CITY OF SEQUIM

CLALLAM COUNTY, WASHINGTON

GENERAL SEWER PLAN



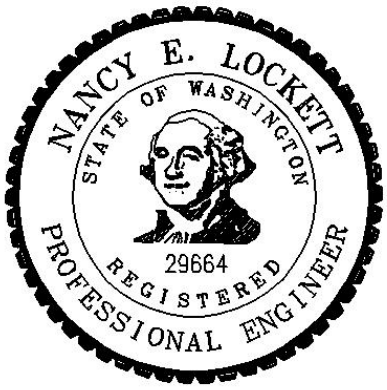
G&O #11594
DECEMBER 2013

Gray & Osborne, Inc.
CONSULTING ENGINEERS

CITY OF SEQUIM

CLALLAM COUNTY **WASHINGTON**

GENERAL SEWER PLAN





G&O #11594
DECEMBER 2013

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LIST OF ABBREVIATIONS

AAF	average annual flow
ac	acre
ACOE	Army Corps of Engineers
ADWF	average dry weather flow
AKART	all known, available, and reasonable technologies
avg.	average
BOD_5	5-day biochemical oxygen demand
BTU	British thermal units
$CaCO_3$	calcium carbonate
$CBOD_5$	5-day carbonaceous biochemical oxygen demand
CCWF	Centennial Clean Water Fund
cf	cubic feet
cfm	cubic feet per minute
CFR	Code of Federal Regulations
cfs	cubic feet per second
CFU	colony-forming units
CIP	Capital Improvement Projects
CM	construction management
CMU	concrete masonry units
COD	chemical oxygen demand
conc.	concentration
constr.	construction
CWA	Clean Water Act
cy	cubic yards
DMR	discharge monitoring reports
DNS	determination of non-significance
DO	dissolved oxygen
DOH	Department of Health
DT	dry tons
EA	each
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERU	equivalent residential unit
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Maps
F/M	food-to-microorganism ratio
fps	feet per second
ft^2	square feet
FTE	full-time equivalent
gal.	gallons
gfd	gallons per square foot per day
GMA	Growth Management Act

LIST OF ABBREVIATIONS

gpad	gallons per acre per day
gpcd	gallons per capita per day
gpd	gallons per day
gpd/ft^2	gallons per day per square foot
gph	gallons per hour
gpm	gallons per minute
gpm/ft^2	gallons per minute per square foot
HDPE	high density polyethylene
HMI	Human-Machine Interface
hp	horsepower
HPA	Hydraulic Project Approval
HRT	hydraulic residence time
HVAC	heating, ventilation, and air conditioning
I/I	infiltration and inflow
in.	inches
kVA	kilovolt-amps
kW	kilowatt
kWh	kilowatt hour
lb	pounds
lb/cap/d	pounds per capita per day
lb/d	pounds per day
$lb/ft^2/d$	pounds per square foot per day
lf	linear foot
LS	lump sum
max.	maximum
MBR	membrane bioreactor
MDF	maximum day flow
mg	milligrams
MG	million gallons
mgd	million gallons per day
mg/L	milligrams per liter
misc.	miscellaneous
mJ/cm^2	millijoules per square centimeter (UV dose measurement)
ml	milliliters
MLSS	mixed liquor suspended solids
mm	millimeter
MM	maximum month
MMF	maximum month flow
MSL	mean sea level
N/A	not applicable
NEPA	National Environmental Policy Act
NH_3	ammonia-nitrogen
NMFS	National Marine Fisheries Service
NO_3-N	nitrate - nitrogen
NPDES	National Pollutant Discharge Elimination System

LIST OF ABBREVIATIONS

NR	not reported
NRCS	National Resource Conservation Service
NTU	nephelometric turbidity units
NWI	National Wetlands Inventory
OD	outside diameter
OFM	Office of Financial Management
O&M	operation and maintenance
PDF	peak day flow
PFRP	process to further reduce pathogens
pH	negative log hydronium ion concentration
PHF	peak hour flow
PHS	priority habitat and species
PLC	Programmable Logic Controller
PMAC	plan to maintain adequate capacity
P.S.	pump station
psi	pounds per square inch
PSRP	process to significantly reduce pathogens
PWTF	Public Works Trust Fund
Q	flow rate
RAS	return activated sludge
RCW	Revised Code of Washington
ROW	right-of-way
rpm	revolutions per minute
SBR	sequencing batch reactor
scfm	standard cubic feet per minute
SEPA	State Environmental Policy Act
SERP	State Environment Review Process
sf	square feet
S.F.	safety factor
SR	State Route
SRF	State Revolving Fund
SRT	solids retention time
SWD	side water depth
TBD	to be determined
TDH	total dynamic head
TKN	total Kjehldahl nitrogen
TMDL	total maximum daily load
TSS	total suspended solids
UGA	Urban Growth Area
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Survey
UV	ultraviolet radiation
V	volts
VFD	variable frequency drive
VOC	volatile organic compounds

LIST OF ABBREVIATIONS

VS	volatile solids
VSS	volatile suspended solids
WAC	Washington Administrative Code
WAS	waste activated sludge
WDFW	Washington State Department of Fish and Wildlife
WT	wet tons
WWTP	wastewater treatment plant
µm	micrometer (micron)

Executive Summary



INTRODUCTION

The City of Sequim 2012 General Sewer Plan (Plan) provides a long-term planning strategy for the City's sewer utility for the 6- and 20-year planning periods. It has been prepared consistent with the provisions of the Revised Code of Washington (RCW), Section 90.48, *Water Pollution Control*, Washington Administrative Code (WAC) Section 173-240-050, *General Sewer Plan* and WAC 173-240-060, *Engineering Report*.

The City's collection system includes over seventy-three miles of sewer line, four City owned and operated pump stations (Port Williams, Doe Run, Jenny's Meadow, and Cedar Ridge), and a pump station managed by a developer at Sequim Bay Lodge. The City also manages approximately 7,320 feet of outfall pipe from the WRF to a diffuser located approximately 1,900 feet into the Strait of Juan de Fuca at a depth of 53 feet. The City owns and operates a Water Reclamation Facility (WRF) that produces Class A reclaimed water and Class A biosolids and water reuse facilities including approximately 4 miles of reclaimed water distribution system piping and a 29-acre Reuse Demonstration Site north of Carrie Blake Park.

The principal issues discussed in the Plan include:

- Improvements to collection and treatment capacity to serve projected growth within the City of Sequim Urban Growth Area (UGA);
- The potential for the City to become a regional wastewater treatment service provider; and
- A capital improvement program to meet projected growth and sewer system needs.

SEWER SYSTEM FLOW AND LOADING FORECASTING – CITY OF SEQUIM

Population within the City of Sequim UGA and areas currently served outside of the UGA is projected to grow at 2.0 percent annually for the next 20 years. Sewered population includes population within the current City limits, annexed areas of the UGA and Bell Hill/Bell Gates area. The projected sewered population within the UGA is projected to be 14,119 persons in the year 2032. Buildout population of the UGA is projected to be 29,900 persons. Table E-1 illustrates the population, system flow and loading projections used in the Plan.

Table E-1 – Sequim Sewer Service Area Flow and Loading Projections

Year	Total Population	Maximum Month Flow (mgd)	Maximum Month BOD5 Load (lb/day)	Maximum Month TSS Load (lb/day)
2012	7,082	0.883	2,017	1,864
2013	7,346	0.903	2,083	1,926
2014	7,617	0.924	2,152	1,989
2015	7,895	0.945	2,222	2,054
2016	8,181	0.967	2,295	2,121
2017	8,476	0.989	2,369	2,189
2018	8,778	1.011	2,445	2,260
2019	9,089	1.036	2,523	2,332
2020	9,408	1.061	2,603	2,406
2021	9,737	1.087	2,686	2,482
2022	10,075	1.113	2,770	2,560

Table E-1 – Sequim Sewer Service Area Flow and Loading Projections – (continued)

Year	Total Population	Maximum Month Flow (mgd)	Maximum Month BOD5 Load (lb/day)	Maximum Month TSS Load (lb/day)
2023	10,422	1.141	2,857	2,641
2024	10,778	1.170	2,946	2,723
2025	11,145	1.219	3,107	2,872
2026	11,522	1.250	3,202	2,959
2027	11,909	1.281	3,299	3,049
2028	12,307	1.314	3,399	3,142
2029	12,716	1.348	3,502	3,237
2030	13,136	1.382	3,607	3,334
2031	13,721	1.418	3,715	3,434
2032	14,119	1.455	3,826	3,536
Buildout	29,900	3.038	7,661	7,080

WATER RECLAMATION FACILITY ANALYSIS

The maximum month rated capacity of the Water Reclamation Facility is 1.67 mgd, 4,036 lb/day BOD_5 and 3,855 lb/day TSS. The projected 20-year wastewater flow and loading do not exceed the current capacity of the WRF; however, loading will exceed 85 percent of capacity in approximately 2029. 85 percent of capacity is an Ecology trigger for municipalities to begin planning for treatment capacity upgrades.

The majority of the recommended improvements to fulfill capacity needs through 2032 are improvements to the biosolids treatment and handling system. Recommended improvements include renovation of the aerobic digester aeration system, development of a Class A Biosolids Distribution Center and expansion of the aerobic digesters.

COLLECTION SYSTEM ANALYSIS

A hydraulic model of the City's collection system was developed to assess the ability of the existing system to transport current flows, to make recommendation for future improvements to

convey projected future flows, and to determine the effects of future development and expansion of the sewer service area on the collection system. Recommended sewer system improvements were developed to address capacity deficiencies through the 2032 planning horizon and staff identified rehabilitation improvements.

REGIONAL PROVIDER STRATEGY

The Plan discusses the potential for the City to become a regional wastewater treatment provider for areas outside of the current service area and UGA. The plan evaluates the conveyance and treatment improvements that would be required to accept wastewater flows from the SunLand, Blyn, and Carlsborg areas. These areas collectively are designated as the Greater Dungeness Regional areas. Maximum month projected flows and loadings for SunLand, Blyn and Carlsborg are shown in Table E-2.

Table E-2 – Projected Maximum Month Flows and Loadings for Sequim and Regions Outside Current Sequim Service Area/UGA

Region/Parameter	2012	2018	2032	Buildout
Sequim (gpd)	856,000	1,011,000	1,455,000	3,038,000
Carlsborg (gpd)	30,000	50,000	98,000	675,000
SunLand (gpd)	140,000	145,000	157,000	157,000
Blyn (gpd)	48,000	73,000	121,000	193,000
Combined Max Month Flow (gpd)	1,074,000	1,279,000	1,830,000	4,063,000
Combined Max Month BOD_5 (lb/d)	2,700	3,253	4,865	11,329
Combined Maximum Month TSS (lb/d)	2,629	3,137	4,403	10,963

REGIONAL WATER RECLAMATION FACILITY ANALYSIS

Phase 2 liquid and solid stream improvements would be required to be in place at the WRF by the year 2025 if wastewater from Sequim and the Greater Dungeness Regional area is treated at the WRF. The need for improvements is delayed until approximately the year 2031 if only wastewater from Sequim and one of the potential regional participants is treated at the WRF. The Phase 2 liquid and solid stream improvements include converting the equalization basin into an aeration basin and construction of a new equalization basin, construction of a new influent pump station, construction of a new clarifier, increased filtration, flocculation and UV disinfection capacity, and new rotary screen thickener and second parallel FKC biosolids treatment system in addition to the aerobic digester improvements discussed above.

REGIONAL COLLECTION SYSTEM ANALYSIS

Collection system capacity improvements would be required to accommodate wastewater flow from any of the potential regional participants. Improvements required to accommodate flow from SunLand include pump station and force main upgrades at the Port Williams pump station. Gravity collection system improvements would be required to accommodate wastewater flows from either Blyn or Carlsborg.

WATER REUSE FACILITIES

The City's current water reuse options include irrigation at the Reuse Demonstration Site, non-potable waters uses at the WRF and City Shop Facility and several commercial irrigation customers. Future additional uses of reclaimed water that will help the City achieve its goal of 100 percent reuse include:

- Additional expansion of existing commercial use;
- Additional landscape irrigation;
- Additional City non-potable water use;
- Groundwater recharge;
- Leaky pipes or additional stream flow/Dungeness River augmentation.

CAPITAL IMPROVEMENT PROGRAM

A summary of the City's 6-year CIP is shown in Table E-3 and illustrated in Figure E-1.

Table E-3 – 6-Year Capital Improvement Plan

Project No.• Project• Year• Cost• • W-1• Auxiliary Generator

Project No.	Project	Year	Cost
W-1	Auxiliary Generator Loadbanks	2014	$55,000
W-2	WRF Headworks Modifications #1	2014	$270,000
W-3	Equalization Basin Aeration System Improvements	2014	$54,000
W-4	Grit Removal System Replacement	2014	$279,000

Table E-3 – 6-Year Capital Improvement Plan – (continued)

Project No.	Project	Year	Cost
W-5	Aerobic Digester Aeration System Improvements[(1)]	2013 2014	$300,000 $295,000
W-6	Purchase Land Near WRF	2014 2015	$29,500 $165,500
W-7	Class A Biosolids Handling and Distribution Center	2016 2017 2019	$75,000 $78,000 $1,167,000
W-8	Aerobic Digester Capacity Upgrades	2016 2019	$220,000 $1,730,000
RW-1	WRF Recirculation Booster Pump	2014	$25,000
CS-1	Cedar Street Sewer Improvements	2014 2015	$142,000 $1,039,000
CS-2	Etta Street Sewer Improvements	2014	$156,000
CS-23	Doe Run Lift Station	2014 2015	$64,000 $510,000
CS-6	Sequim Bay Lodge and State Park Pressure Main Improvement	2014	$90,000
CS-7	WRF Influent Trunk Line Pipeline Repair/Replacement	2015 2016	$154,000 $1,224,000
CS-8	Fir Street Sewer Improvement	2014 2015 2016 2017	$64,000 $64,000 $605,000 $300,000
CS-9	Sunnyside Street Sewer Improvement	2014 2015	$81,000 $592,000
CS-14	East Fir Sewer Replacement	2017 2018 2019	$201,000 $970,000 $500,000
OM-1	Vactor Truck Replacement	2013	$450,000
OM-2	Collection System Survey GIS Mapping	2014	$40,000
OM-3	Collection System I/I Reduction	2013 2014 2015 2016 2017 2018	$38,000 $38,000 $38,000 $38,000 $38,000 $38,000
MI-1	Fixed Base Automatic Meter Reading System	2013 2014	$115,000 $115,000

PORT WILLIAMS LIFT STATION

JEANNIE'S MEADOW LIFT STATION

CITY OF SEQUIM WRF

CEDAR RIDGE LIFT STATION

NEW LIFT STATION

DOE RUN LIFT STATION

CS-1

CS-2

CS-3

CS-4

CS-6

CS-7

CS-8

CS-9

RW-1

RW-5

W-1

W-2

W-3

W-4

W-5

W-6

W-7

W-8

W-10

N

0 1,000 2,000 4,000 Feet

LEGEND:

- LIFT STATION

SEWER PIPE DIAMETER:

- 6" OR LESS
- 8"
- 10"
- 12"
- 15"
- 18"
- CITY FUNDED CAPITAL IMPROVEMENT PROJECTS
- SEWER SERVICE AREA
- URBAN GROWTH AREA
- CITY LIMITS
- PARCELS

CITY OF SEQUIM

2012 GENERAL SEWER PLAN
FIGURE E-1
CITY FUNDED
CAPITAL IMPROVEMENT PROJECTS

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Table E-3 – 6-Year Capital Improvement Plan – (continued)

Project No.	Project	Year	Cost
MI-2	Major Repair Oversizing	2013	$200,000
		2014	$200,000
		2015	$200,000
		2016	$200,000
		2017	$200,000
		2018	$200,000
		2019	$200,000
6-Year Capital Improvement Total			**$13,860,000**

(1) Approved by Council May 2013.
(2) CCI = 5213 per ENR November 2012.
(3) CIP totals only include portion City will fund. Does not include developer projects.

Chapter 1
SEWER SYSTEM DESCRIPTION



INTRODUCTION

This General Sewer Plan for the City of Sequim addresses the City's comprehensive planning needs for the collection, transmission, and treatment of wastewater, and the production of reclaimed water, for the 6- and 20-year planning periods. This Plan was prepared in accordance with the provisions of the Revised Code of Washington (RCW), Section 90.48, *Water Pollution Control*, Washington Administrative Code (WAC) Section 173-240-050, *General Sewer Plan*, and WAC 173-240-060, *Engineering Report.* Development of the Plan has been coordinated with the City's Comprehensive Plan, Clallam County planning efforts, and with the 2013 City of Sequim Water System Plan.

The Plan is intended to be feasible in terms of engineering, economic, regulatory, and political frameworks. Included in the Plan are conceptual designs and cost estimates for recommended major improvements to facilities as well as proposed construction years and a financing plan. A State Environmental Policy Act (SEPA) checklist is provided in Appendix A. The projects described in the Plan are consistent with State regulations relating

to the prevention and control of discharge of pollutants into State waters, anti-degradation of existing and future beneficial uses of ground waters, anti-degradation of surface waters, and water reuse.

SYSTEM OWNERSHIP AND MANAGEMENT

The City of Sequim, located in Clallam County in northwest Washington (Figure 1-1), owns and operates a municipal sewer system which serves the majority of the incorporated City, the Bell Hill community in South Sequim, and other smaller surrounding areas.

The City is governed by a City Manager and a seven member City Council. The sewer system is managed by the Sequim Public Works Department under the direction of the Public Works Director. The City's current contact information is:

City of Sequim
226 North Sequim Avenue
Sequim, Washington 98382

Phone: (360) 683-4908
Fax: (360) 681-3448

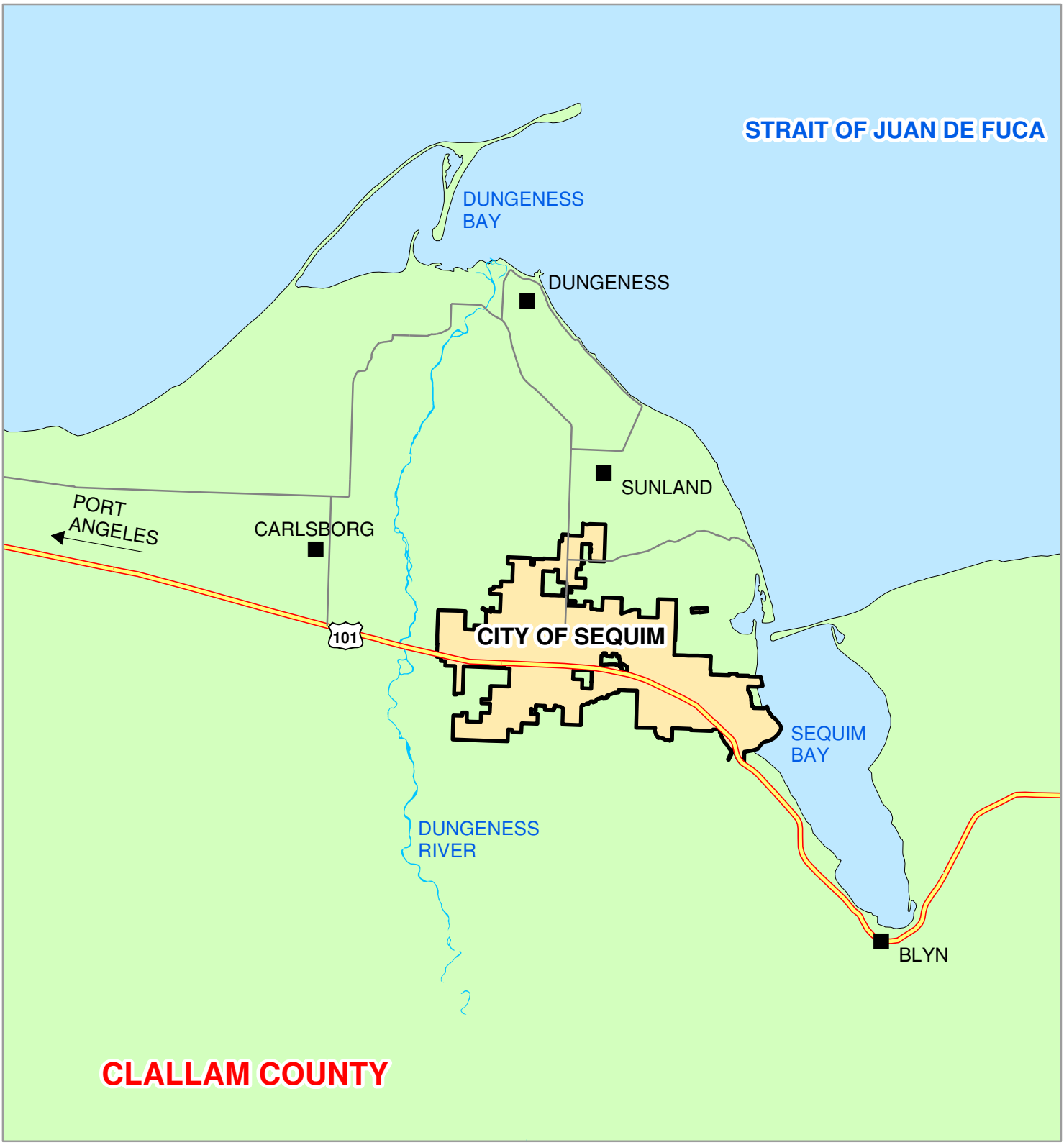
Figure 1-2 shows the City limits, the boundary for the existing Urban Growth Area (UGA), and the existing sewer service area.

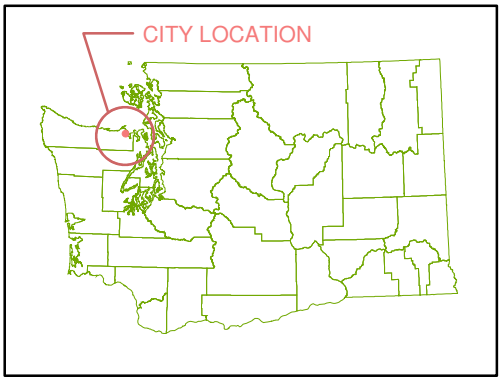
SYSTEM BACKGROUND

SEWER SYSTEM HISTORY

Construction of the City's wastewater collection system, including the main trunk line to the wastewater treatment facility, began in the 1930s. The majority of the collection system was installed from the 1950s to the mid-1970s and consists of concrete pipe, asbestos cement pipe, and ductile iron pipe. Since the 1970s, additional sewers have been constructed using primarily polyvinyl chloride (PVC) pipe.

A wastewater treatment facility was constructed at the current site of the City's Water Reclamation Facility (WRF) in 1966, and further expanded in 1983. In September 1994, the City of Sequim signed a Settlement Agreement with the Departments of Ecology





N

0 2,500 5,000 10,000 Feet

CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 1-1
LOCATION MAP

Gray & Osborne, Inc.

PORT WILLIAMS LIFT STATION

JEANNIE'S MEADOW LIFT STATION

CITY OF SEQUIM WRF

CEDAR RIDGE LIFT STATION

DOE RUN LIFT STATION

STRAIT OF JUAN DE FUCA

SEQUIM BAY

N

0 1,000 2,000 Feet

LEGEND:

- LIFT STATION
- URBAN GROWTH AREA
- SEWER SERVICE AREA
- CITY LIMITS

CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 1-2
CITY OF SEQUIM AERIAL MAP

Gray & Osborne, Inc.

M:\SEQUIM\11594 - 2012 General Sewer Plan\GIS\FIGURE 1-2 AERIAL VIEW.mxd

and Fish and Wildlife, ending several years of contention over extension of the City's wastewater effluent outfall and the closure of valuable shellfish beds decertified by the outfall. As part of that agreement, the City agreed to upgrade its secondary treatment facility to one that is capable of producing Class A reclaimed water. The City also agreed to investigate alternatives for reuse of the reclaimed water.

Construction of the treatment facility upgrade was initiated in the spring of 1997 and was completed in April, 1998. This upgrade included the addition of a coagulation/filtration process as well as conversion of the disinfection system to ultraviolet light. As a result of this and subsequent upgrades, the facility now produces Class A reclaimed water. In 2010, the biological treatment process was converted to conventional activated sludge, and additional facilities for clarification, filtration, and ultra-violet disinfection were added.

In April 1997, the Washington State Legislature provided a special funding appropriation for five water reuse "demonstration" projects. The City of Sequim received $3.4 million of this appropriation to implement its water reuse program. The legislation required the City to develop a program that accomplished several goals:

1. Complete construction of the WRF;
2. Make progress towards 100 percent use of reclaimed water;
3. Improve stream flows in the Dungeness River; and
4. Provide a sustainable supply for irrigation purposes.

As part of the water reuse program, a Reuse Demonstration Site was developed on a 29-acre parcel of land located directly north of Carrie Blake Park in eastern Sequim. Reclaimed water is used at the demonstration site for four types of landscape irrigation, for stream flow augmentation to Bell Creek or the irrigation diversion, and for toilet flushing in the Interpretive Center. The irrigation systems demonstrate the effect of reclaimed water on a variety of irrigation equipment and plant types. Reclaimed water from the WRF is provided to two yard hydrants at the Sequim WRF site, to the City Shops facility, and to a landscape irrigation system along Sequim Avenue. The City has installed reclaimed water piping to a fire hydrant at the City Shops for truck filling or local use. In

addition, reclaimed water can be stored in the City Shop detention pond.

Beginning in 2010, the WRF received several important upgrades that increased capacity to treat wastewater and handle the associated solids loading. These improvements included conversion of the existing oxidation ditch into an equalization basin, conversion of the existing equalization basin into a staged activated sludge aeration basin, installation of new aeration blowers, construction of a new secondary clarifier, as well as modifications to the existing secondary clarifiers and ultraviolet disinfection system.

GEOGRAPHY

The Sequim prairie is temperate, with an average annual precipitation over the last five years of approximately 16 inches. The prairie, which is in the shadow of the Olympic Mountain Range, gently slopes toward the Strait of Juan de Fuca.

The City is located within the Dungeness River, Cassalery Creek, Gierin Creek, Bell Creek and Johnson Creek drainage basins. The Dungeness River is located west of the City and has a basin covering approximately 197 square miles. A series of glacial advances and retreats, interrupted by periods of non-glacial deposition, deposited various hydrogeologic units in the greater Sequim area. Groundwater flow within the area's aquifers generally occurs from south to north-northeast, where it discharges into Sequim Bay or the Strait of Juan de Fuca. Virtually the entire Sequim area is designated as a High Aquifer Recharge Area, containing highly permeable Carlsborg-Puget-Dungeness and Hoypus-Sequim-Agnew soils groups.

TOPOGRAPHY

Figure 1-3 shows the topography of the Sequim area. The area to the north and east of Sequim is relatively flat. To the west, the surface is undulating and to the south elevations rise sharply into the Olympic Mountain Range. Topography within the City ranges from approximately 0 to approximately 700 feet above mean sea level (MSL). Bell Hill, which is out of the City and UGA limits but is served by City sewers has areas exceeding 600 feet in elevation.

N

0 1,000 2,000 4,000 Feet

LEGEND:

- URBAN GROWTH AREA
- CITY LIMITS
- SEWER SERVICE AREA
- 5 FOOT CONTOURS - LIDAR
- PARCELS

SOURCE: PUGET SOUND LIDAR CONSORTIUM (PSLC)

CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 1-3
TOPOGRAPHY MAP

Gray & Osborne, Inc.

M:\SEQUIM\11594 - 2012 General Sewer Plan\GIS\FIGURE 1-3 TOPO.mxd

From the WRF (elevation 40 to 50 feet) to the highest point in the westernmost edge of the UGA (elevation approximately 280 feet near the intersection of Washington Street and Highway 101) the elevation gain is approximately 240 feet. From the WRF to the highest point on the southern boundary of the UGA, the elevation gain is approximately 650 feet. At the northernmost edge of the UGA, the elevation gain from the WRF is approximately 80 feet.

Soil Conditions

The majority of the City of Sequim service area is made up of gravely sandy loams of the Sequim or Carlsborg series. The Agnew soils are found in areas immediately north of the WRF in the Grenan Hill area. Figure 1-4 shows the location of the various soil types for the region.

Climate

Climate plays a significant role in the reuse of reclaimed water. Climatic factors which include temperature, precipitation, wind speed and relative humidity, control evaporation and evapotranspiration rates. Evaporation was a major factor in the design of open water systems that are used to convey, store and, if necessary, cool the reclaimed water. Evapotranspiration rates are a major factor in the design of irrigation systems and, specifically, the determination of how much land a given volume of reclaimed water can irrigate.

Temperature and Precipitation

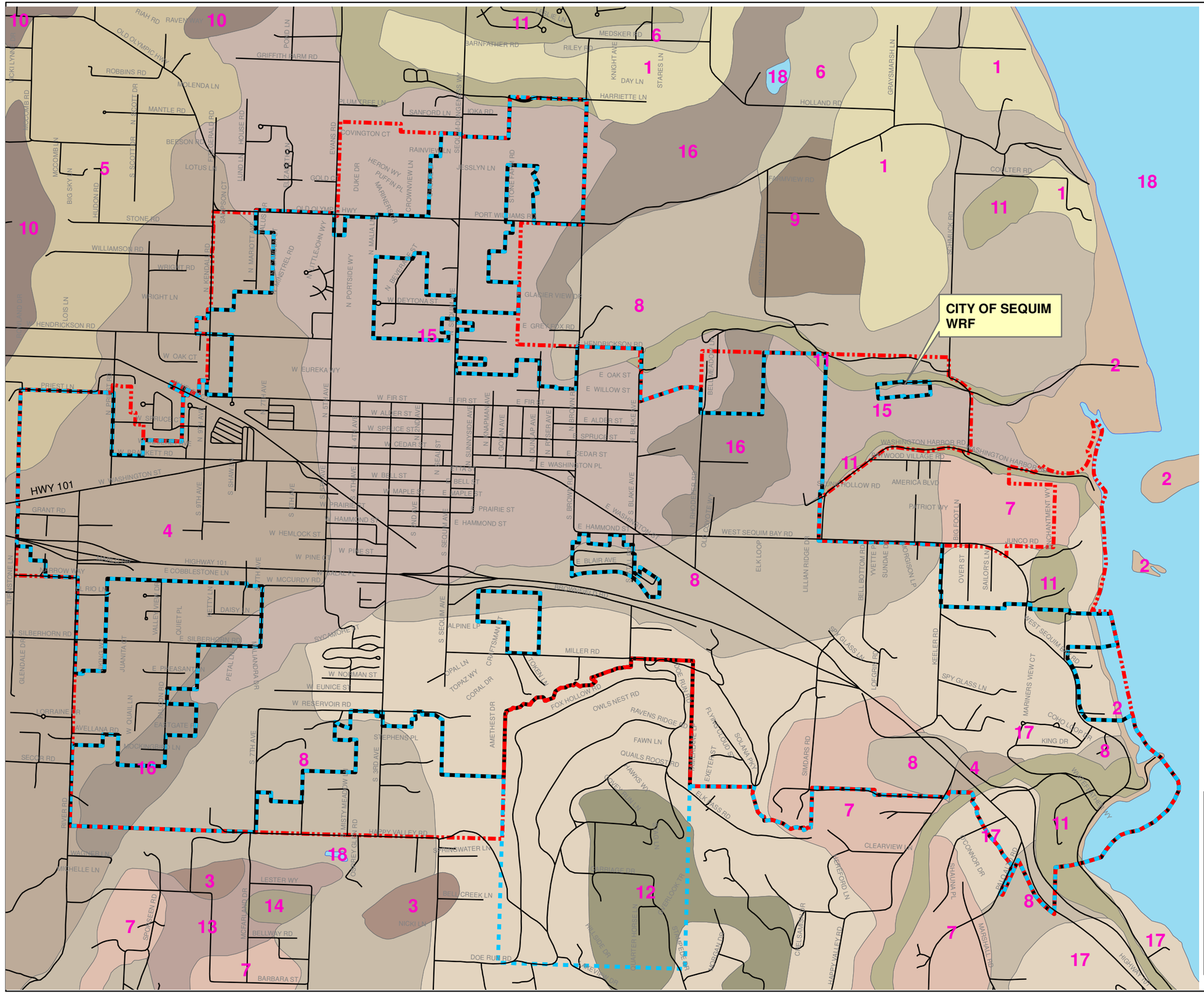
The City collects weather data at the WRF that are used by the National Oceanic and Atmospheric Administration (NOAA) for its climatological records. Data collected at the WRF since 1999 are summarized in Table 1-1, and shown graphically in Figure 1-5.

The City experiences relatively mild weather due to its proximity to the Pacific Ocean and its location in the rain shadow of the Olympic Mountains. Because of these moderate conditions the Sequim area does not experience significant temperature extremes or high precipitation. The latter factor results in a greater dependence on irrigation water to supplement natural precipitation. However, due to the moderate temperatures, overall irrigation requirements are substantially less than other regions of the state with low rainfall.

Table 1-1 Monthly Average and Annual Total Precipitation Data (1)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1999	4.76	1.99	1.97	0.45	0.76	1.20	1.11	1.46	0.00	1.78	2.77	1.90	20.15
2000	1.52	1.07	0.93	0.60	1.65	0.41	0.29	0.22	1.10	1.39	1.73	1.01	11.92
2001	1.40	0.71	0.70	1.24	0.20	0.91	0.06	0.45	0.25	2.30	2.03	2.66	12.91
2002	4.40	1.04	2.08	0.97	1.13	0.49	0.20	0.32	0.44	0.70	0.82	1.52	14.11
2003	2.55	0.32	2.03	1.85	0.57	0.11	0.18	0.12	0.73	2.47	2.72	1.11	14.76
2004	1.56	0.41	1.11	0.28	1.52	0.42	0.22	1.98	1.16	1.20	2.09	1.85	13.80
2005	1.82	0.61	1.12	1.36	1.09	1.29	0.07	0.76	0.59	0.96	1.75	2.89	14.31
2006	2.14	2.80	1.30	1.25	1.90	0.77	0.28	0.06	1.04	0.62	2.80	3.22	18.18
2007	2.41	0.85	1.19	0.93	0.47	0.86	0.80	0.34	0.81	1.35	1.34	2.38	13.73
2008	1.59	0.85	1.22	1.49	0.63	1.31	0.44	0.81	0.33	0.84	3.46	2.32	15.29
2009	2.51	1.75	2.00	0.81	1.63	0.19	0.30	0.30	0.95	3.43	3.84	1.54	19.25
2010	1.54	0.76	1.82	1.62	2.97	0.94	0.06	0.39	1.56	1.12	2.02	2.34	17.14
2011	3.15	2.16	2.48	1.63	3.17	0.77	0.49	0.11	0.19	0.84	3.52	1.26	19.77
AVERAGE	**2.41**	**1.18**	**1.53**	**1.11**	**1.36**	**0.74**	**0.35**	**0.56**	**0.70**	**1.46**	**2.38**	**2.00**	**15.79**

(1) Compiled from *Climatological Data Annual Summaries*, U.S. Department of Commerce.
(2) Data collected at Sequim WRF.



N

0 1,000 2,000 4,000 Feet

LEGEND:

- ROADWAYS
- SEWER SERVICE AREA
- URBAN GROWTH AREA
- CITY LIMITS

SOILS

1. AGNEW
2. BEACHES
3. BELLINGHAM
4. CARLSBORG
5. CARLSBORG-DUNGENESS-COMPLEX
6. CASSOLARY
7. CATLA
8. CLALLAM
9. DICK
10. DUNGENESS
11. HOYPUS
12. LOUELLA
13. MCKENNA
14. MUKILTEO
15. SEQUIM
16. SEQUIM-MCKENNA-MUKILTEO-COMPLEX
17. YEARY
18. WATER

DATA SOURCE:

SOIL SURVEY STAFF, NATURAL RESORCES CONSERVATION SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE. SOIL SURVEY GEOGRAPHIC (SSURGO) DATABASE FOR CLALLAM COUNTY, WASHINGTON. AVAILABLE ONLINE AT http://soildatamart.nrcs.usda.gov ACCESSED 04/05/12.

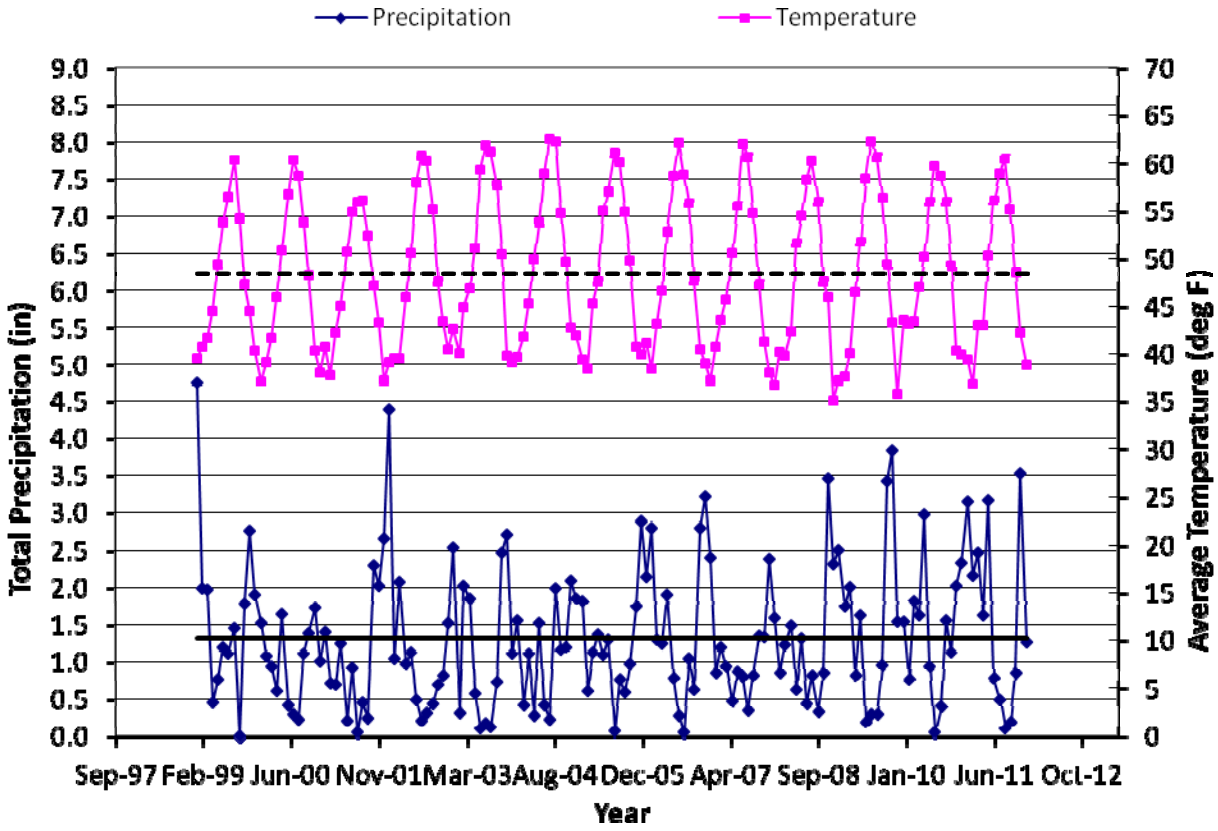
CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 1-4
SOIL CLASSIFICATION MAP

Gray & Osborne, Inc.

M:\SEQUIM\11594 - 2012 General Sewer Plan\GIS\FIGURE 1-4 SOILS.mxd

Figure 1-5 Monthly Average Precipitation and Temperature Data



GROUNDWATER

General information about groundwater, based primarily on information provided by U.S. Geological Survey (USGS, Drost, 1983), was presented in the *2003 Comprehensive Wastewater Facilities Plan*. A more recent study, the *City of Sequim 2008 Hydrologic Monitoring Report*, was completed in December of 2009 by Pacific Groundwater Group and highlights hydrologic facets of the Sequim region and provides a set of recommendations for the City with regards to groundwater usage and resource protection. Highlights from this report regarding groundwater, which is largely a summarization of the USGS hydrologic study completed in 1999, are:

- Groundwater recharge stems from precipitation, leakage from unlined irrigation ditches, unconsumed irrigation water, seepage from streams,

septic tank effluent seepage, and underground subflow from higher elevations.

- Groundwater levels in all three aquifers (upper, middle, and lower) have declined in recent decades.

- Data monitoring for groundwater levels is limited, and additional data points within regions of the City's water system should be collected.

More specific information regarding the three groundwater aquifers is discussed below.

Aquifer Locations and Characteristics

Three major aquifers occur within the Sequim area: (1) the water table (upper) aquifer, (2) upper artesian (middle) aquifer and (3) a lower artesian aquifer. Perched seasonal aquifers are also known to occur due to local irrigation practices.

Upper Aquifer

The thickness of the upper aquifer ranges from 50 to 200 feet. The aquifer is generally unconfined but does exhibit localized confinement beneath fine-grained sediments. The general flow direction of this aquifer is towards the north and northeast (PGG, 2009).

Middle Aquifer

The middle aquifer ranges from 10- to 70-feet thick and contains pre-Vashon glacial outwash deposits of sand and gravel and coarse-grained interglacial deposits. This confined aquifer contains fewer wells than the upper aquifer and flow generally fans out radially beneath the Sequim-Dungeness Peninsula with northeasterly flow in the vicinity of the City.

The upper artesian aquifer is overlain by an upper confining bed, composed of quaternary silts and clays, which varies in thickness from 25 feet in the southeast to 150 feet below Sequim Bay. The upper artesian aquifer is not continuous throughout the entire area. It varies in thickness from "several feet" to more than 120 feet. Little is understood about its flow characteristics. It is believed that, like the water table aquifer, the general direction of flow is toward the northeast, but flows are not affected by area surface waters as much as they are with the water table aquifer.

