states, including the state of Washington, have been delegated the authority to issue these permits. NPDES permits issued by Washington State permit writers are joint NPDES/State permits issued under both state and federal laws.

Pass Through—A discharge which exits the POTW into waters of the state in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation), or which is a cause of a violation of state water quality standards.

pH—The pH of a liquid measures its acidity or alkalinity. A pH of 7 is defined as neutral, and large variations above or below this value are considered harmful to most aquatic life.

Potential Significant Industrial User—A potential significant industrial user is defined as an Industrial User which does not meet the criteria for a Significant Industrial User, but which discharges waste water meeting one or more of the following criteria:

a. Exceeds 0.5 percent of treatment plant design capacity criteria and discharges <25,000 gallons per day; or

b. Is a member of a group of similar industrial users which, taken together, have the potential to cause pass through or interference at the POTW (for example, facilities which develop photographic film or paper, and car washes).

The Department may determine that a discharger initially classified as a potential significant industrial user should be managed as a significant industrial user.

Quantitation Level (QL)—A calculated value five times the MDL (method detection level).

Significant Industrial User (SIU)—

1. All industrial users subject to Categorical Pretreatment Standards under 40 CFR 403.6 and 40 CFR Chapter I, Subchapter N; and

2. Any other industrial user that: discharges an average of 25,000 gallons per day or more of process waste water to the POTW (excluding sanitary, noncontact cooling, and boiler blow-down waste water); contributes a process waste stream that makes up 5 percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant; or is designated as such by the Control Authority* on the basis that the industrial user has a reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement [in accordance with 40 CFR 403.8(f)(6)].

Upon finding that the industrial user meeting the criteria in paragraph 2, above, has no reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement, the Control Authority* may at any time, on its own initiative or in response to a petition received from an industrial user or POTW, and in accordance with 40 CFR 403.8(f)(6), determine that such industrial user is not a significant industrial user.

*The term "Control Authority" refers to the Washington State Department of Ecology in the case of non-delegated POTWs or to the POTW in the case of delegated POTWs.

State Waters—Lakes, rivers, ponds, streams, inland waters, underground waters, salt waters, wetlands, and all other surface waters and watercourses within the jurisdiction of the state of Washington.

Stormwater—That portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes, and other features of a stormwater drainage system into a defined surface water body, or a constructed infiltration facility.

Technology-based Effluent Limit—A permit limit that is based on the ability of a treatment method to reduce the pollutant.

Total Suspended Solids (TSS)—Total suspended solids are the particulate materials in an effluent. Large quantities of TSS discharged to a receiving water may result in solids accumulation. Apart from any toxic effects attributable to substances leached out by water, suspended solids may kill fish, shellfish, and other aquatic organisms by causing abrasive injuries and by clogging the gills and respiratory passages of various aquatic fauna. Indirectly, suspended solids can screen out light and can promote and maintain the development of noxious conditions through oxygen depletion.

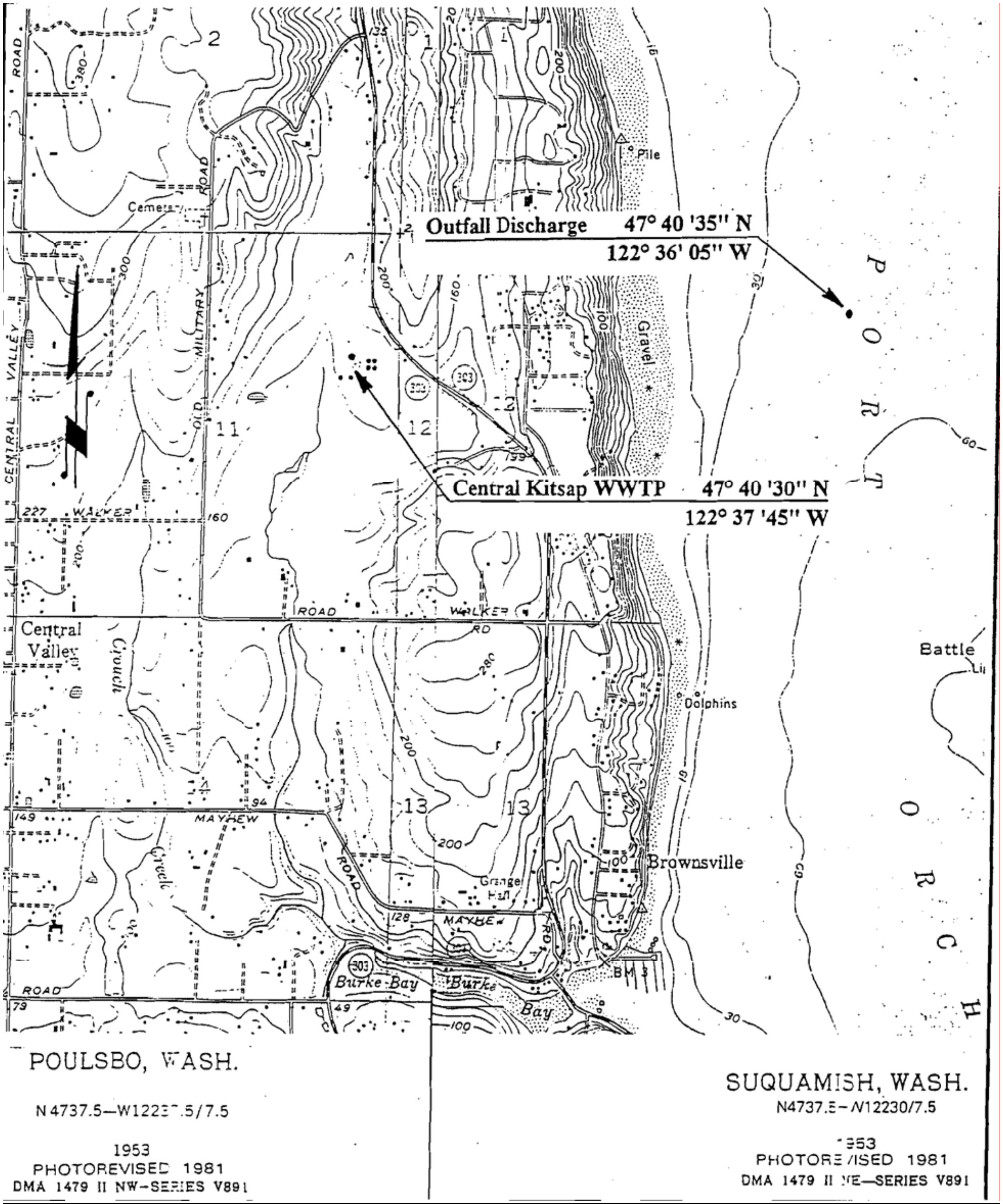
Upset—An exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, lack of preventative maintenance, or careless or improper operation.

Water Quality-based Effluent Limit—A limit on the concentration or mass of an effluent parameter that is intended to prevent the concentration of that parameter from exceeding its water quality criterion after it is discharged into a receiving water.

APPENDIX C—TREATMENT PLANT MAP AND OUTFALL DISCHARGE LOCATION

TREATMENT PLANT MAP

MAP SHOWING OUTFALL DISCHARGE LOCATION



APPENDIX D—REASONABLE POTENTIAL CALCULATION FOR WATER QUALITY CRITERIA

Several of the Excel® spreadsheet tools used to evaluate a discharger's ability to meet Washington State water quality standards can be found on the Department's home page at (http://www.ecy.wa.gov/programs/wq/wastewater/index.html).

AMMONIA WATER QUALITY CRITERIA CALCULATION

Calculation of Ammonia Concentration and Criteria for fresh water. Based on EPA Quality Criteria for Water (EPA 400/5-86-001) and WAC 173-201A. Revised 1-5-94 (corrected total ammonia criterion). Revised 3/10/95 to calculate chronic criteria in accordance with EPA Memorandum from Heber to WQ Stds Coordinators dated July 30, 1992.

INPUT	
1. Temperature (deg C):	17.0
2. pH:	8.3
3. Salinity (g/Kg):	29.7

OUTPUT	
1. Pressure (atm; EPA criteria assumes 1 atm):	1.0
2. Molal Ionic Strength (not valid if >0.85):	0.609
3. pKa8 at 25 deg C (Whitfield model "B"):	9.316
4. Percent of Total Ammonia Present as Unionized:	5.041%
5. Unionized ammonia criteria (mg un-ionized NH3 per liter) from EPA 440/5-88-004	
Acute:	0.23
Chronic:	0.04
6. Total Ammonia Criteria (mg/L as NH3)	
Acute:	4.62
Chronic:	0.69
7. Total Ammonia Criteria (mg/L as NH3-N)	
Acute:	3.80
Chronic:	0.57

REASONABLE POTENTIAL CALCULATION
TO DETERMINE EXCEEDANCE OF WATER QUALITY-BASED CRITERIA

	Metal Criteria Translator as decimal	Metal Criteria Translator as decimal	Ambient Concentration (metals as dissolved)			Acute Mixing Zone	Chronic Mixing Zone	LIMIT REQ'D?	Effluent percentile value		Max effluent conc. measured (metals as total recoverable)	Coeff Variation		# of samples	Multiplier	Acute Dil'n Factor	Chronic Dil'n Factor	
Parameter	Acute	Chronic	ug/L	Acute ug/L	Chronic ug/L	ug/L	ug/L			Pn	ug/L	CV	s	n				COMMENTS
Ammonia				3800.0000	570.0000	897.88	502.39	NO	0.95	0.982	49170.00	0.35	0.34	164	0.86	47	84	
Arsenic				69.00	36.00	0.11	0.06	NO	0.95	0.967	5.52	0.60	0.55	89	0.90	47	84	Out of 89 samples 75 samples < MDL
Cadmium				42.00	9.30	0.11	0.06	NO	0.95	0.970	6.00	0.60	0.55	98	0.88	47	84	All (98) samples < MDL
Chromium (HEX)				1100.00	50.00	0.09	0.05	NO	0.95	0.970	5.13	1.01	0.84	98	0.82	47	84	Out of 98 samples 34 samples < MDL
Copper				4.80	3.10	0.21	0.12	NO	0.95	0.970	11.20	0.60	0.55	97	0.88	47	84	Out of 98 samples 50 samples < MDL
Lead				210.00	8.10	0.19	0.11	NO	1.00	0.970	10.40	0.60	0.55	98	0.88	47	84	Out of 98 samples 78 samples < MDL
Mercury				1.80	0.025	0.00	0.00	NO	0.95	0.970	0.22	0.60	0.55	100	0.87	47	84	Out of 100 samples 97 samples < MDL
Nickel				74.00	8.20	0.26	0.15	NO	0.95	0.970	15.00	1.05	0.86	98	0.82	47	84	Out of 98 samples 17 samples < MDL
Selenium				290	71	0.10	0.05	NO	1.00	0.967	5.00	0.60	0.55	88	0.90	47	84	Out of 88 samples 83 samples < MDL
Silver				1.90	10000	0.05	0.03	NO	0.95	0.967	2.50	0.81	0.71	88	0.88	47	84	Out of 88 samples 22 samples < MDL
Zinc				90.00	81.00	1.02	0.57	NO	0.95	0.970	55.10	0.63	0.58	99	0.87	47	84	Out of 99 samples 7 samples < MDL

APPENDIX E—REASONABLE POTENTIAL CALCULATION FOR PROTECTION OF HUMAN HEALTH

Several of the excel® spreadsheet tools used to evaluate a discharger's ability to meet Washington State water quality standards can be found on the Department's home page at (http://www.ecy.wa.gov/programs/wq/wastewater/index.html).

Revised 3/00	Ambient Concentration (Geometric Mean)	Water Quality Criteria for Protection of Human Health	Max concentration at edge of chronic mixing zone.	LIMIT REQ'D?	Expected Number of Compliance Samples per Month	AVERAGE MONTHLY EFFLUENT LIMIT	MAXIMUM DAILY EFFLUENT LIMIT	Estimated Percentile at 95% Confidence		Max effluent conc. measured	Coeff Variation		# of samples from which # in col. K was taken	Multiplier	Calculated 50th percentile Effluent Conc. (When n>10)	Dilution Factor
Parameter	ug/L	ug/L	ug/L			ug/L	ug/L		Pn	ug/L	CV	s	n			
ARSENIC (inorganic)		0.14	0.03	NO	4	NONE	NONE	0.50	0.97	8.45	0.60	0.6	89	0.36	2.47	91
MERCURY		0.15	0.01	NO	4	NONE	NONE	0.50	0.97	0.53	0.60	0.6	100	0.35	0.43	84
NICKEL		4600	0.04	NO	4	NONE	NONE	0.50	0.97	34.60	1.05	0.9	98	0.20	3.37	84
SELENIUM		4200	0.02	NO	4	NONE	NONE	0.50	0.97	5.00	0.60	0.6	88	0.36	1.70	84
THALLIUM		6.30	0.01	NO	4	NONE	NONE	0.50	0.92	1.00	0.60	0.6	36	0.46	1.00	84

APPENDIX F—LIST OF POLLUTANTS FOR TESTING REQUIRED IN PERMIT CONDITION S2.A.1.(3)

EPA "PART D" NPDES APPLICATION FORM 2A TESTING REQUIREMENTS

The following pollutant scan data are required at the time of NPDES permit application for municipal treatment facilities with design flow greater than 1.0 mgd. At least three scans are to be conducted during the term of the permit. The metals are to be analyzed as "Total recoverable Metals" Section 4.1.4, Publication EPA-600/4-79-020, *Methods for Chemical Analysis of water and Wastes*, 1979. Please see Condition S2.A(4) of the permit.

METALS & MISC.	**VOL. ORGANICS (Cont.)**	**BASE NEUTRALS (Cont.)**
Antimony	Ethylbenzene	Bis (2-Chloroethyl)-Ether
Arsenic	Methyl Bromide	Bis (2-Chloroiso-Propyl) Ether
Beryllium	Methyl Chloride	Bis (2-Ethylhexyl) Phthalate
Cadmium	Methylene Chloride	4-Bromophenyl Phenyl Ether
Chromium	1,1,2,2-Tetrachloro-Ethane	Butyl Benzyl Phthalate
Copper	Tetrachloro-Ethylene	2-Chloronaphthalene
Lead	Toluene	4-Chlorphenyl Phenyl Ether
Mercury	1,1,1-Trichloroethane	Chrysene
Nickel	1,1,2-Trichloroethane	Di-N-Butyl Phthalate
Selenium	Trichlorethylene	Di-N-Octyl Phthalate
Silver	Vinyl Chloride	Dibenzo(A,H) Anthracene
Thallium		1,2-Dichlorobenzene
Zinc	**ACID EXTRACTABLES**	1,3-Dichlorobenzene
Cyanide	P-Chloro-M-Cresol	1,4-Dichlorobenzene
Total Phenolic Compounds	2-Chlorophenol	3,3-Dichlorobenzidine
Hardness (As $CaCO_3$)	2,4-Dichlorophenol	Diethyl Phthalate
	2,4-Dimethylphenol	Dimethyl Phthalate
VOLATILE ORGANICS	4,6-Dinitro-O-Cresol	2,4-Dinitrotoluene
Acrolein	2,4-Dinitrophenol	2,6-Dinitrotoluene
Acrylonitrile	2-Nitrophenol	Fluoranthene
Benzene	4-Nitrophenol	Fluorene
Bromoform	Pentachlorophenol	Hexachlorobenzene
Carbon Tetrachloride	Phenol	Hexachlorobutadiene
Clorobenzene	2,4,6-Trichlorophenol	Hexachlorocyclo-Pentadiene
Chlorodibromo-Methane		Hexachloroethane
Chloroethane	**BASE NEUTRALS**	Indeno(1,2,3-CD)Pyrene
2-Chloro-Ethylvinyl Ether	Acenaphthene	Isophorone
Chloroform	Acenaphthylene	Naphthalene
Dichlorobromo-Methane	Anthracene	Nitrobenzene
1,1-Dichloroethane	Benzidine	N-Nitrosodi-N-Propylamine
1,2-Dichloroethane	Benzo(A)Anthracene	N-Nitrosodi-Methylamine
Trans-1,2-Dichloro Ethylene	3,4 Benzo-Fluoranthene	N-Nitrosodi-Phenylamine
1,1-Dichloroethylene	Benzo(Ghi)Perylene	Phenanthrene
1,2-Dichloropropane	Benzo(K)Fluoranthene	Pyrene
1,3-Dichloro-Propylene	Bis (2-Chloroethoxy) Methane	1,2,4-Trichlorobenzene

APPENDIX G—RESPONSE TO COMMENTS

No comments were received on the draft permit during the 30-day comment period following the date of the public notice in the *Kitsap Sun*, a major local newspaper of general circulation serving the area where the facility discharge occurs.

Issuance Date: May 31, 2007
Effective Date: June 1, 2007
Expiration Date: May 31, 2012

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM WASTE DISCHARGE PERMIT No. WA-003052-0

State of Washington
DEPARTMENT OF ECOLOGY
Northwest Regional Office
3190 – 160th Avenue SE
Bellevue, WA 98008-5452

In compliance with the provisions of
The State of Washington Water Pollution Control Law
Chapter 90.48 Revised Code of Washington
and
The Federal Water Pollution Control Act
(The Clean Water Act)
Title 33 United States Code, Section 1251 et seq.