Lower Aquifer

The lower artesian aquifer is overlain by a lower confining bed that is discontinuous, but ranges in depth from 10 to 180 feet. Little is known about the lower artesian aquifer, however, lateral groundwater movement is thought to be similar to the upper aquifers and it has been postulated that upward movement through the lower confining bed occurs. Groundwater in the lower aquifer is confined.

Connection Between Surface Water and Groundwater

Studies by the USGS have determined a connection exists between surface water and groundwater in the Sequim area (PGG, 2009). Groundwater recharge to the upper aquifer was estimated to be from precipitation and irrigation seepage. Recharge to the upper aquifer was not specifically quantified in this Plan, but the average aquifer recharge for the Primary Study Area listed in Figure 1-1 of the *2008 Hydrologic Report* was 5.4 inches per year, while recharge due to irrigation sources (unused water combined with seepage from leaky ditches) was estimated at an annual average of 23.7 cubic feet per second. This equates to a total estimated recharge of 18,500 acre-feet per year (26.2 cfs).

Pacific Groundwater Group also employed the Deep Percolation Model originally developed by the USGS in 1983 to estimate long term trends in precipitation recharge. The model predicts the 25-year long term average precipitation recharge to be equal to 12 inches per year, which is significantly higher than the current estimation of 5.4 inches per year for the study area. Groundwater recharge due directly from precipitation was shown to be less than either irrigation system or river leakage.

SENSITIVE AREAS

Sensitive areas within the region include those classified as slide hazard areas, erosion hazard areas, seismic hazard areas, flood hazard areas, landslide areas, wetlands, water bodies, and fish and wildlife habitat. The site sensitive areas within the sewer service area are shown in Figure 1-6, and are described further below.

Erosion Hazard Areas

Erosion hazard areas are especially subject to erosion, if disturbed, and may not be well suited for high-density developments or intensive land uses. The hills to the north and south of the WRF, as well as sections of the Bell Hill/Solana regions are erosion hazard areas.

Seismic Hazard Areas

Seismic hazard areas are those with low density soils that are more likely to experience greater damage due to seismic-induced subsidence, liquefaction, or landslides. Seismic hazard areas are regulated mainly with respect to public safety. Although the collection system and facilities at the WRF are designed to withstand seismic activity, there could be damage to sewers, lift stations, and WRF facilities in areas that experience very severe earth movement.

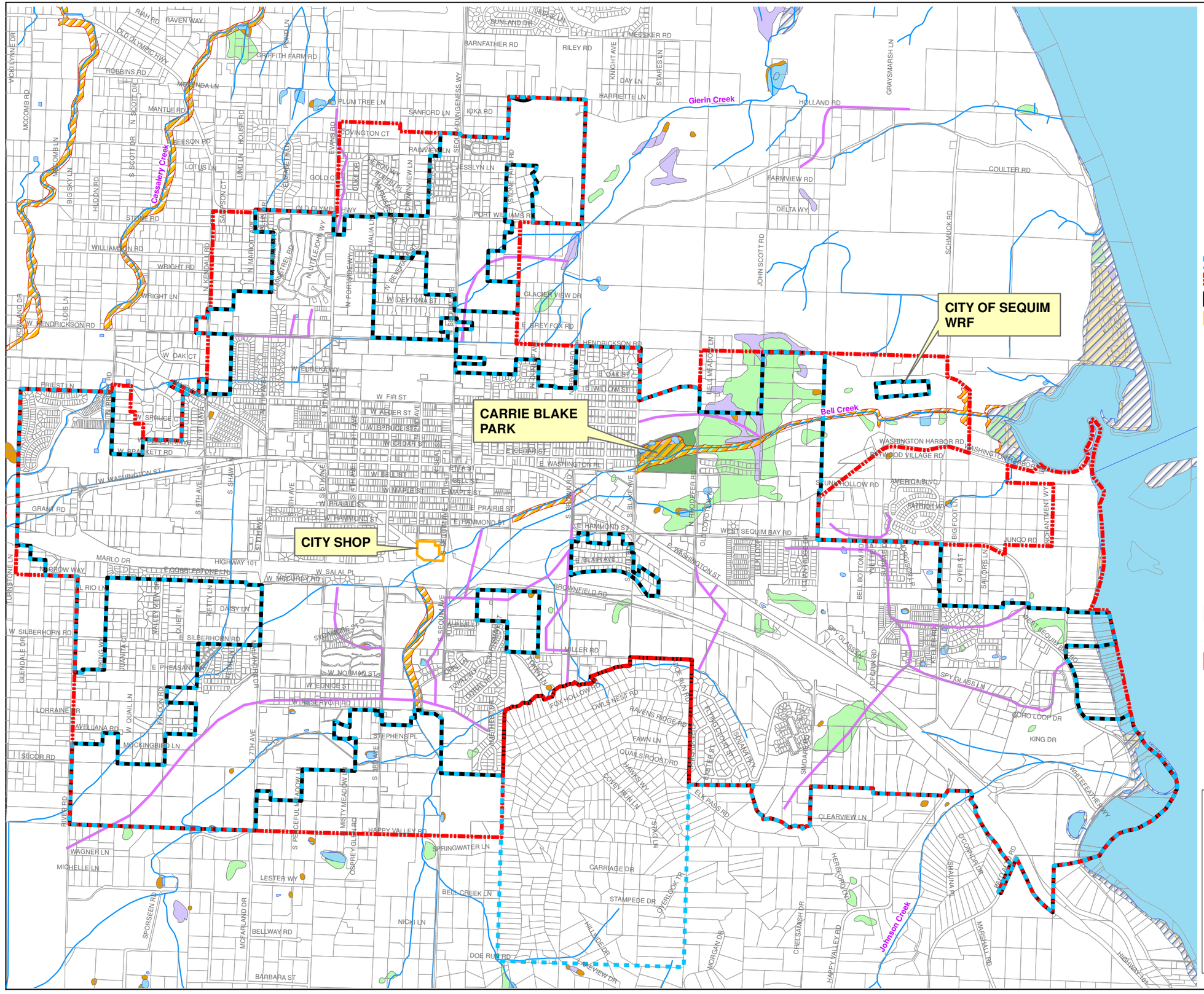
Flood Hazard Areas

Flood hazard areas are areas adjacent to lakes, rivers, and streams that are prone to flooding during peak runoff periods. Flood hazard areas deserve special attention due to the sensitive nature of their ecosystems as well as the potential for damage to structures located in the floodplain. Figure 1-6 shows that very little of the City's collection system nor the WRF are in either the 100-year or 500-year floodplain. These floodplains are centered around areas near creeks, lakes and ponds.

Construction of buildings and other development in these areas is regulated in accordance with the County's flood hazard construction standards. Typically, construction in flood hazard areas is not allowed or is limited to specific activities. Allowed activities might be mining or gravel extraction, recreational uses, repair to existing structures, utility and road construction or uses dependent upon water such as docks, wharves, and boating activities.

Landslide Hazard Areas

Landslide hazard areas include areas potentially subject to land movement due to a combination of geologic, hydrographic, and hydrologic factors. Specific buffers and building setbacks apply to any development that abuts or contains these areas, but buffers may be reduced based on special studies. With respect to sewer



LEGEND:

- SEWER SERVICE AREA
- URBAN GROWTH AREA
- CITY LIMITS
- CITY SHOP
- PARCELS
- IRRIGATION SYSTEMS
- RIVERS / CREEKS
- LAKES AND PONDS

WETLANDS:

- Freshwater Forested/Shrub Wetland
- Freshwater Emergent Wetland
- Freshwater Pond
- Estuarine and Marine Wetland
- Riverine
- Estuarine and Marine Deepwater
- Other Freshwater Wetland
- PARK

FEMA FLOOD ZONES:

A - AN AREA INUNDATED BY 100 YEAR FLOODING, FOR WHICH NO BFE'S HAVE BEEN ESTABLISHED

X500 - AN AREA INUNDATED BY 500 YEAR FLOODING; AN AREA INDUNDATED BY 100-YEAR FLOODING WITH AVERAGE DEPTHS OF LESS THAN 1 FOOT OR WITH DRAINAGE AREAS LESS THAN 1 SQUARE MILE; OR AN AREA PROTECTED BY LEVEES FROM 100 YEAR FLOODING

DATA SOURCE:

U.S. FISH AND WILDLIFE SERVICE AND F.E.M.A.

CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 1-6
SENSITIVE AREA AND WASTEWATER REUSE LOCATIONS

Gray & Osborne, Inc.

M:\SEQUIM\11594 - 2012 General Sewer Plan\GIS\FIGURE 1-6 SENSITIVE.mxd

systems, these development regulations can affect the amount of buildable area (and therefore, impervious surface) and/or reduce the potential risk for landslides and mass wasting that could impact natural or manmade conveyance systems and natural resources. Slide hazards areas are those that are prone to unstable behavior due to steep slopes, lack of vegetation, or unconsolidated soils.

Wetland Areas

Wetlands are defined by the EPA as areas that are inundated with water for at least part of the year. Wetlands support valuable and complex ecosystems and consequently development is severely restricted if not prohibited in most wetlands. The National Wetlands Inventory maps identify several small wetlands on County land in the area of the WRF. The largest wetland system lies approximately 0.6 miles west of the WRF and the includes Carrie Blake Park area.

Specific buffers and allowed alterations apply to wetland areas, as well as requirements for special studies and determinations. In general, Clallam County does not allow impacts to regulated wetlands; however, if such impacts are unavoidable, then mitigation measures are required.

Water Bodies

Lakes and streams are classified as sensitive areas due to the variety of plants and animals that they support. The primary surface water features within or near the City of Sequim sewer service area are the Strait of Juan de Fuca, Sequim Bay, Washington Harbor, Bell Creek and the Dungeness River. The Dungeness River flows north past Sequim on the west side of the City. Bell Creek flows through the City and enters Washington Harbor near the WRF.

Fish and Wildlife Habitat

Fish and wildlife habitat is defined as areas which meet the definition of a "Fish and Wildlife Habitat Conservation Area" pursuant to WAC 365-190-130 as well as Sequim Municipal Code Chapter 18.80 and is essential for maintaining specifically listed species in suitable habitats. Any proposed activity within 300 feet of these areas requires that a habitat assessment be prepared. This assessment is circulated to all the appropriate agencies for review. After review, a Habitat Management Plan may be required to address the project's impacts, provide background information of

specific species and recommend protection and mitigation measures for those species.

After implementation, an assessment and evaluation of the success of the irrigation measures is required. This plan is again circulated to the appropriate agencies for review. Minimum buffers from the critical habitat area may be required. As the main watercourses in the area, maintaining the water quality in Bell Creek and the Dungeness River is of particular concern.

CITY ZONING

Existing zoning for the City is shown in Table 1-2 and Figure 1-7. As shown in this table the majority of parcels are in the residential class. The City's zoning map was last updated in July of 2011.

Future zoning classification targets within the UGA are shown in Table 1-3 as well as Figure 1-8.

Table 1-2 Existing Zoning Designation(1)

Zoning Designation	Name	Code	Area (acres)	Total (acres)	Percentage of Total	Percentage of Total
Residential	Single Family Residential	R-II	1,859.2	2,244.3	45.3	54.7
	Single Family Residential (Medium)	R-III	244.6		6.0	
	Single Family Residential (High)	R-IV	140.5		3.4	
Commercial	Neighborhood Commercial	C-I(NC)	28.1	424.0	0.7	10.3
	General retail	C-II(G)	91.7		2.2	
	Medical & professional offices	C-II(M)	76.0		1.9	
	General commercial	C-III	194.3		4.7	
	Downtown Core	DC	33.9		0.8	
Mixed Use	Downtown mixed use I	DMU-I	75.3	392.1	1.8	9.6
	Downtown mixed use II	DMU-II	42.1		1.0	
	Mixed use	MU	274.6		6.7	
Park	Agricultural Conservancy	AC	40.4	154.7	1.0	3.8
	Park/Open space	P	114.3		2.8	
School	-	SCH	67.2	67.2	1.6	1.6
Public Facilities	-	PF	210.6	210.6	5.1	5.1
ROW/Streets	-	ROW	607.0	607.0	14.8	14.8
			TOTAL	**4,099.9**	**100.0**	**100.0**

(1) Source: City of Sequim official zoning map revised by Ordinance 2011-016, effective July 25, 2011

N

0 1,000 2,000 4,000 Feet

CITY OF SEQUIM WRF

AGRICULTURE CONSERVANCY
R-III
C-II(M)
SCHOOL
C-III
DC
DMU-II
DMU-I
MU
R-IV
R-II
C-II(G)
C-I(NC)
PF
PARK

LEGEND:

- SEWER SERVICE AREA
- URBAN GROWTH AREA
- CITY LIMITS
- PARCELS

COUNTY ZONING:

- R-II SINGLE FAMILY RESIDENTIAL
- R-III MULTI-FAMILY RESIDENTIAL (MEDIUM)
- R-IV MULTI-FAMILY RESIDENTIAL (HIGH)
- R5 RURAL (LOW)
- RDP RESEARCH / DEVELOPMENT PARK
- RSC RURAL SUBURBAN COMMUNITY

CITY ZONING:

- AGRICULTURE CONSERVANCY
- C-I(NC) NEIGHBORHOOD COMMERCIAL
- C-II(G) GENERAL RETAIL
- C-II(M) MEDICAL AND PROFESSIONAL OFFICES
- C-III GENERAL COMMERCIAL
- DC DOWNTOWN CORE
- DMU-I DOWNTOWN MIXED USE I
- DMU-II DOWNTOWN MIXED USE II
- MU - MIXED USE
- R-II SINGLE FAMILY RESIDENTIAL
- R-III MULTI-FAMILY RESIDENTIAL (MEDIUM)
- R-IV MULTI-FAMILY RESIDENTIAL (HIGH)
- SCHOOL
- PARK / OPEN SPACE
- PF - PUBLIC FACILITIES

CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 1-7
EXISTING ZONING DESIGNATIONS

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M:\SEQUIM\11594 - 2012 General Sewer Plan\GIS\FIGURE 1-7 ZONING.mxd

N

LEGEND:

- SEWER SERVICE AREA
- URBAN GROWTH AREA
- CITY LIMITS
- PARCELS

LANDUSE:

- AGRICULTURE CONSERVANCY
- C - COMMERCIAL
- DC DOWNTOWN CORE
- DMU-I DOWNTOWN MIXED USE I
- DMU-II DOWNTOWN MIXED USE II
- MU - MIXED USE
- R-II SINGLE FAMILY RESIDENTIAL
- R-III MULTI-FAMILY RESIDENTIAL (MEDIUM)
- R-IV MULTI-FAMILY RESIDENTIAL (HIGH)
- SCHOOL
- PARK / OPEN SPACE
- PF - PUBLIC FACILITIES
- RESEARCH & DEVELOPMENT PARK

CITY OF SEQUIM

2012 GENERAL SEWER PLAN
FIGURE 1-8
OPTIMUM LAND USE MAP

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Table 1-3 Future Zoning Designation Targets[1]

Zoning Designation	Name	Code	Area (acres)	Total (acres)	Percentage of Total	Percentage of Total
Residential	Single-Family Residential	R-II	2,782.2	3,273.3	51.8	61.0
	Single-Family Residential (Medium)	R-III	338.5		6.3	
	Single-Family Residential (High)	R-IV	152.6		2.8	
Commercial	Commercial	C	398.2	432.1	7.4	8.0
	Downtown Core	DC	33.9		0.6	
Mixed Use	Downtown mixed use I	DMU-I	75.4	393.4	1.4	7.3
	Downtown mixed use II	DMU-II	42.6		0.8	
	Mixed use	MU	275.4		5.1	
Park	Agricultural Conservancy	AC	40.0	110.5	0.7	2.1
	Park/Open space	P	70.5		1.3	
School	-	SCH	66.3	66.3	1.2	1.2
Public Facilities	-	PF	291.1	291.1	5.4	5.4
Research Development Park	-	RDP	100.4	100.4	1.9	1.9
ROW/Streets	-	ROW	703.0	703.0	13.1	13.1
			TOTAL	**5,370.1**	**100.0**	**100.0**

(1) Source: City of Sequim official zoning map revised by Ordinance 2011-016, effective July 25, 2011

EXISTING SYSTEM DESCRIPTION

SEWER COLLECTION SYSTEM

Wastewater Conveyance

The City's collection system includes over seventy-three miles of sewer line. The City of Sequim's sewer system consists mostly of gravity pipelines except for three force mains. The City also manages approximately 7,320 feet of outfall pipe from the WRF to a diffuser located approximately 1,900 feet into the Strait of Juan de Fuca at a depth of 53 feet. The City serves approximately 2,200 sewer connections.

Construction of the City's wastewater collection system, including the main trunk line to the wastewater treatment facility, began in the 1930s in the north part of the City. Much of the collection system for downtown Sequim was installed between 1950 and the mid-1970s, and consists of concrete pipe, asbestos cement pipe, and ductile iron pipe. Overall, approximately 59 percent of all sewer pipe is PVC, approximately 33 percent of all sewer pipe is concrete, and the remaining pipe is either asbestos cement or

ductile iron. Since the 1970s, additional PVC pipe sewers have been constructed in the periphery of the downtown corridor and several other outlying areas. The City's gravity collection system consists of approximately 66 miles of pipe. There are approximately 7.5 miles of pressurized force main pipe, but only approximately 6 miles of this total length is maintained by the City staff. The remaining pipe is privately owned and operated.

A full inventory of collection system piping by type, size, and material is included in Table 3-1.

Pump Stations

The City owns or operates three pump stations within the UGA, and two additional pump stations outside of the UGA. These pump stations are briefly described below and fully described in Chapter 3 – Collection System Evaluation.

The Doe Run Pump Station was installed in 1986 and is located outside of the UGA at the intersection of Doe Run Road and Fox Hollow Road. This station operated by City wastewater staff, but the City does not own the pump station. The Doe Run Pump Station serves the Bell Hill community and is in fair condition.

The Port Williams Pump Station is owned and operated by the City and is located near the intersection of North Brown Road and Harriette Lane and serves much of the City that is north of Fir Street, including residential areas, several medical clinics and schools centered around 5th Avenue. The pump station was constructed in 1996 and remains in good condition.

The Cedar Ridge Pump Station is operated, but not owned by the City and is located near the intersection of Lofgrin Road and Ida Court in East Sequim. This pump station serves the area east of East Washington Street between Highway 101 and West Sequim Bay Road.

Jeannie's Meadow Pump Station is owned and operated by the City and is located on East Lobelia Street. The station serves a large area west of North Priest Road between West Hendrickson Road and Highway 101. This region is also largely underdeveloped, but has a large number of potential residential wastewater connections.

The Sequim Bay Lodge Pump Station serves the hotel, conference, and dining facilities at Sequim Bay Lodge and receives pumped septic tank effluent from Sequim Bay State Park. This pump station is a septic tank effluent pumping (STEP) system and pumps wastewater up Highway 101 through a 4-inch force main to a valve assembly on Whitefeather Road, where a future force main from the John Wayne Development area will connect. From this valve assembly, a 6-inch force main conveys sewage to a manhole near Simdars Road. The pump station is owned, operated, and maintained by Sequim Bay Lodge. The force main is owned, operated, and maintained by the City. The City is typically contacted when maintenance and emergency issues at the Sequim Bay Pump Station arise.

Collection Basins

Figure 1-9 shows the City's collection system. In general, the collection system slopes to the northwest and can be divided into seven major collection basins:

Basin 1 — Central Downtown - Wastewater is conveyed by gravity in this area to the main interceptor, then on to the WRF.

Basin 2 — East Downtown - Wastewater is conveyed by gravity through an interceptor in Still Road and Blake Avenue before connecting to the main interceptor to the WRF.

Basin 3 — North Sequim - Wastewater is conveyed by gravity to the Port Williams Pump Station, then pumped to a short run of gravity pipe and into the main interceptor to the WRF.

Basin 4 — Southwest Sequim - This includes the area west of 3rd Avenue and south of Highway 101. Wastewater is conveyed by gravity to the north to Basin #1 along South 4th Avenue.

Basin 5 — Emerald Highlands - This basin, including the Emerald Highlands development and adjoining area, drains by gravity to Basin #1 along South Sequim Avenue.

Basin 6 — Bell Hill - Bell Hill, south of eastern downtown, drains north to Basin #2 along South Blake Avenue. The southern side of Bell Hill drains to the Doe Run Pump Station, which pumps wastewater up the hill, where it drains north by gravity.

Basin 7 — East Sequim - East Sequim is served by the East Sequim interceptor, which conveys wastewater north to the WRF separately from the main interceptor. The Sequim Bay Lodge Pump Station pumps wastewater into this basin, as will the new John Wayne Marina Pump Station when constructed.

The City was further divided into 63 subbasins for the purposes of the sewer modeling effort. These basins are further outlined in Chapter 3.

On-Site Wastewater Treatment Systems

Information on existing parcels served by public or private on-site septic systems was provided by Clallam County personnel and is shown in Figure 1-10. This figure outlines the presence and permit status of septic systems both within the City limits as well as the UGA. A listing of on-site septic systems within the City, as well as related permit information is available in Appendix B.

From Figure 1-10, of the 4,013 acres within the City limits, approximately 900 acres are served by onsite septic systems. Of the 5,370 acres within the UGA, approximately 1,550 acres are served by onsite septic systems. Approximately 900 acres of land outside of the City but within the UGA are served by onsite septic systems. A majority of these systems do not have current documentation on file with Clallam County Environmental Health Services Division.

WATER RECLAMATION FACILITY (WRF)

A wastewater treatment facility was constructed at the current site of the City's WRF in 1966. The plant was expanded in 1983. In 1997-1998, the City converted its existing secondary wastewater treatment plant to a WRF, adding chemical coagulation, filtration

PORT WILLIAMS PUMP STATION

JEANNIE'S MEADOW LIFT STATION

CITY OF SEQUIM WRF

OUTFALL

CEDAR RIDGE LIFT STATION

DOE RUN PUMP STATION

N

0 1,000 2,000 4,000 Feet

LEGEND:

- SEWER SERVICE AREA
- URBAN GROWTH AREA
- CITY LIMITS
- PARCELS
- LIFT STATION
- RE-USE PIPELINE
- SEWER LINES
- COLLECTION BASIN BOUNDARY
- 16 SECTION NUMBERS
- 3 COLLECTION BASIN NUMBERS

DRAINAGE BASINS:

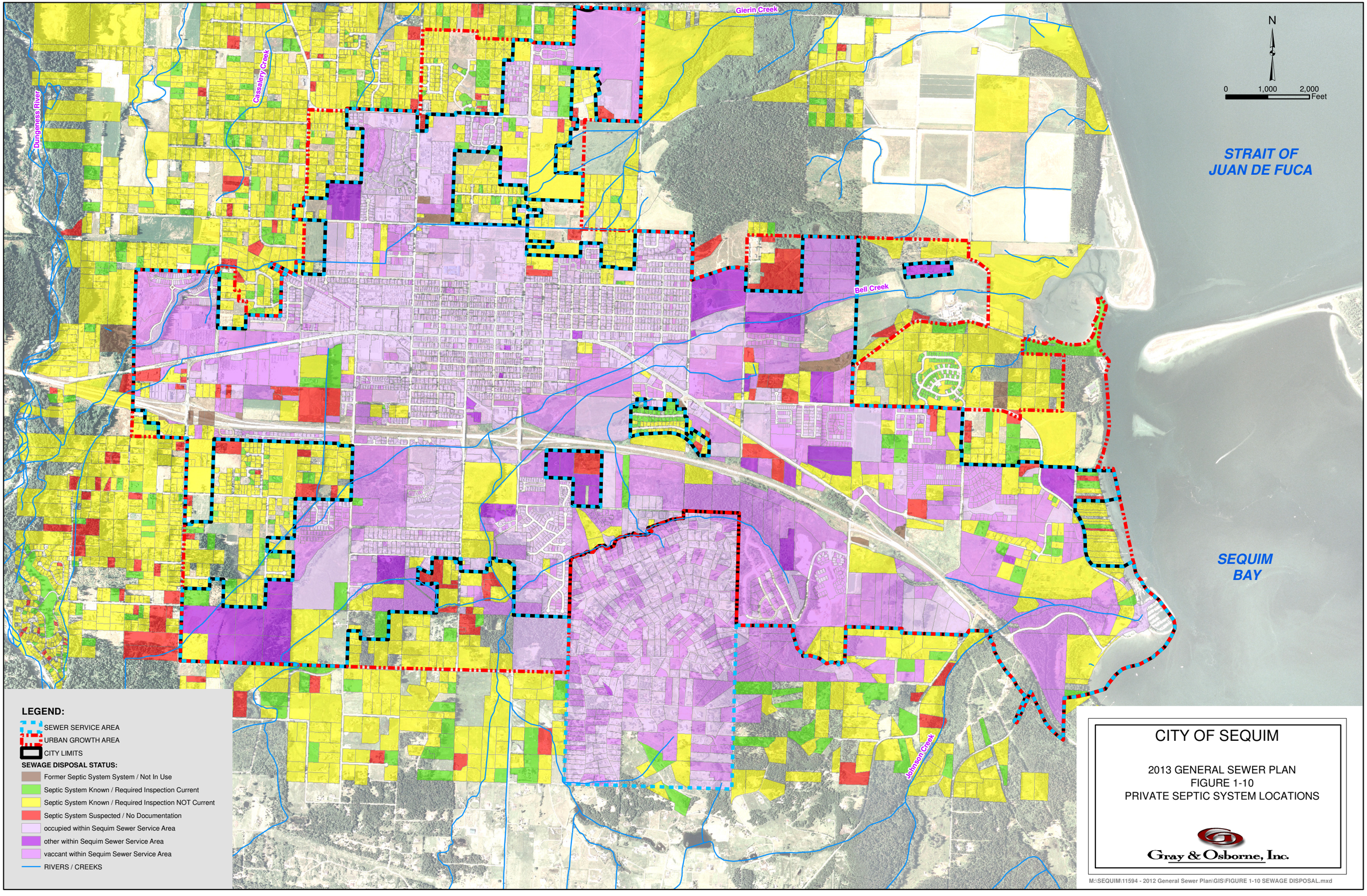
1. CENTRAL DOWNTOWN DRAINAGE BASIN
2. EAST DOWNTOWN DRAINAGE BASIN
3. NORTH SEQUIM DRAINAGE BASIN
4. SOUTHWEST SEQUIM DRAINAGE BASIN
5. EMERALD HIGHLANDS DRAINAGE BASIN
6. BELL HILL DRAINAGE BASIN
7. EAST SEQUIM DRAINAGE BASIN

CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 1-9
COLLECTION SYSTEM, COLLECTION BASINS, AND REUSE PIPELINE

Gray & Osborne, Inc.

M:\SEQUIM\11594 - 2012 General Sewer Plan\GIS\FIGURE 1-9 COLLECTION.mxd



CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 1-10
PRIVATE SEPTIC SYSTEM LOCATIONS

Gray & Osborne, Inc.

M:\SEQUIM\11594 - 2012 General Sewer Plan\GIS\FIGURE 1-10 SEWAGE DISPOSAL.mxd

and high level disinfection using ultraviolet light. These upgrades resulted in a treatment plant capable of meeting Class A reclaimed water standards as defined by the Department of Health (*Washington State Water Reclamation and Reuse Standards,* Department of Health and Department of Ecology, 1997). The WRF also produces Class A biosolids utilizing an FKC Pasteurization/Lime Stabilization process constructed in 2003.

The City completed process and capacity upgrades in 2010 including conversion of the existing oxidation ditch process into a conventional activated sludge process with nitrogen removal. The project also included installation of aeration blowers, a new clarifier, coagulation equipment, new ultra violet disinfection equipment, and back-up power generator.

The WRF is located east of the City on a 4-acre site north of Bell Creek and west of Schmuck Road. Figures 4-1, 4-2, and 4-3 show the existing WRF site plan, process schematic, and hydraulic profile, respectively. The wastewater treatment facility is described in greater detail in Chapter 4 – WRF Evaluation.

WATER REUSE FACILITIES

Reclaimed water is provided to the City Shops facility, a landscape irrigation system along Sequim Avenue, and to the Reuse Demonstration Site at Carrie Blake Park. Reclaimed water is supplied to a fire hydrant at the City Shops for truck filling, landscape irrigation and other municipal uses. Reclaimed water can also be stored in the City Shop detention pond. The locations of the transmission pipeline and reuse pipeline are shown in Figure 3-1. The water reuse pipeline consists of a 2.54-mile trunk pipeline that runs from the WRF to the City Shop, a 0.46-mile branch line to the City's Reuse Demonstration Site and a 0.96-mile branch line to the south, towards U.S. Highway 101.

The Reuse Demonstration Site is a 29-acre parcel of land located directly north of Carrie Blake Park in eastern Sequim. Reclaimed water is used at the demonstration site for landscape irrigation, stream flow augmentation to Bell Creek, and for toilet flushing in the Reuse Interpretive Center.

The *2008 Hydrologic Report* (PGG, 2009) stated that while a majority of reclaimed water produced at the WRF is discharged to

marine bodies in the winter months, approximately 12 percent is used for irrigation during summer months of May thru September, while 10 percent is used for Bell Creek stream flow augmentation.

POTENTIAL FOR PROVIDING REGIONAL SEWER SERVICE

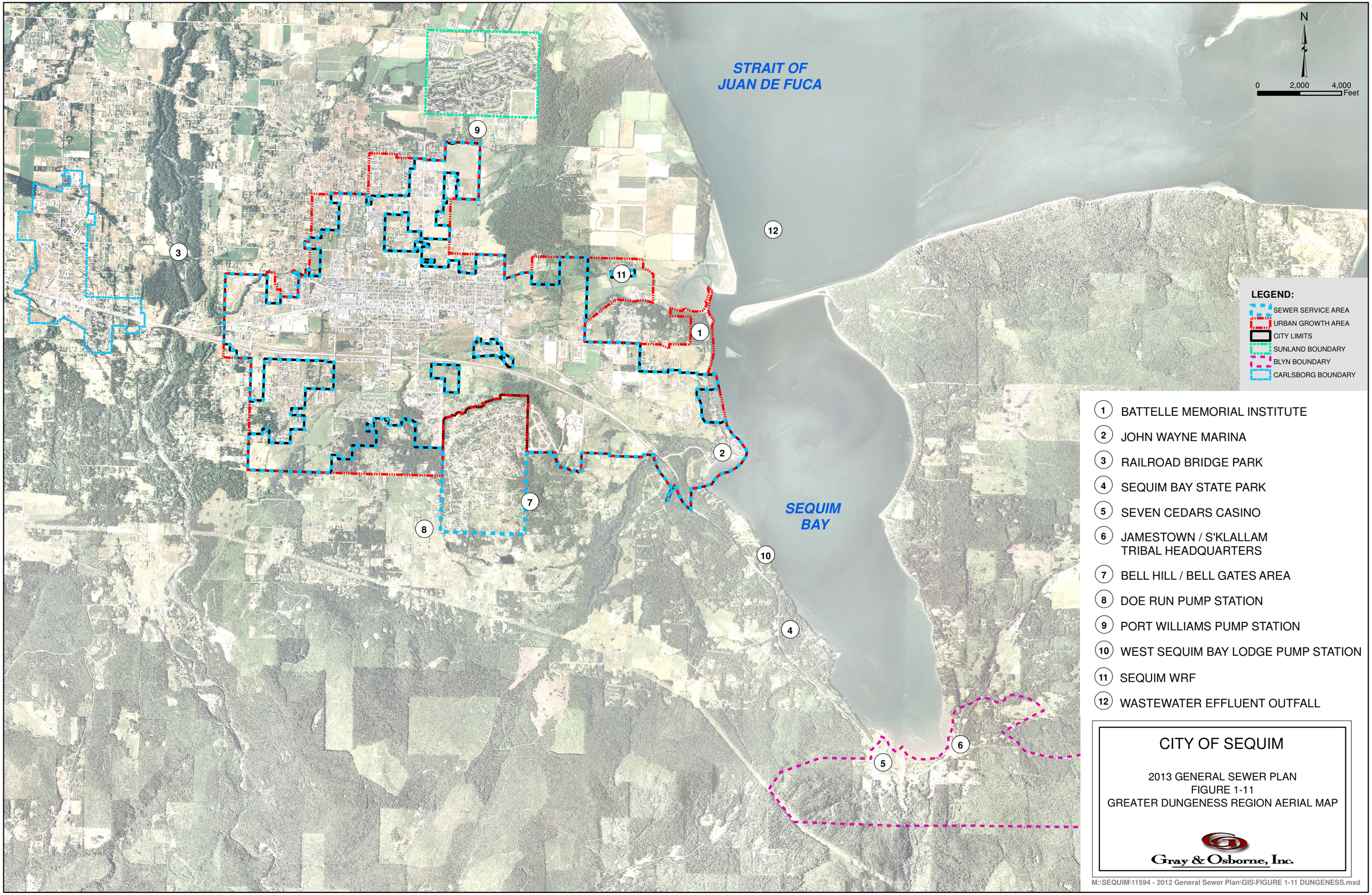
The County is interested in adopting a regional approach to wastewater treatment which would include service areas outside the Sequim UGA. This concept of having larger, centralized wastewater plants serving several neighboring communities has been applied elsewhere in the State of Washington with significant benefits including:

- lower annual operating costs and system maintenance costs for users
- lower costs for staffing and plant supervision
- overall increase in efficiency of wastewater treatment
- greater treatment autonomy
- resource specialization
- system can be designed to easily accommodate future growth

Disadvantages to regional treatment include:

- potential resistance from community members outside the City
- short term increase in annual costs for small community members
- high capital costs for construction of conveyance and treatment capacity

Because the City is the largest municipality in the region and has an existing WRF, it is a logical choice to be the primary wastewater service provider to the region. The small communities of SunLand, Blyn, and Carlsborg surround the City. Functional boundaries for these smaller communities are shown in Figure 1-11.



CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 1-11
GREATER DUNGENESS REGION AERIAL MAP

Gray & Osborne, Inc.

M:\SEQUIM\11594 - 2012 General Sewer Plan\GIS\FIGURE 1-11 DUNGENESS.mxd

In-City/In-UGA Regions

The John Wayne Development lies to the east of the City on the shores of Sequim Bay. This area includes the John Wayne Marina, West Sequim Bay Lodge, and primarily undeveloped land, but has high potential for growth and commercialization. Currently, residents and businesses in this area use on-site septic systems to treat wastewater.

Battelle

The Batelle Northwest Laboratory is loated to the east of the City along the shores of Sequim Bay. Batelle owns approximately 100 acres of land which include upland and waterfront areas, and currently houses a 50,000 square foot research institute. Further development in this area includes additional research laboratory space (up to 240,000 square feet) with some smaller ancillary buildings and facilities. The City completed the *2010 Battelle Revised Water and Sewer Feasibility Plan* (Gray & Osborne, 2010) which outlined several options for conveying wastewater produced from the Battelle complex as well as the John Wayne Development to the City's sewer system.

Outside the UGA

Areas outside the current UGA that could potentially be served by the Sequim WRF include SunLand, Blyn, and Carlsborg. These areas are briefly described below, and the impacts of their wastewater on the City's collection system and WRF are dewscribed in Chapter 3 and Chapter 4, respectively.

SunLand

SunLand is located approximately 2.5 miles northwest of the WRF and contains residential, mixed used and small commercial parcels located around the SunLand Golf Club. The region is primarily a retirement and semi-permanent residential community. The number of housing units currently built within the SunLand Sewer District is 845, and the number of units is restricted to a maximum of 950. Currently, wastewater produced by SunLand residents is conveyed by gravity and pump stations to the SunLand Wastewater Treatment Plant and treated using sequencing batch reactor, equalization, coagulation/filtration, and disinfection processes. For solids treatment, SunLand maintains a service contract with the City for delivery and treatment of sludge at the Sequim WRF.

Options for providing wastewater service to the SunLand community include a dedicated pump station and associated force main which connects to the City's gravity conveyance system and continues to the WRF, or conveyance from SunLand to the Port Williams Pump Station and on to the City conveyance system via the existing 8-inch force main.

The SunLand Golf Club also represents a potential use for reclaimed water produced at the City's WRF.

Blyn

Blyn is located 6 miles south of the City along Highway 101 on the southern shores of Sequim Bay. This community is comprised of the Seven Cedars Casino, Jamestown/S'Klallum Tribal Headquarters, small service businesses, and private residences. Currently, Blyn residents treat wastewater via on-site septic systems. One exception to this is the Longhouse Market and Deli, which treats wastewater using a small membrane bioreactor (MBR) facility and drain field.

Options for the City to provide wastewater service to the Blyn community would likely include construction of a pump station and force main from Blyn directly to the WRF, or to a separate pump station located between the two communities, most likely near the intersection of Highway 101 and Whitefeather Way.

Carlsborg

Carlsborg lies to the west of the City across the Dungeness River. Carlsborg is a growing community with an estimated 2010 population of 1,150 people. Currently, Carlsborg residents use on-site private or group septic tanks and drain fields to treat and dispose of wastewater. Both commercial and residential growth within the Carlsborg UGA is expected to match that of the City in throughout the 6-and 20-year planning periods.

The Clallam County PUD recently prepared a *Sewer Feasibility Study* (BHC Consultants, 2009) and *Sewer Facilities Plan* (BHC Consultants, 2010) in order to investigate and recommend alternatives for wastewater treatment, effluent reuse, and solids disposal. Results of this study concluded that construction of a main gravity sewer interceptor along Carlsborg Road and a wastewater treatment facility within the local PUD operations complex would be the most cost effective wastewater conveyance

and treatment method for the Carlsborg community. However, a report prepared by the City recommended that lower values for Inflow and Infiltration (I&I) be applied to the Carlsborg area. These values are outlined in the *2011 Feasibility Study* (Gray & Osborne, 2011). The impact of using lower values for I&I suggest that conveyance of Carlsborg wastewater to the City's conveyance system is a more cost effective and better long-term solution than a separate treatment facility within Carlsborg.

These surrounding communities are candidates to be included in a regional wastewater service plan for the area. For these communities to participate in the Regional Wastewater System, steps taken by the City should include:

- Consultation with County and State officials regarding legislation or ordinances surrounding wastewater treatment for regions outside of the City's UGA.

- Preparation of engineering reports that estimate the projected flows for these regions, and how the flows might affect the City's wastewater conveyance and treatment systems.

- Dialogue with community members to discuss the advantages and disadvantages of regional wastewater treatment

While no immediate upgrades at the WRF would be required if wastewater from Carlsborg was conveyed to, and treated at the Sequim WRF initially, upgrades would likely be needed before the year 2029. Information on the required upgrades and additional WRF analysis is available in Chapter 4 of this Plan as well as the *2011 Feasibility Study* and the *2008 Engineering Report*.

SERVICE AREA POLICIES

The Washington Administrative Code (173-240-060) requires a statement in all engineering reports regarding both compliance with adopted water quality management plans pursuant to the Federal Water Pollution Control Act, and with the State Environmental Policy Act (SEPA), if applicable. Because the City's current NPDES Permit limits are more stringent than those

set forth in the Federal Water Pollution Control Act (FWPCA), the City is in compliance with all FWCPA requirements so long as it meets the requirements set forth in its NPDES permit. A SEPA checklist is included in Appendix A.

Sequim Municipal Code (SMC) Chapters 13.28 through 13.80 address rules and regulations for the City's sewer system. Table 1-4 lists the sewer-related chapters in the code.

Table 1-4 Sections in the Sequim Municipal Code Addressing Sewer-Related Issues

Chapter	Title
Chapter 13.28	General Provisions for Sewer Service
Chapter 13.32	Definitions and Standards
Chapter 13.36	Administration and Enforcement
Chapter 13.40	Sewer Connection Required
Chapter 13.44	Sewer Connection Permits
Chapter 13.48	Public Sewer Use Regulations
Chapter 13.52	Sewer Maintenance Regulations
Chapter 13.56	Repair and Construction Regulations
Chapter 13.60	Side Sewer Regulations
Chapter 13.72	Installation and Collection Fees
Chapter 13.80	Sewer Rates and Charges

The SMC requires buildings on septic systems within City boundaries to connect to the City sewer system if the sewer is within 200 feet of the building. Buildings with septic systems can request and obtain a delay for sewer connection, up to 10 years from the date of installation of the sewer or up to 2 years from the date of the notice to connect, whichever is later. Residences and businesses outside the City limits are not governed by the SMC and are typically served by on-site septic systems.

The siting of any wastewater facilities such as pump stations or wastewater treatment facilities must adhere to the City's planning and zoning policies at the time of construction. The City has set requirements for the building and repair of sewers in SMC Section 13.56. The City also has ordinances prohibiting the discharge of unsuitable materials or stormwater into the sewer system (SMC Chapter 13.48).

As part of the general requirements for approval of this Plan, service area policies with regards to the governance of wastewater collection must be discussed. These policies are outlined in Table 1-5 below along with the location of the policy within the SMC and recommendations for strengthening the policy's clarity and/or enforceability.

Table 1-5 Service Area Policy Summary

Service Area Policy	Policy Description	City Policy Status	Recommendations
Local Sewer General Regulations	This policy would define local sewer rules, regulations, penalties, and schedules for payment and construction.	The SMC Chapter 13 defines when a connection is required, who is responsible for completing particular stages of the connection, who is financially responsible, and any issues with inspection and project completion.	None
Existing Service Agreements/ Conditions of Service	Describes the process, costs, and responsibilities for providing/accepting City sewer service	Outlined in SMC Chapter 13.	None
Local Improvement District Formation	Describes sewer service with regards to local improvement districts (LID) primarily in terms of payment and funding requirements	The City does not seemingly have a specific policy on the formation of LIDs	The City should develop a section within the SMC regarding LID formation and how sewer requirements affect these entities.
Latecomer's Agreement	Policies that would be affected by a new sewer service, and those that connect to an existing sewer service.	Latecomers are not specifically defined in Chapter 13.32. Payment and fee schedule with regards to connections to existing sewers are outlined in Chapter 13.98.	None
Conditions of Service	Policies that outline the responsibilities of a customer who is connected to the City sewer service.	The SMC outlines the requirements for when a sewer connection is required. It also outlines who is responsible for various aspects of sewer service such as inspection and enforcement.	The City should adapt the SMC with a special chapter outlining the level of service a sewer customer should expect.