KITSAP COUNTY PUBLIC WORKS

614 Division Street, MS-27

Port Orchard, Washington 98366

Plant Location: Central Kitsap Wastewater Treatment Plant 12351 Brownsville Highway NE Poulsbo, WA 98370	Receiving Water: Port Orchard Bay, Puget Sound
Waterbody I.D. No.: 1224819475188	Discharge Location: Latitude: 47° 40' 35" N Longitude: 122° 36' 05" W
Plant Type: Conventional Activated Sludge – Secondary Treatment System	

is authorized to discharge in accordance with the special and general conditions that follow.

Kevin C. Fitzpatrick
Water Quality Section Manager
Northwest Regional Office
Washington State Department of Ecology

TABLE OF CONTENTS

SPECIAL CONDITIONS

GENERAL CONDITIONS

SUMMARY OF PERMIT REPORT SUBMITTALS

Refer to the Special and General Conditions of this permit for additional submittal requirements.

Permit Section	Submittal	Frequency	First Submittal or Testing Date
S2.A.(3)	Priority Pollutants Monitoring Results	Testing 3/permit cycle - January 2008, July 2009, and October 2010	Monitoring Results Submittal in Part D of the next permit renewal application
S2.A.(5)	Conventional Pollutants Monitoring Results	Testing 3/permit cycle	Monitoring Results Submittal in Part B.6 of the next permit renewal application
S3.A.	Discharge Monitoring Report	Monthly	July 15, 2007
S3.E.	Noncompliance Notification	As necessary	
S3.F.	Immediate Noncompliance Notification/Shellfish Protection	As necessary	
S4.B.	Plans for Maintaining Adequate Capacity	As necessary	
S4.D.	Notification of New or Altered Sources	As necessary	
S8.	Application for Permit Renewal	1/permit cycle	November 30, 2011
S9.B.	Acute Toxicity Compliance Monitoring	4/year – February, May, August, and November of each year	First testing in August 2007
S9.B.	Acute Toxicity Compliance Monitoring Reports	4/year – April 30, July 31, October 31, and January 31 of each year	First report submittal by October 31, 2007
S9.C.	Acute Toxicity TI/TRE Plan	As necessary	
S10.A.	Chronic Toxicity Monitoring	2/permit cycle - August 2010 and February 2011	First testing in August 2010
S10.B.9.	Chronic Toxicity Data Reports	2/permit cycle – October 31, 2010, and April 30, 2011	First report submittal by October 31, 2010
S10.B.9.	Chronic Toxicity Tests Summary Report	1/permit cycle	Submittal with the next permit renewal application
S12.A.	Sediment Sampling and Analysis Plan	1/permit cycle	Report submittal by December 31, 2009

Permit Section	Submittal	Frequency	First Submittal or Testing Date
S12.B.	Sediment Data Report	1/permit cycle	Report submittal no later than one year after completion of sediment sampling
S12.C.6.	Sediment Bioassays and Conventional Sediment Variables Analysis	1/permit cycle	Analysis results to be reported in Sediment Data Report to be submitted under S12.B.
S12.C.7.	Sediment Management Standards Chemicals Analysis	If needed, 1/permit cycle	Analysis results to be reported in Sediment Data Report to be submitted under S12.B.
S13.	Outfall Evaluation	1/permit cycle (during 2011)	Evaluation report submittal with the next permit renewal application
G1.	Notice of Change in Authorization	As necessary	
G4.	Reporting Planned Changes	As necessary	
G5.	Engineering Report for Construction or Modification Activities	As necessary	
G20.	Reporting Anticipated Noncompliance	As necessary	
G21.	Reporting Other Information	As necessary	

SPECIAL CONDITIONS

S1. DISCHARGE LIMITATIONS

A. Effluent Limitations

All discharges and activities authorized by this permit shall be consistent with the terms and conditions of this permit. The discharge of any of the following pollutants more frequently than, or at a level in excess of, that identified and authorized by this permit shall constitute a violation of the terms and conditions of this permit.

Beginning on the effective date of this permit and lasting through the expiration date, the Permittee is authorized to discharge municipal wastewater at the permitted location subject to complying with the following limitations:

EFFLUENT LIMITATIONS [a]: OUTFALL # 1		
Parameter	**Average Monthly**	**Average Weekly**
Carbonaceous Biochemical Oxygen Demand (5-day) ($CBOD_5$)	25 mg/L, 1251 lb/day 85% removal of influent $CBOD_5$	40 mg/L, 2002 lb/day
Total Suspended Solids	30 mg/L, 1501 lb/day 85% removal of influent TSS	45 mg/L, 2252 lb/day
Fecal Coliform Bacteria	200/100 mL	400/100 mL
pH [b]	Daily minimum is equal to or greater than 6.0 and the daily maximum is less than or equal to 9.0.	
Acute Toxicity	No acute toxicity detected in a whole effluent toxicity (WET) test concentration representing the acute critical effluent concentration (ACEC). The ACEC is 2.1% effluent.	
[a] The average monthly and weekly effluent limitations are based on the arithmetic mean of the samples taken with the exception of fecal coliform, which is based on the geometric mean.		
[b] Indicates the range of permitted values. The instantaneous maximum and minimum pH shall be reported monthly. The pH shall not be averaged.		

B. Mixing Zone Descriptions

The maximum boundaries of the mixing zones are defined as follows:

1. Chronic Mixing Zone Boundaries:

   a. The width of the mixing zone (perpendicular to the shoreline) is 602 feet. The mixing zone is centered over the diffuser extending 301 feet on both sides.

   b. The length of the mixing zone (parallel to the shoreline) is 482 feet. The mixing zone extends 241 feet from the center line of the diffuser on both sides.

   c. The depth of the mixing zone is the depth of the outfall at mean lower low water.

2. Acute Mixing Zone Boundaries:

   a. The width of the mixing zone (perpendicular to the shoreline) is 168 feet. The mixing zone is centered over the diffuser extending 84 feet on both sides.

   b. The length of the mixing zone (parallel to the shoreline) is 48 feet. The mixing zone extends 24 feet from the center line of the diffuser on both sides.

   c. The depth of the mixing zone is the depth of the outfall at mean lower low water.

C. Dilution Ratios

The dilution ratios for aquatic life criteria, as determined by the water quality modeling analysis are as follows:

1. Receiving Waters: Facility Effluent = 84:1 for the chronic mixing zone.

2. Receiving Waters: Facility Effluent = 47:1 for the acute mixing zone.

S2. MONITORING REQUIREMENTS

A. Monitoring Schedule

The Permittee shall monitor in accordance with the following schedule:

Parameter	Sample Point	Minimum Sampling Frequency	Sample Type
(1) Compliance			
Flow	Plant Influent	Continuous[a]	Measurement
pH	Final Effluent	7/week	Grab
$CBOD_5$	Plant Influent Final Effluent	3/week 3/week	24-hr composite 24-hr composite
BOD_5	Plant Influent	1/week	24-hr composite
TSS	Plant Influent Final Effluent	3/week 3/week	24-hr composite 24-hr composite
Fecal Coliform Bacteria	Final Effluent	5/week	Grab
(2) Toxics			
Total Ammonia (as NH3-N)	Final Effluent	1/month	24-hr composite
Metals (Total Recoverable) Cadmium Chromium Copper Lead Nickel Zinc	Plant Influent Final Effluent	1/month	24-hr composite
Mercury (Total Recoverable)	Plant Influent Final Effluent[b]	1/month 1/3 months	24-hr composite Grab

Parameter	Sample Point	Minimum Sampling Frequency	Sample Type
(3) Pollutants Listed in Part D of the NPDES Permit Application – Form 3510-2A[c]			
(a) Metals (Total Recoverable)[b] (b) Hardness (as $CaCO_3$) (c) Acid-extractable Compounds (d) Base-neutral Compounds	Final Effluent	3/permit term – January 2008, July 2009, and October 2010	24-hr composite (except, for mercury, which shall be Grab)
(e) Cyanide (weak acid dissociable)[d] (f) Total Phenolic Compounds (g) Volatile Organic Compounds	Final Effluent	3/permit term – January 2008, July 2009, and October 2010	Grab
(4) Whole Effluent Toxicity (WET) Testing			
Acute Toxicity[e]	Final Effluent	Beginning August 2007; 4/year during the months of February, May, August, and November	24-hr composite
Chronic Toxicity[f]	Final Effluent	2/permit term - August 2010 February 2011	24-hr composite
(5) Pollutants listed in Part B6 of the NPDES Permit Application – Form 3510-2A[g]			
(a) Total Kjeldahl Nitrogen(TKN) (b) NO_3-N + NO_2-N (c) Total Phosphorus	Final Effluent	3/permit term	24-hr composite
(d) Dissolved Oxygen (e) Oil and Grease (f) Total Dissolved Solids (TDS)	Final Effluent	3/permit term	Grab

[a] Continuous means uninterrupted except for brief lengths of time for calibration, for power failure, or for unanticipated equipment repair or maintenance. Measurements must be taken daily when continuous monitoring is not possible.

[b] The analytical method for mercury in final effluent grab samples shall be in accordance with EPA Method Number 1631, Revision E (Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry) from 40 CFR Part 136. The method detection level (MDL) for mercury using this test method is 0.2 ng/L. The quantitation level (QL) for mercury using this test method is 0.5 ng/L.

[c] Final effluent shall be tested for pollutants listed in Part D, *Expanded Effluent Testing Data*, of EPA Form 3510-2A, *NPDES Application*. These pollutants are also listed in Appendix F of the fact sheet for this permit. The analysis results shall be reported in Part D of the next NDPES permit application.

[d] The analytical method for "weak acid dissociable cyanide" shall be in accordance with 4500-CN^- I, Standard Methods for the Examination of Water and Wastewater, 20th Edition, and as revised.

[e] Testing and reporting requirements for the acute WET tests are specified in Condition S9, *Acute Toxicity*, of this permit. The analysis results shall be submitted no later than the dates specified in Condition S9.B of this permit.

[f] Testing and reporting requirements for the chronic WET tests are specified in Condition S10, *Chronic Toxicity*, of this permit. The analysis results shall be submitted no later than the dates specified in Condition S10.B.9 of this permit.

[g] To provide required data for Part B.6, *Effluent Testing Data*, of the EPA Form 3510-2A, *NPDES Application*, for the next permit application, the final effluent shall be tested for these parameters. Samples shall be collected for analysis at least three (3) times during the term of this permit, and results shall be reported in Part B.6 of the next NDPES permit application.

B. Sampling and Analytical Procedures

Samples and measurements taken to meet the requirements of this permit shall be representative of the volume and nature of the monitored parameters, including representative sampling of any unusual discharge or discharge condition, including bypasses, upsets, and maintenance-related conditions affecting effluent quality.

Sampling and analytical methods used to meet the monitoring requirements specified in this permit shall conform to the latest revision of the *Guidelines Establishing Test Procedures for the Analysis of Pollutants* contained in 40 CFR Part 136, unless otherwise specified in this permit or approved in writing by the Department of Ecology.

C. Flow Measurement

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the quantity of monitored flows. The devices shall be installed, calibrated, and maintained to ensure that the accuracy of the measurements is consistent with the accepted industry standard for that type of device. Frequency of calibration shall be in conformance with manufacturer's recommendations and at a minimum frequency of at least one calibration per year. Calibration records shall be maintained for at least three years.

D. Laboratory Accreditation

All monitoring data required by the Department shall be prepared by a laboratory registered or accredited under the provisions of, *Accreditation of Environmental Laboratories*, chapter 173-50 WAC. Flow, pH, and internal process control parameters are exempt from this requirement. Testing for pH shall be accredited if the laboratory must otherwise be registered or accredited. The Department exempts crops, soils, and hazardous waste data from this requirement pending accreditation of laboratories for analysis of these media.

S3. REPORTING AND RECORDING REQUIREMENTS

The Permittee shall monitor and report in accordance with the following conditions. The falsification of information submitted to the Department shall constitute a violation of the terms and conditions of this permit.

A. Reporting

The first monitoring period begins on the effective date of the permit. Monitoring results shall be submitted monthly. Monitoring data obtained during each monitoring period shall be summarized, reported, and submitted on a Discharge Monitoring Report (DMR) form provided, or otherwise approved, by the Department. DMR forms shall be postmarked or received by the Department no later than the 15th day of the month following the completed monitoring period, unless otherwise specified in this permit. The report(s) shall be sent to:

Department of Ecology
Northwest Regional Office
3190 – 160th Avenue SE
Bellevue, WA 98008-5452

Monitoring results for toxic compounds required under S2.A(2) must be submitted no later than forty-five (45) days following the monitoring period. Monitoring results of the whole effluent toxicity (WET) tests shall be submitted in accordance with Conditions S9.B and S10.B.9 of this permit. The reports shall be sent to:

Department of Ecology
Northwest Regional Office
3190 – 160th Avenue SE
Bellevue, WA 98008-5452

Results of the priority pollutants analyses required in Condition S2.A(3) shall be reported in Part D, *Expanded Effluent Testing Data*, of EPA Form 3510-2A, in the next NPDES permit renewal application. Results of the conventional pollutants analyses required in Conditions S2.A(5) shall be reported in Part B.6, *Effluent Testing Data*, of EPA Form 3510-2A, in the next NPDES permit renewal application.

All laboratory reports providing data for organics and metals shall include the following information: sampling date, sample location, date of analysis, parameter name, CAS number, analytical method/number, method detection limit (MDL), laboratory practical quantitation limit (PQL), reporting units, and concentration detected. Analytical results from samples sent to a contract laboratory must have information on the chain of custody, the analytical method, QA/QC results, and documentation of accreditation for the parameter.

Discharge Monitoring Report forms must be submitted monthly whether or not the facility was discharging. If there was no discharge during a given monitoring period, submit the form as required with the words "no discharge" entered in place of the monitoring results.

B. Records Retention

The Permittee shall retain records of all monitoring information for a minimum of three (3) years. Such information shall include all calibration and maintenance records and all original recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit. This period of retention shall be extended during the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by the Department.

C. Recording of Results

For each measurement or sample taken, the Permittee shall record the following information: (1) the date, exact place, method, and time of sampling or measurement; (2) the individual who performed the sampling or measurement; (3) the dates the analyses were performed; (4) the individual who performed the analyses; (5) the analytical techniques or methods used; and (6) the results of all analyses.

D. Additional Monitoring by the Permittee

If the Permittee monitors any pollutant more frequently than required by this permit using test procedures specified by Condition S2 of this permit, then the results of such monitoring shall be included in the calculation and reporting of the data submitted in the Permittee's DMR.

E. Twenty-four Hour Notice of Noncompliance Reporting

1. The Permittee must take the following action upon violation of any permit condition:

   Immediately take action to stop, contain, and cleanup unauthorized discharges or otherwise stop the noncompliance and correct the problem and, if applicable, immediately repeat sampling and analysis. The results of any repeat sampling shall be submitted to Ecology within thirty (30) days of sampling.

2. The Permittee must report the following occurrences of noncompliance by telephone to Ecology at (425) 649-7000, within 24 hours from the time the Permittee becomes aware of the circumstances:

   a. Any noncompliance that may endanger health or the environment (for example, a fecal coliform measurement in the effluent which is too numerous to count);

   b. Any unanticipated bypass that exceeds any effluent limitation in the permit (See Part S5.F, “Bypass Procedures”);

   c. Any upset that exceeds any effluent limitation in the permit (See G.15, “Upset”);

d. Any violation of a maximum daily or instantaneous maximum discharge limitation for any of the pollutants in S1.A; or

e. Any overflow prior to the treatment works, whether or not such overflow endangers health or the environment or exceeds any effluent limitation in the permit.

3. The Permittee must also provide a written submission within five days of the time that the Permittee becomes aware of any event required to be reported under subpart 2, above. The written submission must contain:

   a. A description of the noncompliance and its cause;

   b. The period of noncompliance, including exact dates and times;

   c. The estimated time noncompliance is expected to continue if it has not been corrected;

   d. Steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance; and

   e. If the noncompliance involves an overflow prior to the treatment works, an estimate of the quantity (in gallons) of untreated overflow.

4. Ecology may waive the written report on a case-by-case basis if the oral report has been received within 24 hours of the noncompliance.

5. Reports must be submitted to:

   Department of Ecology
   Northwest Regional Office
   3190 – 160th Avenue SE
   Bellevue, WA 98008-5452

F. Immediate Noncompliance Notification

Any failure of the disinfection system, and any collection system overflows or plant bypass discharging near a shellfish area shall be reported immediately to the Department of Ecology and the Department of Health, Shellfish Program. The Department of Ecology's Northwest Regional Office 24-hour number is (425) 649-7000, and the Department of Health's Shellfish 24-hour number is (360) 236-3330.

G. Other Noncompliance Reporting

The Permittee must report all instances of noncompliance, not required to be reported within 24 hours, at the time that monitoring reports for S3.A ("Reporting") are submitted. The reports must contain the information listed in paragraph E above, ("Twenty-four Hour Notice of Noncompliance Reporting"). Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with the terms and conditions of this permit or the resulting liability for failure to comply.

H. Maintaining a Copy of This Permit

A copy of this permit must be kept at the facility and be made available upon request to Department of Ecology inspectors.