Table 1-5 Service Area Policy Summary – (continued)

Service Area Policy	Policy Description	City Policy Status	Recommendations
Pretreatment of Fats, Oils, and Grease (FOG)	Conditions that must be met by an industrial discharger when required based on wastewater characterization	The SMC defines pretreatment. The SMC otherwise does not note what conditions would require pretreatment. Requirements for oil and grease traps are specified in the SMC.	The City should modify the SMC to include regulations on when pretreatment would be required for certain discharges, and specify the process for designing and testing a pretreatment technique. Specific items are outlined in Section S6 of the NPDES Permit.
Pipe Replacement Policy	Policies for replacing pipe that is outdated, undersized, or non-functioning.	The SMC defines the conditions on which the pipe will require replacement, and the party that is responsible to bear the cost of the replacement.	The City should specifically note the quantitative criteria that would deem a sewer pipe as "undersized".
New Service Policies	Requirements for completing a new connection to the City sewer service	Chapter 13.40 explains who is required to connect to the sewer system, and the basic process by which this would occur.	None
Within the City	These policies outline the regulations surrounding when a new sewer connection is required, and the regulations that must be followed to lawfully meet these requirements	The SMC Chapter 13.40 outlines when a new connection would be required. Chapter 13.48 outlines the regulations for use of the public sewer system. The new City Developer Standards Book will outline the necessary paperwork and construction standards required for sewer installations/connections.	Solicit comments and review the City Developer Standards Book prior to formal publcation.

REGULATORY REQUIREMENTS

The purpose of this Chapter is to identify and summarize the pertinent federal and state regulations that affect the planning, design, and approval of recommended improvements discussed in this Plan. Subsequent sections of this Plan address technical

requirements of the regulations at a level of detail appropriate for the evaluation provided by that section.

FEDERAL STATUTES, REGULATIONS, AND PERMITS

Federal Clean Water Act and NPDES Permits

The Federal Water Pollution Control Act is the principal law regulating the water quality of the nation's waterways. Originally enacted in 1948, it was significantly revised in 1972 and 1977, when it was given the common title of the Clean Water Act (CWA). The CWA has been amended several times since 1977. The 1987 amendments replaced the Construction Grants program with the State Revolving Fund (SRF), which provides low-cost financing for a range of water quality infrastructure projects.

The National Pollutant Discharge Elimination System (NPDES) is established by Section 402 of the CWA and subsequent amendments. The Department of Ecology (Ecology) administers NPDES permits for the United States Environmental Protection Agency (EPA). Most NPDES permits, including the permit for the City, have a 5-year life span and place limits on the quantity and quality of pollutants that may be discharged.

The City's current NPDES permit, No. WA0022349, is included as Appendix C, while a summary of the permit effluent limits are shown below in Table 1-6. The City's permit requires the treatment plant effluent to meet Class "A" reclaimed water treatment standards regardless of whether it is discharged to the outfall or pumped to the City's reuse facilities. The City is authorized to discharge to either Bell Creek in Carrie-Blake Park or the Strait of Juan de Fuca.

Table 1-6 NPDES Permit Discharge Limitations

Parameter	Average Monthly	Average Weekly
BOD (5-day)	30 mg/L 200 lb/day 85% removal	45 mg/L 300 lb/day
TSS	30 mg/L 200 lb/day 85% removal	45 mg/L 300 lb/day
	Average Monthly	**Sample Maximum**
Turbidity	2 NTU	5 NTU
	7-day Median	**Sample Maximum**
Total Coliform Bacteria	2.2 / 100mL	23 / 100mL
	Average Monthly	**Daily Maximum**
Ammonia - N	3.3 mg/L	5.7 mg/L
Total Nitrogen	**10 mg/L**	**N/A**
pH	Daily minimum is ≥ 6 and daily maximum is ≤ 9	
Dissolved Oxygen	Measurably present in secondary effluent at all times	
Total Flow	0.8 mgd	

In case of extreme flow events (48-hours of flow greater than the maximum day flow) or catastrophic system failure (earthquake, lightning strike), the City is authorized to discharge secondary effluent-quality water through the marine outfall. Effluent not meeting Class "A" reclaimed water standards may not be pumped to the City's reuse facilities or discharged into Bell Creek under any conditions.

Condition S.4 of the City's NPDES permit requires the City to prepare a plan and schedule to maintain adequate capacity when actual flows or loadings to the WRF exceed 85 percent of design capacity for three consecutive months, or when the projected increase would reach design capacity within five years.

Section 307 of the CWA established the National Pretreatment Program. This program is designed to protect publicly owned treatment works (POTW) and limits the amount of industrial or other non-residential pollutant discharged to municipal sewer systems.

A 401 Water Quality Certification is required under the CWA for any activity that may result in discharge to surface waters

including excavation activities that occur in streams, wetlands, or other waters of the nation. The USEPA has delegated 401 Certification to Ecology.

Section 404 of the CWA regulates discharges of fill or dredged materials in wetlands, including any related draining, flooding, and excavation. Pipeline and pump station projects in wetlands will require a Section 404 permit, in addition to any related local permits. In most cases, activities impacting greater than 1/3 of an acre will also require a Section 401 Certification.

EPA Capacity, Management, Operation, and Maintenance Regulations

EPA has proposed a new round of regulations regarding sewer system Capacity, Management Operation and Maintenance (CMOM). Though the regulations are yet to be formally adopted by the EPA, some municipalities are anticipating the adoption and have pro-actively moved forward with implementation. CMOM focuses on the failure of collection systems to have a program for long-term finance and repair. This has resulted in sanitary sewer overflows (SSO) that EPA feels it can legally address under the federal Clean Water Act. It is expected that portions of CMOM could be incorporated into future NPDES Permit requirements.

In general the requirements can be summarized through the following tenets:

1. General performance standards including system maps, information management and odor control.

2. Program documentation including the goals, organizational and legal authority of the organization operating the collection system.

3. An overflow response plan which requires response in less than 1 hour and is demonstrated to have sufficient and adequate personnel and equipment, etc. Estimated volumes and duration of overflows must be accurately measured and reported to the regulatory agency.

4. System evaluation requires that the entire system be cleaned on a scheduled basis (for example, once every 5 years), be regularly inspected through TV work and that a program for short and long term rehabilitation replacement be generated.

5. A capacity assurance plan that will use flow meters to model I&I, ensure pump stations are properly operated and maintained and that source control is maintained.

6. A program for self-audit to evaluate and adjust performance.

7. A communication program to communicate problems, costs and improvements to the public and decision-makers.

EPA is considering some changes in design standards for collection systems including requiring that sanitary sewer overflows not occur except in extreme storms. They have also decided that they will not predefine what that type of storm is, leaving that decision to the design engineer.

Federal Endangered Species Act (ESA)

The Endangered Species Act (ESA) was adopted in 1972 to protect the ecosystems which endangered and threatened species depend on. In Clallam County the US Fish & Wildlife Service has listed the bull trout, marbled murrelet, northern spotted owl and the short-tailed albatross as Threatened. Dolly Varden trout is proposed for listing under the similarity of appearance clause of the ESA for its resemblance to bull trout. Critical habitat has been established in Clallam County for bull trout, marbled murrelets and the northern spotted owl. Listed species in Clallam County under the jurisdiction of the National Marine Fisheries Service include Puget Sound chinook salmon, Hood Canal summer chum and Puget Sound steelhead, all of which are listed as "Threatened." NMFS has also listed the Southern Resident Pod of the killer whale as "Endangered" and re-confirmed this listing on March 17, 2011 as part of their 5-year Review for this species. Critical Habitat has been established for each of these species, except Puget Sound steelhead for which Critical Habitat is under development. Endangered Species Act consultation with the US

Fish & Wildlife Service and the National Marine Fisheries Service is required for any project that receives federal funding (including Washington State Revolving Fund Projects) and/or a federal permit; most often a Clean Water Act, Section 404 or Rivers and Harbors Act, Section 10 permit from the US Army Corps of Engineers. The ESA consultation process can take from six months to more than a year to complete.

National Environmental Policy Act (NEPA)

The National Environmental Policy Act was established in 1969 and requires federal agencies to determine environmental impacts on all projects requiring federal permits or funding. Federally delegated activities such as NPDES permits or Section 401 Certification are considered state actions and do not require NEPA compliance. If a project involves federal action (through, for example, an Army Corps of Engineers Section 404 permit), and is determined to be environmentally insignificant, a Finding of No Significant Impact (FONSI) is issued, otherwise an Environmental Impact Statement (EIS) is required. NEPA is not applicable to projects that do not include a federal component.

Federal Clean Air Act (CAA)

The Federal Clean Air Act requires all wastewater facilities to plan to meet the air quality limitations of the region. The City falls under the jurisdiction of the Olympic Region Clean Air Authority.

Wetlands

Dredging and Filling Activities in Natural Wetlands (Section 404 of the Federal Water Pollution Control Act)

A Corps permit is required when locating a structure, excavating, or discharging dredged or fill material in waters of the United States or transporting dredged material for the purpose of dumping it into ocean waters. Typical projects requiring these permits include the construction and maintenance of piers, wharves, dolphins, breakwaters, bulkheads, jetties, mooring buoys, and boat ramps.

If wetland fill activities cannot be avoided, negative impacts can be mitigated by creating new wetland habitat in upland areas, and if other federal agencies agree, the Corps will generally issue a permit.

Wetlands Executive Order 11990

This order directs federal agencies to minimize degradation of wetlands and enhance and protect the natural and beneficial values of wetlands. The order also mandates avoidance and mitigation of impacts to wetlands, and must be considered before an NPDES permit is issued. Assurances must be provided that the natural and beneficial values of wetlands will be protected and enhanced by the discharge.

National Shellfish Sanitation Program

The Department of Health Shellfish Program determines the location of the "sanitary line" – (also known as a shellfish boundary line). This regulatory line is drawn in the receiving water some distance from a wastewater treatment plant's effluent discharge point, beyond which shellfish may be harvested for human consumption. In modeling the impacts to water quality of the effluent from a wastewater treatment plant, the FDA and the National Shellfish Sanitation Program mandate that a malfunction or upset at the plant be considered "an adverse scenario." Possible interruptions in the disinfection system are used to address this requirement.

A Closure Zone Assessment was completed in 1994 and documented in a Department of Health memorandum dated May 20, 1994. The current closure zone of 300 yards is the minimum allowed by law due to the high performance and reliability features of the Sequim WRF, as well as the excellent dispersion available at the City's outfall. The Closure Zone Assessment was updated for the new design flows prior to the 2010 WRF upgrades.

STATE STATUTES, REGULATIONS, AND PERMITS

State Environmental Policy Act (SEPA)

The WAC 173-240-050 requires a statement in all wastewater comprehensive plans regarding compliance of proposed projects with SEPA, if applicable. The capital improvements proposed in this Plan will fall under SEPA regulations, and a SEPA checklist is included in Appendix A. In most cases a determination of non-significance (DNS) or mitigated determination of non-significance (MDNS) is issued; however, if a project will have a probable significant adverse environmental impact, an Environmental

Impact Statement (EIS) will be required. It is not anticipated that an EIS will be required for any recommended projects in this Plan.

Shoreline Management Act (SMA)

The Shoreline Management Act of 1971 (RCW 90.58) establishes a broad policy giving preference to shoreline uses that protect water quality and the natural environment, depend on proximity to the water, and preserve or enhance public access to the water. The SMA jurisdiction extends to lakes or reservoirs greater than 20 acres, streams with a mean annual flow of ≥20 cubic feet per second, marine waters, and an area inland 200 feet from the ordinary high water mark. The Sequim WRF and portions of the collection system are located within shoreline areas.

State Water Pollution Control Act

The intent of the state Water Pollution Control Act is to "maintain the highest possible control standards to ensure the purity of all waters of the state consistent with public health and the enjoyment…the propagation and protection of wildlife, birds, game, fish and other aquatic life, and the industrial development of the state." Ecology issues permits for wastewater treatment facilities under the Revised Code of Washington (RCW) 90.48 and the Washington Administrative Code (WAC) 173-240, and land application of wastewater under WAC 246-274.

Submission of Plans/Reports for Construction of Wastewater Facilities, WAC 173-240

Prior to construction or modification of domestic wastewater facilities, engineering reports, plans, and specifications must be submitted to and approved by Ecology.

Key provisions of WAC 173-240 state that:

1. An engineering report for a wastewater facility project must contain everything required for a general sewer plan unless an up-to-date general sewer plan is on file with Ecology,

2. An engineering report shall be sufficiently complete so that plans and specifications can be developed from it without substantial changes, and

3. A wastewater facility engineering report must be prepared under the supervision of a professional engineer.

Criteria for Sewage Works Design, Washington State Department of Ecology

Ecology has published design criteria for collection systems and wastewater treatment plants. While these criteria are not legally binding, their use is strongly encouraged by Ecology since the criteria are used by the agency to review engineering reports for upgrading wastewater treatment systems. The latest official version of these design criteria, commonly referred to as the "Orange Book," was issued in 2008. Any expansion or modification of the City of Sequim WRF will require consideration of Ecology Orange Book criteria.

Certification of Operators of Wastewater Treatment Plants, WAC 173-230

Wastewater treatment plant operators are certified by the State water and wastewater operator's certification board. The operator assigned overall responsibility for operation of a wastewater treatment plant is defined by WAC 173-230 as the "operator in responsible charge." This individual must have State certification at or above the classification rating of the plant.

The City of Sequim WRF is currently assigned a Class III rating and the operations staff assigned to the plant possess the required certification. Specifically, three of the operators have Class IV certification, while two others have Class II certification.

Accreditation of Environmental Laboratories (WAC 173-050)

The State of Washington recently established a requirement that all laboratories reporting data to comply with NPDES permits must be generated by an accredited laboratory. This accreditation program establishes specific tasks for quality control and quality assurance (QA/QC) that are intended to ensure the integrity of laboratory procedures. Accreditation requirements must be met for any on-site laboratory or outside laboratory used to analyze samples. Only accredited commercial laboratories may be used for analyses reported for compliance with NPDES permits. In planning for an on-site laboratory, staffing must be sufficient to allow for QA/QC procedures to be performed.

The Sequim WRF Laboratory is an accredited environmental laboratory through Ecology. This accreditation must be renewed annually. Specifically, the WRF lab is certified for the following constituents:

- Turbidity
- Total suspended solids
- Total chlorine (residual)
- pH
- Ammonia
- Dissolved oxygen
- Biochemical oxygen demand
- Total coliform – count
- Fecal coliform - count

Surface-Water Quality Standards (WAC 173-201a)

WAC 173-201A establishes water quality standards within the state of Washington. The state adopted revised water quality standards on July 1, 2003. The standards are based on two objectives: protection of public health and enjoyment, and protection of fish, shellfish, and wildlife. For each surface water body in the state, the standards assign specific uses, such as aquatic life, recreation or water supply. Water quality standards have been developed for each use, for parameters such as total coliform, dissolved oxygen, temperature, pH, turbidity, and toxic, radioactive, deleterious substances.

There are several surface water bodies in and around Sequim which must conform to these standards. Bell Creek, the Dungeness River, and the Strait of Juan de Fuca are the most prominent of these features. The Dungeness River is particularly important because water is collected from underneath the riverbed and used as a source of drinking water for the City's water system. Bell Creek is also important because reclaimed water is delivered to Bell Creek in an attempt to augment typically low summer flows.

The water uses that are defined in the standards for marine waters include:

Aquatic Life Uses

- Extraordinary quality
- Excellent quality
- Good quality
- Fair quality

Shellfish harvesting and Recreational uses

- Primary contact recreation
- Secondary contact recreation

Miscellaneous uses

- Wildlife habitat
- Harvesting
- Commerce and navigation
- Boating
- Aesthetics

Antidegradation

The anti-degradation policy aims to maintain the highest possible quality of water in the state by preventing the deterioration of water bodies that currently have higher quality than the water quality standards require. The revised water quality standards define three tiers of waters in the anti-degradation policy.

Tier I water bodies are those with violations of water quality standards from natural or human-caused conditions. The focus of water quality management is on maintaining or improving current uses and preventing any further human-caused degradation.

Tier II water bodies are those of higher quality than required by the water quality standards. The focus of the policy is on preventing degradation of the water quality and to preserve the excellent natural qualities of the water body. New or expanded actions are not allowed to cause a "measurable change" in the water quality unless they are demonstrated to be "necessary and in the overriding public interest."

Standards for Solid Waste Handling (WAC 173-304)

Grit and screenings are not subject to the sludge regulations in WAC 173-308, but their disposal is regulated under the State solid waste regulations, WAC 173-304. Waste placed in a municipal solid waste landfill must not contain free liquids, nor exhibit any of the criteria of a hazardous waste as defined by WAC 173-303. To be placed in a municipal solid waste landfill, grit and screenings must pass the paint filter test, which determines the amount of free liquids associated with the solids, and the toxic characteristics leachate procedure (TCLP) test, which determines if the waste has hazardous characteristics.

In 2003, the WRF installed the FKC simultaneous pasteurization/lime stabilization facility to treat biosolids produced through the wastewater treatment process. This process allows the City to produce Class A Exceptional quality biosolids which are either land applied for agricultural use or given away to the public. Unlike the grit and screenings mentioned above, these biosolids are governed under WAC 173-308. The City does not currently have a means to make biosolids available to the public, but is interested in developing such a facility.

Hydraulic Project Approval

Under the Washington State Hydraulic Code (WAC 220-110), the Washington State Department of Fish and Wildlife (WDFW) requires a hydraulic project approval (HPA) for activities that will "use, divert, obstruct, or change the natural flow or bed" of any waters of the state. For City activities such as pipeline crossings of streams, an HPA will be required, and will include provisions necessary to minimize project specific and cumulative impacts to fish.

CULTURAL RESOURCES

National Historic Preservation Act

Compliance with Section 106 of the National Historic Preservation Act is an important component of the National Environmental Policy Act (NEPA) review, required for projects that receive federal funds or a federal permit. Section 106 requires consultation with the State, or Tribal, Historic Preservation Office and any concerned Native American Tribes regarding potential disturbance of materials of cultural, historic or archaeological significance.

Project proponents must provide a description of the Area of Potential Effect (APE) memo and maps to the State Department of Archaeology and Historic Preservation (DAHP). The State Archaeologist reviews the APE relative to the national, state and local historic registers and requests a cultural resources/archaeological survey of the project area if the proposed activity has the potential to disturb significant materials. The project proponent must forward Cultural Resources Survey either directly to DAHP and the Tribes, or to the funding or permitting agency for submittal to DAHP and Tribes. If the State Archaeologist or State Historic Preservation Officer at DAHP concurs with the findings in the Cultural Resources Report they will issue a Letter of Concurrence and spell out any necessary mitigation required. Responses to comments from concerned Tribes regarding the proposed project scope, methods and potential mitigation must also be addressed.

In the DAHP concurrence letter will contain language to the following effect regarding inadvertent discovery and disturbance of significant materials:

"In the event that materials of cultural, historic or archaeological significance are disturbed during construction, work at the site must be stopped and the Project Engineer, funding agency Project Manager, the State Department of Archaeological and Historic Preservation and the Cultural Resources Department of any concerned Tribes must be consulted regarding the review and final disposition and curation of the disturbed materials."

Washington Executive Order (EO) 05-05

The Washington State Governor issued EO 05-05 to extend DAHP review of State-funded Projects with the potential to disturb materials of cultural, historic or archaeological significance. Project proponents must provide an APE Memo and potentially a Cultural Resources Report to the State funding agency for submittal to DAHP and any concerned Native American Tribes. DAHP and Tribal concurrence letters and compliance with proposed mitigation measures are required prior to release of funds for project construction.

RECLAIMED WATER STANDARDS

The State legislation authorizing water reuse, RCW 90.46 - Reclaimed Water Use, was passed in 1992. The initial legislation required the Washington Departments of Health (DOH) and Ecology (Ecology) to jointly develop interim standards for the implementation of water reclamation and reuse.

In 2006, RCW 90.46 - Reclaimed Water Use was amended by enactment of Engrossed Substitute House Bill (ESHB) 2884. The key provision of the new law directs Ecology to develop and adopt rules on all aspects of reclaimed water. ESHB 1478 extended the deadline for enactment of the Reclaimed Water Use Rule. ESHB 1478 states that "the Department of Ecology shall adopt rules for reclaimed water use no later than 2013."

"Reclaimed water" is defined in RCW 90.46.010 as "effluent derived in any part from sewage from a wastewater treatment system that has been adequately and reliably treated, so that as a result of that treatment, it is suitable for a beneficial use or a controlled use that would not otherwise occur, and is no longer considered wastewater." Use of reclaimed water is an alternative to effluent disposal. In the State of Washington, any type of direct beneficial reuse of municipal wastewater is defined as water reuse or reclamation. Water Reuse and Reclamation Standards have been issued jointly by the Departments of Health and Ecology. This discussion is based on standards dated September 1997, which are adopted by reference in RCW Chapter 90.46, Reclaimed Water Use.

The *Water Reclamation and Reuse Standards* define the water quality standards for reclaimed water. The reclaimed water standards applicable to the City of Sequim WRF Class "A" treatment process includes the four minimum requirements described below:

> Continuously Oxidized - Wastewater that at all times has been stabilized such that the monthly average BOD_5 and TSS are less than 30 mg/L, is non-putrescible, and contains dissolved oxygen. The monthly average total nitrogen (as N) must be less than 10 mg/L with a maximum sample value of 15 mg/L.

Continuously Coagulated - Oxidized wastewater that at all times has been treated by a chemical or equally effective method to destabilize and agglomerate colloidal and finely suspended matter prior to filtration.

Continuously Filtered - Oxidized and coagulated wastewater that at all times has been passed through a filtering media so that the turbidity of the filtered effluent does not exceed an average of 2 nephelometric turbidity units (NTU), determined monthly, and does not exceed 5 NTU at any time.

Continuously Disinfected - Oxidized, coagulated and filtered wastewater that at all times has been disinfected to destroy or inactivate pathogenic organisms. A group of indicator microorganisms, coliform bacteria, are used as to measure the effectiveness of the disinfection process. The Class "A" reclaimed water standard is a total coliform density of 2.2 per 100 milliliters (mL) for the median of the last seven days of samples, with no sample having a density greater than 23 per 100 ml.

Reclaimed water may be used to recharge groundwater by surface percolation or through direct injection as long as the quality of the reclaimed water meets groundwater recharge criteria which are defined in the Reuse Standards. Groundwater recharge projects must also be in compliance with the state's groundwater regulations listed in WAC 173-200. This regulation contains groundwater quality criteria that are to be met in the saturated zone. Recharge of groundwater with reclaimed water would require a State Waste Discharge Permit issued by Ecology. Ecology may also require the development of a groundwater monitoring program to ensure degradation does not occur.

Discharge of reclaimed water for the purpose of streamflow augmentation, fish and wildlife habitat, irrigation supply, or water right replenishment or transfer must comply with WAC Chapter 173-201a. A beneficial use of the reclaimed water must be established for the project to be accepted as a streamflow augmentation project.

Short-term storage or an alternative disposal system (e.g., an outfall) must be provided for situations where the reclaimed water cannot be used due to bad weather, reduced demand, etc. Provisions must also be made for storage or disposal of water that does not meet the treatment and water quality criteria, perhaps due to a treatment upset or equipment failure.

The Reuse Standards require reliability for individual treatment units such as biological treatment, secondary clarification, coagulation, filtration, and disinfection. Generally, if long-term storage or an alternative disposal method is not available, the facility must have redundant units each capable of treating the entire flow, or short-term storage with standby replacement equipment provided. Furthermore, coagulation and chlorination unit processes must have standby chemical feed equipment provided, regardless of storage and disposal options, to ensure uninterrupted chemical feed.

Groundwater Quality

The State of Washington recognizes the potential benefit of replenishing groundwater with reclaimed water; thus, groundwater recharge is allowed under current state regulations. The Groundwater Quality Standards apply to all groundwater of the state that occur in the saturated zone beneath the land surface. While groundwater may support a number of beneficial uses, the overriding basis for the regulations is to protect all groundwater as a potential drinking water source. Accordingly, the groundwater quality criteria in WAC 173-200 are human health based standards, which, for many parameters, are equivalent to the DOH Drinking Water Standards.

Parameters of Concern

According to the regulations, the reclaimed water must be applied in a manner that "will not cause pollution of any groundwater below the root zone." Compared to surface water, groundwater is relatively immobile and once reaching an underground aquifer the physical and chemical characteristics of water change slowly.

The parameters of major concern with the recharge of reclaimed municipal wastewater are nitrogen and pathogens. The Reuse Standards require treatment equivalent to Class A reclaimed water for groundwater recharge by surface percolation. This treatment level is expected to ensure that pathogen levels in the groundwater

will not exceed drinking water standards (<1 total coliform/100 mL), and that nitrate nitrogen (NO_3-N) does not exceed the current drinking water standard of 10 mg/L. Reduction of total nitrogen (TN) to less than 10 mg/L prior to land application is required if application rates exceed agronomic requirements.

Beginning in 2005, the WRF's NPDES permit limits the total effluent nitrogen concentration to 10 mg/L. The recently completed WRF expansion included modifying the treatment process to a predenitrification mode of operation for carbonaceous BOD removal, nitrification, and denitrification.

Water Rights

RCW 90.46.120 states that "the Owner of a wastewater treatment facility that is reclaiming water with a permit issued under this chapter has the exclusive right to any reclaimed water generated by the wastewater treatment facility."

However, guidance from Department of Ecology indicates that the reclaimed water should normally be retained and utilized in the general use area or basin from which the water originated and for which the original water right was issued. The Reuse Standards require proponents of groundwater recharge projects to provide information on the intended water rights status (i.e., artificial storage or abandonment, of the reclaimed water). RCW 90.46.120 further states that when proposed uses of reclaimed water are intended to augment or replace potable water supplies, such uses must be reflected in the potable water purveyor's water comprehensive plan.

The City holds the water rights for most of the water being transported to the WRF, and as the producer of the reclaimed water, retains the water rights over it. It is not anticipated at this time that holding the rights to the reclaimed water will impact the potable water rights currently held by the City. However, the City will need to perform a Water Rights Impairment Analysis for any new uses of its reclaimed water. This analysis is required by the Water Reclamation and Reuse Standards to ensure that any diversions that occur due to new reclaimed water uses will not impair the previous uses of the water or infringe on the City's rights to the water. This issue will be of particular concern in evaluating groundwater recharge and streamflow augmentation

projects because the City does not desire to surrender any rights to its reclaimed water.

Compliance with Reclaimed Water Rule

Washington State began a rulemaking process in 2006 to update and to convert the 1997 Water Reclamation and Reuse Standards (Washington State Department of Ecology, 1997) into a regulation, the Reclaimed Water Rule, Chapter 173-219 Washington Administrative Code (Washington State Department of Ecology, 2010). The Rule is intended to provide a consistent and efficient regulatory process as well as to be sufficiently adaptable in order to govern reclaimed water production over a long time period.

The Rule refers to a Reclaimed Water Facilities Manual, a.k.a. the "Purple Book," for supplemental guidance on implementing the Rule. Gray & Osborne, Inc. was retained by the Washington Coalition for Clean Water and the Washington State Department of Ecology (Ecology) to assist in development of the manual, which has been released for review by stakeholders. Rule adoption and publication of the Purple Book are anticipated in 2013.

Some facets of the new regulations that might impact the City's production and use of reclaimed water include the following:

1. Reclaimed water use and management plans would be required every 6 years. This information could be encompassed by a General Sewer Plan or other similar type document.

2. City would likely be required to apply for a general reclaimed water permit under the regulatory agency every 5 years.

3. New quality requirements will be placed on reclaimed water use. Enforceable limits based on both the drinking water and groundwater quality standards. Limits must consider potential to be present in reclaimed water, existing groundwater quality, existing or proposed uses of groundwater, and compliance points.

4. Reclaimed water must maintain a chlorine residual (free chlorine) of > 0.2 mg/L at the point of use.

5. Additional restrictions are proposed for the use of reclaimed water in an agronomic setting.

6. New requirements would be established for disinfection. The City's disinfection system is in compliance with the most significant new disinfection requirements (5-log virus removal), but may need to perform additional monitoring and testing.

Compliance with Draft Dungeness Water Rule

The Washington State Department of Ecology, Clallam County, the Jameston S'Klallam Tribe and the Dungeness Water Users Association have developed a new rule for management of water resources in the Dungeness River Watershed. The goal of the rule is to maintain instream flows in surface water bodies in the watershed and provide for the current and future demands of the population, agriculture and wildlife. This new rule is based on the 2005 Elwha-Dungeness Watershed Management Plan which provided the foundation of the new rule and suggests minimum instream flows would be the best method to protect these resources.

The Draft Dungeness Water Rule's key elements are as follows:

1. Set instream flows and close surface waters to new diversions.

2. Require mitigation for all new consumptive uses of water, including permit-exempt wells.

3. Establish reserves of water for future domestic use.

4. Establish maximum depletion amounts for the Dungeness River and smaller streams.

5. Set maximum allocation of the Dungeness River during the open period.

6. Allow storage projects.

7. Require measuring all new water uses.

8. Require new users to first request service from a public water supply.

The proposed rule would regulate water withdrawals to ensure instream flows for several water bodies within the basin including the Dungeness River. The rule would establish a minimum instream flow that would be certificated as a water right making future water diversions junior to the flow in the water body. This would make water rights established after the effective date of the rule interruptible if the instream flow requirements were not met. Any new surface or groundwater uses must measure withdrawals with an Ecology-approved water meter according to WAC 173-518-060. The only exception is water use from the collection of rainwater.

Under the proposed rule, any new water use must be mitigated or offset by "mitigation credits" sold by the Dungeness Water Exchange. The exchange is a place for people who have senior water rights to sell or lease all or a portion of their water rights. New water use must be mitigated by a purchase from the exchange or mitigated by an individual plan that is submitted to and approved by the Department of Ecology. The only exceptions to water mitigation are if the new development is part of a group domestic system established 5 years prior to the effective date of the rule, if one can demonstrate that their water use does not cause an impact on any of the tributaries previously mentioned, or if the development receives water from a public water supplier such as the City or Clallam PUD.

Additional information regarding the Dungeness Water Rule can be found in the *2012 Water System Plan*.

RELATED PLANNING DOCUMENTS

The following documents were consulted in the preparation of this Wastewater Comprehensive Plan:

1. *Comprehensive Wastewater Facilities Plan*, City of Sequim, Brown and Caldwell, August 1992.

2. *Wastewater Treatment Plant Phase II Improvements, Engineering Report - Final, City of*

Sequim, Brown and Caldwell, April 1993 (Amendment to 1992 *Comprehensive Wastewater Facility Plan*

3. *Final Environmental Impact Statement, Comprehensive Wastewater Facilities Plan*, Adolfson & Associates, April 1993

4. *Final Environmental Impact Statement Comprehensive Wastewater Facilities Plan (Addendum)*, Adolfson & Associates, September 1994

5. *Facility Plan Amendment, City of Sequim Wastewater Treatment Plant Effluent Treatment Facility*, CH2M-HILL, September 1995

6. *City of Sequim Comprehensive Plan Draft EIS,* Butler & Associates, CH2M Hill, November 1995.

7. *City of Sequim Comprehensive Plan Draft EIS, Appendices, Volume II,* Butler & Associates, CH2M Hill, Polaris Engineering, December 20, 1995.

8. *City of Sequim Comprehensive Plan,* City of Sequim, December 1996.

9. *City of Sequim Class A Reclaimed Water – 100 Percent Upland Reuse Plan. Amendment to Comprehensive Facilities Plan,* Gray & Osborne, 1998.

10. *Water System Comprehensive Plan*, City of Sequim, Gray & Osborne, November 2000.

11. *Wastewater Comprehensive Plan*, City of Sequim, Gray & Osborne, April 2003

12. *Water Reclamation Facility Expansion Engineering Report*, City of Sequim, Gray & Osborne, September 2007

13. *Revised Water and Sewer Feasibility Analysis for the Battelle Memorial Institute Property*, City of Sequim, Gray & Osborne, June 2010

14. *Carlsborg Wastewater Feasibility Study*, City of Sequim, Gray & Osborne, August 2011.

15. *Sewer Feasibility Study for the Carlsborg UGA*, Clallam County PUD No. 1, BHC Consultants LLC, July 2007.

16. *Sewer Facilities Plan for Carlsborg UGA*, Clallam County PUD No. 1, BHC Consultants LLC, August 2010.

17. *City of Sequim 2008 Hydrologic Monitoring Report*, City of Sequim, Pacific Groundwater Group, December 2009.

18. *Hydrogeologic Assessment of the Sequim-Dungeness Area, Clallam County, Washington*, USGS, Thomas, B., Goodman, L., and Olsen, T., 1999.

Chapter 2
BASIC PLANNING DATA



INTRODUCTION

Proper design of wastewater treatment and conveyance facilities requires the determination of the quantity and quality of wastewater generated from each of the contributing sources. Typically, wastewater is predominantly domestic in origin with lesser amounts contributed by commercial and industrial businesses and by public use facilities such as schools, parks, hospitals, and municipal functions. Infiltration and inflow entering the sewer system during periods of high groundwater levels is another contributor to wastewater.

This chapter summarizes existing population, sewer customers, and wastewater flows and loadings, and also outlines the development of population projections for the City as well as the sewer service are through the 20-year planning period. This chapter also develops projections for wastewater flows and

loadings of the City as well as surrounding areas through the 20-year planning period.

DEFINITION OF TERMS

Several terms and abbreviations used in the analysis are described below.

WASTEWATER

Wastewater is water-carried waste from residential, commercial and public use facilities, together with quantities of groundwater and surface water which enter the sewer system through defective piping and direct surface water inlets. The total wastewater flow is typically expressed in gallons per day (gpd), or millions of gallons per day (mgd).

DOMESTIC WASTEWATER

Domestic Wastewater is wastewater generated from single and multifamily residences, permanent mobile home courts, and group housing facilities such as nursing homes. Domestic wastewater flow is generally expressed as a unit flow based on the average contribution from each person per day. The unit quantity is expressed in terms of gallons per capita per day (gpcd).

EQUIVALENT RESIDENTIAL UNIT (ERU)

An equivalent residential unit (ERU) is a baseline wastewater generator that represents the average single-family residential household. Average annual flow contributed by a single-family household, or ERU, is usually expressed in units of gallons per day (gpd).

NON-RESIDENTIAL WASTEWATER

Non-residential wastewater is wastewater generated from business activities, such as restaurants, hotels and motels, retail and wholesale stores, service stations, schools, public facilities, and office buildings. Non-residential wastewater quantities are expressed in this Plan in terms of ERUs, by dividing the total flow per category by the average flow per ERU.

INFILTRATION

Infiltration is groundwater entering a sewer system by means of defective pipes, pipe joints or manhole walls. Infiltration quantities exhibit seasonal variation in response to groundwater

levels. Storm events or irrigation can trigger a rise in the groundwater levels and increase infiltration. The greatest infiltration is observed following significant storm events during prolonged periods of precipitation. Based on an analysis of Sequim WRF flow records, irrigation did not appear to be a major source of infiltration. Since infiltration is related to the total amount of piping and appurtenances in the ground and not to any specific source of wastewater, it is generally expressed in terms of the total land area being served. The unit quantity generally used is gallons per capita per day (gpcd), or gallons per acre per day (gpad). To the extent feasible, WRF flow records are utilized to characterize infiltration in the Sequim system on the basis of gallons per acre per day during dry and wet weather periods.

INFLOW

Inflow is surface water entering the sewer system from yard, roof and footing drains, from cross connections with storm drains and through holes in manhole covers. Peak inflow occurs during heavy storm events when storm sewer systems are taxed beyond their capacity, resulting in hydraulic backups and local ponding and discharge into the sanitary sewer. Inflow, like infiltration, can be expressed in terms of gallons per capita per day or gallons per acre per day. Typically, inflow and infiltration (I/I) are combined and used as a guide to making recommendations on improving collection system performance, efficiency and capacity.

AVERAGE DRY WEATHER FLOW (DWF)

Average dry weather flow is wastewater flows during periods when the groundwater table is low and precipitation is at its lowest of the year. For the Sequim area, the dry weather flow period will be defined as July, August, and September. During these months, the wastewater strength is highest due to the lack of dilution with the ground and surface water components of I/I. Higher strength wastewater coupled with higher temperatures and longer detention times in the sewer system create the greatest potential for system odors during this time. The average dry weather flow is the average daily flow during July, August, and September.

AVERAGE ANNUAL FLOW (AAF)

Average annual flow is the average daily flow over a calendar year. This flow parameter is used to estimate annual operation and maintenance costs for treatment and pump station facilities.

AVERAGE WET WEATHER FLOW (AWWF)

Average wet weather flow is wastewater flows during periods when the groundwater table is high and precipitation is at its highest levels of the year. For the Sequim area, the wet weather flow period will be defined as November, December, January, and February. This flow can be used in addition to maximum month flow to project flows and loadings and to compare them with the design capacity of the WRF. Average wet weather flow is a more realistic method to project future flows than maximum month flow, which can be skewed and overly conservative since it is based on flows for a single month.

MAXIMUM MONTH FLOW (MMF)

Maximum month flow is the highest average daily flow for any given month during a calendar year. In western Washington, the maximum month flow typically occurs during winter months. This wintertime flow is composed of the normal domestic, commercial and public use flows with significant contributions from I/I. The predicted maximum month flow at the end of the design period is used as the design flow for sizing treatment processes and selecting treatment equipment.

PEAK HOUR FLOW (PHF)

Peak hour flow is the highest hourly flow during a calendar year. The peak hour flow occurs in response to a significant storm event preceded by prolonged periods of rainfall, which have previously developed a high groundwater table in the service area. Peak hour flows are used in sizing the hydraulic capacity of wastewater collection, treatment and pumping components. Peak hour flow is typically determined from treatment plant flow records. Ecology has also developed a formula to calculate a "peaking factor" that may be applied to the average design flows in order to estimate peak hour flows. This formula is based on the population as well as the average annual flows (AAF).

PATHOGENIC MICROORGANISMS

Pathogenic microorganisms found in untreated municipal wastewater can be classified into three broad groups; bacteria, parasites, and viruses. Potential transmission of infectious disease by pathogenic organisms is one of the greatest concerns associated with reuse of treated municipal wastewater. One of the primary

means of ensuring reclaimed water can be used for beneficial use is to provide adequate treatment to reduce or eliminate pathogens. Indicator organisms such as fecal coliform and total coliform are generally used to provide a representative measurement of the amount of pathogenic microorganisms present in the effluent. Mechanisms for pathogenic microorganism reduction include removal by sedimentation and filtration and inactivation.

BIOCHEMICAL OXYGEN DEMAND (BOD)

Biochemical oxygen demand (BOD) is a measure of the oxygen required by microorganisms in the biochemical oxidation (digestion) of organic matter. BOD is an indicator of the organic strength of the wastewater and is measured in either milligrams per liter (mg/L) or pounds per day (lb/day). If BOD is discharged untreated to the environment, biodegradable organics will deplete natural oxygen resources and result in the development of septic (anaerobic) conditions. BOD data together with other parameters are used in the sizing of the treatment facilities and provide a measurement for determining the effectiveness of the treatment process. The term BOD typically refers to a 5-day BOD, often written BOD_5, since the BOD test is typically run for 5 days. The total BOD of a wastewater is composed of two components – a carbonaceous oxygen demand (CBOD) and a nitrogenous oxygen demand (NBOD).

SUSPENDED SOLIDS

Suspended solids are the solid matter carried in the waste stream. The total suspended solids (TSS) in a wastewater sample are determined by filtering a known volume of the sample, drying the filter paper and measuring the increase in weight of the filter paper. TSS is expressed using the same terms as BOD; milligrams per liter for concentration and pounds per day for mass load. The amount of TSS in the wastewater is used in the sizing of treatment facilities and provides another measure of the treatment effectiveness. The concentration of TSS in wastewater affects the treatment facility biosolids production rate, storage requirements, and ultimate disposal requirements.

CHLORINE

The City of Sequim uses ultraviolet disinfection as its primary disinfectant. Hypochlorite, a form of chlorine, is available at the WRF as a backup disinfectant and for control of algae growth in

non-potable water. Hypochlorite is also available at the irrigation pump house at the reuse facilities near Carrie Blake Park. Chlorine is a chemical that acts as a strong oxidant. Chlorine is a toxic chemical and is lethal to aquatic biota if present in too high a concentration. Additionally, some organic constituents may react with the chlorine to interfere with chlorination or form toxic compounds, such as chloroform, that can have long-term adverse effects on the beneficial uses of the waters to which they are discharged. To minimize the effects of potentially toxic chlorine residuals on the environment, it has sometimes been found necessary to dechlorinate wastewater treated with chlorine or substitute alternative disinfection systems such as ultraviolet disinfection.

OTHER CONTAMINANTS OF CONCERN

Other contaminants of concern in wastewater include nutrients, priority pollutants, and heavy metals. The City's NPDES permit requires the removal of biodegradable organics, suspended solids, nitrogen and pathogens. Many recently developed stringent standards deal with nutrient and priority pollutant removal.

Nutrients such as nitrogen, phosphorus, and carbon are essential requirements for growth. When discharged to the aquatic environment, these nutrients can lead to the growth of undesirable aquatic life. When discharged in excessive amounts on land they can lead to the pollution of groundwater. Additionally, in too high a concentration, nutrients, particularly ammonia, can be toxic to aquatic life. The City has effluent ammonia limitations in its NPDES permit due to its discharge into Bell Creek to protect aquatic biota.

Priority pollutants are organic and inorganic compounds selected on the basis of their known or suspected carcinogenicity, mutagenicity, teratogenicity, or high acute toxicity. Examples of these compounds found in wastewater include metals, pesticides and poly-chlorinated biphenyls (PCBs), and poly-aromatic hydrocarbons (PAHs). Inorganic constituents, including heavy metals, are often added to wastewater from commercial and industrial activities and may require removal if the wastewater is to be reused, or if the presence of the metals will adversely affect the receiving water. Some heavy metals (most notably copper) can be present in wastewater due to leaching from drinking water pipes.

Sequim, with little industrial flow to its WRF, is not required to monitor for heavy metals on a frequent basis.

EXISTING CITY POPULATION, FLOWS, AND LOADINGS

EXISTING POPULATION

The 2010 U.S. Census lists the population of the City of Sequim as 6,606 persons living in 3,340 households. Based on these numbers, the average number of persons per household is 1.9. These values will be used as the starting basis for population, flow, and loading projections discussed in the following sections. The population of people outside of the City limits but within the UGA is estimated to be 2,081 people, based on a review of aerial maps, census data and population density.

To determine the number of residential units with sewer service, water consumption/billing and sewer billing records between the years of 2009 and 2011 were reviewed. The total number of sewer connections includes commercial (COM), hotel/motel/RV (HMRV), multifamily residential (MFR), public (PUB), and single-family residential connections (SFR). In 2011, the 2,193 total water connections who also received sewer service included 1,652 single-family residential connections, 341 commercial connections, 51 multi-family residential connections, 33 combined HMRV and public connections (116 irrigation connections were also provided water but not sewer service.)

The number of residential sewer customers was estimated by combining the number of SFR and MFR accounts with a current City water connection, in-City sewer accounts not provided water by the City and out-of-City sewer customers (predominantly in Bell Hill or Bell Gates). Public use facilities, commercial, and hotel/motel/RV Park units were not included in this total because they are assumed to be non-permanent sewer customers.

As shown in Table 2-1, the number of sewer customers in 2011 was approximately 6,742. This total includes the majority of the population of Sequim, except individuals in some areas served by septic systems along the periphery of the City, including the area around the John Wayne Marina and East Sequim.

Table 2-1 Summary of Residential Sewer Customers(1)

Location	Total Sewer /Water Connections	Total Units (4)	Persons per Household (2)	Sewer System Population
In City SFR (provided water and sewer by City)	1,652	1,862	1.9	3,538
In City MFR (provided water and sewer by City)	51	1,152	1.9	2,189
In City Residential (provided sewer but not water)	150	150	1.9	285
Out of City Residential(3)	332	332	2.2	730
TOTAL	**2,183**	**3,494**		**6,742**

(1) Data is estimated from City billing records for the year 2011.
(2) From the Washington State Office of Financial Management.
(3) Includes Bell Hill and Bell Gates neighborhoods. Provided sewer service, but not water, by the City.
(4) Total units > total connections due to multiple dwelling units served off of single water system connections. Duplexes are one example of this.

Seasonal Users and Seasonal Usage Variability

The total number of users served by a water system typically varies throughout the year as residents go on vacations or visit second homes and visitors stay for business or vacation. The variability in residents is quantified by analyzing both water usage records and the number of standby accounts provided by the City.

Monthly hotel occupancy rates were collected by the City for the year 2011. Rates varied from a peak in July of approximately 70 percent occupancy to a low of 14 percent occupancy in January. Using the total current number of hotel, motel and RV units this works out to an occupancy range of 313 units to 63 units.

Table 2-2 shows the number of SFR accounts that were placed on "stand by" in any given month during 2010 and 2011. Stand-by status is granted to those residents who wish to have their water connection temporarily terminated. Contrary to having a water service disconnected, stand-by status allows a resident to resume water consumption at a time of their choosing. The number of standby accounts was used to estimate the number of seasonal accounts within the City's sewer system. The actual number of seasonal accounts will be higher than this value, since not all seasonal users will request standby status.

Table 2-2 Standby Water Account Summary for 2010 and 2011

Month	Average Accounts on Standby	Population
January	78.0	148
February	75.0	143
March	77.5	147
April	61.0	116
May	54.0	103
June	51.5	98
July	54.5	104
August	50.5	96
September	47.0	89
October	55.5	105
November	75.0	143
December	87.0	165
Winter Average(1)	**78.8**	**150** (2)

(1) Average of November, December, January, and February.
(2) Based on 1.9 persons per household from 2010 U.S. Census data.

Winter water use records were analyzed in order to corroborate the number of seasonal accounts estimated in Table 2-2. To do this, a threshold value of 20 cubic feet (cf) of monthly water usage was assumed. If a particular connection was below 20 cf, they were assumed to be part of the seasonal population. The number of connections meeting this criterion was close to the approximately 80 standby connections shown in Table 2-2. However, since this population represents such a small part of the overall community (only 4.3 percent of connections, and 2.3 percent of the population), these users will be accounted for in the overall projected flows and loading estimates for the City. This will help ensure that wastewater projections are appropriately conservative.

New water and sewer monitoring software that is currently being installed will significantly improve the ability for planning personnel to estimate the number of seasonal users. Furthermore, the new billing software will also improve data retrieval and analysis.

EXISTING FLOWS

Table 2-3 summarizes the existing WRF influent flows. Average monthly WRF flows ranged from 0.550 mgd to 0.856 mgd, while

peak day flows ranged from 0.588 mgd to 1.890 mgd for the period of January 2009 through December 2011. The average dry weather flow was 0.564 mgd and was determined by averaging the monthly average flow records for July, August, and September for the years 2009 – 2011. Average precipitation for these months was only 0.53 inches, compared with 1.73 inches for the remaining months, and is considered the dry summer period where precipitation comprises the lowest percentage of overall wastewater influent flows.

The peak day flow of 1.890 mgd was measured on May 15, 2011. This month had a total of 3.17 inches of rain, which is nearly 1.8 times higher than the average precipitation in May for the previous five years. Of the 3.17 inches of precipitation that was recorded, 51 percent fell on May 14th and May 15th. The high volume of precipitation coupled with the short time span led to exceptionally high peak day influent flows at the WRF. However, in prior years with even greater rainfall intensity, the peak day influent flows were significantly less than the 1.890 mgd measured on May 15, 2011. In 2010 the peak day rainfall intensity was 1.79 inches over 72 hours (December 10-12) while in 2009 the peak day rainfall intensity was 1.9 inches over 24 hours (January 7). For these days, peak day flows were 1.070 and 1.499 mgd, respectively. These higher rainfall intensities yet lower peak day flows suggest that the peak day flow measured on May 15, 2011, was atypically high.

Table 2-3 Existing WRF Influent Flows

Flow Type	2009	2010	2011	Design Flow (mgd)
Average Dry Weather Flow	0.560	0.568	0.564	0.564(1)
Annual Average	0.623	0.608	0.659	0.630(2)
Wet Weather Average	0.698	0.654	0.676	0.676(3)
Maximum Month	0.751	0.698	0.856	0.856(4)
Peak Day	1.499	1.070	1.890	1.890(5)
Peak Hour	-	-	2.700	2.700(6)

(1) Average influent flow for July, August, and September 2007-2011.
(2) For the years 2007 through 2011.
(3) Wet weather average influent flow for November, December, January, and February.
(4) March, 2011.
(5) May 15, 2011.
(6) Recorded at approximately 12:00 pm on May 15, 2011.

The design flows are taken to be existing based on historical trends of influent data collected at the WRF. The annual average and dry weather flows do not show a strong growth trend over time. The average dry weather flow is a good measure of the actual wastewater produced, since measurable precipitation and groundwater levels are typically low in the warmer summer months. Because the data for the period from 2007 through 2011 do not trend significantly upward, the design flows listed in Table 2-3 are valid to be used for subsequent calculations and projections of wastewater production.

Existing influent and effluent wastewater characterization as measured at the WRF is summarized in Table 2-4, while Figure 2-1 plots the average monthly influent and the monthly peak day influent.

The precipitation for November 2009, 3.84 inches total, was the greatest measured monthly amount between the years 2007 and 2011.

Figure 2-1 Recent Historical WRF Influent Flows (2005 - 2011)

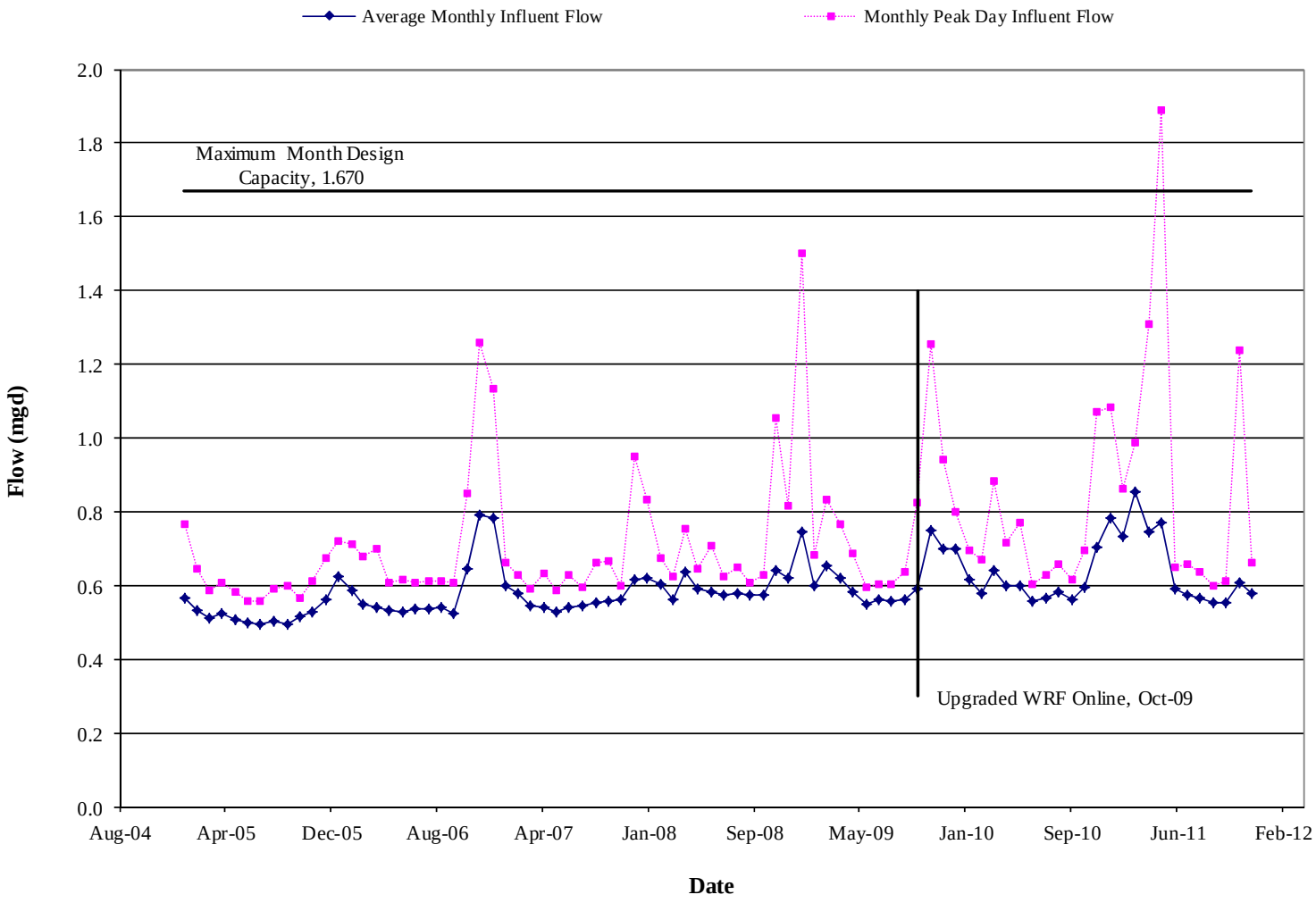


Table 2-4 Recent Historical Wastewater Characterization (2007 - 2011)

Month - Year	Precipitation (in)	Influent						Effluent					
				BOD		TSS		BOD			TSS		
		ADF[1] (mgd)	PDF[2] (mgd)	Concentration (mg/L)	Loading (lb/day)	Concentration (mg/L)	Loading (lb/day)	Concentration (mg/L)	Loading (lb/day)	Removal (%)	Concentration (mg/L)	Loading (lb/day)	Removal (%)
Jan-07	2.41	0.784	1.134	208.4	1363.7	187.4	1226.3	4.3	30.1	98.0	2.9	20.3	98.5
Feb-07	0.85	0.601	0.663	301.6	1513.0	229.8	1152.5	6.5	34.4	97.9	1.8	9.3	99.2
Mar-07	1.19	0.579	0.629	295.6	1427.9	239.5	1156.8	24.9	126.8	91.6	3.5	17.7	98.6
Apr-07	0.93	0.547	0.591	351.5	1603.0	279.3	1273.5	45.1	216.5	87.2	2.9	14.0	99.0
May-07	0.47	0.539	0.633	321.4	1445.4	269.6	1212.5	6.7	30.9	97.9	1.7	8.0	99.4
Jun-07	0.86	0.527	0.588	328.3	1443.6	286.0	1257.7	11.4	52.8	96.5	1.4	6.5	99.5
Jul-07	0.80	0.542	0.630	323.9	1466.1	266.0	1204.1	7.4	34.7	97.7	1.9	8.8	99.3
Aug-07	0.34	0.544	0.594	305.9	1387.3	271.6	1231.8	2.7	12.8	99.1	1.3	6.4	99.5
Sep-07	0.81	0.554	0.663	315.5	1457.4	250.8	1158.3	7.0	35.0	97.8	1.5	7.5	99.4
Oct-07	1.35	0.559	0.666	325.3	1517.7	258.7	1206.7	9.1	46.4	97.2	1.5	7.5	99.4
Nov-07	1.34	0.561	0.600	321.4	1503.1	276.8	1294.4	8.4	42.9	97.4	1.6	7.9	99.4
Dec-07	2.38	0.615	0.950	269.3	1380.7	247.3	1267.9	8.2	46.7	97.0	1.5	8.9	99.4
Average	**1.14**	**0.579**	**0.695**	**305.7**	**1459.1**	**255.2**	**1220.2**	**11.8**	**59.2**	**96.3**	**2.0**	**10.2**	**99.2**
Jan-08	1.59	0.622	0.834	296.5	1538.7	255.4	1325.4	10.9	64.5	96.3	2.4	14.4	99.1
Feb-08	0.85	0.602	0.675	264.1	1326.6	227.8	1143.9	18.6	106.1	93.0	2.9	16.8	98.7
Mar-08	1.22	0.562	0.624	298.6	1401.0	247.0	1158.8	17.8	95.4	94.0	5.1	27.1	97.9
Apr-08	1.49	0.637	0.754	290.0	1541.0	255.7	1358.5	13.9	79.7	95.2	3.5	20.2	98.6
May-08	0.63	0.591	0.646	329.4	1624.4	264.3	1303.2	4.7	22.9	98.6	2.7	13.2	99.0
Jun-08	1.31	0.584	0.707	319.6	1556.6	289.3	1408.7	1.9	8.8	99.4	1.6	7.4	99.4
Jul-08	0.44	0.573	0.624	339.3	1623.0	297.0	1420.6	4.0	17.5	98.8	1.3	5.6	99.6
Aug-08	0.81	0.579	0.648	322.8	1560.6	268.5	1298.3	10.5	45.4	96.8	1.7	7.5	99.4
Sep-08	0.33	0.573	0.609	308.8	1477.0	270.9	1295.8	1.4	5.6	99.6	1.1	4.3	99.6
Oct-08	0.84	0.573	0.627	316.8	1515.0	258.2	1235.0	1.6	6.6	99.5	1.2	5.0	99.5
Nov-08	3.46	0.641	1.055	296.3	1585.1	245.5	1313.6	3.2	15.9	98.9	1.7	8.7	99.3
Dec-08	2.32	0.619	0.818	280.0	1446.1	255.8	1321.1	10.7	54.5	96.2	1.8	9.0	99.3
Average	**1.27**	**0.596**	**0.718**	**305.2**	**1516.3**	**261.3**	**1298.6**	**8.3**	**43.6**	**97.2**	**2.3**	**11.6**	**99.1**
Jan-09	2.51	0.744	1.499	218.0	1355.0	212.0	1313.0	9.1	52.6	95.8	2.7	15.4	98.7
Feb-09	1.75	0.598	0.681	306.4	1527.8	299.5	1493.6	22.5	112.3	92.7	2.8	14.0	99.1
Mar-09	2.00	0.655	0.834	246.7	1348.6	281.3	1538.1	21.9	123.5	91.1	2.6	14.5	99.1
Apr-09	0.81	0.620	0.767	263.2	1361.5	262.4	1357.5	18.0	93.6	93.2	3.2	16.6	98.8
May-09	1.63	0.584	0.686	249.1	1214.9	261.8	1276.5	5.6	27.3	97.8	2.9	14.3	98.9
Jun-09	0.19	0.550	0.596	328.3	1508.1	272.9	1253.4	4.2	17.6	98.7	2.5	10.3	99.1
Jul-09	0.30	0.562	0.604	315.9	1482.0	294.9	1383.5	7.2	29.9	97.7	1.8	7.7	99.4
Aug-09	0.30	0.559	0.602	312.1	1455.0	274.3	1278.4	46.0	184.3	85.3	2.3	9.1	99.2

Table 2-4 Recent Historical Wastewater Characterization (2007 - 2011) – (continued)

Month - Year	Precipitation (in)	Influent						Effluent					
				BOD		TSS		BOD			TSS		
		ADF[1] (mgd)	PDF[2] (mgd)	Concentration (mg/L)	Loading (lb/day)	Concentration (mg/L)	Loading (lb/day)	Concentration (mg/L)	Loading (lb/day)	Removal (%)	Concentration (mg/L)	Loading (lb/day)	Removal (%)
Sep-09	0.95	0.560	0.636	302.6	1414.7	245.0	1145.4	11.8	47.1	96.1	2.1	8.3	99.1
Oct-09[3]	3.43	0.589	0.825	304.3	1496.6	258.5	1271.5	2.0	8.9	99.3	2.0	8.9	99.2
Nov-09	3.84	0.751	1.254	281.8	1766.5	284.0	1780.6	1.5	8.8	99.5	1.6	9.2	99.5
Dec-09	1.54	0.700	0.941	330.1	1926.9	288.2	1682.3	1.6	8.7	99.5	1.5	8.4	99.5
Average	**1.60**	**0.623**	**0.827**	**288.2**	**1488.1**	**269.6**	**1397.8**	**12.6**	**59.6**	**95.6**	**2.3**	**11.4**	**99.1**
Jan-10	1.54	0.698	0.799	289.4	1684.3	231.8	1348.9	1.9	10.6	99.4	1.9	10.8	99.2
Feb-10	0.76	0.617	0.695	326.9	1682.9	231.8	1193.2	1.9	9.4	99.4	1.5	7.7	99.3
Mar-10	1.82	0.577	0.672	349.7	1682.9	261.8	1259.9	1.6	7.6	99.5	1.5	7.2	99.4
Apr-10	1.62	0.640	0.882	280.3	1496.9	211.7	1130.9	1.3	6.8	99.5	2.0	10.5	99.1
May-10	2.97	0.598	0.716	325.9	1624.8	237.8	1185.4	1.4	6.8	99.6	1.1	5.2	99.5
Jun-10	0.94	0.601	0.770	290.2	1454.2	229.6	1150.5	1.2	5.6	99.6	1.6	7.7	99.3
Jul-10	0.06	0.557	0.605	311.4	1447.3	246.5	1145.8	1.6	8.2	99.5	1.2	6.0	99.5
Aug-10	0.39	0.566	0.628	314.3	1484.0	258.4	1220.2	1.9	10.9	99.4	1.0	6.1	99.6
Sep-10	1.56	0.583	0.658	350.6	1705.4	254.7	1238.9	1.8	11.2	99.5	1.0	6.0	99.6
Oct-10	1.12	0.563	0.617	343.1	1612.9	253.0	1189.2	1.8	10.5	99.5	1.0	5.5	99.6
Nov-10	2.02	0.597	0.694	289.0	1438.6	219.6	1092.9	1.7	10.3	99.4	1.0	6.1	99.5
Dec-10	2.34	0.704	1.070	259.4	1523.7	224.4	1318.1	1.3	9.3	99.5	0.9	6.1	99.6
Average	**1.43**	**0.608**	**0.734**	**310.8**	**1569.8**	**238.4**	**1206.2**	**1.6**	**8.9**	**99.5**	**1.3**	**7.1**	**99.4**
Jan-11	3.15	0.783	1.084	206.9	1352.4	193.1	1262.5	1.3	10.4	99.4	0.9	7.1	99.5
Feb-11	2.16	0.734	0.863	201.0	1231.4	199.5	1222.2	1.3	9.6	99.3	1.2	8.7	99.4
Mar-11	2.48	0.856	0.987	202.7	1447.1	187.8	1340.7	2.4	20.9	98.8	1.7	14.3	99.1
Apr-11	1.63	0.746	1.309	252.1	1569.1	230.3	1432.9	2.2	17.5	99.1	1.4	11.2	99.4
May-11	3.17	0.771	1.890	251.0	1615.7	227.6	1464.8	3.0	22.2	98.8	1.5	11.1	99.3
Jun-11	0.77	0.590	0.650	304.9	1501.5	291.1	1433.7	1.6	9.0	99.5	1.0	5.6	99.7
Jul-11	0.49	0.574	0.659	298.5	1429.0	274.1	1312.3	1.7	9.7	99.4	0.9	5.0	99.7
Aug-11	0.11	0.567	0.636	291.8	1379.5	307.8	1455.2	1.6	8.8	99.4	1.0	5.6	99.7
Sep-11	0.19	0.551	0.599	322.1	1482.0	300.8	1383.6	2.0	10.3	99.4	1.3	6.7	99.6
Oct-11	0.84	0.553	0.611	335.3	1546.0	271.5	1252.0	1.7	9.1	99.5	0.9	4.8	99.7
Nov-11	3.52	0.606	1.240	321.1	1624.1	299.6	1515.4	1.8	10.8	99.4	1.1	6.1	99.6
Dec-11	1.26	0.578	0.662	340.4	1642.9	309.3	1492.7	2.0	11.4	99.4	1.0	5.7	99.7
Average	**1.65**	**0.659**	**0.932**	**277.3**	**1485.1**	**257.7**	**1380.7**	**1.9**	**12.5**	**99.3**	**1.2**	**7.7**	**99.5**

(1) Monthly average daily flow
(2) Peak day flow
(3) Upgraded WRF online starting in October, 2009.

Residential and Non-Residential Wastewater Flows

Residential wastewater flows without I/I can be estimated by evaluating winter water consumption for residential water users. Winter water use typically does not include irrigation flows and is a more accurate reflection of water that ultimately is discharged to the sewer system than annual average water consumption if the impact of the seasonal population is considered. Water consumption records for the residential, multi-family and commercial categories were provided by the City for the period of 2009 through 2011. November, December, January and February water consumption data were used to estimate the average winter water use for the City. The winter water consumption for these months is summarized in Table 2-5.

Table 2-5 Winter Water Use Records Summary for 2009, 2010, and 2011(1)

Customer Class	2009 (gpd)	2010 (gpd)	2011 (gpd)	Percent of 2011 Total
Single-Family Residential (SFR)	221,124	216,684	208,026	39.7
Commercial (COMM)	198,490	166,778	165,486	31.6
Hotel, Motel, RV (HMRP)	49,839	42,057	42,642	8.1
Multi-Family Residential (MFR)	114,663	105,790	107,956	20.6
Total	**584,115**	**531,310**	**524,109**	**100.0**

(1) In-City water use for the months of November, December, January, and February.

Single family residential winter water consumption is approximately 40 percent of the total winter water used by the City of Sequim water customers. Water billing records show an average of approximately 1,652 single-family residential water connections, and 1,860 units were actively consuming water during the winter months for 2008 through 2011.

The average daily water consumption per SRF account (or ERU) was calculated by averaging the winter water consumption for each month for the years 2009, 2010, and 2011, then dividing by the number of SFR accounts for that particular year. It is estimated, based on an evaluation of WRF flow and water consumption records, that 95 percent of water consumed is discharged to the sewer system. Using this estimate, the average value of

wastewater discharged per household or per ERU is 110 gallons per day.

This value of 110 gpd per ERU is below the textbook design range of 119 gpd to 179 gpd for a 2.2-member household (Metcalf & Eddy, 4th Edition, 2003). However, according to the 2010 US Census the average number of persons per household within the City limits is 1.9 persons. This smaller average household size correlates with a lower winter water consumption per ERU. Using an SFR population per household of 1.9 and an ERU wastewater production rate of 110 gpd, the per capita wastewater production rate is approximately 58 gpcd. Table 2-6 summarizes these data and calculations.

Data for 2009 through 2011 show a decrease in winter water consumption, but only a slight decrease in the number of connections. There has also been a steady increase in the City's population by about 1.5 to 2.0 percent. This downward trend in winter water use could be due to an increased effort to reduce water use and promote water conservation, or a slight increase in the number of seasonal users who travel elsewhere during the rainy winter months.

Table 2-6 Summary of Winter Water Use and per Capita Wastewater Production for 2009, 2010, and 2011(1)

Parameter	2009	2010	2011
SFR Winter Water Consumption (gpd)	221,124	216,684	208,026
Number of SFR Water Connections	1,866	1,861	1,862
Water Consumption per SFR (gpd)	119	116	112
Wastewater production per SFR (gpd)(2)	113	111	106
Average SFR Household size (persons)	1.9	1.9	1.9
Wastewater Production (gpcd)	59	58	56
Average Wastewater Production (gpcd)	**58**		

(1) Sequim-only data (does not include Bell Hill, etc.)
(2) Equal to 95 percent of water consumption.

Seasonal Population Flows

Using this value of 58 gpcd for average per capita wastewater production, and the number of standby accounts determined above (80 accounts) an estimated 8,800 gallons per day of wastewater is attributed to the seasonal population within the City. Because this quantity is small compared to total winter use, the data available

for accurately analyzing the seasonal population is inadequate, and the fact that the seasonal population could significantly drop at any time due to a multitude of factors (economics, disasters, etc.) the wastewater production for the City should be based on equivalent residential units (ERUs) and should include the small flows attributed to the City's seasonal population.

Number of ERUs

Table 2-3 shows that the average daily dry weather flow to be approximately 564,000 gpd, which includes a small amount of I/I flow. If the estimated I/I component of this dry weather flow is removed, we can estimate the number of ERUs served within the City's collection system. Using a value of 550,000 gpd (base flow) and 110 gpd per ERU the total number of sewer ERUs in 2011 was 5,000. With a 2011 population of sewered customers (both in-City and out-of-City) of approximately 6,742 and an average of 1.9 persons per residence, the total number of residential ERUs is approximately 3,546. Subsequently, it is estimated that the number of commercial, school and State Park ERUs is equal to the total ERUs minus the residential ERUs, or approximately 1,453. Thus, it is estimated that approximately 70 percent (including Bell Hill) of the total number of sewer ERUs are residential and 30 percent of the total number of sewer ERUs are commercial. This estimate is reasonably consistent with winter water consumption records for residential and commercial customers.

Infiltration and Inflow

The amount of infiltration and inflow (I/I) can typically be estimated based on an daily average, maximum month, peak day, and peak hour basis by subtracting the existing dry weather flow at the WRF from the existing daily average, maximum month, peak day, and peak hour flows at the WRF, respectively. Precipitation and WRF flow records from 1999 through 2011, as illustrated in Table 1-2, show that the months of October through March have the highest precipitation and influent flow.

Maximum month I/I (86 gpad) was based on influent data from March, 2011. This value is twice as much as the estimate from the *2008 Engineering Report* (41 gpad). This is likely due to the fact that March 2011 had the highest maximum month WRF influent flows of all months after 2005. The ratio of March 2011 to the

remaining monthly average flow was 1.33. This value is the highest of any maximum month:remaining month ratio since 2005 and suggests that March values were atypical. As a result, it is likely not a true representation of the I/I that would typically be present within the collection system. A more typical value can be obtained by using the daily average wet weather flows to calculate I/I. This value is an estimated 36 gpad and is shown in Table 2-7.

The estimate of peak hour I/I is more complex due to the diurnal flow variations in sanitary flow. The City of Sequim has a large retiree population and therefore, the typical diurnal flow variation seen for most municipalities is likely to be dampened and spread out over a longer time period throughout the day. The diurnal sanitary peaking factor was determined by reviewing influent flow monitoring data to the WRF during consecutive dry days in the months of May (23rd, 24th, and 25th), August (10th, 11th, and 12th), and November (8th, 9th, 10th, and 11th) in 2011. The 2011 peaking factor is approximately 2.24, which is equivalent to the 90th percentile of all the calculated peaking factors for the times listed above. The peak hour influent flow due to I/I was determined from influent flow meters which record the influent flow every 5 minutes. On the peak flow day, May 15, 2011, the influent circular flow chart recorded a peak hour flow of 2.70 mgd at approximately 12:00 p.m. This measured flow occurred after 1.61 inches of rainfall was measured on May 14th and May 15th. Although this rain intensity was not as significant as on prior peak flow days (January 2009 and November 2011), the flow to the WRF was up to 20 percent higher than the corresponding dates with higher rainfall intensity. While the reason for this fact is unknown, it does suggest that using this value for peak day flow projections would be excessively conservative.

The average dry weather peak hour flow to the WRF was obtained by averaging dry weather flows in July of 2009, 2010, and 2011, at 12:00 p.m. This value was subtracted from the peak hour flow that was also recorded at 12:00 p.m. on May 15, 2011 to determine the peak hour I/I component. The peak hour I/I flow is calculated as a separate component expressed as gallons per acre per day as summarized in Table 2-7. The service area for 2011 was comprised of approximately 3,541 sewered acres.

The estimated peak hour I/I rate of 508 gpad is less than the peak hour I/I rate of 539 gpad established in the *2003 Wastewater*

Comprehensive Plan, but slightly more than the 478 gpad listed in the *2008 Engineering Report*. Since estimates for peak hour I/I are used for modeling purposes and identifying critical areas within the collection system, it is an important result that estimates for the peak hour I/I component have not varied significantly over the last 10 years.

In 2005, the City lined approximately 1 mile of pipeline in the vicinity of 5th Avenue to Sunnyside along West Maple Street, West Bell Street, and West Washington Street. The City has also been actively reducing I/I by diverting storm water entering the sewer system from roof drains from the sanitary sewer system. The City has also used newer technology and methods to seal leaks within manholes and manhole inlet pipes, as well as to seal manhole rings. The City has a strong commitment to reducing I/I and will continue to actively reduce I/I.

The summarized data for I/I for January 2009 through March 2011 in Table 2-7 will be used to estimate future flows.

Table 2-7 Estimated Infiltration and Inflow(1)

Flow Type	Flow (mgd)	Base Flow (mgd)	I/I (mgd)	Service Area (acre)(2)	2012 GSP I/I (gpad)(3)	2003 WWCP I/I (gpad)(4)	2008 WRF ER I/I (gpad)(5)
Annual Average Daily Flow	0.659	0.550	0.109	3,541	31	3.3	9.1
Average Daily Wet Weather(6)	0.676	0.550	0.126	3,541	36	-	-
Maximum Month (March 2011)	0.856	0.550	0.306	3,541	86	50	41
Peak Day (May 15, 2011)	1.890	0.550	1.34	3,541	378	354	189
Peak Hour (May 15, 2011)	2.700	0.90(7)	1.800	3,541	508	539	478

(1) Based on flow data from January 2009 – December 2011.
(2) Total area includes parks and open spaces. Estimated 2008 sewer service area.
(3) GSP = General Sewer Plan.
(4) WWCP = Wastewater Comprehensive Plan.
(5) WRF ER = Water Reclamation Facility Engineering Report.
(6) Average Daily flows for November, December, January, and February for 2011.
(7) Average dry weather flow at 12:00 p.m. from selected May 2011 daily flow records (the time of peak hour flow on May 15th, 2011).

EXISTING LOADINGS

The City's NPDES permit establishes discharge limitations for reclaimed water. This permit is included as Appendix C.

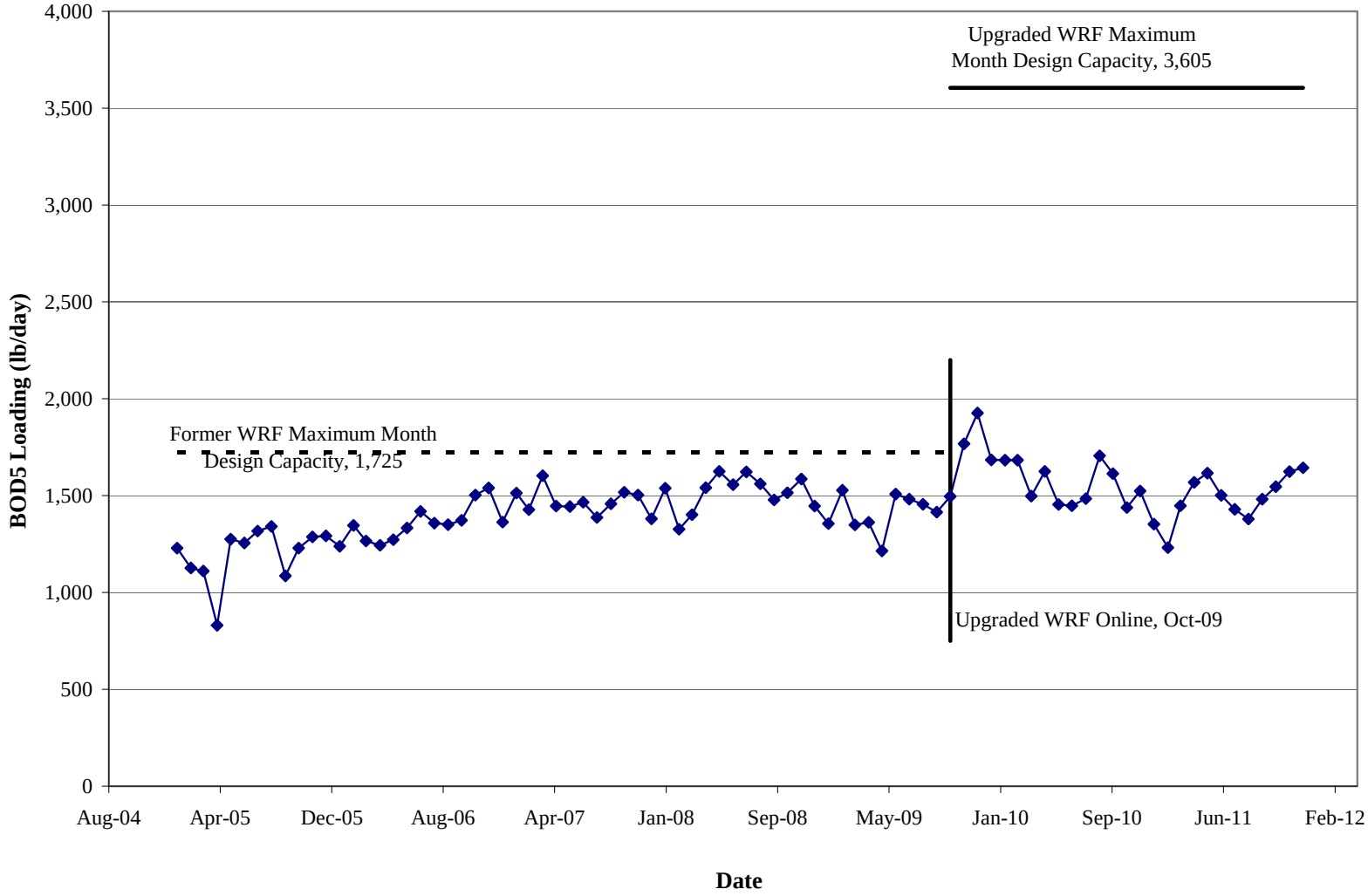
BOD_5

Monthly average influent BOD_5 loadings ranged from 1,215 lb/d to 1,927 lb/d between January 2007 and December 2011. The monthly average influent BOD_5 design loading of 3,605 (Phase 1A/1B plant) was never exceeded during the period of analysis. The average influent BOD_5 concentration for the period of analysis was 297 mg/L. Figure 2-2 shows the influent BOD_5 loading in pounds per day for the period of January 2005 through December 2011.

The 2011 average loading of 1,485 lb/day and a total sewered population of 6,742 for 2011 translates to an average BOD_5 loading of 0.22 ppcd. This value is approximately 10 percent higher than the Ecology Orange Book criteria of 0.2 ppcd. The average BOD_5 load per ERU of 0.30 lb/day/ERU (pounds per ERU per day) is determined by dividing the 2011 average BOD_5 load of 1,485 lb/d by the total number of ERUs (5,000) in 2011.

To convert the maximum month BOD_5 load to an ERU basis, the number of ERUs (5,000) and maximum month BOD_5 load of 1,927 lbs for the analysis period have been used to calculate a maximum month BOD_5 per ERU loading of 0.39 lb/day/ERU. The per capita BOD maximum month loading is 0.29 ppcd assuming a sewered population of 6,742. The ratio of the maximum month BOD_5 loading to the annual average BOD_5 loading is 1,927:1,485 or 1.30:1. This ratio is used in the development of future flow and loadings to the WRF later in the chapter.

Figure 2-2 Influent BOD_5 Loading, 2005 - 2011

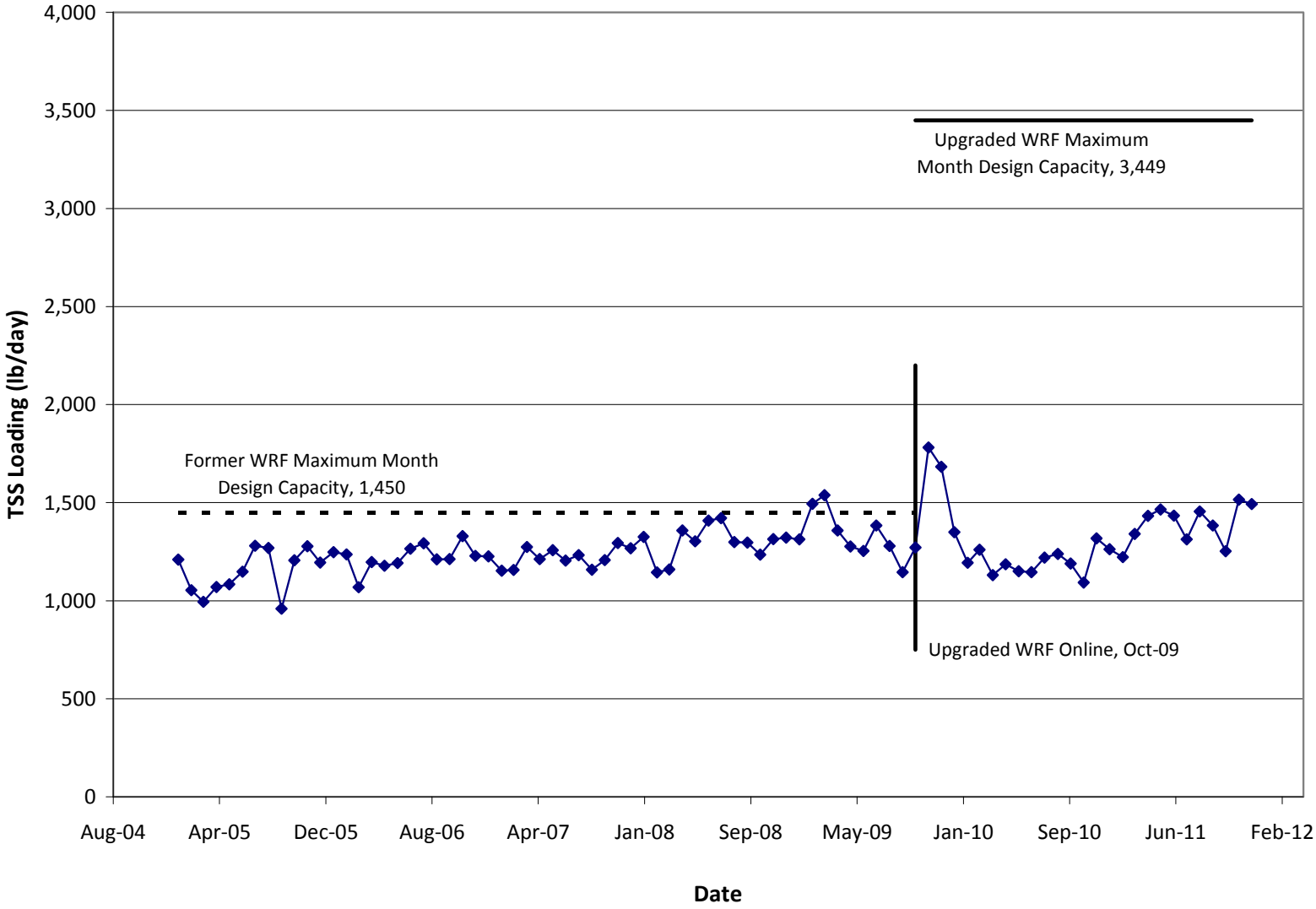


Total Suspended Solids

Monthly average influent TSS loadings ranged from 1,093 lb/d to 1,781 lb/d between January 2007 and December 2011. The monthly average influent TSS design loading of 3,449 (Phase 1A/1B plant), nor the former design loading of 1,450 lb/day was never exceeded during the period of analysis. The average influent TSS concentration for the period of analysis was 297 mg/L. Figure 2-4 shows the influent TSS loading in pounds per day for the period of January 2005 through December 2011..