S4. FACILITY LOADING

A. Design Criteria

Flows or waste loadings of the following design criteria for the permitted treatment facility shall not be exceeded:

Parameter	Design Criteria
Average flow for the maximum month	6.0 MGD
BOD_5 loading for maximum month	14,100 lb/day
TSS loading for maximum month	11,400 lb/day

B. Plans for Maintaining Adequate Capacity

The Permittee shall submit to the Department a plan and a schedule for continuing to maintain capacity when:

1. The actual flow or waste load reaches 85 percent of any one of the design criteria in S4.A for three consecutive months; or
2. The projected increase would reach design capacity within five years, whichever occurs first.

If such a plan is required, it shall contain a plan and schedule for continuing to maintain capacity. The capacity as outlined in this plan must be sufficient to achieve the effluent limitations and other conditions of this permit. This plan shall address any of the following actions or any others necessary to meet the objective of maintaining capacity.

1. Analysis of the present design including the introduction of any process modifications that would establish the ability of the existing facility to achieve the effluent limits and other requirements of this permit at specific levels in excess of the existing design criteria specified in paragraph A above.
2. Reduction or elimination of excessive infiltration and inflow of uncontaminated ground and surface water into the sewer system.
3. Limitation on future sewer extensions or connections or additional waste loads.
4. Modification or expansion of facilities necessary to accommodate increased flow or waste load.
5. Reduction of industrial or commercial flows or waste loads to allow for increasing sanitary flow or waste load.

Engineering documents associated with the plan must meet the requirements of WAC 173-240-060, "Engineering Report," and be approved by the Department prior to any construction. The report shall specify any contracts, ordinances, methods for financing, or other arrangements necessary to achieve this objective. If the Permittee intends to apply for state or federal funding for the design or construction of a facility project, the report must also meet the requirements of a “Facility Plan” as described in 40 CFR 35.2030.

C. Duty to Mitigate

The Permittee is required to take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment.

D. Notification of New or Altered Sources

The Permittee shall submit written notice to the Department whenever any new discharge or a substantial change in volume or character of an existing discharge into the treatment plant is proposed which: (1) would interfere with the operation of, or exceed the design capacity of, any portion of the treatment plant; (2) is not part of an approved general sewer plan or approved plans and specifications; or (3) would be subject to pretreatment standards under 40 CFR Part 403 and Section 307(b) of the Clean Water Act. This notice shall include an evaluation of the system's ability to adequately transport and treat the added flow and/or waste load, the quality and volume of effluent to be discharged to the treatment plant, and the anticipated impact on the Permittee’s effluent [40 CFR 122.42(b)].

S5. OPERATION AND MAINTENANCE

The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems, which are installed by a Permittee only when the operation is necessary to achieve compliance with the conditions of this permit.

A. Certified Operator

An operator certified for at least a Class III plant by the state of Washington shall be in responsible charge of the day-to-day operation of the wastewater treatment plant. An operator certified for at least a Class II plant shall be in charge during all regularly scheduled shifts.

B. O & M Program

The Permittee shall institute an adequate operation and maintenance program for the entire sewage system. Maintenance records shall be maintained on all major electrical and mechanical components of the treatment plant, as well as the sewage system and pumping stations. Such records shall clearly specify the frequency and type of maintenance recommended by the manufacturer and shall show the frequency and type of maintenance performed. These maintenance records shall be available for inspection at all times.

C. Short-term Reduction

If a Permittee contemplates a reduction in the level of treatment that would cause a violation of permit discharge limitations on a short-term basis for any reason, and such reduction cannot be avoided, the Permittee shall give written notification to the Department, if possible, thirty (30) days prior to such activities, detailing the reasons for, length of time of, and the potential effects of the reduced level of treatment. This notification does not relieve the Permittee of its obligations under this permit.

D. Electrical Power Failure

The Permittee is responsible for maintaining adequate safeguards to prevent the discharge of untreated wastes or wastes not treated in accordance with the requirements of this permit during electrical power failure at the treatment plant and/or sewage lift stations either by means of alternate power sources, standby generator, or retention of inadequately treated wastes.

The Permittee shall maintain Reliability Class II (EPA 430/9-74-001) at the wastewater treatment plant, which requires a backup power source sufficient to operate all vital components and critical lighting and ventilation during peak wastewater flow conditions, except vital components used to support the secondary processes (that is, mechanical aerators or aeration basin air compressors) need not be operable to full levels of treatment, but shall be sufficient to maintain the biota.

E. Prevent Connection of Inflow

The Permittee shall strictly enforce their sewer ordinances and not allow the connection of inflow (roof drains, foundation drains, etc.) to the sanitary sewer system.

F. Bypass Procedures

Bypass, which is the intentional diversion of waste streams from any portion of a treatment facility, is prohibited, and the Department may take enforcement action against a Permittee for bypass unless one of the following circumstances (1, 2, or 3) is applicable.

1. Bypass for essential maintenance without the potential to cause violation of permit limits or conditions.

   Bypass is authorized if it is for essential maintenance and does not have the potential to cause violations of limitations or other conditions of this permit, or adversely impact public health as determined by the Department prior to the bypass. The Permittee shall submit prior notice, if possible, at least ten (10) days before the date of the bypass.

2. Bypass which is unavoidable, unanticipated, and results in noncompliance of this permit.

   This bypass is permitted only if:

   a. Bypass is unavoidable to prevent loss of life, personal injury, or severe property damage. “Severe property damage” means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass.

   b. There are no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment downtime (but not if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance), or transport of untreated wastes to another treatment facility.

   c. The Department is properly notified of the bypass as required in Condition S3.E of this permit.

3. Bypass which is anticipated and has the potential to result in noncompliance of this permit.

   The Permittee shall notify the Department at least thirty (30) days before the planned date of bypass. The notice shall contain: (1) a description of the bypass and its cause; (2) an analysis of all known alternatives which would eliminate, reduce, or mitigate the need for bypassing; (3) a cost-effectiveness analysis of alternatives including comparative resource damage assessment; (4) the minimum and maximum duration of bypass under each alternative; (5) a recommendation as to the preferred alternative for conducting the bypass; (6) the projected date of bypass initiation; (7) a statement of compliance with SEPA; (8) a request for modification of water quality standards as provided for in WAC 173-201A-110, if an exceedance of any water quality standard is anticipated; and (9) steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass.

For probable construction bypasses, the need to bypass is to be identified as early in the planning process as possible. The analysis required above shall be considered during preparation of the engineering report or facilities plan and plans and specifications and shall be included to the extent practical. In cases where the probable need to bypass is determined early, continued analysis is necessary up to and including the construction period in an effort to minimize or eliminate the bypass.

The Department will consider the following prior to issuing an administrative order for this type of bypass:

a. If the bypass is necessary to perform construction or maintenance-related activities essential to meet the requirements of this permit.

b. If there are feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment downtime, or transport of untreated wastes to another treatment facility.

c. If the bypass is planned and scheduled to minimize adverse effects on the public and the environment.

After consideration of the above and the adverse effects of the proposed bypass and any other relevant factors, the Department will approve or deny the request. The public shall be notified and given an opportunity to comment on bypass incidents of significant duration, to the extent feasible. Approval of a request to bypass will be by administrative order issued by the Department under RCW 90.48.120.

G. Operations and Maintenance Manual

The approved Operations and Maintenance Manual shall be kept available at the treatment plant and all operators shall follow the instructions and procedures of this manual.

S6. PRETREATMENT

A. General Requirements

The Permittee shall work with the Department to ensure that all commercial and industrial users of the wastewater treatment system are in compliance with the pretreatment regulations promulgated in 40 CFR Part 403 and any additional regulations that may be promulgated under Section 307(b) (pretreatment) and 308 (reporting) of the Federal Clean Water Act.

B. Wastewater Discharge Permit Required

The Permittee shall not allow significant industrial users (SIUs) to discharge waste water to the Permittee's sewerage system until such user has received a wastewater discharge permit from the Department in accordance with chapter 90.48 RCW and chapter 173-216 WAC, as amended.

C. General Prohibitions

In accordance with 40 CFR 403.5(a), a nondomestic discharger may not introduce into the Permittee's sewerage system any pollutant(s) that cause pass-through or interference.

D. Specific Prohibitions

In accordance with 40 CFR 403.5(b), the following nondomestic discharges shall not be discharged into the Permittee's sewerage treatment system.

1. Pollutants that create a fire or explosion hazard in the treatment plant (including, but not limited to waste streams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using the test methods specified in 40 CFR 261.21).

2. Pollutants that will cause corrosive structural damage to the Permittee's sewerage system or treatment plant, but in no case discharges with pH lower than 5.0 standard units, unless the works are specifically designed to accommodate such discharges.

3. Solid or viscous pollutants in amounts that could cause obstruction to the flow in sewers or otherwise interfere with the operation of the treatment plant.

4. Any pollutant, including oxygen-demanding pollutants, (BOD, etc.) released in a discharge at a flow rate and/or pollutant concentration which will cause interference with the treatment plant.

5. Heat in amounts that will inhibit biological activity in the treatment plant resulting in interference, but in no case heat in such quantities such that the temperature at the treatment plant exceeds 40ºC (104ºF) unless the Department, upon request of the Permittee, approves, in writing, alternate temperature limits.

6. Petroleum oil, nonbiodegradable cutting oil, or products of mineral origin in amounts that will cause interference or pass-through.

7. Pollutants which result in the presence of toxic gases, vapors, or fumes within the treatment plant in a quantity which may cause acute worker health and safety problems.

8. Any trucked or hauled pollutants, except at discharge points designated by the Permittee.

E. Notification of Industrial User Violations

The Permittee shall notify the Department if any nondomestic user violates the prohibitions listed in S8.C and S8.D above.

F. Industrial User Survey

If required by the Department, the Permittee shall perform an industrial user survey, or other activities (for example, sewer use ordinance and local limits development), which are necessary for the proper administration of the state pretreatment program.

S7. RESIDUAL SOLIDS

Residual solids include screenings, grit, scum, primary sludge, waste activated sludge, and other solid waste. The Permittee shall store and handle all residual solids in such a manner so as to prevent their entry into state ground or surface waters. The Permittee shall not discharge leachate from residual solids to state surface or ground waters.

S8. APPLICATION FOR PERMIT RENEWAL

The Permittee shall submit an application for renewal of this permit no later than November 30, 2011.

S9. ACUTE TOXICITY

A. Effluent Limit for Acute Toxicity

The effluent limit for acute toxicity is no acute toxicity detected in a test concentration representing the acute critical effluent concentration (ACEC).

The ACEC means the maximum concentration of effluent during critical conditions at the boundary of the zone of acute criteria exceedance assigned pursuant to WAC 173-201A-100. The zone of acute criteria exceedance is authorized in Section S1.C of this permit. The ACEC equals 2.1 percent effluent.

In the event of failure to pass the test described in Subsection B of this section for compliance with the effluent limit for acute toxicity, the Permittee is considered to be in compliance with all permit requirements for acute whole effluent toxicity as long as the requirements in Subsection C are being met to the satisfaction of the Department.

B. Monitoring for Compliance With an Effluent Limit for Acute Toxicity

The Permittee shall conduct monitoring to determine compliance with the effluent limit for acute toxicity. The acute toxicity tests shall be performed using, at a minimum, 100 percent effluent, the ACEC, and a control. Acute toxicity testing shall follow protocols, monitoring requirements, and quality assurance/quality control procedures specified in this section. Testing shall begin in August 2007. A written report shall be submitted to the Department no later than October 31, 2007. The percent survival in 100 percent effluent shall be reported along with all compliance monitoring results.

Compliance monitoring shall begin in August 2007, and shall be conducted quarterly during the months of February, May, August, and November of each year, using each of the species and protocols listed below on a rotating basis. Written reports of compliance monitoring shall be submitted no later than April 30, July 31, October 31, and January 31 of each year.

1. Fathead minnow, *Pimephales promelas* (96-hour static-renewal test, method: EPA-821-R-02-012).

2. Daphnid, *Ceriodaphnia dubia*, *Daphnia pulex*, or *Daphnia magna* (48-hour static test, method: EPA-821-R-02-012). The Permittee shall choose one of the three species and use it consistently throughout compliance monitoring.

The Permittee is in violation of the effluent limit for acute toxicity in Subsection A and shall immediately implement Subsection C if any acute toxicity test conducted for compliance monitoring determines a statistically significant difference in survival between the control and the ACEC using hypothesis testing at the 0.05 level of significance (Appendix H, EPA/600/4-89/001). If the difference in survival between the control and the ACEC is less than 10 percent, the hypothesis test shall be conducted at the 0.01 level of significance.

C. Response to Noncompliance With an Effluent Limit for Acute Toxicity

If a toxicity test conducted for compliance monitoring under Subsection B determines a statistically significant difference in response between the ACEC and the control, the Permittee shall begin additional compliance monitoring within one week from the time of receiving the test results. This additional monitoring shall be conducted weekly for four consecutive weeks using the same test and species as the failed compliance test. Testing shall be conducted using a series of at least five effluent concentrations and a control in order to be able to determine appropriate point estimates. One of these effluent concentrations shall equal the ACEC and be compared statistically to the nontoxic control in order to determine compliance with the effluent limit for acute toxicity as described in Subsection B. The Permittee shall return to the original monitoring frequency in Subsection B after completion of the additional compliance monitoring.

If the Permittee believes that a test indicating noncompliance will be identified by the Department as an anomalous test result, the Permittee may notify the Department that the compliance test result might be anomalous and that the Permittee intends to take only one additional sample for toxicity testing and wait for notification from the Department before completing the additional monitoring required in this subsection. The notification to the Department shall accompany the report of the compliance test result and identify the reason for considering the compliance test result to be anomalous. The Permittee shall complete all of the additional monitoring required in this subsection as soon as possible after notification by the Department that the compliance test result was not anomalous. If the one additional sample fails to comply with the effluent limit for acute toxicity, then the Permittee shall proceed without delay to complete all of the additional monitoring required in this subsection. The one additional test result shall replace the compliance test result upon determination by the Department that the compliance test result was anomalous.

If all of the additional compliance monitoring conducted in accordance with this subsection complies with the permit limit, the Permittee shall search all pertinent and recent facility records (operating records, monitoring results, inspection records, spill reports, weather records, production records, raw material purchases, pretreatment records, and so on) and submit a report to the Department on possible causes and preventive measures for the transient toxicity event which triggered the additional compliance monitoring.

If toxicity occurs in violation of the acute toxicity limit during the additional compliance monitoring, the Permittee shall submit a Toxicity Identification/Reduction Evaluation (TI/RE) plan to the Department within sixty (60) days after the sample date. The TI/RE plan shall be based on WAC 173-205-100(2) and shall be implemented in accordance with WAC 173-205-100(3).

D. Sampling and Reporting Requirements

1. All reports for effluent characterization or compliance monitoring shall be submitted in accordance with the most recent version of Department of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* in regards to format and content. Reports shall contain bench sheets and reference toxicant results for test methods. If the lab provides the toxicity test data on floppy disk for electronic entry into the Department's database, then the Permittee shall send the disk to the Department along with the test report, bench sheets, and reference toxicant results.

2. Testing shall be conducted on 24-hour composite effluent samples. Composite samples taken for toxicity testing shall be cooled to 0 - 6 degrees Celsius while being collected and shall be sent to the lab immediately upon completion. The samples must be 0 - 6°C at receipt. The lab shall begin the toxicity testing as soon as possible but no later than 36 hours after sampling was ended. The lab shall store all samples at 0 - 6°C in the dark from receipt until completion of the test.

3. All samples and test solutions for toxicity testing shall have water quality measurements as specified in Department of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* or most recent version thereof.

4. All toxicity tests shall meet quality assurance criteria and test conditions in the most recent versions of the EPA manual listed in Subsection A and the Department of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. If test results are determined to be invalid or anomalous by the Department, testing shall be repeated with freshly collected effluent.

5. Control water and dilution water shall be laboratory water meeting the requirements of the EPA manual listed in Subsection A or pristine natural water of sufficient quality for good control performance.

6. The whole effluent toxicity tests shall be run on an unmodified sample of final effluent.

7. The Permittee may choose to conduct a full dilution series test during compliance monitoring in order to determine dose response. In this case, the series must have a minimum of five effluent concentrations and a control. The series of concentrations must include the ACEC.

8. All whole effluent toxicity tests, effluent screening tests, and rapid screening tests that involve hypothesis testing and do not comply with the acute statistical power standard of 29 percent as defined in WAC 173-205-020 must be repeated on a fresh sample with an increased number of replicates to increase the power.

S10. CHRONIC TOXICITY

A. <u>Testing Requirements</u>

The Permittee shall test final effluent twice during the permit term, once in August 2010, and once in February 2011. All of the chronic toxicity tests listed below shall be conducted on each sample. The results of this chronic toxicity testing shall be submitted to the Department as a part of the permit renewal application process.

The Permittee shall conduct chronic toxicity testing on a series of at least five concentrations of effluent and a control in order to be able to determine appropriate point estimates and an NOEC. This series of dilutions shall include the acute critical effluent concentration (ACEC). The ACEC equals 2.1 percent effluent. The Permittee shall compare the ACEC to the control using hypothesis testing at the 0.05 level of significance as described in Appendix H, EPA/600/4-89/001.