The 2011 average month loading of 1,381 lb/day, when divided by the sewered population and the number of ERUs leads to a value of 0.20 lb per capita per day and 0.28 lb per ERU per day, respectively. The maximum month TSS loading for the period of 2009 through 2011 was 1,781 lbs/day. Using the same population and ERU values derived for the BOD analysis, this results in a maximum month TSS loading of 0.26 lb per capita per day and 0.36 lb per ERU per day. The ratio of the maximum month TSS loading to the annual average TSS loading is 1,781:1,381 or 1.29:1. This ratio is used in the development of future flow and loadings to the WRF later in the chapter.

Figure 2-3 Influent TSS Loading, 2005-2011



PROJECTED CITY POPULATION, FLOWS, AND LOADINGS

Projected wastewater flows and loadings are based on historical loadings per ERU for the City, the projected residential population, projected new commercial flow and projected new service areas. Population projections for the 20-year planning horizon have been estimated for the probable future Sequim sewer service area using recommendations from the City Planner. A 2.0 percent annual growth rate was assumed for all years within the 20-year planning period. This growth rate was used to project the future sewer service area population for the areas inside the existing City limits, outside the UGA for the currently sewered area (Bell Hill), and the unincorporated UGA.

PROJECTED POPULATION

Population projections for the 20-year planning horizon are estimated for the probable future City of Sequim wastewater service area using an annual growth rate of 2.0 percent as recommended by the City Planner. As noted earlier in this chapter, it is estimated that 2,081 people live within the UGA, but outside the Sequim City limits.

Based on conversations with the Public Works Department, it is anticipated that all areas in the unincorporated UGA will be annexed at an assumed rate of 4.0 percent per year. At this rate, all areas currently in the unincorporated UGA (approximately 1,350 acres) will be annexed by the year 2032.

Table 2-8 shows the projected population for both the City and the sewer service area, along with the projected number of sewer ERUs. A buildout population of 28,880 for the UGA was assumed (*2008 Engineering Report*, Gray & Osborne).

Sewered population for each year was estimated by combining the sewered customers in the City, customers outside the UGA (including the Bell Hill and Bell Gates regions), and customers that are in regions of the UGA that are annexed by the City. Population growth assumptions include:

- City population increases at an annual growth rate of 2 percent.
- Population outside the City limits, but within the UGA, will also grow at an annual rate of 2 percent.

- Residences with septic systems within the existing (2011) City limits will connect to the City sewer system at an annual rate of 1 percent.
- The City will annex additional regions of the UGA at an annual rate of 4 percent.
- These newly annexed regions will be immediately connected to the City sewer system.

Table 2-8 Total and Sewered Population Projections

Year	City Population (Incl. Annexed Area)	Total ERUs	Total Sewered Population in Service Area[(1)(2)]
2011	6,738	5,000	6,743
2012	6,873	5,233	7,082
2013	7,010	5,406	7,346
2014	7,151	5,584	7,617
2015	7,294	5,766	7,895
2016	7,439	5,954	8,181
2017	7,588	6,146	8,476
2018	7,740	6,344	8,778
2019	7,895	6,547	9,089
2020	8,053	6,755	9,408
2021	8,214	6,969	9,737
2022	8,378	7,188	10,075
2023	8,546	7,413	10,422
2024	8,716	7,644	10,778
2025	8,891	8,062	11,145
2026	9,069	8,308	11,522
2027	9,250	8,561	11,909
2028	9,435	8,820	12,307
2029	9,624	9,086	12,716
2030	9,816	9,360	13,136
2031	10,012	9,640	13,721
2032	10,213	9,928	14,119
Buildout	28,800	19,877	29,900

(1) Includes Bell Hill/Bell Gates and annexed unincorporated areas.
(2) Does not include Carlsborg population.

PROJECTED FLOWS

Future WRF flows are projected based on a dry weather flow of 110 gpd/ERU. The assumption was made that in the existing sewer system, the I/I contribution to the WRF will increase as the sewer service area increases. The I/I rate for newly developed areas will differ from the existing I/I rate. The I/I rate for the newly developed areas was estimated based on 20 percent of the existing I/I rate and is increased 2.5 percent per year starting in 2019. New sewers typically have minimal I/I; however, the I/I will increase over time as the sewers age and deteriorate. Although sewer rehabilitation and/or replacement may serve to further decrease I/I in the future, an incremental increase in the I/I rate provides a conservative estimate for WRF sizing.

To estimate annual average, maximum month, and peak day flows, the I/I flow rates (Table 2-7) were added to the base level wastewater flows from the projected population to obtain the respective future WRF influent flow rates.

To estimate peak hour flow, the peak hour I/I was added to a sanitary sewer peaking factor multiplied by the dry weather average flow. The domestic sewer peaking factor is estimated for 2012 and 2032 using the current measured peaking factor (2.24) and applying a 5 percent decrease in the factor over 20 years to reflect the predictions of the population-based peaking factor equation recommended in the Department of Ecology's *Criteria for Sewage Works Design*, 2008. The equation predicts a decrease in peaking factor of 6 percent, however, a conservative estimate was used assuming the peaking factor will decrease by only 5 percent by 2032. The sanitary sewer peaking factor will likely decrease even further as the relative population of retirees increases. A summary of existing and projected flows is given in Table 2-9 and is shown graphically in Figure 2-4.

Table 2-9 Wastewater Flow Projections for Sewered Areas[1]

Year	Total Sewered Population	Total Sewer ERUS	Annual Average Flow (mgd)[2]	Max Month Flow (mgd)[3]	Peak Day Flow (mgd)[4]	Peak Hour (mgd)[5]
2011	6,743	5,000	0.659	0.856	1.890	2.662
2012	7,082	5,233	0.685	0.883	1.924	2.711
2013	7,346	5,406	0.705	0.903	1.947	2.744
2014	7,617	5,584	0.725	0.924	1.971	2.778
2015	7,895	5,766	0.745	0.945	1.995	2.812
2016	8,181	5,954	0.766	0.967	2.019	2.847
2017	8,476	6,146	0.787	0.989	2.045	2.883
2018	8,778	6,344	0.809	1.011	2.071	2.919
2019	9,089	6,547	0.833	1.036	2.102	2.963
2020	9,408	6,755	0.856	1.061	2.134	3.008
2021	9,737	6,969	0.881	1.087	2.168	3.055
2022	10,075	7,188	0.906	1.113	2.204	3.105
2023	10,422	7,413	0.931	1.141	2.242	3.157
2024	10,778	7,644	0.958	1.170	2.281	3.211
2025	11,145	8,062	1.005	1.219	2.342	3.297
2026	11,522	8,308	1.034	1.250	2.385	3.356
2027	11,909	8,561	1.063	1.281	2.429	3.417
2028	12,307	8,820	1.093	1.314	2.476	3.480
2029	12,716	9,086	1.124	1.348	2.524	3.546
2030	13,136	9,360	1.155	1.382	2.574	3.614
2031	13,721	9,640	1.188	1.418	2.626	3.684
2032	14,119	9,928	1.221	1.455	2.679	3.756
2040	16,851	11,905	1.454	1.715	3.084	4.290
2050	20,281	14,385	1.733	2.005	3.433	4.730
Buildout	29,990	19,877	2.837	3.038	3.963	6.890

(1) Does not include Carlsborg.

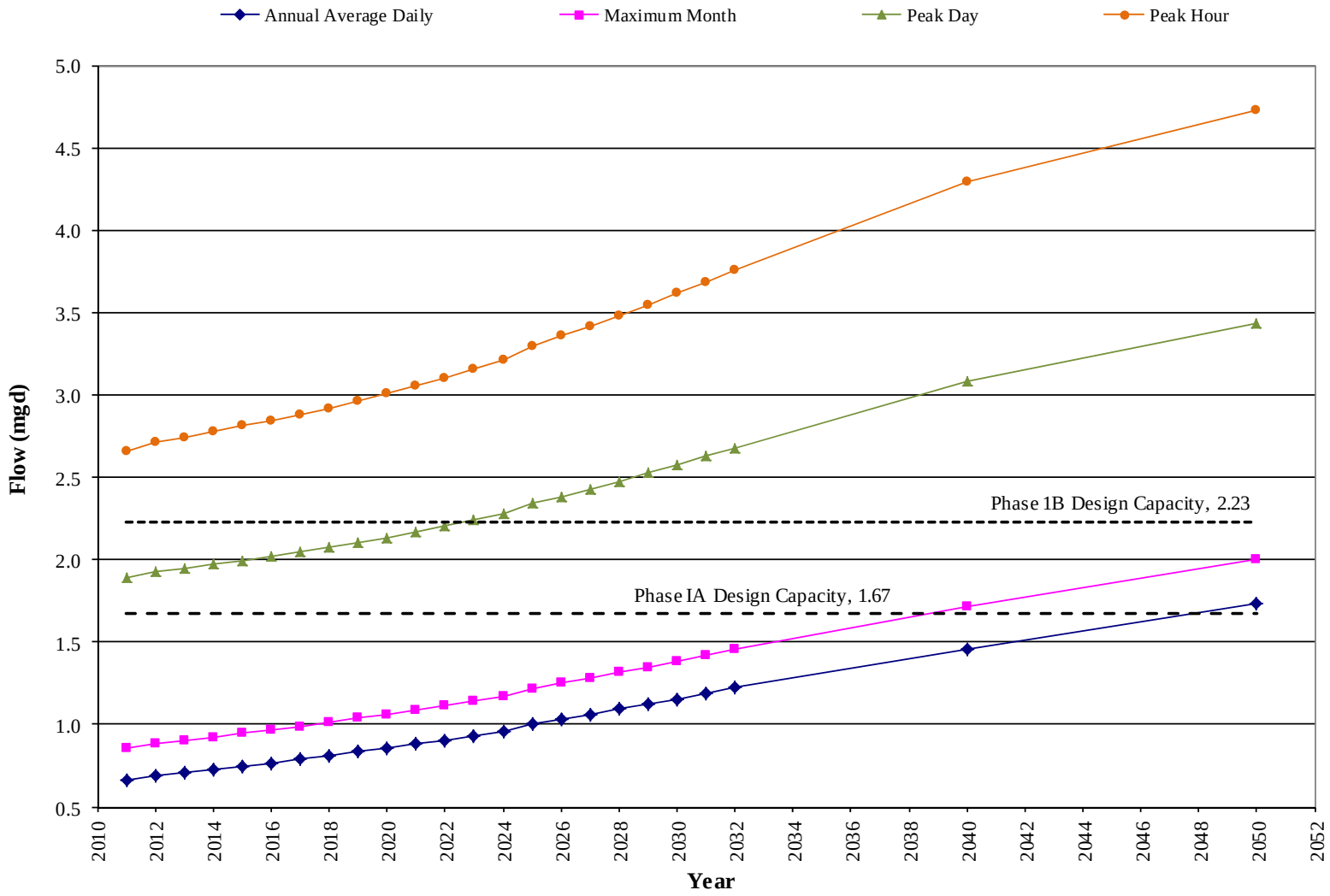
(2) AAF = (ERUs · 110 gpd/ERU) + (sewered acres · AA I/I) + (new sewered acres · adjustment for age · AA I/I).

(3) MMF = (ERUs · 110 gpd/ERU) + (sewered acres · MM I/I) + (new sewered acres · adjustment for age · with MM I/I).

(4) PDF = (ERUs · 110 gpd/ERU) + (sewered acres · PD I/I) + (new sewered acres · adjustment for age · PD I/I).

(5) PHF = 0.7 · peaking factor · CERUs · 110 pged) + (sewered acres · PH I/I) + (new sewered acres · adjustment for age · PH I/I).

Figure 2-4 Projected WRF Influent Flows



The buildout scenario is based on a total City population of 28,800 as projected in the City's draft *2006 Comprehensive Plan Update*, which also served as the basis for buildout projections in the *2008 Engineering Report*. Based on a 2010 City population of 6,606 an annual growth rate of 2.0 percent, and full annexation of the unincorporated UGA within 20 years, the City population will reach 28,800 approximately by the year 2082. Table 2-10 summarizes population and flow projections for the City of Sequim over the 20-year planning period.

Table 2-10 Existing and Projected Wastewater Flows Summary

Parameter	Year			
	2011	2018	2032	Buildout
City Population	6,738	8,508	12,987	28,800
Sewer Population	6,743	8,778	14,119	29,990
Sewer Area	3,541	3,919	4,675	5,370
Total ERUs	5,000	6,344	9,928	19,877
Annual Average Flow (mgd)	0.659	0.809	1.221	2.837
Maximum Month Flow (mgd)	0.856	1.011	1.454	3.038
Peak Day Flow (mgd)	1.890	2.07	2.679	3.963
Diurnal Peaking Factor	2.24	2.20	2.12	1.97
Peak Hour Flow (mgd)	2.700	2.919	3.756	6.893

PROJECTED LOADINGS

BOD_5

Current wastewater characteristics reflect influent loadings typical of high strength domestic wastewater. It is assumed that the residential and commercial composition of the City and surrounding area will remain essentially the same during the 20-year planning period.

Future WRF maximum month BOD_5 and TSS loadings are estimated by multiplying the projected number of ERUs by the respective ERU-based loadings. Future annual average BOD_5 and TSS loadings are estimated using the ratio of the maximum month to annual average loadings of these parameters. Both the daily loading per ERU and maximum month to annual average ratios were assumed to remain constant for the 6-year and 20-year planning periods. Both the BOD_5 and TSS maximum month and annual average daily ERU loading values decreased slightly from those reported in the *2008 Engineering Report*.

The 2011 annual average and maximum month BOD_5 loadings were 0.30 lb/day/ERU and 0.39 lb/day/ERU, respectively. The 2011 ratio of the maximum month to annual average BOD_5 is 1.30:1.

Table 2-11 provides a summary of projected future WRF influent BOD_5 and TSS loadings.

Total Suspended Solids

The 2011 annual average and maximum month TSS loadings were 0.28 lb/day/ERU and 0.36 lb/day/ERU, respectively. The 2011 ratio of the maximum month to annual average BOD_5 is 1.29:1.

BOD_5 and TSS loading projections are shown graphically in Figures 2-5 and 2-6, respectively.

Table 2-11 Projected BOD_5 and TSS Loading[(1)]

Year	Average Annual BOD Loading (lb/day)	Maximum Month BOD Loading (lb/day)	Average Annual TSS Loading (lb/day)	Maximum Month TSS Loading (lb/day)
2011	1,485	1,927	1,391	1,781
2012	1,554	2,017	1,456	1,864
2013	1,606	2,083	1,504	1,926
2014	1,658	2,152	1,553	1,989
2015	1,713	2,222	1,604	2,054
2016	1,768	2,295	1,656	2,121
2017	1,825	2,369	1,710	2,189
2018	**1,884**	**2,445**	**1,765**	**2,260**
2019	1,944	2,523	1,821	2,332
2020	2,006	2,603	1,879	2,406
2021	2,070	2,686	1,939	2,482
2022	2,135	2,770	2,000	2,560
2023	2,202	2,857	2,062	2,641
2024	2,270	2,946	2,127	2,723
2025	2,394	3,107	2,243	2,872
2026	2,467	3,202	2,311	2,959
2027	2,543	3,299	2,382	3,049
2028	2,620	3,399	2,454	3,142
2029	2,699	3,502	2,528	3,237
2030	2,780	3,607	2,604	3,334
2031	2,863	3,715	2,682	3,434
2032	**2,949**	**3,826**	**2,762**	**3,536**
Buildout	5,903	7,661	5,530	7,080

Figure 2-5 Projected WRF Influent BOD_5 Loading

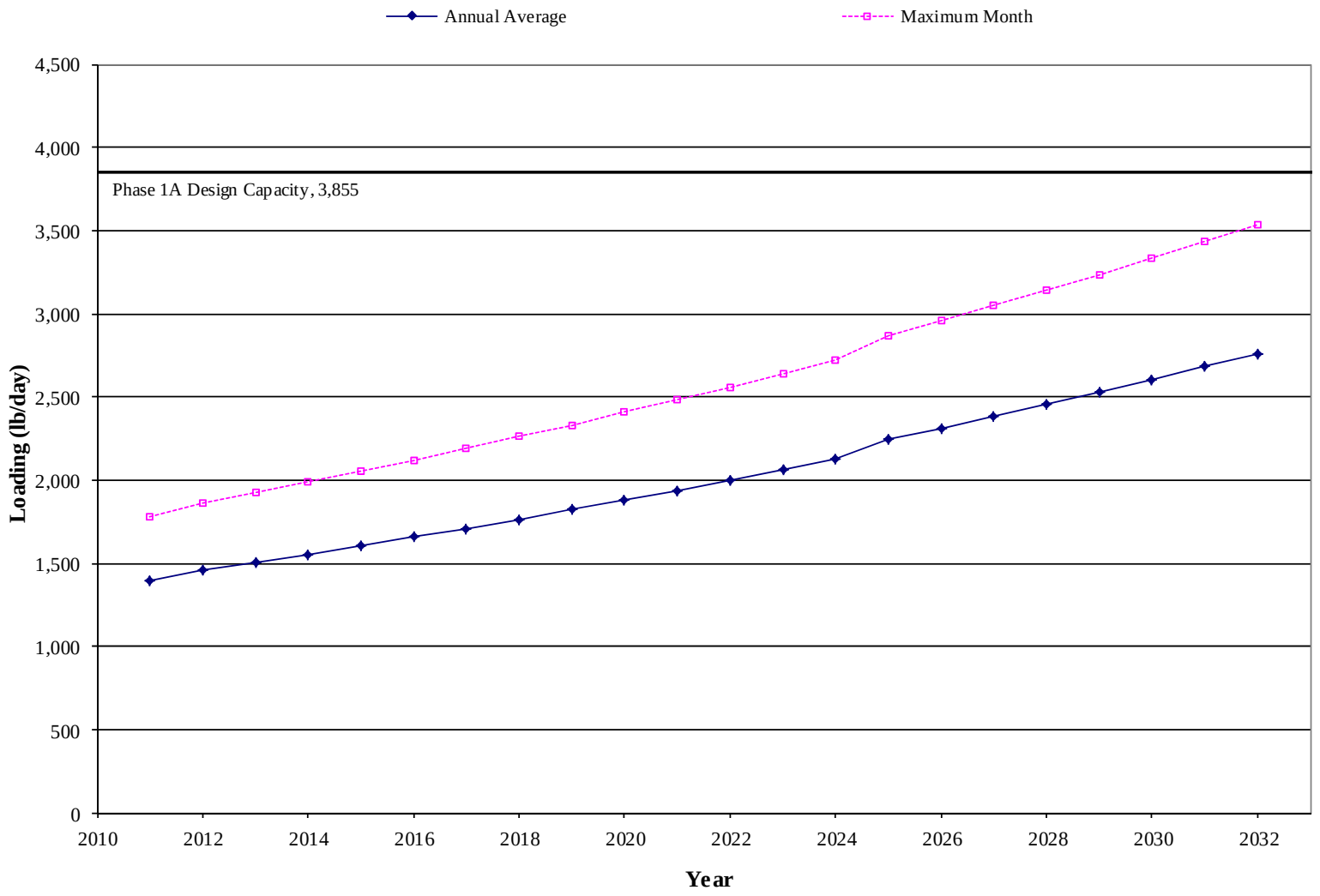
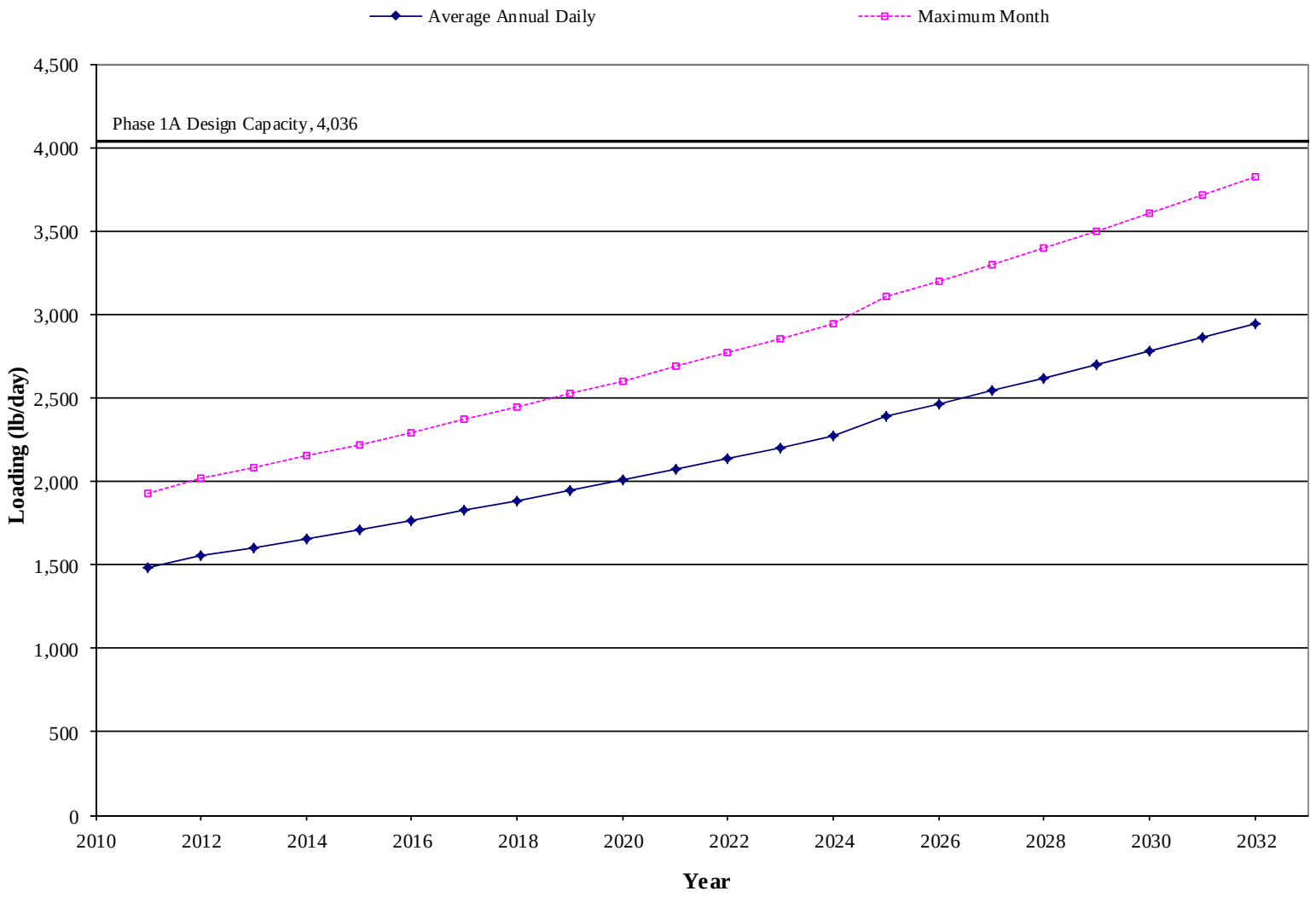


Figure 2-6 Projected WRF Influent TSS Loading



REGIONAL PLANNING DATA

As mentioned in Chapter 1, the City of Sequim and Clallam County officials are interested in adopting a regional approach to wastewater treatment. Although there are many outlying areas that could be served by the City's WRF, the most likely candidates are Carlsborg, SunLand, and Blyn because of their proximity to the City's conveyance system and treatment facility.

The tables below summarize the estimated current and projected flows and loadings for each of the three outlying regions. These projected values are added to the flow and load projections for the City to estimate the combined flows and loads should all three regions have wastewater treated at the City's WRF. Projected flows, ERUs, and loads for Sequim are taken from Table 2-9, Table 2-10, and Table 2-11, respectively.

Carlsborg

Projected flows for Carlsborg were adapted from the Department of Ecology approved *2012 Sewer Facilities Plan for Carlsborg UGA*, BHC Consultants (*2012 Sewer Facilities Plan*). The projected wastewater base flow per ERU (125 gpd/ERU) developed in the *2012 Sewer Facilities Plan* was based on an evaluation of winter water use within the Carlsborg Urban Growth Area (CUGA). The development of this 125 gpd value is consistent with accepted industry practices and is accepted for this plan without modification. Table 12-2 summarizes the wastewater flows for the Carlsborg sewer system projected for the 20-year population and flows (assumed to be the year 3032), and at buildout. In projecting future ERUs and populations for the CUGA, the assumptions used in the *2012 Sewer Facilities Plan* were used, with some exceptions, as described below.

The areal gpad I/I rates utilized for annual average, maximum month, peak day and peak hour flow projections are based on an analysis of flows in the Sequim system, with a 25 percent safety factor added. These I/I rates were higher than the areal I/I rates for annual average, maximum month, peak day and peak hour flows cited for Carlsborg projections in the *2012 Sewer Facilities Plan*. However, instead of assuming the areal rates were cumulative, the I/I rates were added to base flow to generate the annual average, maximum month, peak day and peak hour flows (consistent with typical industry practice and consistent with observed I/I flows in the Sequim system).

A diurnal peaking factor (ration of peak hour to average flow) provided in the State *Criteria for Sewage Works Design* manual was utilized in projection of peak hour flows. This had the effect of increasing peak hour flow projections relative to those in the 2012 *Sewer Facilities Plan*. The *2012 Sewer Facilities Plan* had not used a diurnal peaking factor, instead added peak hour projected I/I to peak day flow to calculate projected peak hour flow.

Since Carlsborg currently does not have any wastewater infrastructure in place, the impact of treating Carlsborg flows at the Sequim WRF would need to be re-evaluated based on the exact timing and extent of planned wastewater pipe construction. The WRF does, however, have sufficient capacity to treat the current flows from Sequim as well as the projected flows from Carlsborg.

Table 2-12 Projected Flows and Loads for Carlsborg

Parameter	2012	2018	2032	Buildout
Average Annual Flow (gpd)	25,000	41,000	82,000	639,000
Maximum Month Flow (gpd)	30,000	50,000	98,000	675,000
Peak Day Flow (gpd)	45,000	75,000	180,000	866,000
Peak Hour Flow (gpd)	90,000	150,000	327,000	2,134,000
BOD (lb/d)(1)	210	243	300	2,552
TSS (lb/d)(1)	290	350	400	2,871
ERUs	380	440	570	4,908

(1) Maximum month values.

SunLand

Current peak hour flows for SunLand are estimated to be 420,000 gpd (*Carlsborg Feasibility Study, 2011*) while maximum month flows are estimated to be 140,000 gpd. This value, when combined with the maximum month flow for Sequim from Table 2-9, suggest that the WRF has adequate capacity to treat current wastewater flows from SunLand.

Projected maximum month flows and loading from SunLand were adapted from the *2011 Feasibility Study*. Average annual flows were estimated using a typical ratio of maximum month to annual average flows of 1.2. Peak day flows were estimated using a peaking factor of 1.5, while peak hour flows were estimated using a peaking factor of 3. Loading projections for SunLand were

estimated using a typical loading ratio of 0.32 lb/day/ERU and 0.4 lb/day/ERU for BOD and TSS, respectively. ERUs were taken from the *2011 Feasibility Study* and capped at 950 ERUs, which is the maximum allowable number according to community established covenants. Table 2-13 below summarizes flow and loading projections for the SunLand region.

Table 2-13 Projected Flows and Loads for SunLand

Parameter	2012	2018	2032	Buildout
Average Annual Flow (gpd)	116,000	121,000	131,000	131,000
Maximum Month Flow (gpd)	140,000	145,000	157,000	157,000
Peak Day Flow (gpd)	210,000	217,000	235,000	235,000
Peak Hour Flow (gpd)	420,000	435,000	471,000	471,000
BOD (lb/d)(1)	264	278	305	305
TSS (lb/d)(1)	340	353	380	400
ERUs	845	880	950	950

(1) Maximum month values.

Blyn

Projected maximum month flows and loadings for Blyn were also adapted from the *2011 Feasibility Study*. To generate these values, data from the Seven Cedars Casino and Tribal Headquarters was combined with an estimate for the wastewater generation of Blyn residences. Residential wastewater flows for Blyn for 2012 were estimated using a population of 177 people, an estimate of 140 gpd/ERU, plus an estimate of 50 gpd for maximum month I/I. Estimates of wastewater flows for 2018, 2032, and buildout assume a population growth rate of 1.5 percent along with the same factors as described above. Flows estimated for the year 2050 were assumed to be equal to the buildout value. Where data was not directly available, average annual flows were estimated using the typical ratio of maximum month to annual average flows of 1.2. Peak day flows were estimated using a peaking factor of 1.5, while peak hour flows were estimated using a peaking factor of 3. Loadings were estimated using the projected flows and a typical loading concentration of 500 mg/L and 200 mg/L for BOD and TSS, respectively. Table 2-14 below summarizes flow and loading projections for the Blyn region, while Table 2-15 summarizes the combined flows and loadings for the Greater Dungeness regions including Sequim.

Table 2-14 Projected Flows and Loads for Blyn

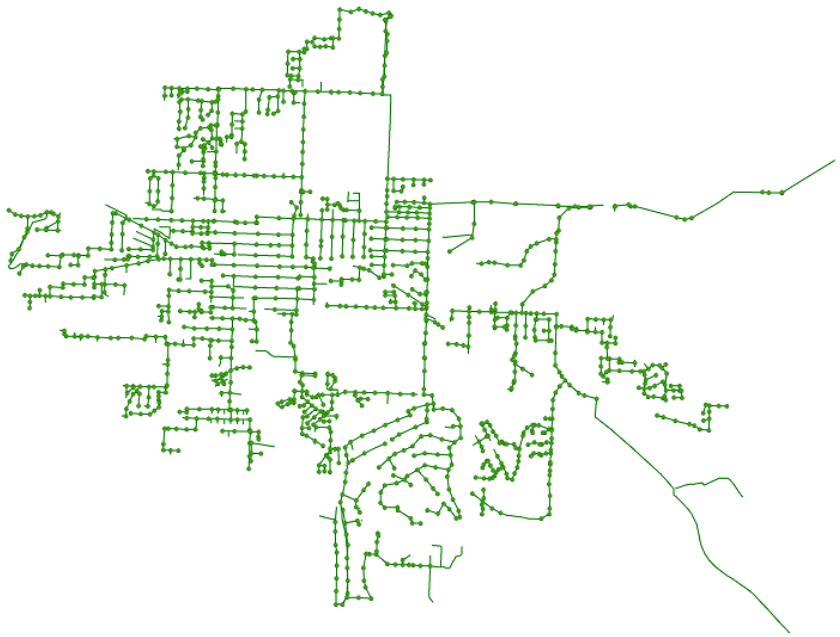
Parameter	2012	2018	2032	Buildout
Average Annual Flow (gpd)	40,000	61,000	100,000	161,000
Maximum Month Flow (gpd)	48,000	73,000	121,000	193,000
Peak Day Flow (gpd)	59,000	90,000	154,000	236,000
Peak Hour Flow (gpd)	134,000	204,000	356,000	594,000
BOD (lb/d)(1)	117	218	421	723
TSS (lb/d)(1)	50	110	170	290
ERUs	200	360	721	1,240

(1) Maximum month values.

Table 2-15 Maximum Month Projected Flows and Loadings for Sequim and Regions Outside the Current UGA

Region/Parameter	2012	2018	2032	Buildout
Sequim	856,000	1,011,000	1,455,000	3,038,000
Carlsborg	30,000	50,000	98,000	675,000
SunLand	140,000	145,000	157,000	157,000
Blyn	48,000	73,000	121,000	193,000
Combined Maximum Month Flow (gpd)	1,074,000	1,279,000	1,830,000	4,063,000
Combined Max Month BOD (lb/day)	2,700	3,253	4,865	11,329
Combined Max Month TSS (lb/day)	2,629	3,137	4,403	10,963
Combined ERUs	6,725	8,182	12,115	27,567

Chapter 3
COLLECTION SYSTEM EVALUATION



GENERAL

The City will require some improvements to its collection system to accommodate growth and collection system expansions and to repair damaged and deteriorating facilities. This chapter describes the existing collection system as well as recommended capital improvements that are required to repair damaged facilities and to accommodate projected wastewater flows.

SYSTEM CONDITION

City staff were interviewed regarding the condition of the sewer system for this Plan. Based on discussions with collection system maintenance staff, most of the collection system is in good condition. However, based on their manhole inspections and review of close circuit television (CCTV) inspection videos, some of the system components are deteriorating and may need to be replaced within the 6-year and 20-year planning periods. City staff indicated that they preferred a pipe rehabilitation method that was cost-effective and required the least amount of surface restoration.

STAFF AND MAINTENANCE

There are 24 public works staff members including managers, engineers, operators, field staff, and office staff; all of whom report to the Public Works Director. A summary of Public Works staff with regards to wastewater includes:

- One utilities manager
  - Oversees water and wastewater utilities for the City
- Four WRF operations personnel
  - Includes lead WRF operator
  - WRF staff operate and maintain reclaimed water facilities and equipment
- Three City collection system personnel

Maintenance operations are fully described in Chapter 6. Briefly, the staff uses preventive maintenance practices whenever time and workload allow. The staff regularly jet and clean sewer pipes that are prone to buildup of fats, oils, and grease (FOG). They also visually inspect manholes and sewer pipe. Staff also inspects all collection system piping using a City-owned high-definition camera on an annual basis.

GRAVITY AND PRESSURIZED PIPES

Construction of the City's wastewater collection system, including the main trunk line to the wastewater treatment facility, began in the 1930s in the north part of the City. Much of the collection system for downtown Sequim was installed between 1950 and the mid-1970s, and consists of concrete pipe, asbestos cement pipe, and ductile iron pipe. Overall, approximately 59 percent of all sewer pipe is PVC, approximately 33 percent of all sewer pipe is concrete, and the remaining pipe is either asbestos cement or ductile iron. Since the 1970s, additional PVC sewers have been constructed in the periphery of the downtown corridor and several other outlying areas. A summary of the City's sewer system pipes is shown in Table 3-1, while Figure 3-1 shows the City's wastewater collection system.

PORT WILLIAMS LIFT STATION

JEANNIE'S MEADOW LIFT STATION

CITY OF SEQUIM WRF

CEDAR RIDGE LIFT STATION

DOE RUN LIFT STATION

N

0 1,000 2,000 4,000 Feet

LEGEND:

- MANHOLES
- LIFT STATION
- SEWER LINES:
- WATER RE-USE PIPING
- SEWER SERVICE AREA
- URBAN GROWTH AREA
- CITY LIMITS
- PARCELS

CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 3-1
EXISTING WASTEWATER COLLECTION AND WATER REUSE SYSTEM

Gray & Osborne, Inc.

M:\SEQUIM\11594 - 2012 General Sewer Plan\GIS\FIGURE 3-1 EXISTING SEWER.mxd

Table 3-1 Existing Sewer Pipe Inventory

Pipe Diameter	Concrete (feet)	PVC (feet)	Ductile Iron (feet)	Asbestos Cement (feet)	TOTAL (feet)
Gravity Sewer					
6-inch	2,217	12,846	-	-	15,063
8-inch	43,875	209,565	496	11,029	264,965
10-inch	626	25,154	-	349	26,129
12-inch	7,436	17,662	-	541	25,640
15-inch	4,798	1,781	-	-	6,578
18-inch	1,319	6,096	2,343	-	9,758
TOTAL (feet)	**60,271**	**273,104**	**2,839**	**11,919**	**348,133**
TOTAL (miles)	**11.4**	**51.7**	**0.5**	**2.3**	**65.9**
Force Mains					
2-inch	-	3,505(1)	-	-	3,505
3-inch	-	3,511(1)	-	-	3,511
4-inch	-	19,640(2)	-	-	19,640
6-inch	-	5,797	-	-	5,797
8-inch	-	6,695(3)	-	-	6,695
TOTAL (feet)	**-**	**39,148**	**-**	**-**	**39,148**
TOTAL (miles)	**-**	**7.4**	**-**	**-**	**7.4**
Dry Sewer(4)					
8-inch	-	3,583	-	-	3,583
TOTAL (feet)	**-**	**3,583**	**-**	**-**	**3,583**
TOTAL (miles)	**-**	**0.7**	**-**	**-**	**0.7**

(1) Private line not managed by City.
(2) Includes 2,800 feet for Doe Run PS and 6,600 feet for Sequim Bay Lodge STEP system.
(3) Includes Port Williams PS.
(4) Includes sewer pipe that was installed during plat development, but is not yet connected to the City's functional collection system. This section of dry sewers is located east of Sequim along Spyglass Lane.

SIDE SEWERS

Common sewer system defects in many collection systems are collapsed or leaking service laterals or side sewers. Side sewers refer to sewer lines that connect buildings or residential units on private property to the public sewer main in the public right-of-way or sewer mains on easements. Side sewers are usually installed at shallow depths with a minimum self-cleansing grade from the building or residential unit to the property line. From the property line to the main sewer line, the grade may change abruptly as the side sewer descends to the elevation of the main sewer line.

Research studies sponsored by the USEPA indicate that a significant percentage of infiltration and inflow (I/I) is often caused by defects in side sewers, including cracked, broken, or open-jointed pipes, which can allow storm-induced infiltration. In addition to I/I from the laterals, infiltration frequently results from a leaky connection of the lateral to the main sewer and leakage at main sewer joints close to the lateral.

A detailed evaluation of side sewers, including television inspection and smoke testing, was not performed for this Plan. It is recommended that the City investigate side sewers by CCTV inspection or smoke testing and any side sewers likely to be a source of I/I be replaced as necessary.

MANHOLES

A detailed evaluation of manhole condition was not performed for this Plan, nor the Plan prepared in 2003. However, based on discussion with collection system maintenance staff, most of the system manholes are in fair to good condition. Manholes located in the downtown corridor are typically in poorer condition due to higher use and larger amounts of FOG within the waste stream. One particular issue for staff is the deterioration of manholes downstream of the STEP force main from Sequim Bay State Park and the Sequim Bay Lodge. It appears that septic conditions are developing in the pipe which create a corrosive environment that degrades manholes and joint sealants. The City is currently investigating options for chemical injection into the force main that will maintain aerobic conditions and eliminate the corrosive environment that develops.

PUMP STATIONS

The City owns and operates three pump stations within the UGA, and an additional pump station outside of the UGA (Doe Run). Run time data has been plotted for all of the pump stations and is shown in Appendix D.

The Doe Run Pump Station was installed in 1986. The pump station is located south of the City at the intersection of Doe Run Road and Fox Hollow Road and serves the Bell Hill community. however; facilities and methods of freeze protection at the pump station are primitive. The station uses an old diesel powered auxiliary generator that is near the end of its useful life and should be replaced. Pump run time logs indicate that the Doe Run pumping time averages approximately 0.75 hours per day per

pump in the summer months, and approximately 2.1 hours per day per pump during the wet winter months.

The Port Williams Pump Station is located near the intersection of North Brown Road and Harriette Lane and serves much of the City that is north of Fir Street, including residential areas, several medical clinics and schools centered around 5th Avenue. The pump station was constructed in 1996 and remains in good condition. Pump run time data indicate that the Port Williams pumps average approximately 1.6 hours per day per pump. This data from 2010, 2011, and 2012 also shows that daily pump run time ranged from 1 to 2 hours per day during both the dry summer months and the wet winter months.

The Cedar Ridge Pump Station is located near the intersection of Lofgrin Road and Ida Court in East Sequim. This pump station houses two 216 gpm Wilo-EMU USA submersible pumps and serves the area east of East Washington Street between Highway 101 and West Sequim Bay Road. This area is largely underdeveloped due to economic reasons, but has a large number of potential residential connections. Pumps at this pump station are currently running an average of 0.06 hours per day. The pump station was constructed in 2009 and is in good condition.

Jennie's Meadow Pump Station is located in East Lobelia and serves a large area west of North Priest Road between West Hendrickson Road and Highway 101. This region is also largely underdeveloped, but has a large number of potential residential wastewater connections. Pumps at this pump station are currently running an average of 0.23 hours per day. The Jenny's Meadow Pump Station was constructed in 2008 and is in good condition.

The Sequim Bay Lodge Pump Station serves the hotel, conference, and dining facilities at Sequim Bay Lodge and receives pumped septic tank effluent from Sequim Bay State Park. This pump station is a septic tank effluent pumping (STEP) system and pumps wastewater up Highway 101 through a 4-inch force main to a valve assembly on Whitefeather Road, where a future force main from the John Wayne Development area will connect. From this valve assembly, a 6-inch force main conveys sewage to a manhole near Simdars Road. The pump station is owned, operated, and maintained by Sequim Bay Lodge. The force main is owned, operated, and maintained by the City. The City is typically

contacted when maintenance and emergency issues at the Sequim Bay Pump Station arise.

Pump stations are susceptible to mechanical and/or electrical failures and it is important that these alarms are relayed to City staff in an efficient manner so that appropriate action can be taken. Currently, no telemetry exists at the Doe Run, Cedar Ridge, or Jeannie's Meadow pump stations. Port Williams Pump Station utilizes an autodialer, which automatically calls a pre-determined cell phone number and relays details of the error message to City staff.

Improvements to Doe Run Pump Station (CIP number CS-3) are discussed in Chapter 8 – Capital Improvement Program and would include the addition of new facilities including simple telemetry such as an autodialer. Furthermore, although both the Cedar Ridge and Jeannie's Meadow pump stations pump extremely low flows, it is recommended that upgrades to these stations include the addition of simple telemetry such as autodialers in order to relay error messages when they occur.

An inventory of the City's sewage pump stations is included in Table 3-2.

Table 3-2 Existing Wastewater Pump Station Inventory

Parameter	Doe Run PS	Port Williams PS	Cedar Ridge PS	Jeannie's Meadow PS
Location	Doe Run Road and Fox Hollow Road	N. Brown Road and Harriette Lane	Lofgrin Road and Ida Court	East Lobelia
Pumps to manhole	29-3-09	17-4-01	27-2-05	24-3-11
No. of Pumps	2	2	2	2
Manufacturer	Smith and Loveless	Cornell	Wilo-EMU USA	Wilo-EMU USA
Type	Dry Pit Non-clog centrifugal	Non-Clog Centrifugal	Wet-pit, non-clog, Submersible	Wet-pit, non-clog, Submersible
Power Requirements (hp, each)	25	20	10	23.5
Flow (gpm/pump)	100	350	216	165
Rated head (feet)	162	108	82	135
Motor speed (rpm)	1,760	1,760	1,740	1,740
Wet well Dimensions(1)	Depth = 20 feet, 6 foot OD, 5 foot ID	Depth = 14 feet, 8 foot ID	Depth = 18 feet, 8 foot ID	Depth = 17 feet, 7 foot ID

(1) OD indicates outer diameter, ID indicates inner diameter

INFILTRATION AND INFLOW

In Chapter 2, a moderate amount of I/I entering the City's sewer system was identified. The amount of I/I estimated to be entering the collection system is not considered excessive according to published EPA criteria. In recent years, the City has been proactive in completing maintenance projects with the goal of reducing I/I by installing inflow protectors in manholes and disconnecting roof drains from the collection system. Further discussion of I/I is provided in Chapter 5.

PREVIOUS MODEL RESULTS AND IMPROVEMENT PROJECT STATUS

With the increasing complexity and sophistication prevalent in municipal wastewater collection systems, many municipalities utilize modeling software to model the collection system and identify improvements necessary to convey both existing and projected wastewater flows. This trend toward modeling and proactive planning for needed improvements has resulted in fewer failures and surcharging events, and better management of limited funding available for improvement projects.

As part of the 2003 Comprehensive Plan, the City's collection system was modeled using HYDRA software by Pizer, Inc. As a results of this effort, the 2003 Plan identified nine capital improvement projects to address projected collection system deficiencies. These recommended improvements as well as information on their implementation/construction status are summarized below. Manhole numbers have been updated and reflect the current manhole numbering scheme.

- CIP #1: Line pipe sections between manholes 19-3-1 and 20-3-4 with cast-in-place pipe (CIPP).
  - This project was modified and these sections of sewer pipe were lined using cured-in-place pipe technology.

- CIP #2: Replace pipe sections between manholes 20-3-4 and 20-2-38.
  - Project has not been designed nor constructed.

- CIP #3: Line pipe sections between manholes 24-2-54 and 19-1-17 with CIPP, and replace pipe sections between manholes 19-1-17 and 19-1-26.
  - Project has not been designed nor constructed.

- CIP #4: Line pipe sections between manholes 19-1-18 and 19-1-16 with CIPP.
  - This project was completed in two parts. The pipe along Fir Street between 3rd Street and 2nd Street was replaced using pipe bursting method, while the section between 2nd Street and North Seal Street was lined.

- CIP #5: Replace pipe sections between manholes 19-4-34 and 20-3-10.
  - Project has not been designed nor constructed.

- CIP #6: Replace pipe sections between manholes 19-4-48 and 19-4-46.
  - Project has not been designed nor constructed.

- CIP #7: Replace pipe sections between manholes 19-4-45 and 19-4-40.
  - Project has not been designed nor constructed.

- CIP #8: Construct a new sewer line from manhole 19-3-02 to a new manhole downstream from existing manhole 19-2-17.
  - Project has not been designed nor constructed.

- CIP #9: Line pipe sections between manholes 20-1-06 and 21-2-06 with CIPP.
  - Project has not been designed nor constructed.

CURRENT MODEL DEVELOPMENT

A sewer system hydraulic model for the City was last developed in 2003 to support development of the City's 2003 Wastewater Comprehensive Plan. This model was constructed using HYDRA® software, which is no longer available for commercial use. For this Plan, InfoSEWER® software from Innovyze Inc. was used. InfoSEWER® is a popular commercial sewer modeling program which has both steady state and dynamic capabilities, and is based on a geographic information systems (GIS) platform.

Modeling scenarios based on existing flows, projected 6-year flows (2018), projected 20-year flows (2032), and buildout flows were analyzed using InfoSEWER®. A brief discussion of modeling methodology is included here, while additional information regarding assumptions and methodology is available in Appendix E.

SYSTEM CAPACITY: SUMMARY OF HYDRAULIC MODEL RESULTS

A hydraulic model of the City's collection system was developed with the modeling software program InfoSEWER® to support development of this Plan. The model is based on projected peak hour flows from single and multi family residential properties, commercial properties, schools, hotel/motel, and commercial properties, as well as I/I. The primary functions of the collection system model are:

- to assess the ability of the existing system to transport current flows
- to make recommendations for future improvements to convey projected future flows, and
- to determine the effects of future development and expansion of the sewer service area on the system

Hydraulic models were constructed to simulate peak flows in the years 2012, 2018, 2032 and for the buildout condition. All of these hydraulic scenarios were based on the sanitary flow projections described in Chapter 2. More detailed information about hydraulic model assumptions, outputs, supplemental information, and analysis techniques is provided in Appendix E.

The entire Sequim sewer system (including Bell Hill/Bell Gates) was divided into 63 subbasins, each of which contained a single

loading manhole. Loading manholes are points within the collection system where projected wastewater flows are loaded into the model. To be conservative, the loading manholes were located within each subbasin at the farthest upstream manhole within that basin.

Input data for each loading manhole is the estimated peak hour flow in gallons per minute (gpm). This value is determined by using the City's zoning designation, land area for each subbasin, number of ERUs and estimates for peak hour I/I.

The model included all known sources of flow, identified as single-family residential flow (SFR), multi-family residential flow (MFR), commercial flow (COMM), and school flow (SCH). Each of these flow inputs included estimates for peak hour I/I, which were developed in Chapter 2 – Basic Planning Information. Both SFR and MFR flows were based on the average wastewater production value of 110 gallons per ERU per day (gped) developed in Chapter 2 – Basic Planning Information. Commercial flows were based on commercial water usage, and school flows were based on historical water use and enrollment for each school.

The total peak hour flows from SFR, MFR, COMM and SCH groups were combined for each subbasin. This value was then input to the model at the appropriate loading manhole.

In the following evaluation of sewer system capacity for years 2012, 2018 and 2032, the criteria for listing a sewer as "deficient" is that the peak hour depth of flow exceeds 85 percent of the pipe diameter (d/D > 0.85). *However, it is not recommended that pipes be replaced unless d/D is greater than 0.85 and the upstream manhole with a depth less than or equal to eight feet surcharges one foot or more at projected peak hour flow, or a manhole with a depth of greater than eight feet surcharges three feet or more at the projected peak hour flow.*

Tables of hydraulically deficient sewer pipe as well as manholes with surcharge depths in excess of one foot for each modeling scenario are shown below. Due to the number of data gaps and assumptions used in setting up the model, the accuracy of the GIS input information from the City should be confirmed prior to undertaking any replacement or rehabilitation projects for the listed pipes and manholes. If it is found that the input information differs

significantly from actual conditions, then the model should be updated accordingly and rerun to confirm the original results.

Recommended pipe replacement projects will take into account the location of hydraulically deficient pipes within a pipe reach. A recommended project may require upsizing of downstream pipes. Recommended pipe replacement projects are discussed later in this Chapter.

The City is interested in the impacts of connecting various regional areas to the City's sewer system. In this model, only flows from Carlsborg were considered since they would result in the largest impact to flows within the City's collection system. Projected peak hour Carlsborg flows were developed in Chapter 2 – Basic Planning Information. Peak hour estimates for Carlsborg flows were added to loading manhole 24-3-06 (Grant Road), which is roughly equivalent to Connection Alternative No. 3 in the *2011 Feasibility Study*. Results presented later in this chapter include data for model runs with and without Carlsborg flows.

Impacts of wastewater flows from SunLand and Blyn are fully developed in the *2011 Feasibility Study*. Briefly, no new collection system improvement projects would be required to handle projected buildout flows from Blyn. For SunLand, modifications to the Port Williams pump station would be required prior to the year 2018, and a larger forcemain would be required prior to the year 2032 to accommodate the projected wastewater flows.

2012 Hydraulic Analysis

The 2012 hydraulic analysis found that the existing collection system has adequate capacity to convey the projected peak hour flow for the City. However, if it is assumed that the initial peak hour flow from the CUGA (64 gpm) is introduced into the collection system at MH 24-3-06 (Grant Road) one sewer section in the collection system would be at or near capacity during current peak hour flows. The 165 LF of hydraulically deficient sewer at current peak hour flows is listed in Table 3-3. No manholes experience a surcharge depth of greater than 1 foot in this scenario. Figure 3-2 shows the location of City sewer pipe that is hydraulically deficient for the year 2012 according to the InfoSEWER® model; however, since the manhole is not surcharged this pipe segment is not recommended for replacement at this time.

Table 3-3 Existing Hydraulically Deficient Existing Gravity Sewers at Current Flows

Upstream MH	Downstream MH	Pipe Diameter (in)	Length (ft)	Surcharge Upstream Manhole	Location
Sequim and Carlsborg Peak Hour Flow					
20-1-19	20-1-13	15	165	No	North Blake Avenue

2018 HYDRAULIC ANALYSIS

The 2018 hydraulic analysis found six sewer sections in the collection system that, based on the model, would be at or near capacity during projected 2018 peak hour flow conditions. All four pipe sections listed in Table 3-3 above are again projected to be over capacity for the year 2018. In total, approximately 900 linear feet of sewer pipe is projected to be hydraulically deficient in the year 2018 regardless if Carlsborg flows are conveyed via the City's collection system.

The hydraulically deficient sewers projected for year 2018 are listed below in Table 3-4. Manholes experiencing a surcharge depth of greater than one foot are listed in Table 3-5. Figure 3-3 shows City sewer pipes and manholes that are hydraulically deficient for the year 2018 according to the model.

Regardless if Carlsborg flows are included, the model results suggest that only approximately 57 LF of pipe would require replacement.

PORT WILLIAMS LIFT STATION

MH 19-2-15

JEANNIE'S MEADOW LIFT STATION

CITY OF SEQUIM WRF

MH 24-4-03

MH 24-3-06

CEDAR RIDGE LIFT STATION

DOE RUN LIFT STATION

N

0 1,000 2,000 4,000 Feet

LEGEND:

- MANHOLE WITH SURCHARGE >1 FOOT
- SEWER PIPE WITH d/D > 85 PERCENT
- MANHOLES
- LIFT STATION
- SEWER LINES:
- SEWER SERVICE AREA
- URBAN GROWTH AREA
- CITY LIMITS
- PARCELS

NOTE: SURCHARGES AND PIPE LEVELS INCLUDE THE IMPACT OF CARLSBORG FLOWS.

CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 3-2
HYDRAULICALLY DEFICIENT
PIPES AND MANHOLES
YEAR 2012

Gray & Osborne, Inc.

M:\SEQUIM\11594 - 2012 General Sewer Plan\GIS\FIGURE 3-2 2012 MODEL_FINAL.mxd

PORT WILLIAMS LIFT STATION

JEANNIE'S MEADOW LIFT STATION

MH 19-2-15

MH 24-4-03

MH 24-4-03

DOE RUN LIFT STATION

CITY OF SEQUIM WRF

CEDAR RIDGE LIFT STATION

N

0 1,000 2,000 4,000 Feet

LEGEND:

- MANHOLE WITH SURCHARGE >1 FOOT
- SEWER PIPE WITH d/D > 85 PERCENT
- MANHOLES
- LIFT STATION
- SEWER LINES:
- SEWER SERVICE AREA
- URBAN GROWTH AREA
- CITY LIMITS
- PARCELS

NOTE: SURCHARGES AND PIPE LEVELS INCLUDE THE IMPACT OF CARLSBORG FLOWS.

CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 3-3
HYDRAULICALLY DEFICIENT
PIPES AND MANHOLES
YEAR 2018

Gray & Osborne, Inc.

M:\SEQUIM\11594 - 2012 General Sewer Plan\GIS\FIGURE 3-3 2018 MODEL_FINAL.mxd

Table 3-4 Hydraulically Deficient Gravity Sewers, Year 2018

Upstream MH	Downstream MH	Pipe Diameter (in)	Length (ft)	Surcharge Upstream Manhole
With Carlsborg				
19-4-25	19-4-24	8	56	-
20-1-06	21-2-01	8	57	12
20-1-13	20-1-07	15	117	-
20-1-19	20-1-13	15	165	-
21-4-20	21-4-19	8	323	-
30-2-13	30-2-12	8	176	-
Without Carlsborg				
19-4-25	19-4-24	8	56	-
20-1-06	21-2-01	8	57	12
20-1-13	20-1-07	15	117	-
20-1-19	20-1-13	15	165	-
21-4-20	21-4-19	8	323	-
30-2-13	30-2-12	8	176	-

Table 3-5 Manholes with Surcharge in Excess of 1 Foot, Year 2018

Surcharged Manholes With Carlsborg
20-1-06
27-2-05
Surcharged Manholes Without Carlsborg
20-1-06
27-2-05

2032 Hydraulic Analysis

The 2032 hydraulic analysis found four sewer sections in the collection system that would be at or near capacity during 2032 Sequim and Carlsborg peak hour flow conditions. In total, approximately 750 linear feet of sewer pipe is projected to be hydraulically deficient in the year 2032, if Carlsborg flows are included in the City's collection system. Without Carlsborg flows, it is projected that approximately 370 feet of pipe would be hydraulically deficient.

The hydraulically deficient sewers projected for year 2032 are listed below in Table 3-6. Manholes experiencing a surcharge depth of greater than 1 foot are listed in Table 3-7. Values for with and without Carlsborg peak hour flows are included. Figure 3-4

shows City sewer pipes and manholes that are hydraulically deficient for the year 2032 according to the model.

If Carlsborg flows are included, the estimated pipe replacement requirement is approximately 339 LF. Without Carlsborg flows, this value drops to approximately 57 LF.

Table 3-6 Hydraulically Deficient Gravity Sewers, Year 2032

Upstream MH	Downstream MH	Pipe Diameter (in)	Length (ft)	Surcharge Upstream Manhole	Location
Sequim Peak Hour Flow					
20-1-13	20-1-07	15	117	No	North Blake Avenue
20-1-19	20-1-13	15	165	No	North Blake Avenue
20-3-01	20-2-42	12	88	No	North Sunnyside Avenue
Sequim and Carlsborg Peak Hour Flow					
20-1-13	20-1-07	15	117	No	North Blake Avenue
20-1-19	20-1-13	15	165	Yes	North Blake Avenue
20-3-01	20-2-42	12	88	No	North Sunnyside Avenue
20-2-40	20-2-39	12	383	No	North Sunnyside Avenue

Table 3-7 Manholes with Surcharge in Excess of 1 Foot, Year 2032

Surcharged Manholes With Sequim and Carlsborg Peak Hour Flow
20-1-06
20-1-19
20-1-20
27-2-05

BUILDOUT HYDRAULIC ANALYSIS

The buildout hydraulic analysis found three sewer sections in the collection system that, based on the model, would be at or near capacity during City buildout peak hour flow conditions. The hydraulically overloaded sections of sewer in the buildout scenario are the same sewers identified as hydraulically overloaded in 2032. In total, approximately 370 linear feet of sewer pipe is projected to be hydraulically deficient in the buildout year.

If Carlsborg peak hour buildout flows (1,481 gpm) were introduced to the Sequim collection system at MH 24-3-06 (Grant Road), 42 sewer sections would be at or near capacity during buildout Sequim and Carlsborg peak hour flow conditions.

PORT WILLIAMS LIFT STATION

JEANNIE'S MEADOW LIFT STATION

CITY OF SEQUIM WRF

MH 19-2-15

MH 24-4-03

MH 24-3-06

CEDAR RIDGE LIFT STATION

DOE RUN LIFT STATION

N

0 1,000 2,000 4,000 Feet

LEGEND:

- MANHOLE WITH SURCHARGE >1 FOOT
- SEWER PIPE WITH d/D > 85 PERCENT
- MANHOLES
- LIFT STATION
- SEWER LINES:
- SEWER SERVICE AREA
- URBAN GROWTH AREA
- CITY LIMITS
- PARCELS

NOTE: SURCHARGES AND PIPE LEVELS INCLUDE THE IMPACT OF CARLSBORG FLOWS.

CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 3-4
HYDRAULICALLY DEFICIENT
PIPES AND MANHOLES
YEAR 2032

Gray & Osborne, Inc.

M:\SEQUIM\11594 - 2012 General Sewer Plan\GIS\FIGURE 3-4 2032 MODEL_FINAL.mxd

Without the Carlsborg flows, it is projected that only approximately 1,500 feet of pipe will be hydraulically deficient.

The hydraulically deficient sewers projected for full buildout are listed below in Table 3-8. Manholes experiencing a surcharge depth of greater than 1 foot are listed in Table 3-9. Figure 3-5 shows City sewer pipes and manholes that are hydraulically deficient for buildout year according to the model.

If buildout peak hour Carlsborg flows are included, the estimated pipe replacement requirement is approximately 13,574 LF. Without Carlsborg flows, this value drops to approximately 370 LF.

Table 3-8 Hydraulically Deficient Gravity Sewers, Buildout

Upstream MH	Downstream MH	Pipe Diameter (in)	Length (ft)	Surcharge Upstream Manhole	Location
Sequim and Carlsborg Peak Hour Flow					
19-3-01	19-4-05	8	69.2	Yes	Alley West Bell Street
19-3-02	19-3-01	8	138.5	Yes	South 5th Avenue
19-3-03	19-3-37	8	218.7	Yes	West Washington Street
19-3-04	19-3-36	8	322.7	Yes	West Washington Street
19-3-05	19-3-04	8	319.6	Yes	Alley West Bell Street
19-3-07	19-3-05	8	203.3	Yes	West Washington Street
19-3-08	19-3-07	8	161.2	Yes	West Washington Street
19-3-09	19-3-08	8	341.2	Yes	West Washington Street
19-3-10	19-3-09	8	289.1	Yes	West Washington Street
19-3-11	19-3-10	8	376.9	Yes	West Washington Street
19-3-36	19-3-03	8	254.2	Yes	West Washington Street
19-3-37	19-3-02	8	174.5	Yes	West Washington Street
19-4-01	20-3-02	8	400.1	Yes	Alley West Bell Street
19-4-02	19-4-01	8	407.1	Yes	Alley West Bell Street
19-4-03	19-4-02	8	691.3	Yes	Alley West Bell Street
19-4-04	19-4-03	8	720.4	Yes	Alley West Bell Street
19-4-05	19-4-04	8	607.4	Yes	Alley West Bell Street
20-1-13	20-1-07	15	117.4	Yes	North Blake Avenue
20-1-19	20-1-13	15	165.4	Yes	North Blake Avenue
20-1-51	20-1-19	15	399.3	Yes	East Willow Street
20-2-04	20-1-49	15	391.0	Yes	East Willow Street
20-2-05	20-2-04	15	311.9	Yes	North Brown Road

Table 3-8 Hydraulically Deficient Gravity Sewers, Buildout – (continued)

Upstream MH	Downstream MH	Pipe Diameter (in)	Length (ft)	Surcharge Upstream Manhole	Location
20-2-17	20-2-46	15	330.4	Yes	East Fir Street
20-2-25	20-2-21	15	150.6	Yes	East Fir Street
20-2-32	20-2-29	15	331.3	Yes	East Fir Street
20-2-34	20-2-32	15	328.1	Yes	East Fir Street
20-2-38	20-2-34	15	438.8	Yes	East Fir Street
20-2-39	20-2-43	12	427.6	Yes	North Sunnyside Avenue
20-2-40	20-2-39	12	382.8	Yes	North Sunnyside Avenue
20-2-41	20-2-40	12	217.5	Yes	North Sunnyside Avenue
20-2-42	20-2-41	12	92.5	Yes	North Sunnyside Avenue
20-2-43	20-2-38	12	369.1	Yes	North Sunnyside Avenue
20-2-46	20-2-05	15	322.7	Yes	East Fir Street
20-3-01	20-2-42	12	87.8	Yes	North Sunnyside Avenue
20-3-02	20-3-03	8	231.0	Yes	Etta Street
20-3-04	20-3-01	12	110.3	Yes	South Sunnyside Avenue
21-1-01	21-1-02	18	769.5	Yes	West of WRF
21-2-03	21-2-22	18	109.0	Yes	East of North Blake Avenue
21-2-06	21-1-01	18	790.8	Yes	West of WRF
24-4-01	19-3-11	8	463.3	Yes	West Washington Street
24-4-02	24-4-01	8	207.1	YES	West Washington Street
24-4-03	24-4-02	8	333.2	YES	West Washington Street
Sequim Peak Hour Flow					
20-1-13	20-1-07	15	117		
20-1-19	20-1-13	15	165		
20-3-01	20-2-42	12	88		

(1) Demotes a section of pipe in which d/D is greater than 0.85 but upstream manhole does not exhibit a surcharge depth of greater than 1 foot.

PORT WILLIAMS LIFT STATION

JEANNIE'S MEADOW LIFT STATION

MH 19-2-15

MH 24-4-03

MH 24-3-06

CITY OF SEQUIM WRF

CEDAR RIDGE LIFT STATION

DOE RUN LIFT STATION

N

0 1,000 2,000 4,000 Feet

LEGEND:

- MANHOLE WITH SURCHARGE >1 FOOT
- SEWER PIPE WITH d/D > 85 PERCENT
- MANHOLES
- LIFT STATION
- SEWER LINES:
- SEWER SERVICE AREA
- URBAN GROWTH AREA
- CITY LIMITS
- PARCELS

NOTE: SURCHARGES AND PIPE LEVELS INCLUDE THE IMPACT OF CARLSBORG FLOWS.

CITY OF SEQUIM

2013 GENERAL SWERE PLAN
FIGURE 3-5
HYDRAULICALLY DEFICIENT
PIPES AND MANHOLES
BUILDOUT

Gray & Osborne, Inc.

M:\SEQUIM\11594 - 2012 General Sewer Plan\GIS\FIGURE 3-5 BUILDOUT_FINAL.mxd

Table 3-9 Manholes with Surcharge in Excess of 1 Foot, Buildout

Surcharged Manholes With Carlsborg					
19-3-01	19-3-36	20-1-50	20-2-34	20-3-03	24-1-08
19-3-02	19-3-37	20-1-51	20-2-38	20-3-04	24-1-13
19-3-03	19-4-01	20-2-04	20-2-39	21-1-01	24-1-14
19-3-04	19-4-02	20-2-05	20-2-40	21-2-06	24-1-15
19-3-05	19-4-03	20-2-17	20-2-41	24-4-01	24-1-16
19-3-07	19-4-04	20-2-21	20-2-42	24-4-02	24-1-26
19-3-08	19-4-05	20-2-25	20-2-43	24-4-03	24-2-54
19-3-09	20-1-13	20-2-28	20-2-46		
19-3-10	20-1-19	20-2-29	20-3-01		
19-3-11	20-1-49	20-2-32	20-3-02		
Surcharged Manholes Sequim Peak Hour Flow					
19-4-22	20-1-06	20-1-19			

MODELING RESULTS

The results of the INFOSewer model for the City suggest that minimal pipe rehabilitation and/or replacement would be required to accommodate the projected peak hour wastewater flows from Carlsborg for both the 6- and 20-year planning periods. The model also suggests that minimal rehabilitation/replacement projects to correct hydraulic deficiencies would be required should Carlsborg flows not be connected to the City's sewer system.

Depending on when Carlsborg flows are connected to the City's collection system, a more detailed analysis of the projected flows, connection point, and pipe sizes involved may need to be completed. Another factor that needs to be considered that impacts the amount of Sequim collection system piping that will require rehabilitation/replacement is the location at which Carlsborg flows are connected to the City's collection system, as well as how quickly Carlsborg residents are connected.

One way to lessen the impact of storm events and fluctuations in peak hour flows is to provide sufficient flow equalization within Carlsborg. Providing adequate equalization storage within Carlsborg and pumping wastewater to the City's collection system at a constant rate should significantly reduce the pipe rehabilitation/replacement that would be required to accommodate buildout Carlsborg peak hour flows. Furthermore, these flows could be pumped at a higher rate to the Sequim WRF for treatment

between 9 pm and 6 am, which would limit the impact to the City's existing customers. All of the factors discussed above should be further analyzed if it is decided that Carlsborg flows will be directed to the City's collection system and WRF for treatment.

Table 3-10 below summarizes the projected lengths and diameters of sewer pipe that would be hydraulically overloaded peak hour flows for the City alone, and the City and Carlsborg were conveyed through the existing collection system.

Table 3-10 Over Capacity Pipe Summary

Existing Pipe Diameter	2012	2018	2032	Buildout
Length of Pipe Recommended Replacement for City of Sequim Peak Hour Flow(1)				
8 inch	-	-	-	-
12 inch	-	-	-	-
15 inch	-	-	-	165
18 inch	-	-	-	-
Length of Pipe Recommended Replacement for City of Sequim and Carlsborg Peak Hour Flow				
8 inch	-	-	-	6,930
12 inch	-	-	-	1,688
15 inch	-	-	165	3,287
18 inch	-	-	-	1,669

(1) Assumes Carlsborg connection Alternative No. 4 from the *2011 Carlsborg Feasibility Study*.
(2) Indicates that no replacement is required to accommodate projected flows.

METHODS FOR PIPELINE REHABILITATION

The City has identified pipe segments that need replacement due to the condition of the pipe or location. Different methods of rehabilitation for trunk sewers and manholes reaching the end of their design life are described in this section.

PIPE REPLACEMENT BY OPEN CUT

Pipe replacement by open cut installation has been the conventional way to rehabilitate sewer pipes in past years. This method requires either removing the existing sewer pipe and installing new pipe on the same alignment or abandoning the existing pipe and installing new pipe on a different alignment. Surface restoration costs when the sewer segment is located in a paved roadway are high and generally will cause more disruption to the area in terms of the number of working days to construct the work than a trenchless rehabilitation method.

The advantage of this method is the hydraulic capacity of the sewer segment can be increased by selecting a larger pipe diameter. Furthermore, when existing sewer segments are observed to have major sags and side sewer laterals are separated from the mainline, this method becomes the preferred option.

CURED-IN-PLACE PIPE

Cured-in-place pipe (CIPP) is a method of rehabilitation where a new pipe is formed within an existing pipe. A resin impregnated liner is inserted into the sewer segment from the manhole and extended to the other manhole, expanded using hydrostatic head of water to press the liner firmly against the existing host pipe and heated to activate the resin to cure against the host pipe. Active side sewers are reinstated by remote controlled cutters used in conjunction with CCTV video inspection. Typically a CIPP installer will clean, internally televise (with close circuit television, CCTV) the sewer segment (before and after the installation) and take exact inside pipe diameter dimensions prior to mobilizing.

The thickness of the liner (7.5 mm minimum) and physical properties of the resins can be specified to suit the specific application. When the resin cures, the inside diameter becomes smaller than the host pipe, but the hydraulic capacity may not be reduced, as the Manning's roughness coefficient becomes lower than that for the host pipe. It is desirable to maintain sewage flow at a self-cleansing velocity of 2 feet per second based on full flow conditions and Manning's roughness coefficient of 0.013. Generally, the capacity of the CIPP –rehabilitated segments will increase slightly for pipe diameters over 18 inches due to the new pipe having a lower Manning's roughness coefficient; however, for pipe sizes of 8, 10, 12, and 15 inches, the hydraulic capacity will decrease by approximately 17, 11, 6 and 2 percent, respectively.

The advantages of using this technology is it is the least disruptive to the surface and can be completed in a relatively short period of time as opposed to pipe replacement by open cut or other trenchless methods.

Pipe segments that would be candidates for this method should have little to no sags, side sewer laterals intact with the mainline and segment slope that provides a self-cleansing velocity of 2 feet per second.

PIPE BURSTING

Pipe bursting is a semi-trenchless method capable of increasing the diameter of the existing host pipe by using a pneumatically powered bursting head to pull in a welded High Density Polyethylene Pipe (HDPE). The pipe bursting process is the only trenchless pipe rehabilitation method that allows the installation to increase the diameter of the sewer pipes without excavating. Active laterals are individually excavated for reinserting into the new pipe. There are several methods that can be used for pipe bursting. In the most common method, a pneumatic pipe bursting head is inserted from one manhole and pulled through a breakable host pipe by a winch, the percussive action breaks apart the existing pipe as the head moves through the pipe and displaces the pipe fragments into the surrounding pipe zone. The head can be equipped with an expander that can further displace the host pipe fragments. The replacement pipe is usually standard diameter (SDR) 17 HDPE to protect against gouging during pipe installation.

Sewer segments that are candidates for this method are in areas that require the benefits of minimal surface disturbance such as resident, business or environmental areas, increasing hydraulic capacity, silty-clay soil conditions, and an easily breakable host pipe. This method will not eliminate sags in the mainline.

Difficult pipe bursting conditions are encountered in sandy gravel soils with cobbles and the host pipe material is reinforced concrete. The maximum diameter of the new pipe that can be installed is a function of the diameter of the existing pipe and the amount of cover.

SLIPLINING

Sliplining is a rehabilitation method that inserts a new pipe, High Density Polyethylene pipe (HDPE) inside a host pipe, creating a decrease in inside diameter. The annular space between the host and new pipe is backgrouted, providing additional structural capacity. Access to the host pipe is provided from the existing manhole and active laterals are reconnected to the mainline by an open cut installation using gasketed Insert-a-Tee connections.

Advantages of sliplining are minimal surface disturbances and short construction period as opposed to pipe replacement by excavation. Disadvantages of sliplining include decrease in

hydraulic capacity; cannot repair sags in mainline and broken laterals.

CIPP Internal Point Repair

Cured-in-place-pipe internal point repair rehabilitates damaged pipe using a resin-impregnated tube, up to 10 feet in length with diameters from 6 to 24 inches, without digging.

This method is used for repairing localized structural defects due to localized settling, an offset joint, excess loading conditions, corrosion or poor initial construction in an otherwise sound sewer pipe. However, point repairs may stop infiltration at the location of the repair but the groundwater may find another location to enter the pipe.

Point repairs are non-disruptive and completed from the surface by inserting the resin-impregnated tube through the manhole into the pipe to place of repair using visual monitoring. Once tube is in place, the point repair is pressed against the host pipe walls then cured in place.

The advantage of point repairs is they are non-disruptive to the ground surfaces and can be completed in a few hours without disrupting the sewage flow.

Chemical Grouting

Chemical grouting is a solution to prevent infiltration in structurally adequate sewer systems. It is the oldest pipeline rehabilitation process and was first developed and applied in 1955.

Grouting chemicals are forced through cracks and joints extending out into the surrounding soil where it gels with the soil to form a waterproof collar around a leaking pipe or manhole. This watertight collar adheres to the outer surface of the pipe or manhole and will remain indefinitely unless removed by an excavation.

Manhole Rehabilitation

The City's sewer system manholes are generally in good condition. However, in the 20-year planning period, it is projected that some of the older manholes will need to be rehabilitated or replaced in the downtown area. Manholes are rehabilitated to correct structural deficiencies, to address maintenance concerns, and

eliminate I/I. Some manhole rehabilitation options include lining, sealing, grouting, or replacing various components of the entire manhole.

Inflow typically occurs through holes in the manhole lid or around the manhole rim and lid. Manhole lids can be sealed by replacing them with new watertight covers, by sealing existing covers through the use of rubber cover gaskets and rubber vent and pick hole plugs, by installing water-tight inserts under the existing manhole covers or raising the manhole rim. In order to remove infiltration sources, grouting is commonly employed. The City has been actively reducing I/I into manholes by installing water-tight inserts into existing manhole covers.

Historically, manholes were repaired by workers filling voids with cement by hand, which amount to a temporary solution. Today, aging brick and concrete manholes are not only repaired to stop ground water infiltration, but are structurally rehabilitated with a cementitious and/or epoxy coating.

Before the cementitious coating is sprayed onto the inside of the mortar and brick, CMU, or precast concrete manhole, a chemical grout is applied to the inside of the manhole to dry the brick or concrete. Once the inside surface is satisfactorily dry, a cementitious and/or epoxy coating is sprayed on the inside of the manhole, creating a durable corrosion-resistant manhole-within-a-manhole that is designed to eliminate infiltration caused by hydrostatic pressure from groundwater.

HYDRAULIC MODEL PIPE REPLACEMENT/REHABILITATION RECOMMENDATIONS

The objective of sewer replacement and rehabilitation is to maintain the overall viability of a wastewater collection and conveyance system by ensuring its structural integrity, reducing excessive I/I, and minimizing raw sewage overflows. Sewer rehabilitation can be achieved by a number of methods including the repair of existing pipe, lining of the pipe or full replacement. Based on the results from the hydraulic modeling and recommendations of City staff, there are three recommended projects for the 6-year planning period. Recommendations for sewer replacement and rehabilitation projects for 2012 - 2018, and from 2018 - 2032 are briefly discussed below, and are shown in

Figure 3-6. A full list of all recommended WRF and collection system improvements is discussed in detail in Chapter 8. The project numbers below correspond to the numbering listed in Chapter 8.

SEWER REHABILITATION/REPLACEMENT PROJECTS, 2012 – 2018

Project Name: East Hammond Street Sewer Extension
Project Number: CS-12

Project Description: This project would install an 8-inch sewer from South Sequim Avenue to a point of connection with the existing 8-inch sewer on Hammond Street east of Sunnyside Street. Construction will consist of approximately 1,000 LF of 8-inch sewer main along East Hammond Street and the unopened right-of-way of East Hammond Street. This project is recommended in order to accommodate future commercial growth in the area near the intersection of Highway 101 and South Sequim Avenue, as well as to reduce flows through the congested utility route down Sunnyside Avenue.

This project is estimated to cost $358,000, and a detailed preliminary construction cost estimate is provided in Appendix F.

Project Name: North Blake Street Sewer Improvements
Project Number: CS-13

Project Description: This project will replace approximately 300 LF of sewer pipe along North Blake Street between East Willow and East Oak Avenues. The existing pipe is 15-inch and lacks capacity to convey either the projected City and/or Carlsborg peak hour flows for the year 2018. This project would install new 18-inch HDPE sewer pipe using open cut or pipe bursting methods.

This project is estimated to cost $156,000, and a detailed preliminary construction cost estimate is provided in Appendix F.

SEWER REHABILITATION/REPLACEMENT PROJECTS, 2018 – 2032

The selection of projects for sewer replacement and rehabilitation for years 2018-2032 is intended to increase capacity in sewer

reaches that will be at or near capacity by 2032. It is recommended that a site-specific evaluation be conducted before proceeding with pipe bursting or open-cut replacement techniques. The recommended pipe diameters are intended to provide sufficient capacity to accommodate the projected buildout flows.

Project Name: Sunnyside Street Sewer Improvements
Project Number: CS-9

Project Description: This project will replace the sewer line along Sunnyside Avenue. This is a sewer line that is undersized for existing flows, especially in an area designated for significant proposed commercial growth. Sewer pipe north of Washington Avenue along Sunnyside Avenue would be moved to within the Sunnyside right-of-way. Approximately 1,500 LF of 18-inch HDPE sewer pipe would be installed in the north and south Sunnyside Avenue right-of-way.

This project will address sewer pipes identified in this Plan as well as the *2003 Sequim Wastewater Comprehensive Plan* as being undersized.

This project is estimated to cost $673,000, and a detailed preliminary construction cost estimate is provided in Appendix F.

Project Name: WRF Influent Trunk Pipeline Repair/Replacement
Project Number: CS-7

Project Description: This project will address the condition of the existing trunk line between North Blake Street and the WRF. The project should include examination, repair, and/or replacement of the primary trunk line to ensure adequate conveyance of wastewater influent. The existing pipeline should be removed and replaced with approximately 5,000 LF of 24-inch HDPE pipe in order to accommodate projected flows for the City and surrounding areas. Pipe bursting is the recommended method of replacement for this pipeline. The project would also include the installation of new manholes approximately every 500 feet along the new pipe section.

This project is estimated to cost $1,378,000, and a detailed preliminary construction cost estimate is provided in Appendix F.

PORT WILLIAMS LIFT STATION

CITY OF SEQUIM WRF

JEANNIE'S MEADOW LIFT STATION

CS-13, 2018

CS-7, 2032

CS-9, 2032

CS-12, 2018

CEDAR RIDGE LIFT STATION

DOE RUN LIFT STATION

N

0 1,000 2,000 4,000 Feet

LEGEND:

- LIFT STATION

SEWER PIPE DIAMETER:

- 6" DIAMETER OR LESS
- 8"
- 10"
- 12"
- 15"
- 18"
- CAPITAL IMPROVEMENT PROJECTS
- SEWER SERVICE AREA
- URBAN GROWTH AREA
- CITY LIMITS
- PARCELS

CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 3-6
HYDRAULIC MODEL RECOMMENDED
PIPE REPLACEMENT & REHABILITATION
PROJECTS THROUGH 2032

Gray & Osborne, Inc.

M:\SEQUIM\11594 - 2012 General Sewer Plan\GIS\FIGURE 3-6 CIP 2032.mxd

COLLECTION SYSTEM RECOMMENDATIONS SUMMARY

The projects listed above are a result of the hydraulic modeling effort for 2012, 2018, 2032, and the buildout condition. In addition to these projects, City staff desire to repair and rehabilitate other regions of the collection system due to their condition and or frequently required maintenance. These projects are summarized below, and are fully described in Chapter 8 – Capital Improvement Program.

Table 3-11 Collection System Pipe Replacement/Rehabilitation Summary

Project No.	Project Name	Estimated Year of Initiation	Estimated Cost
CS-1	Cedar Street Sewer Improvement	2013	$1,181,000
CS-2	Etta Street Sewer Improvement	2013	$156,000
CS-3	Doe Run Lift Station Modifications	2014	$574,000
CS-4	Outfall Pipeline Repair / Replacement	2014	$1,040,000
CS-5	East Sequim Sewer Improvement #1	2014	$871,000
CS-6	Sequim Bay Lodge and State Park Pressure Main Improvements	2014	$90,000
CS-7	WRF Influent Trunk Pipeline Repair/Replacement	2015	$1,378,000
CS-8	Fir Street Sewer Improvement	2015	$1,033,000
CS-9	Sunnyside Street Sewer Improvement	2015	$673,000
CS-10	East Sequim Sewer Improvement #2	2015	$651,000
CS-11	East Sequim Sewer Improvement #3	2016	$2,093,000
CS-12	Hammond Street Sewer Extension	2016	$358,000
CS-13	North Blake Street Sewer Improvements	2017	$156,000
	Total		**$10,254,000**

POPULATION TRIGGER ANALYSIS

In order to plan for future wastewater infrastructure improvements, small scale projected growth was analyzed and population triggers were identified.

The population trigger analysis was completed for each collection basin identified in Figure 1-9, which used information based on the 63 subbasins identified earlier in this chapter. Existing flows in each subbasin were manipulated to estimate a population for each subbasin. These values were adjusted based on estimates for the current sewered population described in Chapter 2 – Basic Planning Information. The estimated wastewater production per

person for these collection basins included both residential and commercial production, as well as I/I.

Within each collection basin, populations for individual sub basins were combined in order to estimate the population within each collection basin. Based on information from the City, the most likely areas for growth and further development are the regions south of Washington and east of Sequim Avenue, East Sequim (which includes the John Wayne Development, Cedar Ridge Development, and Solana Developments), and the area north of Fir Street that drains to the Port Williams Pump Station. These areas correspond to Collection Basins 4, 7 and 3, respectively. Special consideration was given to primary plat information provided by the City which listed potential large scale developments and the number of units that might result if the plat were fully developed. Collection Basins 1, 2, 5, 6 and 8 are largely or fully developed and are not expected to experience significant growth. For the purposes of this analysis, populations within these collection basins were assumed to increase at the nominal rate of approximately 0.5 percent annually.

For the analysis, the population of Collection Basin 3 was increased systematically and the impact to major wastewater trunklines was analyzed. It was assumed that Collection Basins 4 and 7 would grow at a rate that was directly proportional to the rate of growth in Collection Basin 3. Carlsborg flows are not included in this analysis.

Results of the analysis suggest that when the population within Collection Basin 3 reaches 3,500 (an increase of 2.5 times the current estimated population of 1,360), there will be significant repairs and pipe replacement required to convey the projected wastewater flows through the downtown corridor. At this point in time, it is estimated that the populations within Collection Basins 4 and 7 would be 2,000 and 3,310, respectively. Repairs would include approximately:

- 1,000 LF of 8-inch pipe along McCurdy Street;
- 600 LF of 12-inch pipe near East Washington Street and South Sunnyside Avenue; and
- 2,000 LF of 8-inch and 10-inch pipe in the alley between Cedar Avenue and Spruce Avenue.

It is recommended that the City continually monitor or estimate collection basin populations to the best of its ability, and that planning begin for necessary improvements as the triggers are approached. These triggers can be a useful tool in order to plan for required wastewater pipe repair and/or replacement, but should be supplemented with data from flow monitoring, wastewater staff, and regular preventive maintenance. At the current rates of growth, the repairs listed above are not anticipated to occur prior to the year 2025.

REGIONAL SEWER PLANS

In keeping with the County's desire to develop a regional wastewater treatment strategy for the Sequim area, impacts to the City's collection system regarding SunLand, Blyn, Carlsborg, as well as the development of east Sequim, are briefly described.