Chronic toxicity tests shall be conducted with the following species and the most recent version of the following protocols:

Saltwater Chronic Toxicity Test Species		**Method**
Topsmelt or Silverside minnow	*Atherinops affinis* or *Menidia beryllina*	EPA/600/R-95/136 or EPA/821/R/02/014
Mysid shrimp	*Holmesimysis costata* or *Mysidopsis bahia*	EPA/600/R-95/136 or EPA/821/R/02/014

The Permittee shall use the West Coast fish (topsmelt, *Atherinops affinis*) and mysid (*Holmesimysis costata*) for toxicity testing unless the lab cannot obtain a sufficient quantity of a West Coast species in good condition in which case the East Coast fish (silverside minnow, *Menidia beryllina*) or mysid (*Mysidopsis bahia*) may be substituted.

B. Sampling and Reporting Requirements

1. All reports for effluent characterization or compliance monitoring shall be submitted in accordance with the most recent version of Department of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* in regards to format and content. Reports shall contain bench sheets and reference toxicant results for test methods. If the lab provides the toxicity test data on floppy disk for electronic entry into the Department's database, then the Permittee shall send the disk to the Department along with the test report, bench sheets, and reference toxicant results.

2. Testing shall be conducted on 24-hour composite effluent samples. Composite samples taken for toxicity testing shall be cooled to 0 - 6 degrees Celsius while being collected and shall be sent to the lab immediately upon completion. The samples must be 0 - 6°C at receipt. The lab shall begin the toxicity testing as soon as possible but no later than 36 hours after sampling was ended. The lab shall store all samples at 0 - 6°C in the dark from receipt until completion of the test.

3. All samples and test solutions for toxicity testing shall have water quality measurements as specified in Department of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* or most recent version thereof.

4. All toxicity tests shall meet quality assurance criteria and test conditions in the most recent versions of the EPA manual listed in Subsection A and the Department of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. If test results are determined to be invalid or anomalous by the Department, testing shall be repeated with freshly collected effluent.

5. Control water and dilution water shall be laboratory water meeting the requirements of the EPA manual listed in Subsection A or pristine natural water of sufficient quality for good control performance.

6. The whole effluent toxicity tests shall be run on an unmodified sample of final effluent.

7. The Permittee may choose to conduct a full dilution series test in order to determine dose response. In this case, the series must have a minimum of five effluent concentrations and a control. The series of concentrations must include the ACEC (2.1% effluent) and the CCEC (1.2% effluent). The ACEC and CCEC may either substitute for the effluent concentration that is closest to it in the dilution series or be an extra effluent concentration.

8. All whole effluent toxicity tests that involve hypothesis testing and do not comply with the chronic statistical power standard of 39 percent as defined in WAC 173-205-020 must be repeated on a fresh sample with an increased number of replicates to increase the power.

9. Written reports of monitoring results of the testing during August 2010 and February 2011 shall be submitted no later than October 31, 2010, and April 30, 2011, respectively. A final summary report shall be submitted to the Department with the next permit renewal application. This summary report shall include a tabulated summary of the individual test results, and any information on sources of toxicity, if any, toxicity source control, toxicity treatability, and correlation with effluent data.

S12. SEDIMENT MONITORING (MARINE)

A. Sediment Sampling and Analysis Plan

No later than December 31, 2009, the Permittee shall submit to the Department of Ecology (Department), for review and approval, a sediment sampling and analysis plan for sediment monitoring in the vicinity of the Permittee's discharge location. The purpose of the plan is to recharacterize the nature and extent of biological toxicity and/or chemical contamination in the vicinity of the discharge location. The Permittee must follow the guidance provided in the *Sediment Source Control Standards User Manual, Appendix B: Sediment Sampling and Analysis Plan, Department of Ecology, 2003.*

B. Sediment Data Report

Following approval, by the Department, of the sediment sampling and analysis plan, the Permittee shall collect sediment samples for analysis between August 15th and September 15th. No later than one year after completion of sediment sampling, the Permittee shall submit to the Department, a sediment data report containing the results of the sediment sampling and analysis required under S12.C.6 and S12.C.7 of this permit. The sediment data report must conform to the approved sediment sampling and analysis plan.

The sediment data report must also include electronic copies of the sediment biological and/or chemical data formatted according to the Department's *Sediment Quality Information System* templates.

C. Sampling and Reporting Requirements

1. Sediment sampling locations shall be the same as, or in the immediate vicinity of, the sampling locations during the sediment sampling and analysis conducted by the Permittee in January 1999. These sediment sampling locations are shown in *Central Kitsap Wastewater Treatment Plant NPDES Sediment Monitoring Report,* Beak Consultants Incorporated, May 1999, prepared by the Permittee.

2. All sampling for biological and chemical analyses shall be conducted between August 15th and September 15th, which is the standard sampling time to capture "worst case" scenarios.

3. Sediment samples for both bioassays and chemistry shall be taken at a depth of approximately 10 cm, which represents the sediment's biologically active zone.

4. The Permittee must ensure that a sufficient amount of sediment samples are collected at each location during the initial sampling effort, in case both bioassays and chemical analyses are to be performed.

5. Recommended practical quantitation limits (PQL) as well as recommended analytical methods for the 47 marine sediment chemicals are listed in Table 5 of *Sediment Sampling and Analysis Plan Appendix*[1]. The detection limits for the sediment analyses must be at or below the recommended PQLs.

6. The Permittee shall first conduct sediment bioassays and conventional sediment variables[2] analyses. Bioassay results override chemical data when determining compliance with the sediment quality standards (SQS). Conventional sediment variables analyses shall include analyses for ammonia, grain size, total solids, total organic carbon, total sulfides, acid volatile sulfides, and total volatile solids.

7. If the bioassays fail the SQS, the Permittee shall conduct analyses for the 47 *Sediment Management Standards*[3] chemicals listed in Table 1 in *WAC 173-204-320, Marine Sediment Quality Standards*. The chemical analyses must be conducted on the same sediment samples that are collected for the bioassays and conventional sediment variables analyses in order to produce synoptic data. The Permittee must ensure that sufficient amount of sediment samples are collected at each sampling location during the initial sampling effort, in case both bioassays and chemical analyses are to be performed.

S13. OUTFALL EVALUATION

The Permittee shall inspect, once during the year 2011, the submerged portion of the outfall line and diffuser to document its integrity and continued function. If conditions allow for a photographic verification, it shall be included in the report. The inspection report shall be submitted to the Department with the next NPDES permit application.

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[1] Washington State Department of Ecology, 2003. *Sediment Sampling and Analysis Plan Appendix: Guidance on the Development of Sediment Sampling and Analysis Plans Meeting the Requirements of the Sediment Management Standards (chapter 173-204 WAC)*. Revised April 2003. Ecology Pub No. 03-09-043. URL: http://www.ecy.wa.gov/biblio/0309043.html.

[2] Conventional sediment variables: ammonia, grain size, total solids, total organic carbon, total sulfides, acid volatile sulfides, and total volatile solids.

[3] Washington State Department of Ecology, 1995. *Sediment Management Standards, chapter 173-204*. Amended December 1995. URL: http://www.ecy.wa.gov/biblio/wac173204.html.

GENERAL CONDITIONS

G1. SIGNATORY REQUIREMENTS

All applications, reports, or information submitted to the Department shall be signed and certified.

A. All permit applications shall be signed by either a principal executive officer or a ranking elected official.

B. All reports required by this permit and other information requested by the Department shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

1. The authorization is made in writing by a person described above and submitted to the Department.

2. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

C. Changes to authorization. If an authorization under paragraph B.2, above, is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph B.2, above, must be submitted to the Department prior to or together with any reports, information, or applications to be signed by an authorized representative.

D. Certification. Any person signing a document under this section shall make the following certification:

> *"I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."*

G2. RIGHT OF INSPECTION AND ENTRY

The Permittee shall allow an authorized representative of the Department, upon the presentation of credentials and such other documents as may be required by law:

A. To enter upon the premises where a discharge is located or where any records must be kept under the terms and conditions of this permit.

B. To have access to and copy - at reasonable times and at reasonable cost - any records required to be kept under the terms and conditions of this permit.

C. To inspect - at reasonable times - any facilities, equipment (including monitoring and control equipment), practices, methods, or operations regulated or required under this permit.

D. To sample or monitor - at reasonable times - any substances or parameters at any location for purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act.

G3. PERMIT ACTIONS

This permit may be modified, revoked and reissued, or terminated either at the request of any interested person (including the Permittee) or upon the Department's initiative. However, the permit may only be modified, revoked and reissued, or terminated for the reasons specified in 40 CFR 122.62, 122.64 or WAC 173-220-150 according to the procedures of 40 CFR 124.5.

A. The following are causes for terminating this permit during its term, or for denying a permit renewal application:

1. Violation of any permit term or condition.

2. Obtaining a permit by misrepresentation or failure to disclose all relevant facts.

3. A material change in quantity or type of waste disposal.

4. A determination that the permitted activity endangers human health or the environment, or contributes to water quality standards violations and can only be regulated to acceptable levels by permit modification or termination [40 CFR Part 122.64(3)].

5. A change in any condition that requires either a temporary or permanent reduction, or elimination of any discharge or sludge use or disposal practice controlled by the permit [40 CFR Part 122.64(4)].

6. Nonpayment of fees assessed pursuant to RCW 90.48.465.

7. Failure or refusal of the Permittee to allow entry as required in RCW 90.48.090.

B. The following are causes for modification but not revocation and reissuance except when the Permittee requests or agrees:

1. A material change in the condition of the waters of the state.

2. New information not available at the time of permit issuance that would have justified the application of different permit conditions.

3. Material and substantial alterations or additions to the permitted facility or activities which occurred after this permit issuance.

4. Promulgation of new or amended standards or regulations having a direct bearing upon permit conditions, or requiring permit revision.

5. The Permittee has requested a modification based on other rationale meeting the criteria of 40 CFR Part 122.62.

6. The Department has determined that good cause exists for modification of a compliance schedule, and the modification will not violate statutory deadlines.

7. Incorporation of an approved local pretreatment program into a municipality's permit.

C. The following are causes for modification or alternatively revocation and reissuance:

1. Cause exists for termination for reasons listed in A1 through A7 of this section, and the Department determines that modification or revocation and reissuance is appropriate.

2. The Department has received notification of a proposed transfer of the permit. A permit may also be modified to reflect a transfer after the effective date of an automatic transfer (General Condition G8) but will not be revoked and reissued after the effective date of the transfer except upon the request of the new Permittee.

G4. REPORTING PLANNED CHANGES

The Permittee shall, as soon as possible, but no later than sixty (60) days prior to the proposed changes, give notice to the Department of planned physical alterations or additions to the permitted facility, production increases, or process modification which will result in: 1) the permitted facility being determined to be a new source pursuant to 40 CFR 122.29(b); 2) a significant change in the nature or an increase in quantity of pollutants discharged; or 3) a significant change in the Permittee's sludge use or disposal practices. Following such notice, and the submittal of a new application or supplement to the existing application, along with required engineering plans and reports, this permit may be modified, or revoked and reissued pursuant to 40 CFR 122.62(a) to specify and limit any pollutants not previously limited. Until such modification is effective, any new or increased discharge in excess of permit limits or not specifically authorized by this permit constitutes a violation of the terms and conditions of this permit.

G5. PLAN REVIEW REQUIRED

Prior to constructing or modifying any wastewater control facilities, an engineering report and detailed plans and specifications shall be submitted to the Department for approval in accordance with chapter 173-240 WAC. Engineering reports, plans, and specifications shall be submitted at least one hundred eighty (180) days prior to the planned start of construction unless a shorter time is approved by Ecology. Facilities shall be constructed and operated in accordance with the approved plans.

G6. COMPLIANCE WITH OTHER LAWS AND STATUTES

Nothing in this permit shall be construed as excusing the Permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

G7. TRANSFER OF THIS PERMIT

In the event of any change in control or ownership of facilities from which the authorized discharge emanate, the Permittee shall notify the succeeding owner or controller of the existence of this permit by letter, a copy of which shall be forwarded to the Department.

A. Transfers by Modification

Except as provided in paragraph (B) below, this permit may be transferred by the Permittee to a new owner or operator only if this permit has been modified or revoked and reissued under 40 CFR 122.62(b)(2), or a minor modification made under 40 CFR 122.63(d), to identify the new Permittee and incorporate such other requirements as may be necessary under the Clean Water Act.

B. Automatic Transfers

This permit may be automatically transferred to a new Permittee if:

1. The Permittee notifies the Department at least thirty (30) days in advance of the proposed transfer date.

2. The notice includes a written agreement between the existing and new Permittees containing a specific date transfer of permit responsibility, coverage, and liability between them.

3. The Department does not notify the existing Permittee and the proposed new Permittee of its intent to modify or revoke and reissue this permit. A modification under this subparagraph may also be minor modification under 40 CFR 122.63. If this notice is not received, the transfer is effective on the date specified in the written agreement.

G8. REDUCED PRODUCTION FOR COMPLIANCE

The Permittee, in order to maintain compliance with its permit, shall control production and/or all discharges upon reduction, loss, failure, or bypass of the treatment facility until the facility is restored or an alternative method of treatment is provided. This requirement applies in the situation where, among other things, the primary source of power of the treatment facility is reduced, lost, or fails.

G9. REMOVED SUBSTANCES

Collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of waste waters shall not be resuspended or reintroduced to the final effluent stream for discharge to state waters.

G10. DUTY TO PROVIDE INFORMATION

The Permittee shall submit to the Department, within a reasonable time, all information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee shall also submit to the Department upon request, copies of records required to be kept by this permit.

G11. OTHER REQUIREMENTS OF 40 CFR

All other requirements of 40 CFR 122.41 and 122.42 are incorporated in this permit by reference.

G12. ADDITIONAL MONITORING

The Department may establish specific monitoring requirements in addition to those contained in this permit by administrative order or permit modification.

G13. PAYMENT OF FEES

The Permittee shall submit payment of fees associated with this permit as assessed by the Department.

G14. PENALTIES FOR VIOLATING PERMIT CONDITIONS

Any person who is found guilty of willfully violating the terms and conditions of this permit shall be deemed guilty of a crime, and upon conviction thereof shall be punished by a fine of up to ten thousand dollars ($10,000) and costs of prosecution, or by imprisonment in the discretion of the court. Each day upon which a willful violation occurs may be deemed a separate and additional violation.

Any person who violates the terms and conditions of a waste discharge permit shall incur, in addition to any other penalty as provided by law, a civil penalty in the amount of up to ten thousand dollars ($10,000) for every such violation. Each and every such violation shall be a separate and distinct offense, and in case of a continuing violation, every day's continuance shall be deemed to be a separate and distinct violation.

G15. UPSET

Definition – "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of the following paragraph are met.

A Permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:
1) an upset occurred and that the Permittee can identify the cause(s) of the upset;
2) the permitted facility was being properly operated at the time of the upset;
3) the Permittee submitted notice of the upset as required in Condition S3.E; and
4) the Permittee complied with any remedial measures required under S4.C of this permit.

In any enforcement proceeding the Permittee seeking to establish the occurrence of an upset has the burden of proof.

G16. PROPERTY RIGHTS

This permit does not convey any property rights of any sort, or any exclusive privilege.

G17. DUTY TO COMPLY

The Permittee shall comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

G18. TOXIC POLLUTANTS

The Permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if this permit has not yet been modified to incorporate the requirement.

G19. PENALTIES FOR TAMPERING

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two (2) years per violation, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this condition, punishment shall be a fine of not more than $20,000 per day of violation, or by imprisonment of not more than four (4) years, or by both.

G20. REPORTING ANTICIPATED NONCOMPLIANCE

The Permittee shall give advance notice to the Department by submission of a new application or supplement thereto at least one hundred eighty (180) days prior to commencement of such discharges, of any facility expansions, production increases, or other planned changes, such as process modifications, in the permitted facility or activity which may result in noncompliance with permit limits or conditions. Any maintenance of facilities, which might necessitate unavoidable interruption of operation and degradation of effluent quality, shall be scheduled during noncritical water quality periods and carried out in a manner approved by the Department.

G21. REPORTING OTHER INFORMATION

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application, or in any report to the Department, it shall promptly submit such facts or information.

G22. COMPLIANCE SCHEDULES

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than fourteen (14) days following each schedule date.

APPENDIX G – FUTURE INFRASTRUCTURE TABULATIONS AND COSTS

G-1 Lift Station Capacity Requirements Based on Populations

G-2 Evaluation of Future Revisions to Existing Lift Stations and Conveyance Piping

G-3 Silverdale New Lift Stations and Force Main Projects

G-4 Central Kitsap New Lift Stations and Force Main Projects

G-5 Silverdale Conceptual Gravity Collectors

G-6 Central Kitsap Conceptual Gravity Collectors

G-7 Estimated Project Costs for Expansion of Existing Lift Stations in Silverdale UGA

G-8 Estimated Project Costs for Expansion of Existing Lift Stations in Central Kitsap UGA

G-9 Estimated Project Costs for Gravity Sewer Replacements in the Silverdale UGA

G-10 Estimated Project Costs for Gravity Sewer Replacements in the Central Kitsap UGA

Table G-1 Lift Station Capacity Requirements Based on Populations

AAF(gpd)	Peaking Factor					
100	**4**					
Central Kitsap East Basin (7)	**Population**		**GPD**	**GPM**	**Peak Flow**	**Anticipated Design Q**
7.3.1	240		24,000	17	67	**75**
7.3.2	375		37,500	26	104	**115**
7.3.3	55		5,500	4	15	**20**
7.3.4	150		15,000	10	42	**50**
7.3.5	268		26,750	19	74	**85**
7.3.6	615		61,520	43	171	**200**
7.3A	55					
7.3B	120					
7.3	1,878	**Total**	187,770	130	522	**575**
7.1	280		28,000	19	78	**90**
7.2	110		11,000	8	31	**35**
ps7	4,664					
7	29					
7A	165					
7B	55					
7C	685					
7D	30					
7E	223					
7F	18					
7G	30					
Sta 7 Gravity only	5,898					
Sta 7 Basin 7+7.1+7.2+7.3	8,166				630	
65.2.1	440		44,000	31	122	**150**
65.2	1,128		112,750	78	313	**350**
65.2 Total	1,568		156,750	109	435	**490**
65.1	363		36,250	25	101	**120**
65A	483					
65B	600					
65C	175					
65D	175					
65	460					
LS 65 Total	3,823		382,250	265	1,062	**1,200**
38	2		180	0	1	**10**
44A	20					
44	85		8,500	6	24	
LS 44 Total	105		10,500	7	29	**50**
8	1,623		162,330	113	451	
Sta 8 Total 8+65+38+44	5,553	Total	555,260	386	1,542	**1,700**
63	190		19,000	13	53	**60**
30	218					
30A	10					
Total 30	228		22,750	16	63	**75**
18B	235					
18A	33					
18	453					
Sta 18 Total	1,366		136,550	95	379	**350**
69.1	400		40,000	28	111	**125**
69A	462					
69	425					
69 Total	1,288		128,760	89	358	**400**
32A	179					
32B	5					
32	920					
32 Total	1,104		110,390	77	307	**350**
33A	505					
33	362					
33 total	867		86,660	60	241	**275**
31	163		16,250	11	45	**50**
Minor Basin Total	5,014		501,360	348	1,393	
Grd Total to LS 7	18,732		1,873,220	1,301	5,203	**7,000**

Central Kitsap West Basin (6)	Population	GPD	GPM	Peak Flow	Anticipated Design Q
10.3.4	13	1,250	1	3	**10**
10.3.2	48	4,750	3	13	**20**
10.3.1	148	14,750	10	41	**50**
10.3	588				
Total 10.3	795	79,500	55	221	**250**
10.3.3	200	20,000	14	56	**75**
10.2	145	14,500	10	40	**50**
10.4	15	1,500	1	4	**10**
10.1	440	44,000	31	122	**135**
10A	43				
10B	25				
Fair Flow	2,160	216,000	150	600	
LS 10 Basin	507				
LS 10 Total	4,330	432,984	301	1,203	**1,400**
11.1	103	10,250	7	28	**35**
11A	65				
11	448				
LS 11 Total	615	61,500	43	171	**190**
LS 5 Basin	1,123	112,260	78	312	
LS 5 Total	6,067	606,744	421	1,685	**1,900**
34.1.1	823	82,250	57	228	**250**
34.1.2	25	2,500	2	7	**10**
34.1	805	80,500	56	224	**250**
34B	50				
34A	570				
34	1,043				
LS 34 Total	3,315	331,500	230	921	**1,025**
36A	667				
36B	18				
36	668				
LS 36 Total	1,352	135,200	94	376	**420**
6C	0				
6B	10				
6A	40				
LS 6 Basin	50				
LS 6 Total 6+34+5+36	10,785	1,078,484	749	**2,996**	**3,300**

Silverdale South Basin (3)	Population	GPD	GPM	Peak Flow	Anticipated Design Q
14	317	31,700	22	88	**100**
13.1	258	25,750	18	72	**100**
13.2	318	31,750	22	88	**100**
13A	95				
13B	248				
13C	233				
13D	125				
13	340				
LS 13 Total	1,932	193,200	134	537	**600**
68	221	22,100	15	61	**70**
G1	1,124				
12.1	553	55,250	38	153	**170**
12.2	335	33,500	23	93	**110**
12.3	213	21,250	15	59	**70**
12.4	110	11,000	8	31	**50**
12.5	604	60,400	42	168	**190**
12A	75				
12B	340				
12C	370				
12	1,308				
LS 12 Total 68+13+12	7,183	718,331	499	1,995	**2,000**
40	63	6,250	4	17	**20**
3.3.1	108	10,750	7	30	**35**
3.3	118	11,750	8	33	**70**
3.1	330	33,034	23	92	**100**
3.2	1,726	172,624	120	480	**500**
3.4	330	33,000	23	92	**100**
3B	1,283				
3A	152				
3	3,090				
3C	504				
3D	85				
LS 3 Total 3+12+40	14,971	1,497,122	1,040	4,159	**4,600**

Silverdale North **Basin (4)**	**Population**	**GPD**	**GPM**	**Peak Flow**	**Anticipated Design Q**
51	105				
51A	360				
	465	46,500	32	129	**150**
1.1.1	100	10,000	7	28	**35**
1.1	405	40,500	28	113	**120**
1.2	48	4,750	3	13	**20**
1.3	463	46,250	32	128	**140**
1.4	417	41,687	29	116	**130**
1A	88				
1B	307				
1C	262				
1D	42				
1E	90				
1	8,606				
LS 1 Total 1+51	11,757	1,175,669	816	3,266	**3,500**
2	263	26,316	18	73	**80**
39	370	37,000	26	103	**120**
4.1.1	120	12,000	8	33	**40**
4.1	1,028	102,750	71	285	**320**
4.2	141	14,140	10	39	**50**
4A	115				
4	673				
LS 4 Basin	2,077				
LS 4 Total 4+3+1+2+39	29,438	2,943,767	2,044	8,177	**9,000**

Basin (19)	**Population**	**GPD**	**GPM**	**Peak Flow**	
21.2.1	203	20,250	14	56	**65**
21.2	115				
Total 21.2	318	31,750	22	88	**100**
21.3	73	7,250	5	20	**25**
21.1	390	39,000	27	108	**120**
21	983				
21A	175				
21 Total	1,938	193,830	135	538	**600**
22A	175				
22.1	85	8,500	6	24	**30**
22.2	65	6,500	5	18	**20**
22	435				
22 Total 21+22	2,698	269,830	187	750	**850**
25	75	7,500	5	21	**25**
26	35	3,500	2	10	**20**
19A	102				
19B	18				
19	1,930				
Total 19 basin	2,050				
19 Total 19+ 21+22+25+26	6,796	679,610	472	1,888	**1,500**
19 Future cannot carry LS-4 in Alternate mode					
20A	165				
20B	270				
20.1	55	5,500	4	15	**20**
20	948				
20 total	1,438	143,810	100	399	**450**
37A	25				
37	148				
37 total	173	17,340	12	48	**60**
CKTP-A	193				
XX					
Silverdale Totals to 20" Interceptor 4+19+20+37+CKTP+XX	38,038	3,803,827	2,642	10,566	**15**
70	190	19,000	13	53	
23	488	48,750	34	135	
23A	587				
23B	407				
23 total	1,482	148,150	103	412	**450**
35A					
35	248	24,750	17	69	**80**
9	200	20,000	14	56	**100**
Other Flows to Interceptor to CKTP	2,119	211,900	147	589	

Table G-2: Evaluation of Future Revisions to Existing Lift Stations and Conveyance Piping

Lift Station Information					Existing Conditions					Future Requirements								
Lift Station	Year Installed	No. of Pumps	VFD	Constant Speed	Capacity (gpm)	Capacity (cfs)	FM Length (ft)	Static Head (ft)	FM Dia. (in)	Capacity (gpm)	Capacity (cfs)	Static Head (ft)	Force Main Dia. (in)	Force Main Length (ft)	Force Main Friction (ft/1000')	TDH (ft)	HP	Comments
LS-1	1986/1995	3	✓	-	3,200	7.13	2,750	140	12/15	3,500	7.60	140						Existing Capacity Adequate (97%)
LS-2	1980	2	-	✓	264	0.59	240	125	8/14	80	0.18	125						Existing Capacity Adequate (30%)
LS-3	1980/2005	3	✓	-	1,800	4.01	7,300	135	14	4,600	10.30	135	18	7,300	7.8	200	350	
LS-4	1980/2005	3	✓	-	2,865	6.38	1,585	100	14	9,000	20.10	100	27	1,575	3.5	106	360	
							1,808		20									
LS-5	1980	2		✓	530	1.18	1,800	80	8	1,200	4.20	80	12	1,800	6.0	104	100	
LS-6	1980/2004	2	✓	-	1,200	2.67	3,275	65	10	3,200	7.30	65	18	3,275	5.2	83	115	
LS-10	1980	2	-	✓	270	0.60	3,000	90	6	675	3.10	90	10	3,000	5.0	105	75	
LS-18	1977	2	-	✓	301	0.67	800	35	4/12	350	0.80	35						Existing Capacity Adequate (10% over)
LS-19	1986/1999	3	✓	-	3,264	7.27	50	70	16	750	3.30	70						Adequate (23%) Except in Alt Mode
LS-24	1988/2000	3	✓	-	8,000	17.82	8,800	160	24		0.00	160						Not Evaluated
LS-31	1975	2	-	✓	61	0.14	2,000	35	4/8	50	0.11	35						Existing Capacity Adequate (80%)
LS-38	1972	2	-	✓	70	0.16	400		8	10	0.02							Existing Capacity Adequate (15%)
LS-67	1998/1999	3	✓	-	700	1.56	480	40			0.00	40						Not Evaluated
LS-11	1979/1985	2	-	✓	230	0.51	2,000	60	4/12	190	0.43	60						Existing Capacity Adequate (85%)
LS-16	1980	3	✓	-	2,000	4.46	4,080	40	16/30		0.00	40						Not Evaluated
LS-20	1981	2	-	✓	327	0.73	2,700	110	6/20	300	0.68	110						Existing Capacity Adequate (92%)
LS-8	1980	2	-	✓	300	0.67	3,000	40	8	1,700	3.88	40	15	3,000	4.0	52	40	
LS-9	1980	4	-	✓	400	0.89	6,480	155	8	65	0.15	155						Existing Capacity Adequate (16%)
LS-12	1980	2	-	✓	250	0.56	1,900	15	12	2,000	4.56	15	15	1,900	5.3	26	25	
LS-13	1980	2	-	✓	400	0.89	1,600	20	8	600	1.37	20	10	1,600	4.0	27	10	
LS-17	1980	3	✓	-	3,000	6.68	22,000	40	18/20		0.00	40						Not Evaluated
LS-21	1986	2	-	✓	240	0.53	2,650	90	8	550	1.25	90	10	2,650	4.0	101	25	
LS-22	1986	2	-	✓	380	0.85	1,050	120		850	1.90	120	15	1,050	10.0	130	50	
LS-23	1985	2	-	✓	600	1.34	1,250	105		150	0.34	105						Existing Capacity Adequate (25%)
LS-25	1989	2	-	✓	150	0.33	1,250	30	4	25	0.06	30						Existing Capacity Adequate (17%)
LS-26	1990	2	-	✓	70	0.16	425	30		20	0.05	30						Existing Capacity Adequate (29%)
LS-30	1993	2	-	✓	160	0.36	1,450	145	8		0.00	145		1,450				Existing Capacity Adequate
LS-32	1983	2	-	✓	165	0.37	2,500	30	8	350	0.80	30	8	2,500	5.0	43	10	
LS-33	1983	2	-	✓	90	0.20	550	50	8	275	0.63	50	8	550	5.0	53	10	
LS-34	1989	2	-	✓	900	2.01	6,000	130	12/10	1,025	2.34	130						Existing Capacity Adequate (14% over)
LS-35	1983	2	-	✓	160	0.36	950	85	8	80	0.18	85						Existing Capacity Adequate (50%)
LS-36	1979/1999	2	-	✓	150	0.33	2,000	30	4	420	0.90	30	4	2,000	10.0	50	20	
LS-37	1983	2	-	✓	170	0.38	3,500	25	13/8	60	0.14	25						Existing Capacity Adequate (30%)
LS-39	1994	2	-	✓	110	0.25	700	25		110	0.25	25						Existing Capacity Adequate (100%)
LS-40	1993	2	-	✓		0.00	875	90	8	20	0.05	90	4	875	15.0	104	2	
LS-44	1995	2	-	✓	50	0.11	1,200	80		50	0.11	80						Existing Capacity Adequate (100%)
LS-51	1995	2	-	✓	250	0.56	500	40		150	0.30	40						Existing Capacity Adequate
LS-64	2003	2	-	✓	70	0.16	50	40			0.00	40						Not Evaluated
LS-65	1994	4	-	✓	300	0.67	5,950	275		1,200	2.74	275	12	5,950	6.0	311	175	
LS-69	1998	2	-	✓	160	0.36	2,700	95		400	0.91	95	8	2,700	6.0	112	25	
LS-14	1981	2	-	✓	300	0.67	6,880	25	6	100	0.23	25						Existing Capacity Adequate (33%)
LS-7	2006	3	✓	-	4,200	9.36	850		14	7,000	15.96	100	24	850	5.0	100	400	
LS-63	2006	2	-	✓	90	0.20	750	35	4/8	60	0.14	35		750				Existing Capacity Adequate
LS-68		2	-	✓	310	0.69	8,360	50	8	70	0.16	50						Existing Capacity Adequate (23%)

Table G-3 Silverdale New Lift Stations and Force Main Projects

	Lift Station			Forcemain			Total Costs	
	No.	H.P.	Const. Cost[1] ($)	Dia (in)	Length (ft)	Const. Cost[2] ($)	Total Cost ($)	Total Project[3] ($)
	1.1	12	240,000	4	1,700	81,600	321,600	482,400
	1.1.1	1	20,000	2	3,000	72,000	92,000	138,000
	1.2	1	20,000	2	1,550	37,200	57,200	85,800
	1.3	6	120,000	6	4,400	316,800	436,800	655,200
	1.4	4	80,000	4	1,250	60,000	140,000	210,000
	3.1	2	40,000	4	750	36,000	76,000	114,000
	3.2	10	200,000	4	900	43,200	243,200	364,800
	3.3	4	80,000	4	3,500	168,000	248,000	372,000
	3.3.1	2	40,000	2	400	9,600	49,600	74,400
	3.4	3	60,000	4	1,300	62,400	122,400	183,600
	4.1	12	240,000	6	1,300	93,600	333,600	500,400
	4.1.1	1	20,000	2	2,600	62,400	82,400	123,600
	4.2	2	40,000	3	1,100	39,600	79,600	119,400
	12.1	8	160,000	4	750	36,000	196,000	294,000
	12.2	7	140,000	4	1,000	48,000	188,000	282,000
	12.3	5	100,000	4	850	40,800	140,800	211,200
	12.4	2	40,000	2	550	13,200	53,200	79,800
	12.5	4	80,000	4	950	45,600	125,600	188,400
	13.1	4	80,000	4	900	43,200	123,200	184,800
	13.2	1	20,000	4	650	31,200	51,200	76,800
	20.1	1	20,000	2	600	14,400	34,400	51,600
	20.2	-	-	-	-	-	-	-
	21.1	5	100,000	2	2,600	62,400	162,400	243,600
	21.2	1	20,000	4	600	28,800	48,800	73,200
	21.2.1	2	40,000	3	1,200	43,200	83,200	124,800
	21.3	1	20,000	4	700	33,600	53,600	80,400
	22.1	1	20,000	2	1,350	32,400	52,400	78,600
	22.2	1	20,000	2	1,450	34,800	54,800	82,200
Total UGA	**28**		**$ 2,060,000**		**$ 37,900**	**$ 1,590,000**	**$ 3,650,000**	**$ 5,475,000**

(1) Pump Station cost based on $20,000/HP
(2) Forcemain cost based on $12.00/in-ft
(3) Total Project cost = Total Const. cost x 1.5