EAST SEQUIM

As previously mentioned, this area east of downtown Sequim is a region in which significant development is expected within the next 20 years. Plans exist to construct new gravity lines and pressure lines that will connect east Sequim (Batelle, John Wayne) and south Sequim (Sequim Bay Lodge, Sequim Bay State Park), to the City's collection system near the intersection of Independence Drive and West Sequim Bay Road.

Significant residential and mixed use development is also projected for the region south of West Sequim Bay Road and north of Highway 101. The existing collection system and planned collection system improvements in this area appear to have adequate capacity to handle projected wastewater flows through the year 2032.

SUNLAND

Currently, wastewater produced in SunLand is treated at the SunLand Water Reclamation Facility located on Woodcock Road. Should SunLand decide to connect to the City's collection system, the most likely location is to the Port Williams Pump Station.

The Port Williams Pump Station contains two 25-horsepower, 350 gpm Cornell constant-speed pumps. The current peak hour flow for the North Sequim area tributary to the pump station is estimated to be 235,000 gpd or 164 gpm. The current peak hour flow for SunLand is estimated to be 291 gpm. The existing

capacity of the pump station is insufficient to handle the estimated combined current wastewater flows of 455 gpm from SunLand and the area in North Sequim that is served by this pump station as well as provide required pumping redundancy.

Projected peak hour wastewater flows in SunLand for 2032 are 471,000 gpd or 327 gpm. If SunLand connects to the Sequim WRF through the Port Williams Pump Station, the combined peak hour flows from SunLand and North Sequim (221 gpm) would be 548 gpm. As is the case for current peak hour flows, the Port Williams pump station (PWPS) would not have adequate capacity to handle combined North Sequim and SunLand flows. Furthermore, the forcemain from the PWPS to manhole 17-4-01 does not have adequate capacity to convey the projected combined wastewater flows for the year 2032. To convey these projected flows, a new, 12-inch forcemain would be required.

BLYN

This region includes the Seven Cedars Casino, Jamestown / S'Klallam Tribal Headquarters, small retailers, and residential wastewater producers. The Jamestown S'Klallam Tribe currently operates a small MBR treatment plant that serves the Longhouse Market and Tribal Headquarters. Most residents within the Blyn area use on-site septic tanks to treat wastewater.

Wastewater generated in Blyn would likely be transported in a force main along Highway 101 to either the future Whitefeather Way or Forrest Road Pump Stations. The Whitefeather Way and Forrest Road Pump Stations are proposed as part of the master plan in the *2010 Battelle Feasibility Report* as well as the east Sequim sewer improvement #3 CIP (CS-11). The flows would then be pumped north and enter the Sequim gravity sewer collection system in the area of Independence Way. This plan would require increasing the capacity of the existing gravity sewer by installing 820 feet of 12-inch-diameter PVC pipe and 778 feet of 15-inch-diameter PVC pipe to convey the projected wastewater flows for 2032. Prior to 2032, however, no pipe rehabilitation or replacement is required to convey projected wastewater flows.

CARLSBORG

Carlsborg lies to the west of Sequim across the Dungeness River. This area is the largest of the three regions and contains single-family, multi-family, commercial, and school entities within its UGA. Carlsborg has no wastewater infrastructure and treats

wastewater using on-site septic systems. The *2011 Feasibility Study* described five connection alternatives for Carlsborg, which are shown in Figure 3-7. For this Plan, Alternative No. 4 (connection at manhole 24-3-06 (Grant Road) was used to model current and projected wastewater flows within the Sequim collection system.

Prior to the year 2018, if Carlsborg were to connect to the Sequim collection system at manhole 24-3-06, no minor pipe replacement would be required to accommodate the projected flows. The model results and subsequent pipe replacement requirements are based on several assumptions, including:

- Flows are not equalized at a Carlsborg facility.
- Growth rates within Sequim remain steady at 2 percent, and all planned commercial development in West Sequim is completed prior to 2018

PORT WILLIAMS PUMP STATION

OPTION 1 DEDICATED FORCE MAIN

JEANNIE'S MEADOW PUMP STATION

CITY OF SEQUIM WRF

OPTION 3 CONNECTION AT MANHOLE 19-2-15

OPTION 2 CONNECTION TO MANHOLE 18-3-9

OPTION 4 CONNECTION AT MANHOLE 24-4-11

CEDAR RIDGE PUMP STATION

DOE RUN PUMP STATION

STRAIT OF JUAN DE FUCA

SEQUIM BAY

N

0 1,200 2,400 Feet

LEGEND:

- MANHOLES
- LIFT STATION

WASTEWATER CONVEYANCE OPTIONS:

- OPTION 1
- OPTION 2
- OPTION 3
- OPTION 4
- FORCE MAIN
- SEWER LINES
- SEWER SERVICE AREA
- CARLSBORG BOUNDARY
- CITY LIMITS
- CONNECTION POINTS

CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 3-7
CARLSBORG WASTEWATER
CONNECTION ALTERNATIVES

Gray & Osborne, Inc.

M:\SEQUIM\11594 - 2012 General Sewer Plan\GIS\FIGURE 3-7.mxd

Chapter 4
WATER RECLAMATION FACILITY AND REUSE FACILITIES ANALYSIS



This chapter provides an evaluation of the City of Sequim's Water Reclamation Facility (WRF) and water reuse facilities, including the performance of the WRF in meeting its NPDES permit requirements. Current and projected influent flows and loadings to the City of Sequim WRF are discussed relative to permitted WRF capacity. WRF components are evaluated for their ability to meet future WRF treatment requirements, and recommended improvements to the WRF are provided with planning level cost estimates. The possibility of providing treatment for wastewater from surrounding regions within the Greater Dungeness Region, including neighboring regions located outside of the Sequim urban growth area, is evaluated. Finally, opportunities for water reuse within the UGA and the Greater Dungeness Region are discussed.

WRF HISTORY AND PERFORMANCE

A wastewater treatment facility was constructed at the current site of the City's WRF in 1966. The plant was expanded in 1983. In 1997-1998, the City converted the wastewater treatment plant into a

water reclamation facility, adding chemical coagulation, filtration, and high level disinfection using ultraviolet light. The 1997 upgrade and conversion of the City's WWTP into a WRF resulted in the ability to produce high quality reclaimed water (<5 mg/L BOD_5 and TSS, <3 mg/L ammonia, <10 mg/L nitrogen and <2.2 mg/L total coliform). The addition of the effluent holding pond and filtration system, along with the outfall extension, allowed the Department of Health the ability to reduce the size of the Shellfish Prohibited Area and move it further off-shore, thereby opening 3,000 acres of shellfish beds in the vicinity of the outfall.

In 2008, in response to increases in WRF influent loadings approaching the WRF's capacity, the facility was further upgraded by converting an existing equalization basin into a new aeration basin and by adding a new secondary clarifier, new disc filtration and ultraviolet disinfection systems, and other improvements outlined in the 2008 *Engineering Report*. The 2008 upgrade increased the maximum month treatment capacity from 0.8 mgd to 1.67 mgd. These upgrades have resulted in a WRF capable of meeting current and proposed future Class A reclaimed water standards as defined by the Department of Health and Department of Ecology (*Washington State Water Reclamation and Reuse Standards,* Department of Health and Department of Ecology, 1997, 2011).

PERMIT STATUS

The City's current NPDES permit, No. WA0022349, is attached as Appendix C, while the City's current NPDES permit effluent limits are summarized in Table 4-1. The City's permit requires the treatment plant effluent to meet Class A reclaimed water treatment standards regardless of whether it is discharged to the outfall or pumped to the City's reuse facilities. The City is authorized to discharge to Bell Creek in Carrie Blake Park, the Strait of Juan de Fuca or to reuse sites. In case of extreme flow events (48 hours of flow greater than the maximum day flow) or catastrophic system failure (earthquake, lightning strike), the City is authorized to discharge secondary effluent-quality water through the marine outfall. Effluent not meeting Class A reclaimed water standards may not be pumped to the City's reuse facilities or discharged into Bell Creek under any conditions. Condition S.4. of the City's NPDES permit requires plan and schedule preparation to maintain

adequate capacity when flows and loads to the WRF exceed 85 percent of design capacity.

Table 4-1 WRF NPDES Permit Limits and Design Criteria

NPDES Permit Requirements		
Parameter	**Average Monthly**	**Average Weekly**
5-day Biochemical Oxygen Demand (BOD_5), Monthly average	30 mg/L[(1)] (200 lbs/day) or ≥ 85% Removal	45 mg/L (300 lbs/day)
Total Suspended Solids (TSS), Monthly average	30 mg/L[(1)] (200 lbs/day) or ≥ 85% Removal	45 mg/L (300 lbs/day)
pH	-	6.0 – 9.0
Parameter	**Average Monthly**	**Average Weekly**
Turbidity	2 NTU	5 NTU
Parameter	**7-day Median**	**Sample Maximum**
Total Coliform	2.2 MPN/100 mL	23 MPN/100 mL
Parameter	**Average Monthly**	**Sample Maximum**
Ammonia (as N)	3.3 mg/L avg. monthly	5.7 mg/L sample max.
Total Nitrogen, average monthly	10 mg/L	-
Dissolved Oxygen	-	Measurably Present
Criteria for Prevention of Facility Overloading		
Average Flow for the Maximum Month[(2)]	1.67 mgd	
Influent BOD_5 Loading for Maximum Month[(2)]	4,036 lb/day	
Influent TSS Loading for Maximum Month[(2)]	3,855 lb/day	

(1) Or 15 percent of the respective monthly average concentrations, whichever is more stringent.
(2) Limits in draft revised permit.

WRF Performance

Figures 4-1, 4-2 and 4-3 summarize WRF performance with regard to removal of Biochemical Oxygen Demand (BOD_5), Total Suspended Solids (TSS), Ammonia Nitrogen and Total Nitrogen. As shown in these figures, removal of these constituents improved dramatically with the increase in WRF capacity provided by the 2008 WRF expansion. Although there were some violations prior to the completion of WRF expansion in October 2009, the WRF performance since that time has been excellent. The City of Sequim Water Reclamation Facility received the 2011 "Wastewater Treatment Plant Outstanding Performance" award from Ecology for its track record of compliance.

Figure 4-1 WRF Effluent BOD_5 Concentrations and Percent Removal, 2005-2011

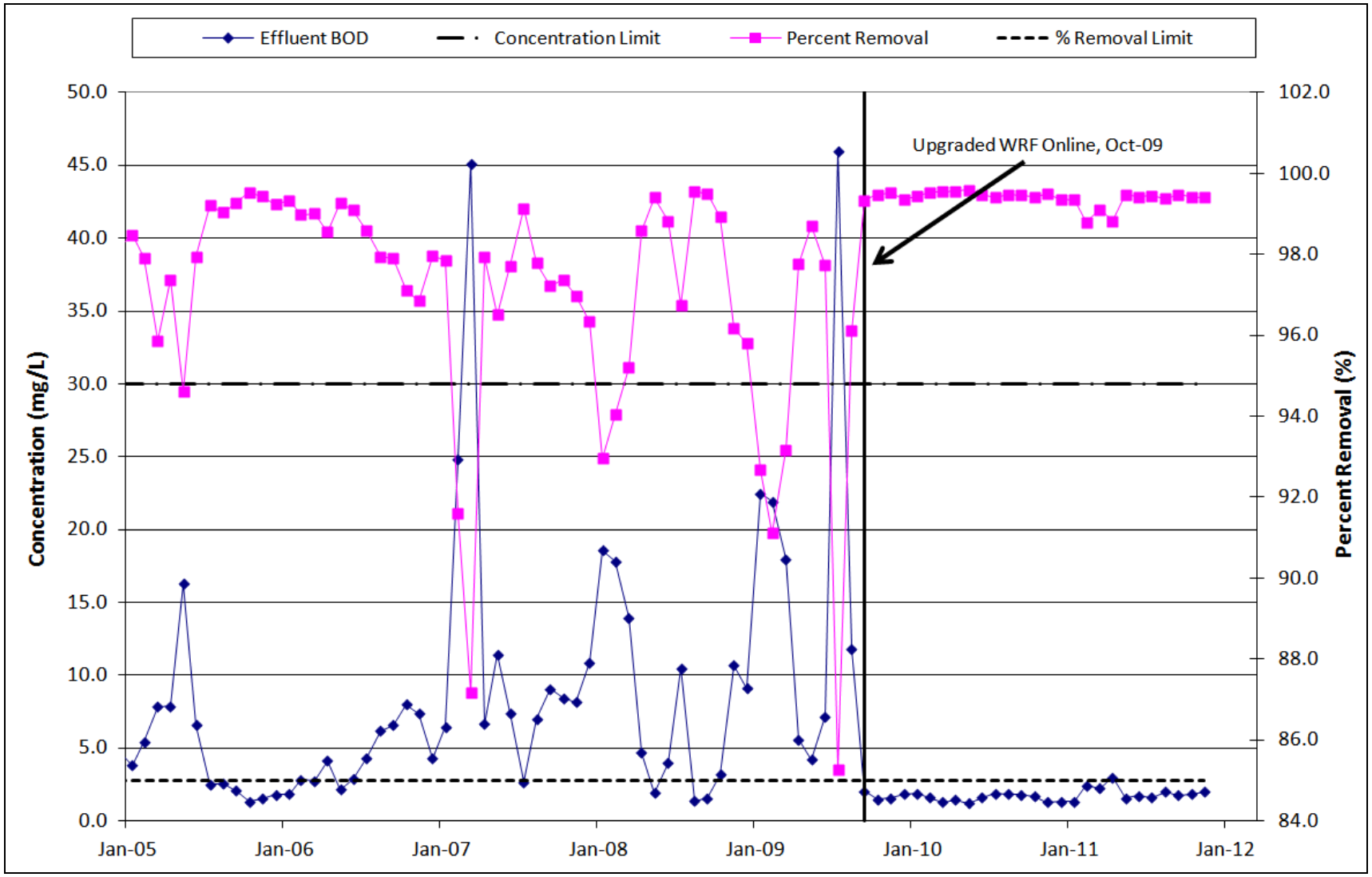


Figure 4-2 WRF Effluent TSS Concentrations and Percent Removal, 2005-2011

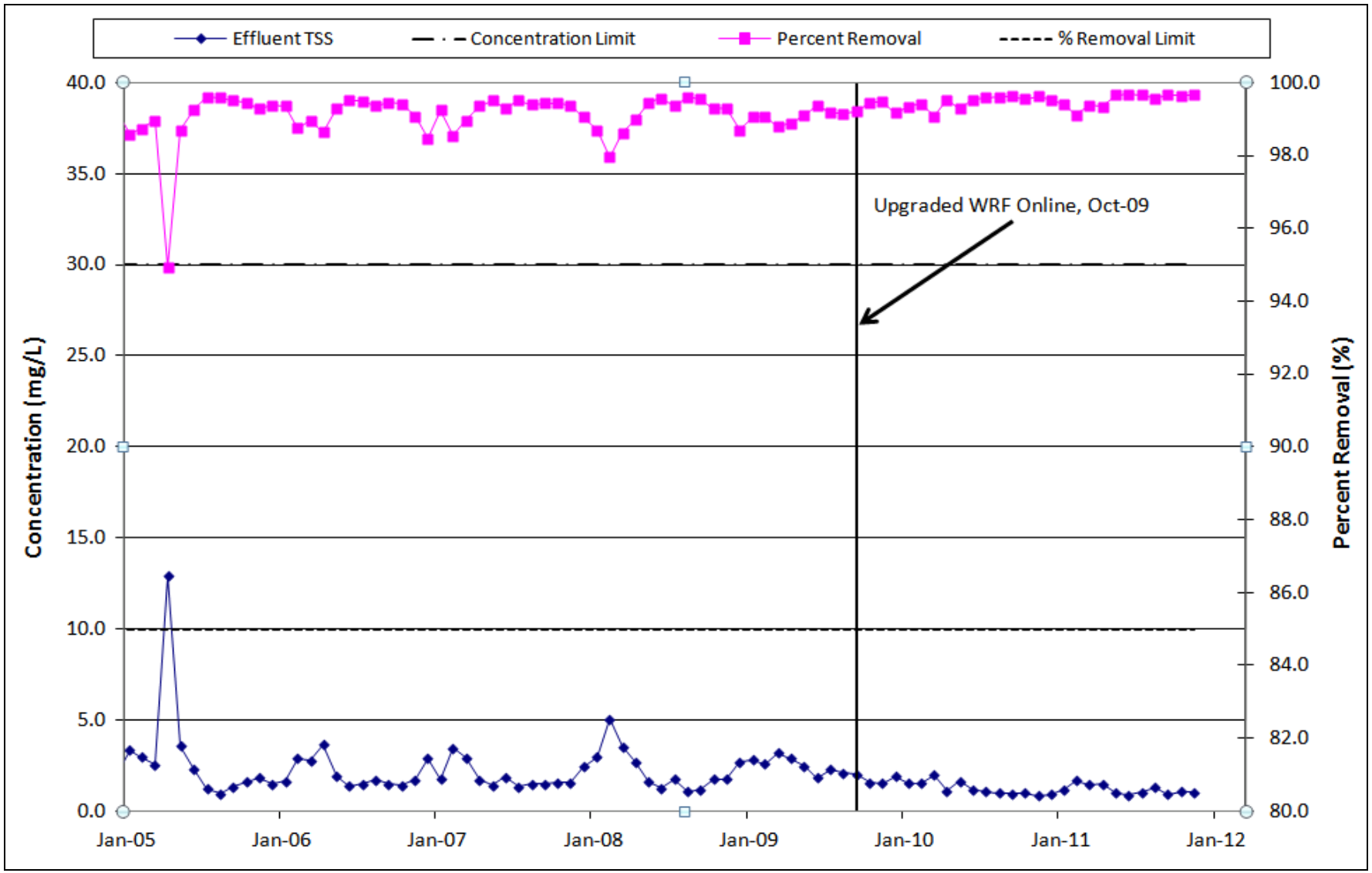
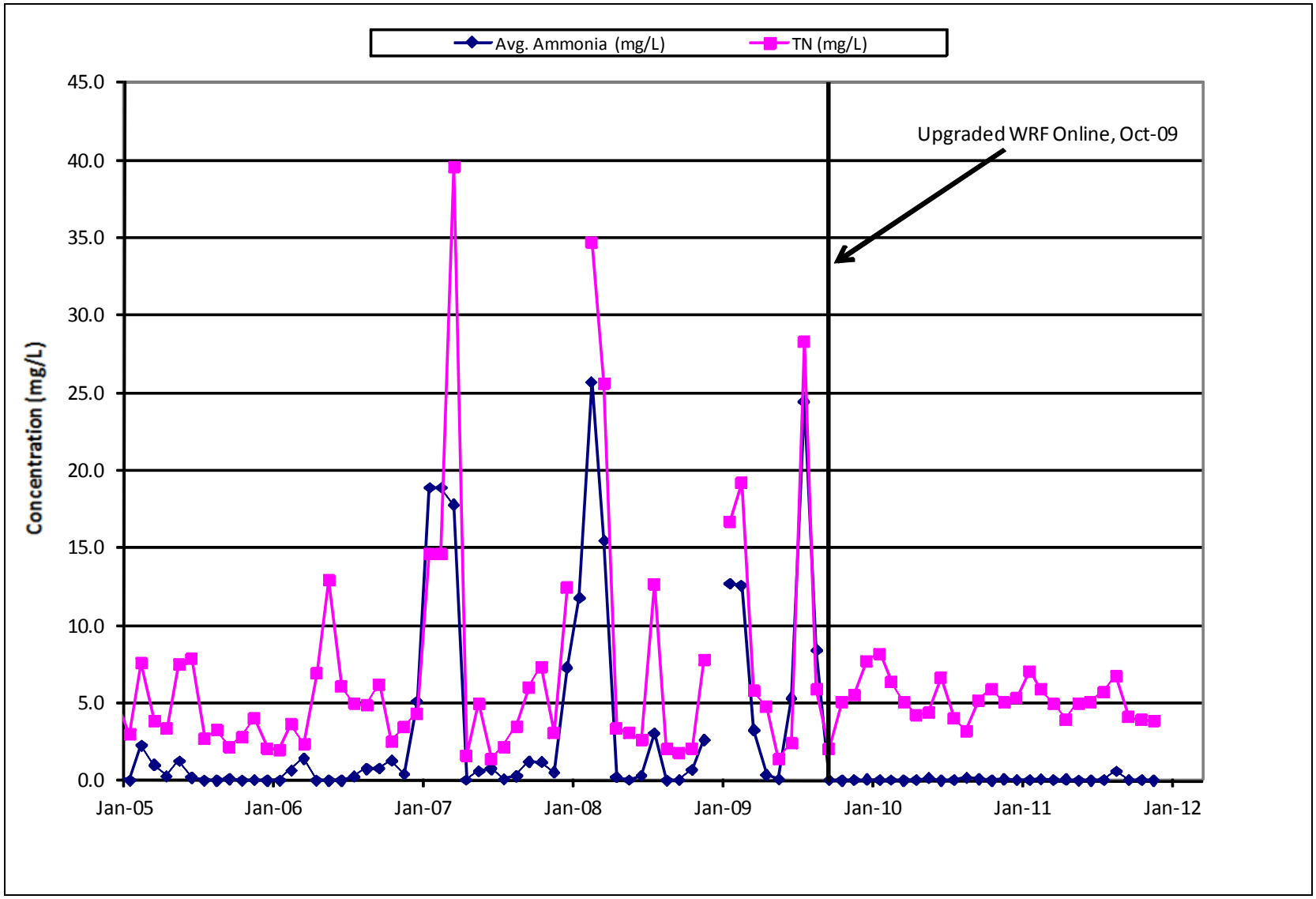


Figure 4-3 WRF Effluent Ammonia-N and Total Nitrogen Concentrations, 2005-2011



ANALYSIS OF WRF FLOW AND LOADING PROJECTIONS

Table 4-2 summarizes current and projected flows and loadings to the WRF relative to NPDES-permitted capacity and WRF design criteria, assuming no contributions from regional partners. (An evaluation of the impact of serving Carlsborg and other additional areas in the Greater Dungeness Region is provided later in this chapter.) As shown in Table 4-2, the projected maximum month influent flows to the WRF approach, but do not exceed, the rated capacity of the WRF (1.67 mgd) for the 20-year period. Similarly, the projected maximum month BOD_5 and TSS loadings to the WRF approach, but do not exceed, the rated capacity of the WRF (4,036 and 3,855 lb/d, respectively) for the 20-year period.

As noted above, the City's NPDES permit requires that when actual monthly average influent flow or loading to the WWTF exceed 85 percent of design criteria for 3 consecutive months, or if the City has projected increases in wastewater flow or loading that would cause exceedance of design capacity within 5 years, the City must submit a plan and schedule to maintain adequate capacity to Ecology. The 85 percent and 5-year requirements are needed to provide sufficient time for municipalities to plan, design and construct sufficient capacity. Based on projections, the City may exceed the 85 percent flow and loading criteria prior to 2032. Because of this, the City may need to submit an additional plan and schedule to maintain adequate capacity to Ecology prior to 2032.

Future peak day flows, when projected using the historical peak day flow from 2007 – 2011 (1.89 mgd, on May 15, 2011), would exceed the current design peak day flow by 2032. Although not formally a part of the NPDES design rating, peak day design flows are significant because they are used to size the equalization basin and control the maximum peak equalized flows to downstream treatment components. However, since it exceeds all other daily flows by over 30 percent, the May 15, 2011 flow is considered an outlier and has not been used in the analysis in this chapter. Accordingly, Table 4-2 uses the second-highest daily flow from 2007-2011, 1.44 mgd, as the basis for projecting peak day flows.

Table 4-2 Current and Projected WRF Influent Flows and Loadings

Parameter	2011	2018	2032	Buildout	NPDES Permit Limitations and/or WRF Design Criteria	85% of NPDES Limitations and/or WRF Design Criteria
Total ERUs	5,000	6,344	9,928	19,877	-	-
Annual Average Flow (mgd)	0.66	0.81	1.22	2.84	-	-
Maximum Month Flow (mgd)	0.86	1.01	1.45	3.04	1.67	1.42
Peak Day Flow (mgd)(1)	1.44	1.61	2.15	3.96	2.46	2.09
Peak Hour Flow (mgd)(1)	2.70	2.92	3.76	6.89	4.65	3.95
Average Annual BOD_5 Loading (lb/day)	1,485	1,884	2,949	5,903	-	-
Maximum Month BOD_5 Loading (lb/day)	1,927	2,445	3,826	7,661	4,036	3,431
Average Annual TSS Loading (lb/day)	1,391	1,765	2,762	5,530	-	-
Maximum Month TSS Loading (lb/day)	1,781	2,260	3,536	7,080	3,855	3,277

(1) The WRF must equalize and fully treat peak hour flows for continuous compliance with reclaimed water standards. The historical peak day flow of 1.89 mgd, 30 percent higher than any other daily flow from 2007-2011, was rejected as an outlier.

(2) The flows and loading projections in this table do not assume any contributions from regional partners; see discussion at the end of the chapter.

As a producer of reclaimed water, the process units at the Sequim WRF must be sized to provide 5-log virus removal on a continuous basis, unlike traditional secondary plants that can meet disinfection and other permit limits on a weekly and/or monthly basis. Additionally, the WRF must be in continuous compliance with permit limits for turbidity and total coliform, or the reclaimed water must be bypassed. Peak hour flows are equalized at the WRF in the EQB to attenuate the flow peaks such that the capacities of the secondary clarifiers, filtration system, and ultraviolet disinfection system are not exceeded. If peak hour WRF design flows are exceeded, the WRF will not be able to equalize the flow (attenuate the peaks) adequately. Peak hour flows, however, are the most difficult to project due to the influence and variability in infiltration and inflow and diurnal flow patterns.

WATER RECLAMATION FACILITY EVALUATION

The WRF is located east of the City on a 4-acre site north of Bell Creek and west of Schmuck Road. The WRF site is bordered by a steep hill on the north, on the south by Bell Creek, to the east by Schmuck Road, and to the west by farm land. The neighboring land is primarily used for dairy farming. Because the WRF site once was the riverbed for the Dungeness River, the groundwater is high and typically lies within 2 feet of the surface. The existing site is underlain by silt and cobbles.

A site plan showing the existing facilities is shown in Figure 4-4. Figure 4-5 shows the existing process schematic for the WRF, while Figure 4-6 shows the current hydraulic profile. The WRF liquid stream treatment processes include influent screening, grit removal, biological treatment, secondary settling, coagulation, filtration, and ultraviolet disinfection. Solids treatment facilities to generate Class A biosolids using alkaline stabilization and a heated screw press were constructed in 2003. These individual process components are discussed below.

HEADWORKS

The existing headworks equipment includes an automatically cleaned mechanical fine screen and grit removal facilities. The screen, a Heliclean HLC 500 manufactured by Hycor, Inc., has a capacity of 5.3 mgd. This 1/4-inch perforated screen removes and washes screenings with good performance and minimal maintenance (once every 1 to 2 weeks, debris must be removed from the upstream mixer impeller).

The grit removal facilities include a single vortex-type (Pistagrit) unit with a grit pump and a grit classifier tank. The grit removal facilities have sufficient capacity for a peak hour flow of 5.2 mgd.

Recommended Headworks Improvements

The screen does not have sufficient capacity for the projected buildout peak hour flow of 6.89 mgd and should be upgraded by adding an additional screen of similar capacity. A new mechanical fine screen should be installed within the existing bypass channel (some channel modifications will be necessary) in order to meet the standards set forth in WAC 173-308 for Class A screening. In the future, after this new unit is operational, the existing Hycor screen

will be replaced, giving the WRF two operational mechanical fine screen systems.

The existing Pistagrit unit and classifier has adequate capacity for year 2032 flows. However, the unit is almost twenty years old and nearing the end of its useful life. The unit should be replaced with a similar type unit of an adequate size and capacity to handle the projected flows and loadings for the year 2032.

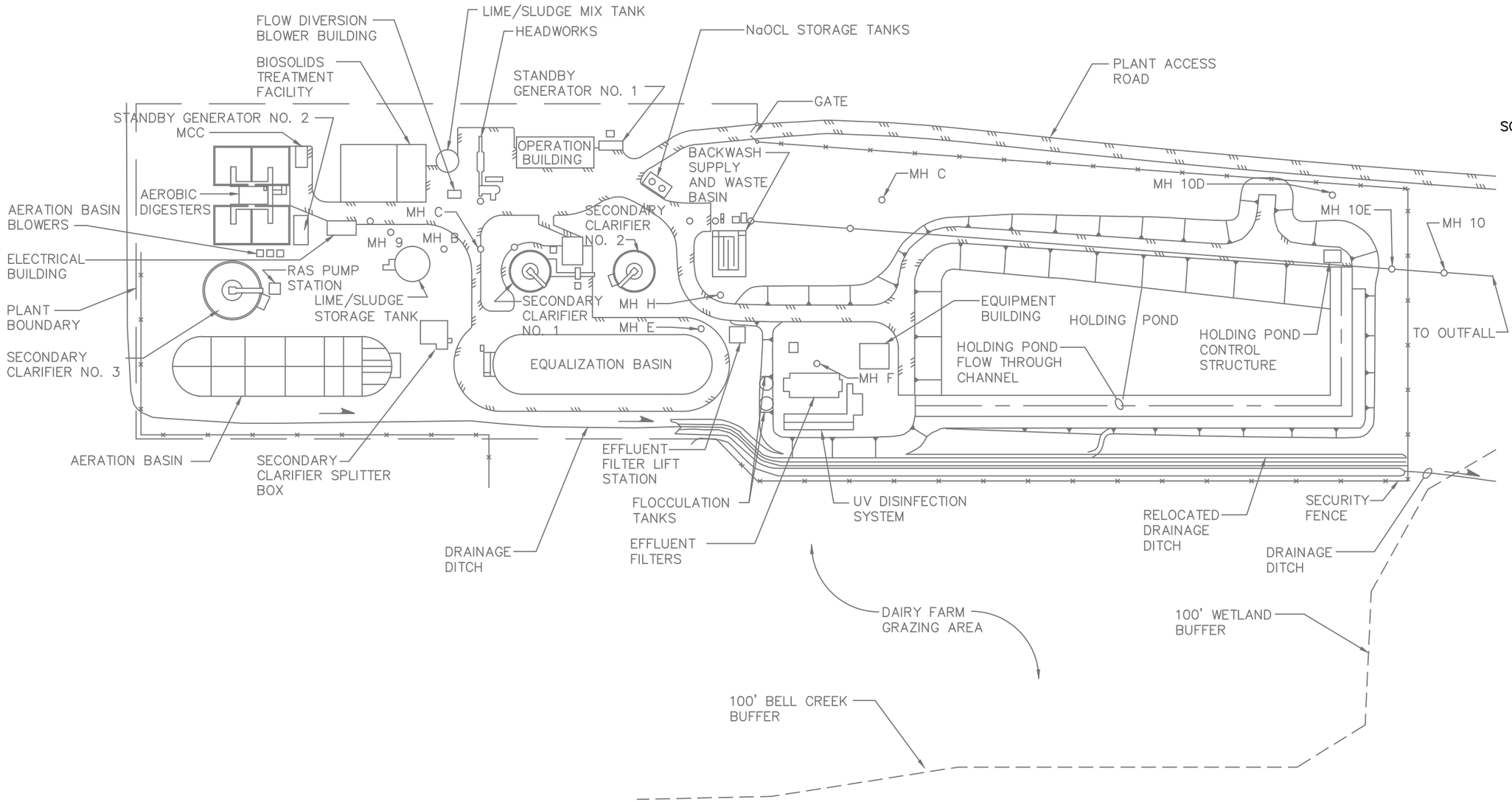
EQUALIZATION BASIN (EQB)

In the 2008 WRF Expansion, an oxidation ditch was converted into an equalization basin. The new EQB provides approximately 700,000 gallons of storage and serves to attenuate changes in flow to the plant. Equalized flow is pumped from the EQB to the EQB outlet box through an 8-inch pipe by two 20-hp Flygt submersible pumps (1,700 gpm). An 18-inch pipe connects the EQB outlet box and the aeration basin influent box.

To maintain solids in suspension, the equalization basin uses two Aeromix Tornado 7.5-hp floating/aspirating submersible mixers, and two House 10-hp floating brush aerators. One Aeromix aspirating mixer is currently out of service; plans to refurbish it are described in Chapter 8.

AERATION BASIN

In the 2008 WRF Expansion, the former equalization basin was converted into an aeration basin. For this conversion, the existing EQB walls were raised 10 feet to provide an aeration basin volume of 1,350,000 gallons. The basin consists of two trains, each with three selector zones, two anoxic zones, and four aerobic zones. The volume of each zone is presented in Table 4-3.

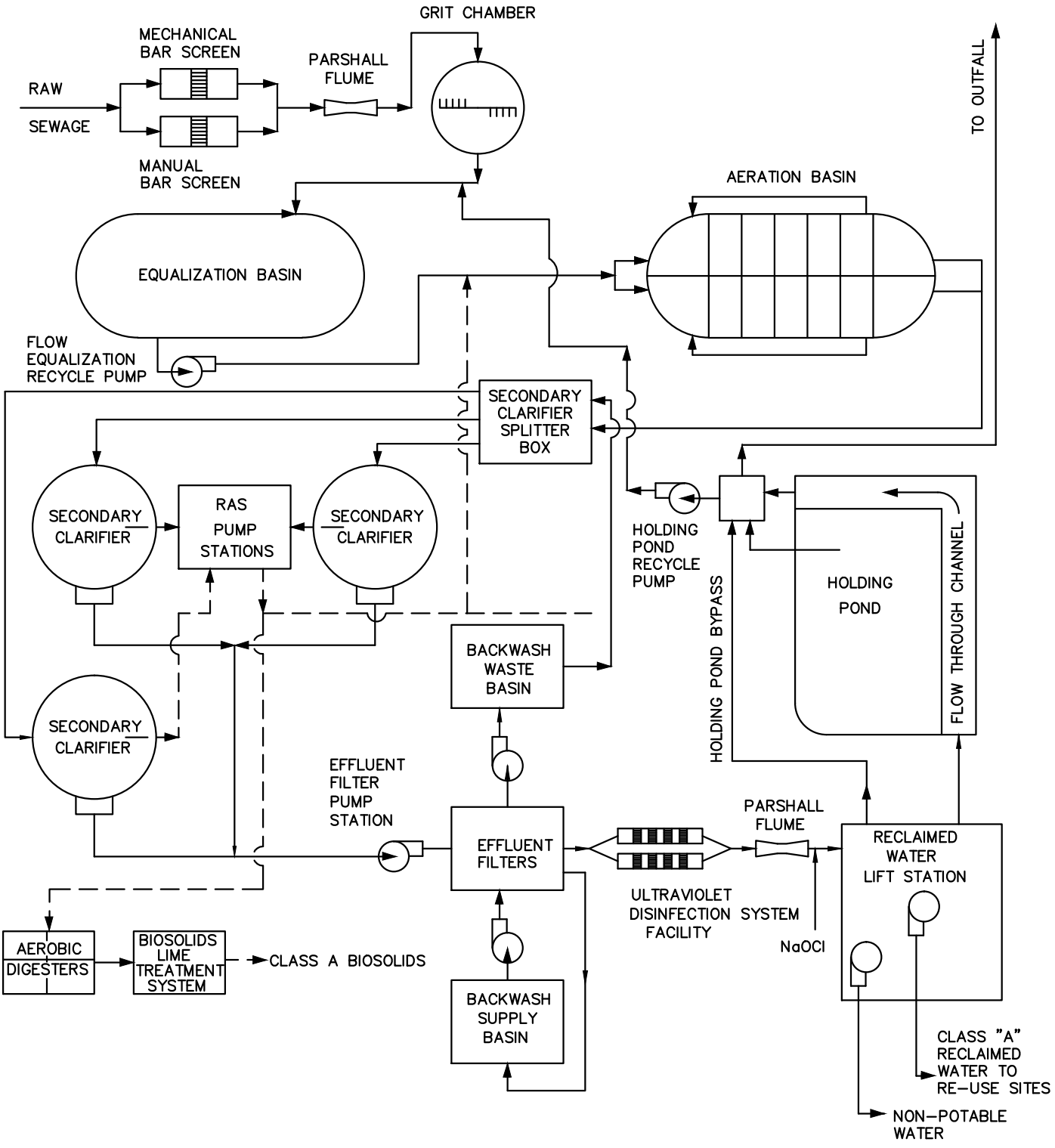


CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 4-4
EXISTING WRF SITE PLAN

Gray & Osborne, Inc.
CONSULTING ENGINEERS

M:\SEQUIM\111594 - 2012 General Sewer Plan\Sewer Report\Figures\Figure 4-4 - Site Plan.dwg, 3/4/2014 7:48:43 AM, DWG To PDF.pc3

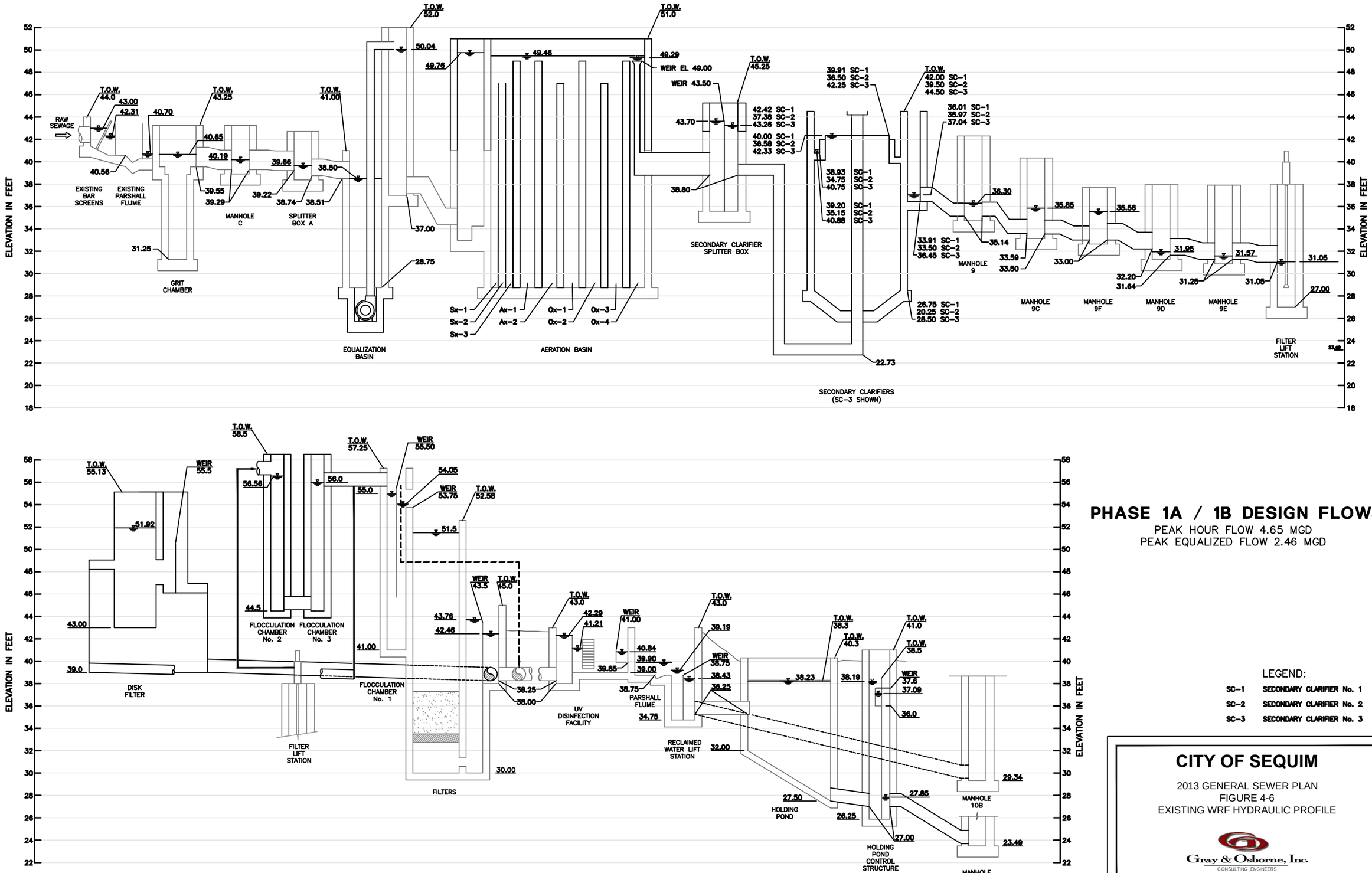


CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 4-5
EXISTING WRF PROCESS SCHEMATIC

Gray & Osborne, Inc.
CONSULTING ENGINEERS

M:\SEQUIM\11594 - 2012 General Sewer Plan\Sewer Report\Figures\Figure 4-5 - Process Schematic.dwg, 3/4/2014 7:47:42 AM, DWG To PDF.pc3



PHASE 1A / 1B DESIGN FLOWS

PEAK HOUR FLOW 4.65 MGD
PEAK EQUALIZED FLOW 2.46 MGD

LEGEND:

SC-1	SECONDARY CLARIFIER No. 1
SC-2	SECONDARY CLARIFIER No. 2
SC-3	SECONDARY CLARIFIER No. 3

CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 4-6
EXISTING WRF HYDRAULIC PROFILE

Gray & Osborne, Inc.
CONSULTING ENGINEERS

M:\SEQUIM\111594 - 2012 General Sewer Plan\Sewer Report\Figures\Figure 4-6 - Hydraulic Profile.dwg, 3/4/2014 7:49:31 AM, DWG To PDF.pc3

Table 4-3 Aeration Basin Design Criteria

Items	Equipment Data/ Design Criteria
Basins	
Trains	2 per Basin
Volume (each train)	675,000 gal
Detention Time @ Design Flow	19.4 hrs
MLSS Concentration	4,000 mg/L
Aerobic Solids Retention Time	8.1 days
Zones	**Volume (Gallons)**(1)
Selector Zone 1	15,123
Selector Zone 2	15,123
Selector Zone 3	30,246
Anoxic Zone 1	135,000
Anoxic Zone 2	135,000
Aerobic Zone 1	256,000
Aerobic Zone 2	256,000
Aerobic Zone 3	256,000
Aerobic Zone 4	256,000

(1) Volume includes both trains.