Table G-4 Central Kitsap New Lift Stations and Force Main Projects

	Lift Station			Forcemain			Total Costs	
	No.	H.P.	Const. Cost[1] ($)	Dia (in)	Length (ft)	Const. Cost[2] ($)	Total Cost ($)	Total Project[3] ($)
	7.1	2	40,000	4	500	24,000	64,000	96,000
	7.2	5	100,000	2	950	22,800	122,800	184,200
	7.3	55	1,100,000	8	2,750	264,000	1,364,000	2,046,000
	7.3.1	6	120,000	4	3,200	153,600	273,600	410,400
	7.3.2	8	160,000	4	3,300	158,400	318,400	477,600
	7.3.3	1	20,000	6	2,800	201,600	221,600	332,400
	7.3.4	4	80,000	3	4,050	145,800	225,800	338,700
	7.3.5	7	140,000	4	5,900	283,200	423,200	634,800
	7.3.6	10	200,000	4	6,600	316,800	516,800	775,200
	10.1	10	200,000	4	2,250	108,000	308,000	462,000
	10.2	4	80,000	3	1,350	48,600	128,600	192,900
	10.3	15	300,000	6	1,550	111,600	411,600	617,400
	10.3.1	1	20,000	3	950	34,200	54,200	81,300
	10.3.2	1	20,000	2	2,250	54,000	74,000	111,000
	10.3.3	4	80,000	3	1,750	63,000	143,000	214,500
	10.3.4	1	20,000	2	700	16,800	36,800	55,200
	10.4	1	20,000	2	2,750	66,000	86,000	129,000
	34.1	10	200,000	8	3,800	364,800	564,800	847,200
	34.1.1	10	200,000	6	1,900	136,800	336,800	505,200
	34.1.2	10	200,000	2	1,400	33,600	233,600	350,400
	65.1	10	200,000	4	1,350	64,800	264,800	397,200
	65.2	25	500,000	6	2,950	212,400	712,400	1,068,600
	65.2.1	2	40,000	6	3,350	241,200	281,200	421,800
	69.1	5	100,000	4	1,250	60,000	160,000	240,000
Total UGA	**24**		**$ 4,140,000**		**$ 59,600**	**$ 3,186,000**	**$ 7,326,000**	**$ 10,989,000**

(1) Pump Station cost based on $20,000/HP
(2) Forcemain cost based on $12.00/in-ft
(3) Total Project cost = Total Const. cost x 1.5

Table G-5 Silverdale Conceptual Gravity Collectors

Silverdale North			Silverdale South					
Basin	**Length**	**Basin Total**	**Basin**	**Length**	**Basin Total**	**Basin**	**Length**	**Basin Total**
1.1	3,700	3,700	3.4	2,000	2,000	12.4	1,600	3,900
1.3	3,700	3,700	3 B	4,500	10,100		1,400	
21 A	3,300	3,300		2,200			900	
51 A	2,400	5,700		2,000		12.3	2,100	5,800
	1,800			1,400			2,100	
	1,500		3.3	2,100	4,700		1,600	
1 B	1,300	5,200		2,000		12.2	2,200	12,000
	1,300			600			1,800	
	2,600		3A	2,100	2,100		1,800	
21.1	1,200	1,200	3 C	2,000	12,300		1,500	
1.4	4,000	10,100		1,500			1,400	
	2,600			1,800			800	
	800			1,100			2,500	
	2,700			1,000		12 C	1,400	1,400
1 C	700	700		2,300		12A	1,100	1,100
1 D	1,700	1,700		2,600		12.1	3,400	7,300
1A	1,400	1,400	3.2	5,800	20,700		1,400	
21.2.1	1,400	1,400		4,500			1,400	
20 A	3,600	3,600		3,300			1,100	
4.1	4,200	11,400		2,100		13A	2,200	2,200
	1,800			1,200		13 B	3,200	3,200
	2,100			800		13 C	2,500	4,900
	2,000			2,000			1,600	
	1,300			1,000			800	
4.2	3,100	3,100	3 D		0	13 D	2,500	7,600
4A	1,300	1,300	3.1	1,400	1,400		1,900	
			12 B	2,500	4,600		1,200	
				800			1,200	
				1,300			800	
			12.5	1,800	6,300	13.1	3,300	3,900
				4,500			600	
NORTH MILES		10.89	SOUTH MILES					22.25
Silverdale UGA TOTAL MILES								**33.14**

Table G-6 Central Kitsap Conceptual Gravity Collectors

CK East Collectors			CK West Collectors		
Basin	**Length**	**Basin Total**	**Basin**	**Length**	**Basin Total**
65.2	6,000	11,000	34.1	2,400	6,200
	5,000			3,800	
65 B	5,600	5,600	34.1.1	1,200	5,800
65 A	1,700	1,700		4,600	
7.3.2	2,700	2,700	10.1	2,300	5,400
7.3	600	600		2,100	
				1,000	
			10.3.1	2,700	2,700
7.3.3	5,700	14,300	10.3	3,200	4,500
	2,500			1,300	
	3,000		10.4	1,700	1,700
	1,800		10 B	2,600	4,600
	1,300			2,000	
65.2.1	2,800	2,800	XX	3,000	4,900
69.1	2,900	2,900		1,200	
7A	1,500	1,500		700	
70	1,500	5,200			
	1,500				
	2,200				
23 B	2,600	9,000			
	2,400				
	2,500				
	1,500				
23A	2,300	5,900			
	3,600				
EAST MILES		11.97	WEST MILES		6.78
Central Kitsap UGA TOTAL MILES					**18.75**

Table G-7 Estimated Project Costs for Expansion of Existing Lift Stations in Silverdale UGA

	Pump Station		Discharge Piping: Force Mains			Discharge Piping: Gravity Pipes			Total Costs	
L.S. #	HP	Cost[1] ($)	Length (ft)	Dia. (in)	Cost[1] ($)	Length (ft)	Dia. (in)	Cost ($)	Total Const. Cost ($)	Total Project Cost[3] ($)
3	350	3,500,000	7,300	18	1,576,800	-	-	-	5,076,800	7,615,200
4	360	3,600,000	1,575	27	510,300	-	-	-	4,110,300	6,165,450
12	25	500,000	1,900	15	342,000	-	-	-	842,000	1,263,000
13	10	200,000	1,600	10	192,000	-	-	-	392,000	588,000
21	25	500,000	2,650	10	318,000	550	12	99,000	917,000	1,375,500
Total										**17,007,150**

(1) $20,000/horsepower for pump stations under 200HP; $10,000/horsepower for pump stations greater than 200 HP.
(2) $12.00/inch-ft
(3) Project cost = 1.5 x const. cost

Table G-8 Estimated Project Costs for Expansion of Existing Lift Stations in Central Kitsap UGA

	Pump Station		Discharge Piping: Force Mains			Discharge Piping: Gravity Pipes			Total Costs	
L.S. #	HP	Cost[1] ($)	Length (ft)	Dia. (in)	Cost[1] ($)	Length (ft)	Dia. (in)	Cost ($)	Total Const. Cost ($)	Total Project Cost[3] ($)
5	100	2,000,000	1,800	12	259,200	-	-	-	2,259,200	3,388,800
6	115	2,300,000	3,275	18	707,400	-	-	-	3,007,400	4,511,100
				24						
7	400	4,000,000	850	24	244,800	-	-	-	4,244,800	6,367,200
8	40	800,000	3,000	15	540,000	-	-	-	1,340,000	2,010,000
10	75	1,500,000	3,000	12	432,000	-	-	-	1,932,000	2,898,000
32	10	200,000	-	-	-	-	-	-	200,000	300,000
33	10	200,000	-	-	-	-	-	-	200,000	300,000
36	20	400,000	-	-	-	-	-	-	400,000	600,000
65	175	3,500,000	5,950	12	856,800	-	-	-	4,356,800	6,535,200
69	25	500,000	2,700	8	259,200	-	-	-	759,200	1,138,800
Total						-	-	-		**28,049,100**

(1) $20,000/horsepower for pump stations under 200HP; $10,000/horsepower for pump stations greater than 200 HP.
(2) $12.00/inch-ft
(3) Project cost = 1.5 x const. cost

Table G-9 Estimated Project Costs for Gravity Sewer Replacements in the Silverdale UGA

Project	Location	Description	Length	Dia. (in)	Const. Cost[1] ($)	Project Cost[2] ($)
1	Anderson Hill Rd	Provost Rd to Silverdale Loop Rd	2,700	8	324,000	486,000
2	Silverdale Way NW	NW Anderson Hill Rd to McConnell Ave. NW	1,200	8	144,000	216,000
3	Washington Way NW	Bayshore Dr. to alley south 1,000 of Byron	950	8	114,000	171,000
4	LS-2 Influent Line	Bucklin Hill Rd to LS-2	250	8	30,000	45,000
5	Silverdale Way NW	400 ft south of NW Misty Ridge Ln to Clear Creek	700	8	84,000	126,000
6	Silverdale Way NW	LS-51 FM to NW Misty Ridge Ln	550	8	66,000	99,000
			250	10	37,500	56,250
7	Provost Rd NW	60 ft north of NW Bernard St to 180 ft south of NW Bernard St	300	8	36,000	54,000
8	NW Newberry Rd	Provost Rd to Hwy 3	200	8	24,000	36,000
Total						**1,289,250**

(1) Estimated at $15.00/in(diameter) - ft(length)
(2) Estimated at 1.5 x construction cost

Table G-10 Estimated Project Costs for Gravity Sewer Replacements in the Central Kitsap UGA

Project	Location/Description	Length	Existing Dia. (in)	Required Dia. (in)	Replacement Const. Cost[1] ($)	Project Cost[2] ($)
1	East of LS-7 along Fairgrounds Road	4,800	8	12	864,000	1,296,000
2	South of LS-7	3,200	12 and 15	18	864,000	1,296,000
3	West of LS-6 along Fairgrounds Road	2,100	8 and 10	12 and 18[3]	567,000	850,500
4	East of LS-33	900	8	12	162,000	243,000
Total						**3,685,500**

(1) Estimated at $15.00/in(diameter) - ft(length)
(2) Estimated at 1.5 x construction cost
(3) Cost Estimated at 2,100 ft of 18" Dia. Pipe

APPENDIX H – ALTERNATIVES TECHNICAL MEMORANDUMS

H-1 CKWWTP Sludge Dryer Cost Analysis

H-2 CKWWTP Class A Biosolids Survey

H1

CKWWTP Sludge Dryer Cost Analysis

Technical Memorandum

BROWN AND CALDWELL

Technical Memorandum

701 Pike Street, Suite 1200
Seattle, WA, 98101
206-624-0100

Prepared for: Kitsap County Department of Public Works

Project Title: Kitsap Wastewater Treatment Plant Phase III Upgrade

Project No. 132325.120.122

Technical Memorandum

Subject: Central Kitsap Wastewater Treatment Plant Phase III Upgrade
Sludge Dryer Cost Analysis

Date: June 22, 2007

To: Barbara Zaroff, Project Manager

From: Chris Muller, Project Engineer

Reviewed by: Patricia Tam, Project Engineer

1. INTRODUCTION

The Central Kitsap Wastewater Treatment Plant (CKWWTP) was notified that Soil Key, currently the plant's sole biosolids disposal site, has been experiencing problems related with rising fuel costs and odor complaints at its facility. To mitigate odor problems, Soil Key is experimenting with placing a geotextile covering over the compost pile to help control the odor. If successful, the additional costs of the new odor abatement procedure will be passed on to existing clients. Those additional costs will amount to $8 per wet ton of biosolids. This would increase the disposal cost for the County from $63.36 per wet ton, which includes $ 17.12 per wet ton hauling fee and $ 46.24 per wet ton tipping fee, to $71.36 per wet ton for the next three years, a 12.6 percent increase in disposal costs. In addition, an annual assessment to cover Soil Key's increasing fuel costs will be added to its contract with the County as well.

In the event that the odor mitigation steps prove unsuccessful, Soil Key has indicated that it may close its doors to biosolids processing in the future. In that case, the County would lose its only disposal option.

Under these circumstances the County has requested that Brown and Caldwell revisit the cost of a sludge dryer installation at the CKWWTP to determine whether the operation of the dryer would save the County money in the long term while also generating a Class A biosolids product, which has fewer regulations on disposal. Based on this analysis a recommendation will be made whether to move forward with a more detailed analysis of sludge dryers or continue to keep the process as future consideration.

2. ANALYSIS OF COST DATA

In order to estimate the County's cost of installing and operating a sludge dryer at the CKWWTP, certain assumptions as to how the dryer would operate had to be made. The subsections below identify the operating assumptions on which the County's costs were estimated. The method of determining the County's long-term costs are explained, and the impact of changes in the final biosolids product on the economic feasibility of adding sludge drying at the plant.

2.1 Assumptions for Cost Analysis

The following assumptions were made to conduct the following economic analysis:

- The selected dryer equipment would be the unit manufactured by Fenton Environmental Inc., Brownwood, Texas.
- The sludge dryer to be installed would be the Fenton RK-72E, one unit.
- The dryer would operate for 8 hours per day, 5 days per week, though 12 hours per day would be required when the input load approaches system capacity.
- The sludge dryer would dry the product to 90 percent solids, the minimum for Class A biosolids.
- The capital cost of the sludge dryer equipment is $ 1.2 million in 2007.
- A 2,700 square foot building would house the dryer equipment. Construction of the building would cost $200 per square foot which includes all electrical and plumbing to make the structure habitable. Ancillary equipment, specialty plumbing and electrical requirements for the process equipment is not included in the building cost.
- Installation costs would be 25 percent of the total capital cost, since the Fenton dryer is shipped on a skid preassembled.
- The conveyor and sludge storage silos would cost $300,000.
- They dryer would be purchased in 2009, begin operation in 2010, and have capacity to operate until 2028 without further expansion.
- Operational cost of the dryer would be $ 30/wet ton, including electricity, fuel, and typical maintenance, (as per information provided by a Fenton representative).
- The dryer would process 13.7 cubic yards of material in a single batch.
- A batch would take 3 hours to process.
- An operator will need to be present for all batches. Operator attention, monitoring, and routine maintenance will account for 30 percent of the total annual dryer operation time. (The basis of this assumption is a conversation with the operations staff at the Friday Harbor WWTP.)

- Operator labor was assumed to cost $ 40/hr.
- Soil Key will accept the dried product and charge the same hauling and tipping rate as Class B sludge.
- Costs would escalate at 4% annually.
- The discount rate assumed was 6% annually.
- Soil Key's assumed 8 $/ton additional cost for odor control would not be removed after three years
- The fuel surcharge would escalate at the same rates as other costs (i.e., 4 percent annually).

2.2 Net Present Value (NPV) Analysis

As stated in the Introduction above, Brown and Caldwell's objective was to determine whether, by installing and operating a sludge dryer to change the final solids product from a wet Class B biosolids to a dried Class A product, the CKWWTP will realize a net financial benefit over 20 years of dryer system operation.

A good approach to determining the financial benefit of a process is to conduct a NPV analysis. A NPV analysis determines the overall planning period cost of a particular operation or alternative in today's dollars (2007). The analysis takes into account capital expenditures for equipment, structures, labor, operations and maintenance cost as well as other fees, revenues and expenditures that are part of the operation of a process. By conducting this analysis not only is the cost of the equipment accounted for but the operating of that equipment as well. This gives a much better picture of the financial commitment the County would take on if it chooses a particular alternative.

Table 1 summarizes the NPV values for the installation and operation of a sludge dryer system at the CKWWTP relative to continued disposal of a Class B product at the Soil Key facility from 2010 through 2028. The net present value analysis shows that the cost of installation and operation of a dryer in 2007 dollars to be $ 10.3 million, while the continuation of disposal of a Class B product at Soil Key in Tenino, WA, would cost $ 6.9 million between 2010 and 2028. The additional $3.4 million in expense suggests that the installation of a dryer is not financially sound at this time, even in light of an addition 8 $/wet ton service fee.

To determine which factors have the most significant impact on the biosolids disposal for the dryer and sludge hauling alternatives a sensitivity analysis was conducted, which is addressed in the following section.

Table 1: Results of NPV Analysis of CKWWTP's Change to Dried Class A Biosolids Production

Alternative	Total Operations and Maintenance Costs (million 2007-$)	Total Capital Cost (million 2007-$)	Total NPV of Installing and Operating Dryer (million 2007-$)
Dried Class A Product	5.6	4.7	10.3
Class B Product*	6.9	0	6.9

Notes:
* Class B costs do not include costs associated with increase in the truck fleet required by increased biosolids production.

2.3 Sensitivity Analysis of a Dried Class A Product

A sensitivity analysis was conducted on the cost data for the proposed dryer system and the continued practice of hauling Class B wet sludge to Soil Key to determine which cost variables have the most significant impact on the overall NPV. The results of the sensitivity analysis are as follows.

2.3.1 Class B Product

- The fees charged by Soil Key represent the largest share of the overall net present value of disposing of biosolids.

2.3.2 Class A Product

- The largest single component of the NPV of the dryer system is the capital investment in the dryer and building to house it. The capital investment in this line item represents $4.7 million of the total NPV.
- The NPV of the operations and maintenance costs is lower with the dryer option. Of the component costs of operations and maintenance the following are ordered in order of significance to the NPV, from greatest to least.
  - Dryer O&M (fuel, maintenance, electricity): $ 2.9 million
  - Sludge Hauling and Tipping: $ 1.7 million
  - Labor: $1 million

2.4 Analysis of Annual Operating Costs

The annual operating costs of producing Class A and Class B products were investigated to determine the cost per dry ton for the biosolids product disposed of from the CKWWTP so that the respective costs of producing the two products could be prepared. To estimate future production costs, current production cost estimates were escalated by 4 percent per year over current rates, and future solids production rates were applied for the 20 year planning horizon. The capital investment in equipment and infrastructure for the dryer facility (based on 2007 vendor quotes) was escalated to 2009 values (the predicted time of purchase), then discounted back to a present worth value. This was done to account for the differential in the escalation rate and the discount rate. The present value of the capital investment in equipment and infrastructure was then annualized. The line item cost for operations and maintenance was returned to a present value for each year of the design period using a discount rate of 6 percent. The annual operations and maintenance (O&M) expenditure includes all fuel, power, labor, maintenance and biosolids disposal costs associated with a the specified final disposal option. The total annual project cost includes the annual O&M and the annualized present value of the capital expenditures for equipment and infrastructure associated with each biosolids disposal option. Once the present value of both the total annual costs and the annual O&M costs were determined, that value was normalized to the projected production of dry biosolids produced at the facility. The costs of the two option were expressed in two formats dollars per dry ton and total dollars (2007) per year, by multiplying by projected dry tonnage of solids.

Table 2 summarizes the total annual project and annual O&M costs for operating under a Class A and a Class B disposal regime. The table shows that the operation of the dryer will reduce the Annual O&M, below that of the Class B option on a $ per dry ton basis. The reduction in cost is due to the reduction in mass of biosolids as a result of increasing the cake dryness from 22 percent to 90 percent solids. The present value of the annual O&M cost will decrease over the design period, as observed in Table 2, because the escalation rate (4 percent) is less than the discount rate (6 percent).

When the capital investment in equipment and infrastructure is annualized based on 2007 dollars, cost of Class A biosolids disposal increases $411,000 dollars per year. This additional cost, which represents the total annual project cost, increases the dollar per dry ton to such an extent that at no time during the 20 year planning period would it be less expensive to dry and dispose of the Class A biosolids product than it would be to continue to produce and dispose of the wetter Class B product currently produced at the plant.

When the estimated annual expenditure (the product of the projected dry solids production in a given year and the total annual project cost per dry ton for the corresponding year) is calculated, the total annual costs of drying to produce Class A biosolids exceeds the cost of producing the Class B product by at least $397,000 to as high as $399,000 in any given year through 2028. This calculation further supports the findings of the NPV analysis that continued disposal under the Class B alternative is less expensive.

Table 2: Summary of Annual Operating Costs in 2007 Dollars for Class A and Class B Biosolids Production at CKWWTP

		Total Annual O&M and Disposal Cost Per Dry Ton		Total Annual Project Costs		Total Annual O&M and Disposal Cost Per Dry Ton		Total Annual Project Cost Per Dry Ton	
	Biosolids Production	Class A	Class B	Class A	Class B	Class A	Class B	Class A	Class B
Year	dry tons/year	1000 -$/year	1000 -$/year	1000 -$/year	1000 -$/year	$/dry ton	$/dry ton	$/dry ton	$/dry ton
2010	1104	273	286	684	286	248	259	620	259
2011	1139	277	289	688	289	243	254	604	254
2012	1173	280	292	691	292	238	249	589	249
2013	1208	283	295	694	295	234	244	574	244
2014	1242	285	298	696	298	230	240	560	240
2015	1277	288	300	699	300	225	235	547	235
2016	1312	290	303	701	303	221	231	534	231
2017	1346	292	305	703	605	217	226	522	226
2018	1381	294	307	705	307	213	222	510	222
2019	1415	295	308	706	308	209	218	499	218
2020	1450	297	310	708	310	205	214	488	214
2021	1484	298	311	709	311	201	210	478	210
2022	1519	299	313	710	313	197	206	468	206
2023	1554	300	314	711	314	193	202	458	202
2024	1588	301	315	712	315	190	198	449	198
2025	1623	302	315	713	315	186	194	439	194
2026	1657	303	316	714	316	183	191	431	191
2027	1692	303	317	714	317	179	187	422	187
2028	1726	304	317	715	317	176	184	414	184

3. RECOMMENDATIONS FOR FURTHER ANALYSIS

It is not recommended that Kitsap County pursue immediately installing a sludge dryer as a means of reducing hauling and tipping costs associated with the disposal of biosolids at the Soil Key facility at this time. It is strongly recommended, however, that the County revisit this topic every three to five years or as market conditions dictate. Refinements to the dryer analysis should include the following elements, which are beyond the scope of the current contract.

- *Local Disposal Site*: The County should investigate if there is a local disposal option for a dried product and what the hauling and tipping fees would be.
- *Regulation Requirements*: The County should closely monitor the regulatory climate in the state of Washington to determine if there will be increasing restrictions on Class B biosolids used for land application. Increased restrictions could significantly increase the cost of disposal.
- *Operating Conditions*: The County should visit several dryer installations and determine a level of operator attention that the County would find acceptable. An increase in the daily operating time beyond an eight-hour shift, five days per week would allow the County to purchase a smaller, less expensive dryer, thereby reducing the County's capital investment .
- *Phased Construction:* As opposed to installing a single, large dryer, installing multiple, smaller units may be feasible. However, this cost impacts of that arrangement will be strongly influenced by the dryer operational period.
- *Multiple Dryer Manufactures:* The Fenton product was selected for this cost analysis because it is competitively priced with the dryers produced by most other manufactures. However, the current projection of the solids loading to the facility and the operating constraints set forth are such that no single dryer unit fits this application perfectly. Other dryers should be investigated for sizing and pricing.
- *Dried Pellet Market:* The dried pellet market is not currently well developed in the region. It is expected that as the number of sludge dryers in the region increases, a stronger pellet market will develop. Pierce County, Sumner, and Friday Harbor currently operate sludge dryers. The new Alderwood facility will also use a sludge dryer to stabilize its final biosolids product. The County should follow up with the potential end users identified in the Biosolids Survey Technical Memorandum as it relates to a dried pellet product..

4. RECOMMENDATIONS FOR BIOSOLIDS DISPOSAL

It is recommended that Kitsap County investigate other biosolids disposal methods, given the current status of the Soil Key disposal option. The scope of the investigation should be broad ranging to identify the most cost effective and reliable alternatives for a given planning horizon. Areas of investigation should include:

- Determine the increased likelihood that Soil Key will accept a dried product rather than a wet product.
- Investigate the likelihood and impact of development of a regional biosolids composting facility.
- Investigate the viability of a Class A compost market in the area.
- Investigate the feasibility of a regional or multi-facility sludge drying facility.

H2

CKWWTP Class A Biosolids Survey

Technical Memorandum

BROWN AND CALDWELL

Technical Memorandum

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Prepared for: Kitsap County, Washington

Project Title: Kitsap Wastewater Treatment Plant Phase III Upgrades

Project No: 131325-120-121

Technical Memorandum

Subject: Class A Biosolids Survey

Date: May 21, 2007

To: Barbara Zaroff, Project Manager

From: Christopher Muller, Project Engineer

Reviewed by: Patricia Tam, Project Engineer

1. INTRODUCTION

This Technical Memorandum (Tech Memo) reports the results of the Class A Biosolids Survey conducted to determine the market viability of a Class A product in the Kitsap County region. The primary driver for Kitsap County to investigate other stabilization techniques and technologies is to reduce disposal costs and increase flexibility by moving away from a single disposal option. Currently the County pays approximately $63 per wet ton to dispose of its biosolids with Soil Key in Tenino, WA. Recent developments at the Soil Key may immediately increase the disposal cost to $73 per wet ton. These costs are expected to continue to escalate with increasing fuel costs in the future.

Kitsap County primarily has two options available to satisfy its cost-reduction and flexibility objectives. Both options involve the conversion of the solids processing facility at the Central Kitsap Wastewater Treatment Plant (CKWWTP) from Class B biosolids production to Class A production. Moving from a Class B to a Class A biosolids production will likely increase the number of disposal options, as the disposal regulations are less restrictive for Class A product due to the additional pathogen kill. The United States Environmental Protection Agency (USEPA) lists several alternatives under which biosolids can be stabilized to meet Class A requirements for land application.

One alternative would be to convert the existing, mesophilic digestion system from a Class B process to a Class A process. Class A requirements can be met during the digestion process by using thermophilic temperatures. Under Alternative 1 of the 40 CFR 503 Regulations, a prescribed time and temperature greater than 50°C, can be used to meet the pathogen reduction requirements. However, the process must guarantee that all particles are exposed to the prescribed time and temperature regime; otherwise, a Class A product will not be produced. To satisfy this requirement, the time and temperature portion of the process is usually carried out on a batch basis. Otherwise significant hydraulic modeling would be required or process equivalency testing may be required.

A second alternative available to Kitsap County to produce a Class A product is to install a sludge dryer system. The sludge dryer would fall under Alternative 5 as a Process to Further Reduce Pathogens (PFRP) in the 40 CFR 503 regulations. The Class A requirements are met by reducing the solids moisture content to less than 10 percent with temperatures of the solids exiting the dryer or the gas in contact with the solids reaching 80°C. Drying does not provide any additional volatile solids destruction but will remove significant amounts of water, thus lowering the mass for disposal considerably. The dryer option can be integrated with the current digestion and dewatering scheme at CKWWTP. The addition of a building to house a dryer and associated equipment and a fuel source would constitute most of the initial capital investment.

Concurrent with the change over to the Class A product, the County should investigate whether or not a classification of Exceptional Quality ("EQ") can be obtained for its solids. In order to obtain the "EQ" status, the biosolids must have pollutant concentrations below the levels set forth in Table 3 of CFR 503.13. If the pollutant concentrations are below set values and Class A pathogen reductions and vector attraction requirements are met, then the EQ biosolids are not subject to the general requirements for management practices of land application.

1.1 Scope of Work

The scope of work associated with Task 121 focused on contacting potential end users of a Class A biosolids product. The primary groups contacted in this survey include:

- Composters and topsoil manufacturers
- Nursery operators
- Landscape supply companies

The facilities contacted were those in relatively close proximity to the CKWWTP. By focusing on regional disposal locations, overall hauling fees could be minimized. A list of facilities contacted can be found in Appendix A.

1.1.1 Approach

The biosolids survey was conducted via telephone, fax, and mail, depending on specific requests made by the survey participants during initial conversations. The survey was developed to act a guide for determining the level of interest and demand for a Class A biosolids product in the Kitsap County market area. Along with responses to the standard line of questioning, additional responses and information were recorded during the regular flow of conversation. This was done to not only capture the level of interest of a specific survey participant but also to gather extra information that could be useful or informative regarding the market in the Kitsap County area.

The reporting of data fell into one of two categories. One group of data dealt strictly with the results of the survey as they relate to the level of interest in a Class A product and current market. The second group of data to be presented related to additional responses provided by the survey participants beyond the initial line of questioning as well as information regarding current topics in biosolids disposal and how they may affect Kitsap County in the future.

2. CLASS A BIOSOLIDS SURVEY RESULTS SUMMARY

The results of the biosolids survey are divided by 3 distinct groups. These groups include compost and topsoil manufacturers, landscape supply companies, and nurseries. The response from the survey participant was categorized as positive, negative, and no response. A positive response reflects some level of interest from the survey participant; the interest may range from tacit interest to extremely interested. The survey participants whose responses were considered positive should receive a follow up contact from the County if it decides to moves forward with Class A production. A response was considered negative if the survey participant which showed no interest or no capacity to accept a Class A product. No response indicates someone who did not return the completed survey or phone calls.

The survey results are presented in both table form as well as graphical form (Table 1 and Figure 1, respectively). A list of the survey participants and the completed survey forms are included in Appendix A.

Table 1. Summary of Class A Biosolids Survey Responses

Survey Participant	Number Contacted	Number of Positive Responses	Number of Negative Responses	No Response
Compost and topsoil manufacturers	7	3	2	2
Landscape supply companies	2	0	2	0
Nurseries	6	0	3	3

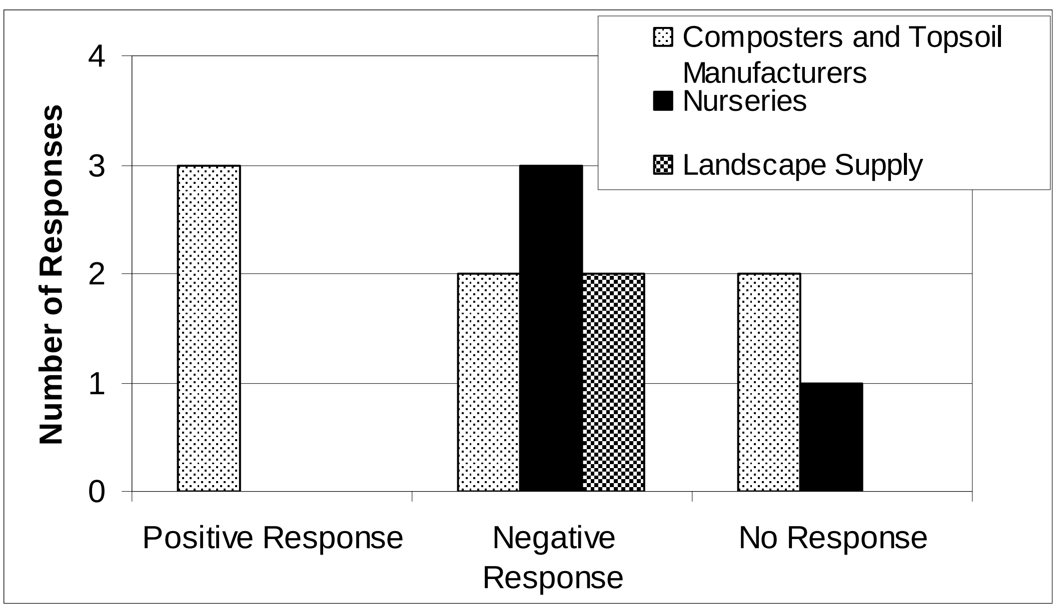

Figure 1-1. Summary of Central Kitsap County WWTP Class A Biosolids Survey.

The results of the survey suggest that there is a moderate level of interests in one group of respondents, compost and topsoil manufacturers, but not an overwhelming demand for a Class A product in the region. Based on the results of this survey, the market Kitsap County should focus its efforts on developing disposal options with the compost and topsoil manufacturing industry. Listed below are the survey respondents that showed an interest in a Class A biosolids product.

- Asbury's Topsoil Inc., 7051 NW Newberry Hill Road, Silverdale WA, 360-692-8393
- Bud's Yard Products, 7501 McKinley Ave, Tacoma WA, 253-474-1556
- Dave Stewarts Topsoil 4 Less, 2650 NW Mountain View Road, Silverdale WA, 360-509-2222

The moderate level of interest in Class A biosolids products in the Kitsap region suggests no overwhelming demand for a Class A product at this time. However, Kitsap County may want to further investigate other Class A technologies available as well as other Class B disposal options.

While the survey participants who showed interest in a Class A product represent a different disposal option for Kitsap County, that option is not that different from the County's current disposal practice. Other options or alternatives beyond the compost and topsoil industry might be explored to protect the County against the possibly of catastrophic loss of its current disposal method. With multiple disposal options, the possibility that a regulatory change or shift in public perception resulting in the elimination of a single disposal option or class would be reduced.

3. ADDITIONAL CONSIDERATIONS FOR BIOSOLIDS DISPOSAL

This section presents additional biosolids disposal considerations, including emerging research and possible additional disposal options. The section includes information that was not part of the survey. Each topic was included based on its potential to impact on biosolids disposal and operation at the CKWWTP. Some of these topics will impact biosolids production and disposal directly; other topics identify issues that could present a challenge for the biosolids program in the future.

3.1 Public Perception

One of the greatest challenges facing the wastewater industry today is public perception. Biosolids are a by-product of a waste treatment process that the public believes is inherently dirty. The combination of this initial perception and the large amounts of conflicting information available on the subject can lead to confrontations between the utility and the public they serve. Several survey participants noted that they were not interested in a biosolids product due to the negative public stigma associated with the product. One participant indicated concern over liability of selling such a product to the general public. A significant amount of public education may be required to increase public acceptance and the marketability of biosolids products.

3.2 Pathogen Reactivation and Regrowth

Currently, the Water Environment Research Foundation (WERF) is investigating the reactivation and regrowth of pathogens from biosolids that have been dewatered using centrifuges. To date, the research has focused on fecal coliforms, which are indicator organisms for pathogenic populations, to quantify reactivation and regrowth. Reactivation is defined as the instantaneous increase in the culturable population of bacteria. The current data show that reactivation can occur either during or following centrifugation. The rate of population increase under those circumstances is even higher than the normal growth rate of those organisms before they were deactivated. The reactivation phenomenon is thought to occur when an organism leaves a dormant state, viable but not culturable, and becomes active due to the forces in the centrifuge. Once reactivation occurs, regrowth can occur in which the fecal population repopulates the stabilized sludge matrix.

Currently, the study of the reactivation and regrowth phenomenon has focused on the fecal coliform population and not other, specific pathogens. Therefore, it is not yet known if specific pathogenic organisms (e.g., *Salmonella* sp) exhibit the same characteristic regrowth as the fecal colifom indicators. The EPA has taken no action on the subject. Furthermore, despite the current WERF research, the EPA has indicated that with current handling practices, the biosolids are still safe for land application.

While not having an impact on the biosolids program currently, the reactivation and regrowth issue and any potential future changes in biosolids regulations should be considered in evaluating disposal options at the CKWWTP. In the event that there are changes to the regulations and or a public push to ban land application of biosolids in the region, having current information available will help mitigate the impact of such changes. The County will either be able to foresee the upcoming changes in regulations and plan for changes in disposal practices or provide the public with current, relevant, and correct information to ameliorate public concern.

Additional literature concerning reactivation and regrowth can be obtained from the following studies and reports:

- Higgins, M.J., S.N. Murthy, (2006) "Report 03-CST-13T Examination of Reactivation and Regrowth of Fecal Coliforms in Centrifuge Dewatered, Anaerobically Digested Sludge", Water Environment Research Foundation, Alexandria VA

- Higgins, M.J., Y.-C. Chen, S. N. Murthy, D. Hendrickson, J. Farrel and P. Schafer "Reactivation and growth of non-culturable indicator bacteria in anaerobically digested biosolids after centrifuge dewatering" *Water Research*, *Volume 41, Issue 3*, *February 2007*, *Pages 665-673*

Note: The second and third phases of the WERF study on pathogen reactivation and regrowth should be published later this year (2007).

3.3 Contaminants of Emerging Concern

Another topic that is moving to the forefront of biosolids management is the field of contaminants of emerging concern (CECs). Typically, CECs are chemicals or agents which are introduced to the wastewater stream and are removed through the treatment process but are not necessarily degraded. CECs include pharmaceuticals, endocrine disruptors, and other anthropogenic compounds. As the name suggests, concerns about these chemicals are emerging, because there is not much information on the fate and transport of these compounds in the environment.

Significant research efforts are now underway to determine the fate and transport of these compounds in the environment. In particular, there is interest in the sorption and bioavailability of these chemicals once they have been land applied. On more than one occasion during the survey, survey participants noted concern over chemicals of unknown nature and toxicity being present in sewage sludge. One can expect that there will be increasing public resistance to accept biosolids or changes in regulatory conditions as more information about CECs becomes available.

As with pathogen reactivation/regrowth, CEC research and potential regulatory changes should be closely monitored to ensure that the County can be proactive rather than reactive to changes. The involvement of research institutions in the Pacific Northwest in investigating CECs in the region is likely to bring a greater level of local notoriety to the subject. Recently, the results of a study performed at Eastern Washington University were published[1]. This particular study was the subject of a front page article (September 18, 2006) in the Tacoma *News Tribune*. The impact of this research as not yet been felt by the industry, nor has there been a change in regulations by the USEPA or the Department of Ecology. Given the Washington's beneficial biosolids reuse directive, any potentially negative information could have a significant impact on biosolids disposal practices.

3.4 Certified Organic Composts and Fertilizers

Several organic composters were contacted during the course of the survey. Some survey participants showed an initial interest in the concept of utilizing a Class A biosolids product, but it is presently against the law to incorporate biosolids into products certified as organic. Because Washington regulations expressly prohibit biosolids from certified organic products, County collaboration with certified organic composting operations should be avoided. If a biosolids disposal program is started with a certified organic compost manufacturer, it should be clearly understood by the manufacturer that the product cannot be certified as organic or blended with other, certified organic material in any way and still maintain its certification as organic.

3.5 Additional Disposal Options

The Class A biosolids survey focused primarily on businesses as potential partners for Kitsap County to expand its biosolids disposal options. However, during conversations with the survey participants, other options were suggested that the County may want to explore.

The paper industry currently applies liquid biosolids to tree stands in forested areas. The intent of the application is to improve the growth of the trees to produce a greater harvest in the future. In an interview with the owner of Bud's Yard Products, he mentioned that Cascade Paper is currently spraying tree stands with biosolids in the Mount Rainier area and Scott Paper and Weyerhaeuser are also interested in this approach. Depending on the locations of harvest areas, supplying biosolids to paper producers may be a disposal option for the County. The City of Bremerton has also been reported to be spraying trees stands with biosolids. This may represent an option for Central Kitsap as well.

Another disposal option would be to work the Washington State Department of Transportation (WSDOT) to provide biosolids for soil amendments for roadside work. WSDOT supports a soil bioengineering

[1] Kinney, C.A., E.T. Furlong, S.D. Zaugg, M.R.. Burkhardt, S.L. Werner, J.D. Cahill and G.R. Jorgensen.(2006) "Survey of Organic Wastewater Contaminants in Biosolids Destined for Land Application" *Environmental Science and Technology, Vol. 40, No. 23, pg 7207-7215.*

program for such purposes and has reported a project using biosolids in the Chehalis area. Biosolids were used to amend the soil and improve its quality. The only potential drawback to this type of disposal option is that it is not sustainable, in the sense that it will consume a significant portion of the County's biosolids, unless the affected areas require constant, future biosolids additions.

Buffer zones may serve as another location for the land application of biosolids from the CKWWTP. Certain entities, such as airports, typically have buffer zones around the property to exclude and protect the general public. Typically, these areas are covered with vegetation that could benefit from the addition of biosolids. Given the limited access and the non-food crop nature of the vegetation, there could be less public resistance to application in these areas. Identifying potential disposal sites will require additional research and effort due to not only dealing with local governmental entities but also federal entities in certain circumstances.

Kitsap County Parks and Recreation Department may also be able to provide locations for the final disposal of some of the biosolids generated from the facility. If Kitsap County were to install new recreational fields, biosolids could be used as a fertilizer or soil conditioner. There are three primary challenges to using this as a disposal option–the limited quantities of material required, public perception, and public contact with the treated field. The fields represent a relatively small land area and thus small quantity of material would be required periodically to maintain the vegetation. The public perception of using biosolids on a field where children are going to be playing will likely present a challenge. A public relations effort will need to be undertaken to educate people about biosolids' use as a fertilizer where human contact will occur. Since there will be human contact on the fields, a Class B product will not suffice. Class B biosolids have significant time restrictions associated with human contact. It is likely that these fields would be multiseasonal and multisport facilities. Having them closed for a period following biosolids application will not likely be possible. Therefore a Class A product would be required.

The challenges to using CKWWTP biosolids in conjunction with the Parks and Recreation Department are not insurmountable. There are benefits that the County can realize. The first is that the use of biosolids is sustainable and environmentally friendly when compared to the production and use of inorganic fertilizers. Second, the County will save some revenue by not having to purchase fertilizer if it is provided at no cost by the CKWWTP.

4. CONCLUSIONS AND RECOMMENDATIONS

The decision that was reached in Workshop 1 was that there is no reason to switch from Class B biosolids production to Class A biosolids production based on the response of the regional end users and the County's current drivers. The Class A process selected by the County, sludge dryers, would require a significant capital investment which would not pay out under current conditions (See Sludge Dryer Memo). The dried pellet market is not developed enough to generate revenue which would offset some costs of sludge drying.

It is recommended that the County monitor the need for a Class A product in the region and explore other disposal alternatives to diversify their biosolids program. Class A composting may be one alternative the County should investigate, if topsoil manufacturers and composters are to be the primary end users. It may be possible to have the composters, rather than the County, bring the biosolids up to Class A standards.

Appendix A

Contact List of Class A Biosolids Survey Participants

Name	Address	Phone Number
Soil Manufacturing & Retail		
Bud's Yard Products	7501 McKinley Avenue, Tacoma, WA 98404	(253) 474-1556
GroCo, Inc	15 S. Spokane St.; Seattle, WA 98134.	(206) 622-5141
EMU Topsoil	22244 Port Gamble Rd NE, Poulsbo	(360)779-5614
A&L Topsoil	23997 Miller Bay Rd NE, Poulsbo	(360)598-4846
Vern's Organic Topsoil & Bark	22622 Bond Rd NE, Poulsbo	(360)779-2764
Asbury's Topsoil Inc	7051 NW Newberry Hill Rd, Silverdale	(360)692-8393
Dave Stewart's Topsoil 4 Less	2650 NW Mountain View Rd ,Silverdale	(360)509-2222
B&B Landscape & Design	8045 Old Military Rd, Bremerton	(360)692-2871
Peninsula Topsoil & Landscape	1113 NE Riddell Rd, Bremerton	(360)373-4500
Nurseries		
Valley Nursery Inc	20882 Bond Rd NE, Poulsbo	(360)779-3806
Central Valley Nursery	10981 Central Valley Rd NW, Poulsbo	(360)692-7254
Clear Creek Nursery	11688 Clear Creek Rd NW, Silverdale	(360)308-8210
Port Orchard Nursery Inc	1012 Mitchell Ave, Port Orchard	(360)876-3138
Country Nursery & Gardens	2075 Seabeck Hwy NE, Bremerton	(360)478-0288
Savage Plants & Landscape	6810 NE State Highway 104, Kingston	(360)297-8711
Other Landscape Products/Building Materials Suppliers		
Morrison Gravel	1004 SE Spencer Ave, Port Orchard	(360)876-4701
Fred Hill Materials Inc	8430 SW Barney White Rd,Port Orchard	(360)674-3131

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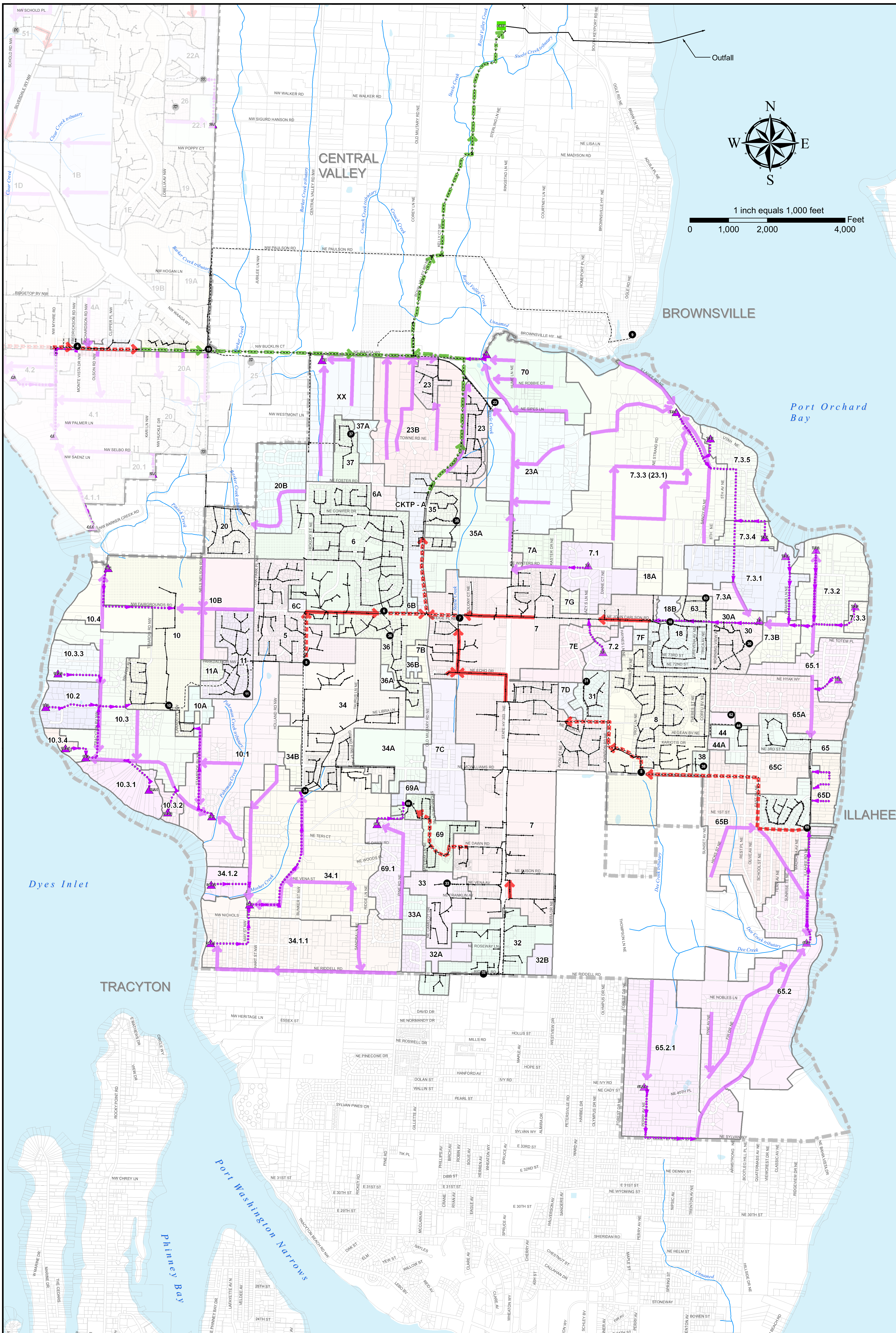

LEGEND

- Treatment Plant
- Lift Stations
- Existing Gravity Sewer
- Existing Force Main
- Replacement Gravity
- Replacement Force Main
- Existing Low Pressure Gravity
- Future Lift Station
- Future Force Main
- Future Gravity Collector
- Central Kitsap UGA
- Sewer Permits
- Water Bodies
- Rivers & Streams

EXAMPLE BASIN & LIFT STATION NUMBERING

6	Existing lift station basin
6A	Future gravity to lift station 6
6.1	Future lift station pumps to lift station 6
6.1.1	Future lift station pumps to lift station 6.1
G-1	Grinder pump basin

Data sources supplied by Kitsap County 2006 & 2007, and may not reflect actual or current conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

MAP DATE: JANUARY 2008

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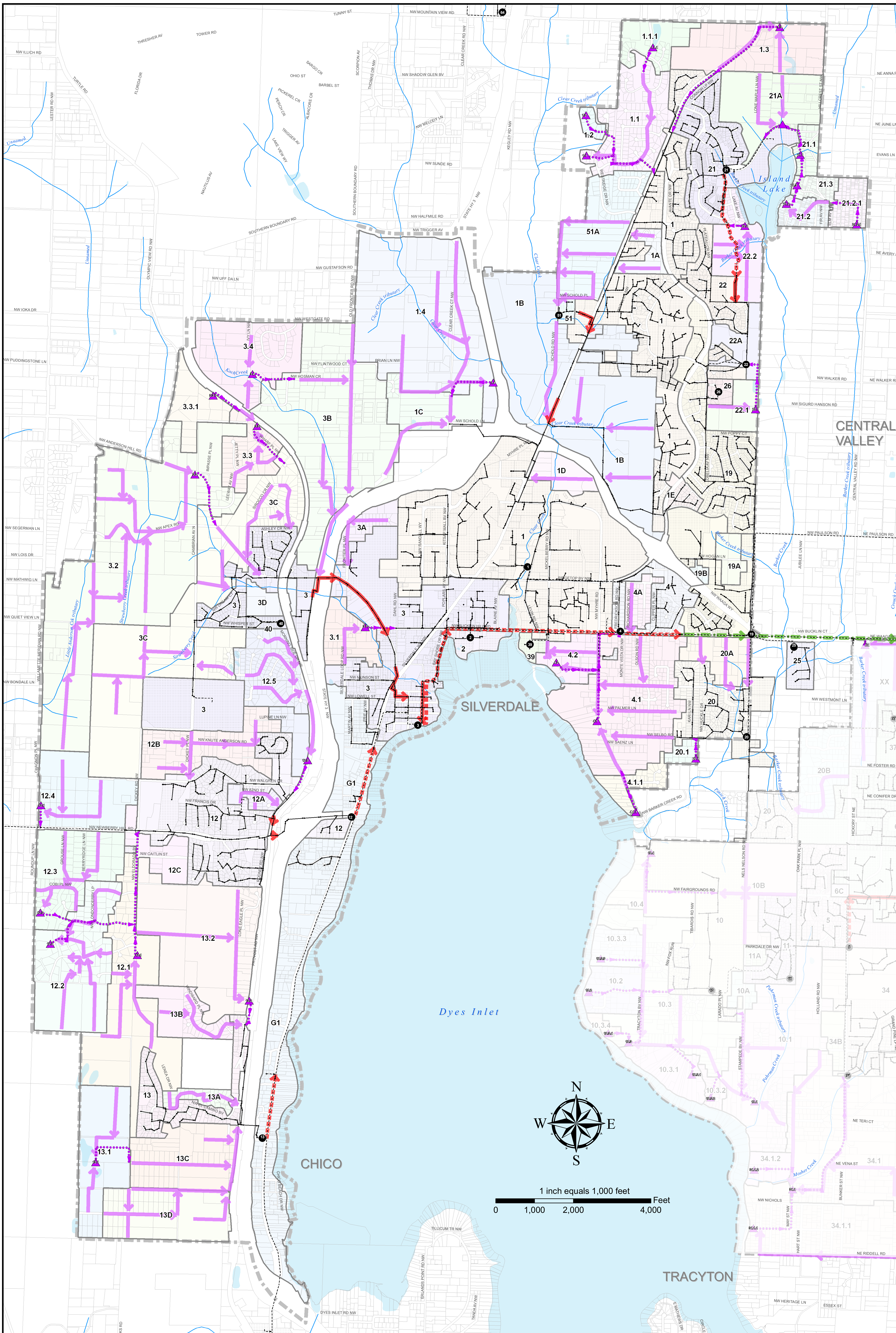
KITSAP COUNTY PUBLIC WORKS
CENTRAL KITSAP WASTEWATER
GMA COMPLIANCE PLAN

PLATE 1
CENTRAL KITSAP UGA
CONCEPTUAL PLAN FOR
WASTEWATER CONVEYANCE



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- Lift Stations
- Existing Gravity Sewer
- Existing Force Main
- Replacement Gravity
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MAP DATE: JANUARY 2008

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KITSAP COUNTY PUBLIC WORKS CENTRAL KITSAP WASTEWATER GMA COMPLIANCE PLAN

PLATE 2 SILVERDALE UGA CONCEPTUAL PLAN FOR WASTEWATER CONVEYANCE