The aeration basin operates in a predenitrification Modified Ludzack-Ettinger (MLE) configuration for biological nitrogen removal. Suspended microbial growth in the two parallel trains removes organic pollutants, ammonia nitrogen, and nitrate nitrogen from the wastewater. The treatment trains are designed to nitrify (biologically oxidize ammonia nitrogen to nitrate nitrogen) and denitrify (biologically reduce nitrate to nitrogen gas) in the same reactor. This process is accomplished by maintaining the high solids retention time (SRT) necessary to support nitrifying bacteria, while simultaneously utilizing separate anoxic and aerobic zones within the basin to achieve the environmental conditions necessary to support both nitrification and denitrification within the same reactor.

Aeration of the aerobic zones is accomplished using an air distribution system consisting of aeration blowers and submerged fine bubble diffusers. Mixing of the selector zones is accomplished with coarse bubble diffusers while the anoxic zones are mixed using submersible mechanical mixers. Influent wastewater is combined with return activated sludge (RAS) to create the mixed liquor that

enters the aeration basin. Submersible propeller pumps recirculate nitrified mixed liquor from the aerobic zones back to the selectors and anoxic zones to achieve denitrification. Mixed liquor entering each treatment train first passes through the selector zones designed to promote a rapid uptake of soluble substrate, which promotes the development of a floc with good settling characteristics. The selector zones are followed by two anoxic zones and four aerobic zones.

The aeration basin uses four (three operational, one redundant) Aerzen Model GM 35S 75 hp positive displacement blowers capable of providing 850 SCFM each.

The aeration basin has adequate capacity to treat the projected maximum month flows and loadings through the 20-year planning period.

Clarifier Splitter Box

The clarifier splitter box regulates the flow of mixed liquor prior to clarification so that it may be directed as desired between the secondary clarifiers. The clarifier splitter box is capable of splitting the combined flow to four clarifiers, however; until a fourth clarifier is constructed, as planned in the Phase 2 expansion of the WRF, the clarifier splitter box directs flow from the aeration basin to any of the three existing secondary clarifiers. The splitter box is mixed with a vertical, slow speed Lightnin mixer to prevent solids settling.

Secondary Clarifiers

The WRF currently has three secondary clarifiers in operation. Clarifier 1 has a diameter of 50 feet, a sidewater depth of 13 feet and a volume of 191,000 gallons. Clarifier 2 has a diameter of 50 feet, a sidewater depth of 16.3 feet and a volume of 235,000 gallons. Clarifier 3, constructed during the 2008 WRF Expansion, has a diameter of 50 feet, a sidewater depth of 14 feet, and a volume of 206,000 gallons. A fourth secondary clarifier is planned to provide additional treatment capacity when necessary.

Per State reliability standards for water reclamation, the facility was designed to treat the design flow with one clarifier out of service. The clarifiers have adequate capacity for projected flows through the 20-year planning period.

RAS/WAS Pump Stations

The concentration of bacteria (Mixed Liquor Suspended Solids, MLSS, expressed as mg/L) in the activated sludge system must be maintained at a level that provides the minimum Solids Retention Time required to oxidize the organic matter and ammonia in the wastewater. The MLSS concentration is maintained by recycling return activated sludge (RAS) from the underflow of the secondary clarifiers to the activated sludge process, and carefully controlling the mass of solids (Waste Activated Sludge, WAS) removed from the system. RAS is recycled from the clarifiers to the aeration basin splitter box by the RAS/WAS pumps, located at the RAS/WAS Pump Stations. There are six existing RAS/WAS pumps which convey RAS to the aeration basin, and WAS to the digester.

RAS/WAS Pump Station No. 1 serves Clarifiers No. 1 and No. 2, and utilizes two Gorman-Rupp 5-hp self-priming pumps capable of pumping 450 gpm at 23 feet of TDH. RAS/WAS Pump Station No. 2, constructed in the 2008 WRF Expansion, serves Clarifier No. 3, and uses two Gorman-Rupp 7.5-hp self-priming pumps capable of pumping 400 gpm at 28 feet of TDH.

Coagulation and Filtration Facilities

Two filtration systems are provided to remove additional suspended solids following secondary clarification. The original effluent filter, installed in 1997-1998, consists of four cells containing 5-foot depth of anthracite media. The capacity of each cell is 0.62 mgd, so there is sufficient capacity to filter a peak equalized flow of 1.86 mgd with one cell out of service.

A fabric filter provides additional capacity beyond the 1.86 mgd that is provided by the anthracite filter. Per the evaluation presented in the 2007 *WRF Expansion Study*, four disks provide an additional capacity of 1.24 mgd (4 x 0.31 mgd) peak hour equalized flow. With one gravity anthracite cell offline, the nominal capacity is 3.10 mgd (1.24 mgd plus 1.86 mgd). With the 4-disc fabric filter off-line, the capacity is 2.48 mgd.

The effluent filter pump station filter houses three lift pumps. Each pump is a Goulds Model 12RJLC, 15 hp, vertical turbine, variable speed pump with a capacity of 855 gpm (1.23 mgd) at 39 feet of TDH. The pumps are typically operated in a lead-lag-backup configuration. When one of the pumps is down for maintenance,

the other two pumps have sufficient capacity to convey the peak equalized flow from the clarifiers (2.46 mgd). Design criteria and equipment data for the effluent filtration system is summarized in Table 4-4. The coagulation and filtration facilities have adequate capacity for projected flows through the 20-year planning period.

Table 4-4 Effluent Filtration System Design Criteria

Items	Design Data
Effluent Fabric Filter	
Manufacturer	Aqua Aerobic Systems Inc.
Type	Fabric Filter
Quantity	1
Number of Disks	4
Capacity (each disk)	0.31 mgd
Anthracite Filters	
Quantity of cells	4
Type	Single Media, Gravity
Surface Area	100 sf each
Media	Anthracite
Capacity (each cell)	0.62 mgd

ULTRAVIOLET DISINFECTION SYSTEM

The ultraviolet light (UV) disinfection system for the Sequim WRF was upgraded in the 2008 WRF Expansion in accordance with Ecology's *Criteria for Sewage Works Design* that incorporates the *National Water Research Institute/American Water Works Research Foundation (NWRI/AwwaRF) Guidelines for Drinking Water and Reuse* (2003 edition) and the 2011 draft Washington State Reclaimed Water Facilities Manual. The *NWRI/AwwaRF* guidelines are designed to verify effective pathogen removal through the use of a rigorous validation process. *NWRI/AwwaRF* standards are already de facto State standards, since they are now essentially required by the Department of Health.

The UV disinfection system, manufactured by Trojan Technologies, Inc. (Model 3000 Plus), includes six banks of 30 low-pressure high-intensity horizontal lamps per bank in two open channels. One bank in each channel is redundant at the peak equalized flow of 2.46 mgd. At lower flows, fewer banks are needed, and the system can be operated with proportionately fewer banks energized, allowing the operation of a single channel during maintenance of

the other channel. (The capacity of the Parshall flume, located downstream of the disinfection system, is 5.73 mgd, which is sufficient for the projected peak hour equalized flow for buildout of 4.0 mgd). Design criteria and equipment data for the UV disinfection system is summarized in Table 4-5. The UV disinfection system has adequate capacity for projected flows through the 20-year planning period.

Table 4-5 Ultraviolet Disinfection System Equipment Data

Item	Equipment Data
Manufacturer	Trojan Technologies, Inc.
Model	UV 3000 Plus
Configuration	Horizontal Open Channel
Quantity of Channels	2
Peak Disinfection and Hydraulic Flow	2.46 mgd
Peak Hydraulic Flow	2.46 mgd
Max. Effluent Suspended Solids	10 mg/L
UV Transmittance	65%
UV Dose, Min.	100 mJ/cm^2 (MS-2 bioassay-based, in accordance with the 2003 NWRI Guidelines)
Effluent Disinfection Standard	2.2 total coliform/100 ml, based on a 7-day median, 23 total coliform/100 ml in a single sample
Quantity Of Banks Per Channel	3 (2 are duty, 1 is redundant)
Quantity Of Modules Per Bank	5
Quantity Of Lamps Per Module	6
Total Quantity of Lamps	180

RECLAIMED WATER LIFT STATION

Class A reclaimed water produced at the WRF is pumped from a wet-well downstream of the UV disinfection facilities by two Goulds 50-hp vertical turbine booster pumps. The pumps are controlled by variable frequency drive (VFD) units that vary the operating speed of the pumps to match the reclaimed water production rate. The reclaimed water production rate varies due to seasonal conditions (e.g., inflow/infiltration during wet weather), diurnal variations and the variable use of reclaimed water internal to the treatment plant (e.g., as backwash for the filters).

If the reuse pump station is in use and an alarm condition occurs indicating that Class A standards are not being met (e.g., high turbidity), then the control system shuts down the pumps, causing

the effluent to overflow into a holding pond flow-through channel described below. In this situation the operators must be cognizant of the status of the gate to the outfall in the holding pond control structure (open or closed) and take appropriate action if necessary.

The capacity of each of the existing reuse pumps is 650 gpm. Since the City can use the Juan de Fuca outfall, there is adequate capacity for 2020 peak day flows; however, the City is in the process of developing additional reuse sites, and therefore, additional reuse pumping capacity will be necessary in the future. The reuse pumping capacity will be expanded when additional reuse sites are developed.

HOLDING POND

The WRF includes a holding pond to store effluent that fails to meet permit limits. The pond includes a flow-through channel with a volume of 533,000 gallons and a total volume of 2,680,000 gallons. A Flygt 465-gpm submersible constant speed recycle pump returns out-of-specification effluent to the headworks of the WRF.

Effluent from the UV disinfection system currently flows into the flow-through channel, which provides detention under plug flow conditions prior to discharge to the outfall. In the event that Class A reclaimed water treatment criteria for turbidity is not met (greater than 2 NTU) or a failure of the UV system to maintain the required dosage occurs, an alarm condition exists. Operators are alerted by local annunciation or via telemetry and must manually close the gate to the outfall at the holding pond control structure. Once this effluent gate is closed, the effluent is diverted into the holding pond which provides several days of storage. Once the alarm condition is resolved the effluent is again discharged to the outfall and the holding pond contents are pumped back to the head of the treatment plant.

OUTFALL

The City's NPDES permit allows discharge of Class A reclaimed water to two locations – the City's marine outfall in the Strait of Juan de Fuca and Bell Creek. The City's marine outfall consists of 18-inch concrete pipe terminating in a diffuser that includes 6-inch risers for effluent dispersal. The City's outfall was extended approximately 1,400 feet in 1997 to a total of 1,900 feet. The

City's permitted outfall in Bell Creek is incorporated in the City's Reuse Demonstration Site, which is discussed below.

As discussed in Chapter 3 a portion of the outfall pipe is in poor condition and needs to be replaced. This project has been included in the CIP in Chapter 8.

DIGESTERS

Waste solids produced at the WRF are pumped to the digester, and then treated with the FKC lime stabilization/pasteurization/ dewatering system to produce Class A biosolids. Each of the four digester cells is 100,000 gallons and contains a 25-hp floating Aqua-Aerobic Systems mechanical surface aerator/mixer. (As of November 2012, one of the 25-hp mixers is currently being refurbished and has been temporarily replaced with two 15-hp mixers.)

Sludge is wasted from the clarifiers to Digester Cells No. 1, No. 3 and No. 4. All three of these cells are operated either in aeration or decant mode. Typically, the cells are filled to a depth of 13 feet with sludge, aerated, and decanted, leaving 9 feet of sludge. The supernatant is conveyed back to the EQB and the sludge is pumped to Cell No. 2 for additional digestion. Waste activated sludge is typically 1.0 to 1.2 percent solids entering the digester and 1.4 to 1.8 percent solids leaving the digester.

The SunLand Water District delivers an average of 180 lb/day (1,400 gallons at 1.5 percent total solids) of WAS from the SunLand WRF for biosolids treatment at the Sequim WRF.

The digester is currently used to partially stabilize sludge, and is not operated with the intent of generating Class B biosolids. If the FKC system used in the process to produce Class A biosolids is out of service for any extended period of time, the existing WRF solids handling system has no provision for producing Class B biosolids, which would require the facility to haul secondary waste sludge offsite for further treatment and disposal or reuse. The City's options are limited and costly when disposing of waste sludge that does not meet Class A regulatory criteria. To provide redundancy and increased flexibility in long-term biosolids management, and to avoid the costs of off-site treatment if the Class A system fails, it is

recommended that aerobic digestion to produce Class B biosolids upstream of the existing FKC process be performed.

An additional major concern is ammonia – both in the supernatant recycle stream (since this recycled ammonia can tax the nitrification capacity of the activated sludge system), and in the sludge (due to odors). Aerobic digestion to Class B standards will result in stabilization and nitrification prior to the use of the FKC process, reducing ammonia in recycle streams and reducing odors.

Aerobic Digestion to Produce Class B Biosolids

Aerobic digestion is similar to the activated sludge process. Waste solids from the secondary clarifiers are conveyed to the aerobic digesters for stabilization and solids reduction. The sludge is aerated and mixed in the digesters to provide oxygen to microorganisms which break down available food to carbon dioxide, water, and cell tissue. As the supply of available food is depleted, the microorganisms begin to consume their own cell mass to obtain energy for cell maintenance. When this occurs, cell mass is oxidized aerobically to form carbon dioxide, water, and ammonia. A major objective of aerobic digestion is to reduce the mass of the solids for disposal. This reduction takes place predominantly with the biodegradable (organic) content of the sludge, although there may be some removal of inorganics through biological processes as well.

Production of Class B biosolids using aerobic digestion provides greater flexibility for the long-term management of waste solids at the WRF. Also, odor may be reduced by stabilizing the sludge and nitrifying in the aerobic digestion process. Wastewater treatment facilities like Sequim's with design flows of 5 mgd and less typically use aerobic digestion (as opposed to anaerobic digestion) for sludge stabilization primarily due to lower capital costs and ease and reliability of operation.

Presently, the WRF provides limited aerobic digestion of the waste sludge. However, the digester does not have enough volume and aeration capacity to produce Class B biosolids for future (year 2032) sludge production. It is recommended that additional aerobic digester volume be constructed at the WRF to produce Class B biosolids. The recommended upgrades include the installation of a sludge thickener, constructing new aerobic sludge digester cells and

installation of aeration blowers and diffusers in all digester cells for aeration and mixing.

Thickening with a second Rotary Screen Thickener (RST) to approximately 3.5 to 4.0 percent upstream of the aerobic digester will increase detention time, nitrification and volatile solids reduction. In order to provide adequate aeration in the digester tanks after thickening, a new aeration system including blowers and diffusers would have to be installed.

Aerobic Digester Tank Sizing

The required volume for an aerobic digestion system is based on the required detention time to achieve pathogen reduction requirements to produce Class B biosolids. The State of Washington Administrative Code (WAC) provides the requirements for biosolids to be classified as Class B with respect to pathogens. WAC 173-308-170 states that to achieve Class B biosolids using aerobic digestion, the biosolids must be agitated with air or oxygen to maintain aerobic conditions for a specific solids retention time (SRT) at a specific temperature. Values for the SRT and temperature must be between 40 days at 20 degrees C (68 degrees F) and 60 days at 15 degrees C (59 degrees F) when accommodating the projected maximum month sludge loadings. To be conservative, the design temperature used to size the aerobic digestion system is 15 degrees C with an SRT of 60 days.

Thickening the waste activated sludge prior to entering the digester minimizes the variability of the waste solids concentration and reduces the volume of the digester cells. It is recommended that the thickening be performed with a rotary screen thickener, which provides reliable thickening of WAS from the current 1 percent to up to 3.5 to 4.0 percent solids. Thickening in the RST to this level will allow the sludge solids concentration be maintained at approximately 2.5 to 3.0 percent in the digesters (accounting for volatile solids reduction within the digester) for optimal digestion performance. (Solids concentrations higher than 3.5 percent in the digester typically become difficult to mix and aerate.)

It is recommended that two phases of improvements be constructed for digesters. In the first phase, fine bubble diffusers, blowers, variable frequency drives and dissolved oxygen sensors will be installed in the existing cells to improve energy efficiency and oxygen transfer.

In the second phase, additional tankage, diffusers and an additional blower will be provided to treat projected 2032 sludge volumes to Class B criteria. It is recommended that a series configuration be utilized for aerobic sludge digestion for the 2032 design. The existing digester will be used as the second basin in the aerobic digestion process. A new basin will be constructed for the first stage in the series. The series configuration improves the digester performance and efficiency. Placement of the existing digester as the second stage retains the existing layout for connections to the FKC system. The size of the new digester tank is calculated below.

The 2008 manual *Design of Wastewater Treatment Plants* (Water Environment Federation, WEF MOP-8) provides the following aerobic digester volume sizing equation:

$$V = \frac{Qi \cdot (Xi + Y \cdot Si)}{X \cdot (Kd \cdot Pv + {}^{1}\!/_{SRT})}$$

Where,

Qi = Sludge feed flow rate to new aerobic digester from RST (ft^3/day)
Xi = Feed solids concentration from RST, (mg/L)
Y = Percent of feed consisting of raw primary solids, (%)
Si = Digester feed BOD_5, (mg/L)
X = Suspended solids in new aerobic digester, (mg/L)
Kd = Reaction rate constant, from Fig. 22.39 in WEF MOP-8 (1/d)
Pv = Volatile fraction of digester SS, (%)
SRT = Solids retention time, (days)

Example calculations for Sequim and Sunland Year 2032 projected flows and loadings are shown below.

The terms Qi and SRT, used in the new aerobic digester sizing equation are determined as follows:

The influent to the new aerobic digester will consist of waste solids from the rotary screen thickener. The waste solids will be thickened to 3.5 to 4.0 percent. The influent flow to the new aerobic digester is calculated as follows:

AD Influent Flow, Qi = (Waste solids production, Px)/[(suspended solids concentration output from RST)*8.34] * 1,000,000

= (3,528 lb/d)/[(40,000 mg/L) *8.34]*1,000,000
= 9,770 gal/d
= 1,306 ft^3/d

The SRT used to size the new aerobic digester cells is the design SRT of 60 days minus the SRT of the existing aerobic digester cells as the new aerobic cells will be in series with the existing cells. The SRT of the existing digester cells is calculated as follows:

SRT (Existing Cells) = (Volume of Sludge Holding Tank [SHT])/[(Mass of solids wasted from aerobic digesters (Px))/(suspended solids concentration in new aerobic digester*8.34) * 1,000,000]

= (400,000 gal)/(2,314 lb/d/(27,000 mg/L*8.34)*1,000,000)
= 40.8 days

Therefore, the required SRT of the new aerobic digester is calculated as follows:

SRT (New Digester cells) = Design SRT – SRT in Sludge Holding Tank
= 60 days – 40.8 days
= 19.2 days

The New Aerobic Digester sizing calculation is presented as follows:

New AD Volume required = Qi*(Xi +YSi)/X*(KdPv + 1/SRT)
= 192,000 gal

Although 192,000 gallons is required in order to provide 60-day detention and meet Class B criteria, it is recommended that two additional 100,000-gallon cells be constructed adjacent to two of the existing cells to match existing cell volumes.

Aerobic Digester Aeration System

The total aerobic digestion oxygen demand is calculated below assuming 49 percent VSS destruction (during summer operation) and a VSS fraction of 80 percent.

Carbonaceous O_2 Demand = 1.42 lb/lb(feed sludge P_{xbio} lb/d)(% VSS destruction)
= 1.42 lb/lb(3,528 lb/d)(0.8)(0.49)
= 1,963 lb O_2/d

Nitrogenous O_2 Demand = 4.57 lb/lb(N/VSS destroyed)(feed sludge P_{xbio})*(%VSS destroyed)
= 4.57 lb/lb(0.12 lb/lb)(3,528 lb/d)(0.8)(0.49)
= 758 lb O_2/d

Total O_2 Demand = Carbonaceous O_2 Demand + Nitrogenous O_2 Demand
= 2,721 lb O_2/d

Oxygenation equipment is specified based upon standard oxygen transfer rate (SOTR) as well as the actual oxygen transfer rate (AOTR), the oxygen transfer rate in clean 20 degrees C water with no suspended solids. The SOTR is calculated as follows:

$$AOTR = SOTR\left(\frac{\beta C_{STH} - C_O}{C_{S20}}\right)\left(1.024^{T-20}\right)\alpha$$

Where:

α = oxygen transfer correction factor, 0.6 (appropriate for this application)
β = salinity surface tension factor, 0.95
C_{STH} = dissolved oxygen concentration at operating temperature and elevation,
= 10.0 mg/L
C_{S20} = dissolved oxygen concentration at 20 degrees C and 1 atm, 9.08 mg/L
C_O = operating dissolved oxygen concentration, 2 mg/L
T = 15 degrees C

Thus the total oxygen demand is 6,184 lb/d.

Assuming an aeration diffuser efficiency of 20 percent, the required airflow is then:

Air flow = 6,184 lb O_2/d/(1440 min/d)(0.0173 lb O_2/scfm)(0.20)
= 1,241 scfm

The air required for mixing the aerobic digester with fine bubble diffusers is calculated with the mixing requirement of 0.012 scfm/ft^3:

Mixing Requirement = (80,000 ft^3)(0.012 scfm/ft^3)
= 960 scfm

The design criteria for the aerobic digesters, sludge thickener, and associated equipment are provided below in Table 4-6.

Table 4-6 Aerobic Digester Equipment Data and Design Criteria

Aerobic Digesters Design Criteria (at year 2032 conditions)	
Existing Digester Cells	
Quantity	4 current, converted to 2
Volume	4 x 100,000 gallons each, current 2 x 200,000 gallons each, future (400,000 gallons total)

Table 4-6 Aerobic Digester Equipment Data and Design Criteria – (continued)

Aerobic Digesters Design Criteria (at year 2032 conditions)	
Side Water Depth	17 feet
Solids Retention Time	40.8 days
New Aerobic Digester Cells	
Quantity	2
Volume	100,000 gallons each
Side Water Depth	17 feet
Solids Retention Time	20.4 days
Total Solids Retention Time	61 days
Influent Thickened Sludge Feed Rate	10,600 gpd
Influent Sludge Solids Concentration	3.5 – 4.0 percent
Total Solids Loading (Sunland and Sequim)	3,528 lb/day
Digester Operating Temperature	15 degrees C to 20 degrees C
Estimated Volatile Solids Reduction	43 percent winter, 49 percent summer
Digester Mixing/Aeration	
Type of Mixing	Fine Bubble Aeration
Minimum Mixing Air per Digester	12 ft^3/min/1,000 ft^3
Blowers	30 hp each on VFDs, two for Year 2020, three for year 2032
WAS Thickener	
Quantity	1
Type	Rotary Screen Thickener
Flow Capacity	75 gpm
Flocculation Tank Capacity	150 gallons
Feed Solids	1%
Thickened Solids	3.5 - 4%
Thickening Polymer Feed System	
Quantity	1
Type	Hydro-Mechanical Mixing Chamber
Polymer Type	Liquid
Solution Feed Pump Capacity	1 gph
Thickened WAS Pumps	
Quantity	1
Type	Progressing Cavity

CLASS A BIOSOLIDS TREATMENT SYSTEM

The Class A biosolids are hauled approximately 5 miles for beneficial use at a farm near Blyn.

The Class A system, provided by FKC, Inc., provides mechanical sludge dewatering, lime stabilization and heat pasteurization to achieve Class A pathogen reduction requirements and vector attraction requirements. The system also provides dewatering simultaneously with the heat pasteurization. When combined with the inherent low pollutant levels in the City's sludge, the product will be marketable as Exceptional Quality Biosolids, meaning it is considered a safe soil amendment and can be given away to the public and/or land-applied with limited restrictions.

In the biosolids treatment system, the partially digested sludge is transferred from the digester to the 40,000-gallon lime sludge mix tank and into the sludge storage tank. Lime is added directly to the mix tank and pH is monitored manually after lime addition and again after 2 and 24 hours to verify compliance with vector attraction reduction criteria. Next, the sludge is pumped through a flocculation tank and on to the Rotary Screen Thickener. Polymer is added to the sludge just prior to entering the flocculation tank to agglomerate or flocculate the sludge so it can be thickened and mechanically dewatered. From the top of the flocculation tank, the sludge flows by gravity into the rotary screen thickener and then into the screw press where simultaneous dewatering and pasteurization occurs.

The components of the Class A Biosolids Treatment System include:

- Screw press;
- Rotary sludge thickener;
- Flocculation tank;
- Sludge feed pumps;
- Polymer system;
- Boiler system (diesel-fuel);
- Lime storage tank (silo) and feed system;
- Lime and sludge mixing and storage tanks;
- Control panel; and
- Class A Biosolids screw conveyor.

Table 4-7 summarizes key design criteria and operating parameters.

Table 4-7 FKC Biosolids Treatment Facilities Design Criteria and Operational Parameters

Parameter	Design	Actual Current Operation
Lime Consumption		
Lime Dosage (quicklime)	530 pounds quicklime per dry ton sludge (or equivalent amount of hydrated lime, 700 pounds hydrated lime per dry ton sludge)	200 pounds per dry ton of sludge
Flocculation Tank		
Volume	100 gallons	
Polymer Dosage	88-113 lbs emulsion polymer (Cytec 2081) per dry ton sludge	276 pounds of polymer per dry ton of sludge(1)
Rotary Screen Thickener (RST)		
Model	RST-S480x2000L	
Capacity	1.64 dry tons/day	NA
RST Influent Total Solids	≥1.5%	≥1.4%
RST Thickened Sludge Total Solids	4-6% w/lime and polymer addition	4-6% w/lime and polymer addition
Screw Press		
Model	SHX-600x5000L	
Capacity	123 dry lbs/hr of biosolids plus quicklime	NA
Screw Press Inlet Total Solids	4-6%	4-6%
Screw Press Outlet Total Solids	20-30% w/lime, polymer, and steam use	20-30% w/lime, polymer, and steam use

Figure 4-7 shows WRF biosolids production for the period of 2007-2011. Since the completion of the WRF expansion, biosolids production has dropped from an average of 1,540 pounds per day (in 2007 - 2008) to current levels of 1,280 pounds per day. Approximately 13 percent of the biosolids mass is from the lime added. (The WRF currently uses approximately 30 tons of lime a year, or about 164 pounds per day.)

Performance of the Class A Biosolids Treatment System, although historically very good, has diminished recently, with reduced levels of dewatering, reduced sludge temperatures and significant odor generation. It is anticipated that performance could be improved by the following modifications:

1. Digestion improvements (additional aeration in the digesters to increase nitrification and volatile solids reduction and reduce odors);

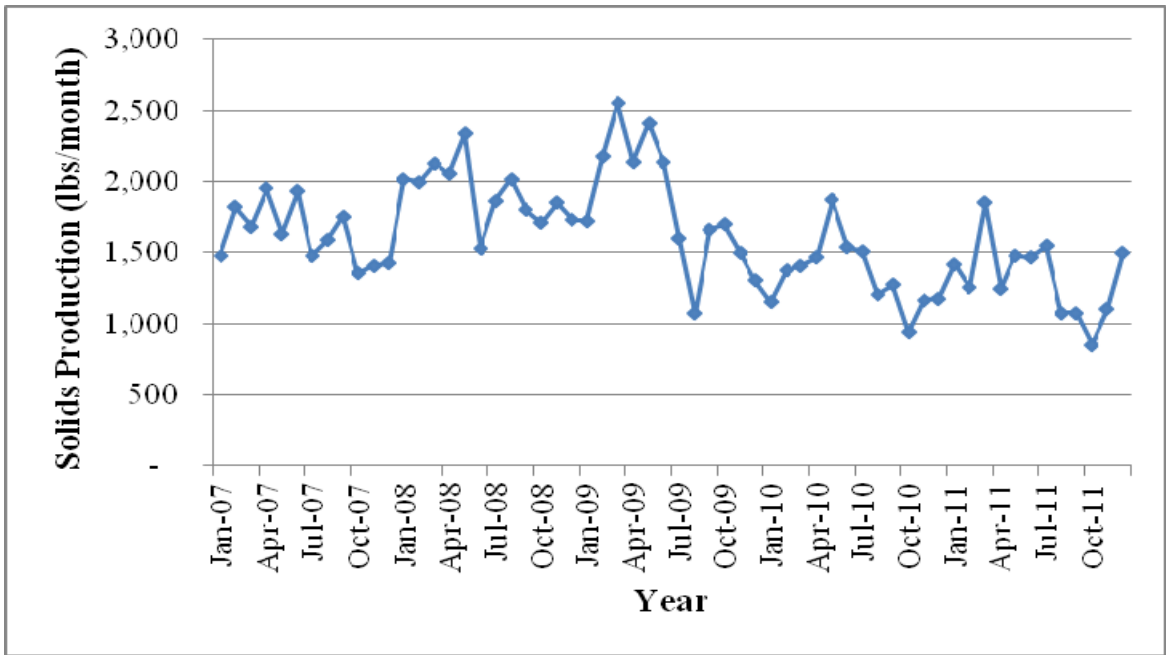
2. Mixing improvements in the lime-sludge storage tank (which is currently poorly mixed, resulting in anaerobic conditions and poor dewatering);

3. Operation of the screw press at a higher head box elevation after installation of a high-high level switch and telemetry (to increase pressure on the sludge and reduce air entrainment).

The first two recommendations have been included in the Capital Improvement Plan later in this chapter. The third recommendation requires an operational modification after completion of the telemetry modifications already being implemented.

Based on current production and future biosolids projections (including the sludge the City receives from SunLand), it is anticipated the City will need to add additional capacity for the FKC system by 2025. It is also anticipated that this expansion will include a second FKC system in a mirror image configuration with a second Screw Press, Rotary Screen Thickener, flocculation tank, boiler system, addition to the existing building, and ancillary equipment. Since the sludge would be thickened upstream of the digesters, new lime-sludge mix tanks would not be required, and the existing lime silo could be used.

Figure 4-7 WRF Biosolids Production



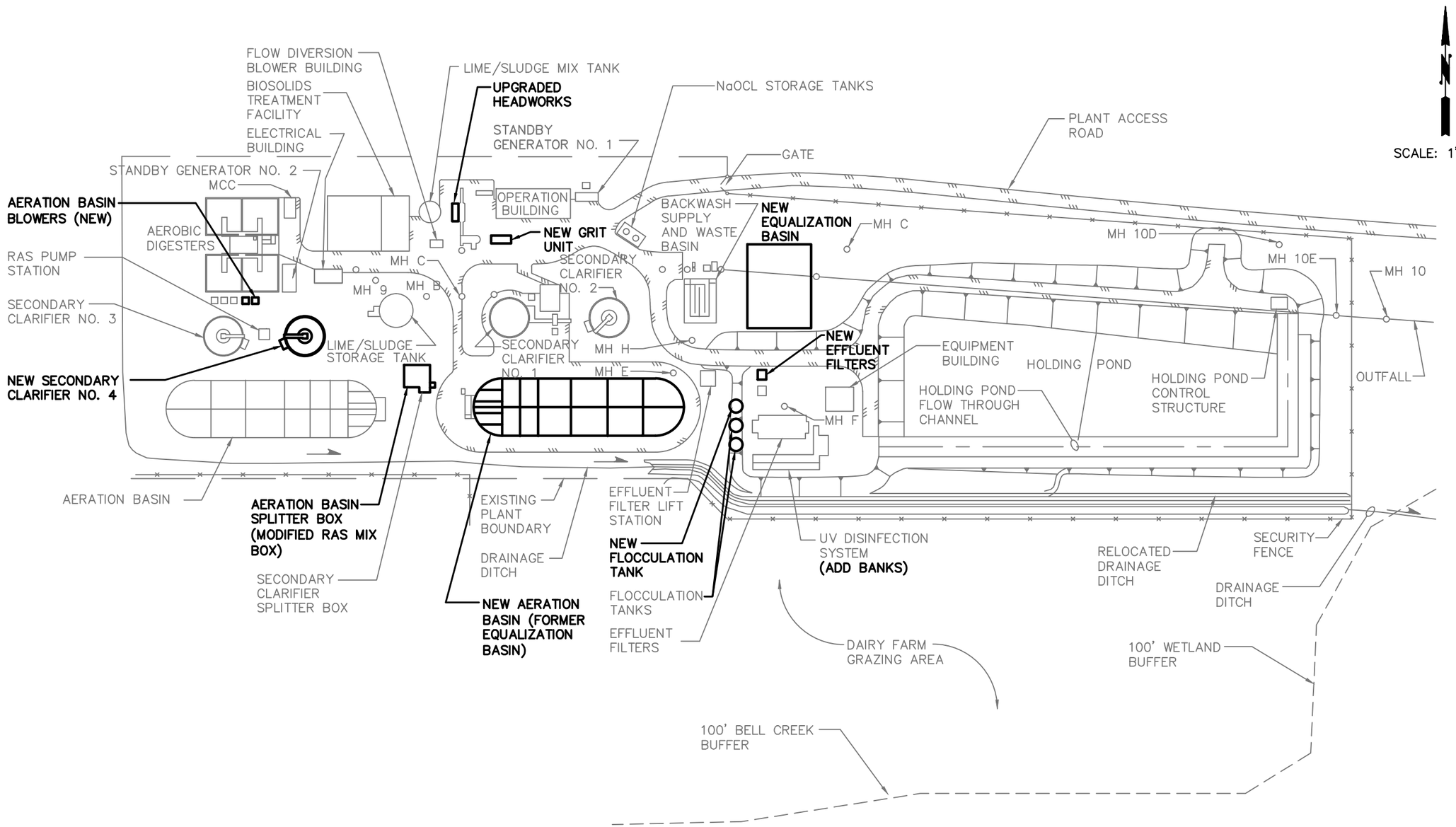
RECOMMENDED WRF IMPROVEMENTS: 2013-2018 PROJECTS

The following projects are recommended for completion in the period from 2013-2018.

AUXILIARY GENERATOR LOADBANKS (W-1)

Estimated Cost: $55,000
Proposed Year: 2014

This project includes acquisition of a trailer mounted portable load bank so that auxiliary generators within the City's water and wastewater infrastructure facilities can be tested under load. This load bank will have a capacity of 400 kW, which is appropriately sized for current equipment and contains extra capacity for future equipment. The cost of this project will be shared between the Water and Wastewater Utilities.



CITY OF SEQUIM

2013 GENERAL SEWER PLAN
FIGURE 4-8
WRF SITE PLAN - PHASE 2

Gray & Osborne, Inc.
CONSULTING ENGINEERS

M:\SEQUIM\11594 - 2012 General Sewer Plan\Sewer Report\Figures\Figure 4-8.dwg, 3/4/2014 7:50:52 AM, DWG To PDF.pc3

WRF Headworks Modifications #1 (W-2)

Estimated Cost: $270,000
Proposed Year: 2014

This project will replace the existing manual bar screen in the headworks area with a new mechanical fine screen system to conform with new regulations for influent wastewater and biosolids screening. The new orifice size must be less than or equal to 3/8-inch wide in order to prevent the passage of larger items in compliance with WAC 173-308. This project includes an installation of a new mechanical fine screen, and channel modifications required to accommodate the new equipment. Following its installation, this new screen will serve as the primary headworks screen, and the current HYCOR fine screen will serve as the auxiliary screen.

Equalization Basin Aeration System Improvements (W-3)

Estimated Cost: $54,000
Proposed Year: 2014

This project will improve the mixing capability of the Equalization Basin by refurbishing an existing Aeromix submersible mixer. This unit is not currently used and has had parts removed for use with other functioning equipment. The unit will be sent to a manufacturer or repaired onsite, and re-installed within the existing equalization basin.

Grit Removal System Replacement (W-4)

Estimated Cost: $279,000
Proposed Year: 2014

This project will replace the existing John Meunier cyclone grit collection system immediately after the mechanical fine screen at the WRF headworks. The existing system was installed in 1984 and has reached the end of its useful life. This project includes an evaluation of grit removal alternatives, installation of a new grit removal system, and system modifications required to accommodate the new equipment.

AEROBIC DIGESTER AERATION SYSTEM IMPROVEMENTS (W-5)

Estimated Cost: $595,000
Proposed Year: 2013 (design) and 2014 (construction)

This project will address the need for higher oxygen transfer and more energy efficient aeration within the existing aerobic digesters located at the WRF. This project will replace the existing aeration equipment with a fine bubble diffusion system that will increase the availability of oxygen within the digester. The removal of more ammonia from the biosolids is also a goal of this project. New turbo blowers will be installed to run the diffusers.

PURCHASE LAND NEAR WRF (W-6)

Estimated Cost: $195,000
Proposed Year: 2014 - 2015

This project includes the purchase of land at the west and east ends of the existing WRF to provide space for future WRF expansion as well as a new biosolids handling and distribution center listed in Project W-8.

CLASS A BIOSOLIDS DISTRIBUTION CENTER (W-7)

Estimated Cost: $1,320,000
Proposed Year: 2016 - 2019

This project will include construction of new facilities to increase public access to the Class A biosolids produced at the WRF. Facilities will include a large, covered area for biosolids storage, smaller holding areas for biosolids and various amendments, and a small area for public access and biosolids loading. Facilities will be designed to minimize odors and will include appropriate stormwater controls.

AEROBIC DIGESTER CAPACITY UPGRADES (W-8)

Estimated Cost: $1,950,000
Proposed Year: 2016 (design)

This project will increase the capacity of the existing aerobic digestion system by adding additional tank space. It is anticipated that two new 100,000-gallon cells will be constructed with additional blowers and diffusers for aeration, and a rotary screen

thickener will be provided to thicken WAS upstream of the digester.

WRF Headworks Modifications #2 (W-9)

Estimated Cost: $285,000
Proposed Year: 2019

This project will replace the existing HYCOR mechanical fine screen at the WRF headworks. The existing screen was installed in 1998 and is nearing the end of its useful life. The unit will be replaced with a new mechanical fine screen model that meets the requirements set forth in WAC 173-308. Following its installation, this new screen will serve as the primary headworks screen, and the mechanical screen described in Project W-2 above will serve as the auxiliary screen.

RECOMMENDED WRF IMPROVEMENTS: 2019-2028 PROJECTS

Class A Biosolids Treatment System Capacity Upgrade (W-10)

Estimated Cost: $1,650,000
Proposed Year: 2025

This project includes installation of a second FKC system in a mirror image configuration with a second Screw Press, Rotary Screen Thickener, flocculation tank, boiler system, expansion of the existing building and ancillary equipment. Since the sludge would be thickened upstream of the digesters, new lime-sludge mix tanks would not be required, and the existing lime silo could be used.

PHASE 2 IMPROVEMENTS

Based on current projections, flows and loadings will not exceed the rated capacity of the WRF within the 20-year planning period (until approximately 2037). Accordingly, Phase 2 improvements are recommended to be completed by 2036.

The following improvements are recommended for the Phase 2 WRF expansion. Table 4-8 summarizes design criteria for Phase 2. Figure 4-8 shows the site layout for Phase 2.

Table 4-8 Phase 2 Construction Schedule and Design Flows and Loadings

Parameter	Phase 2
Construction Completion	2036
Design Capacity Basis (Year)	2058
Estimated Annual Average Flow, gpd	2,033,000
Maximum Month Flow Capacity, gpd	2,234,000
Peak Day Flow Capacity, gpd	3,158,000
Estimated Peak Hour Flow, gpd	5,770,000
Estimated Annual Average BOD_5, (lb/d)	4,919
Estimated Max Month BOD_5, (lb/d)	5,507
Estimated Annual Average TSS, (lb/d)	4,706
Estimated Max Month TSS, (lb/d)	5,261
Estimated Annual Average TKN, (lb/d)	799
Estimated Max Month TKN, (lb/d)	1,059

Convert the EQB into an Aeration Basin with an MLE Configuration

The EQB will be converted to an aeration basin with an MLE configuration during Phase 2. A wall will be constructed down the center of the basin to create two treatment trains and each train will be equipped with submersible mixers and fine bubble diffusers to provide an additional treatment volume of 1.2 million gallons. The two parallel aeration basins will have a total volume of 2.4 million gallons, which is also sufficient for treatment of the projected buildout flows and loadings.

Install an Aeration Blower

It will be necessary to install two additional aeration blowers (one per train). There will be a total of five aeration blowers, each with a capacity of 950 scfm. Four blowers will provide sufficient aeration to treat the projected flows and loadings, and one blower will be redundant to fulfill Class I Reliability standards.

Construct a New EQB

The equalization basin will be converted to an aeration basin with an MLE configuration in Phase 2 to accommodate biological treatment of maximum month flows. As a result, a new equalization basin must be constructed. The new equalization basin constructed in Phase 2 will be designed to accommodate buildout peak hour flows. The total volume of the new EQB will be

722,000 gallons. Assuming a mixing requirement of 0.04 hp per 1,000 gallons of storage (*Metcalf and Eddy, Fourth Edition, 2003*), the mixing requirement for the total volume of the new EQB is 29 hp. Air should be supplied at a rate of 1.25 to 2 ft^3/minute per 1,000 gallons of storage (*Metcalf and Eddy, Fourth Edition, 2003*). The air supply rate to maintain aerobic conditions based on the volume of the new EQB ranges from 910 to 1,460 ft^3/minute. The energy requirement will be sufficient to prevent deposition of solids and maintain aerobic conditions.

CONSTRUCT AN INFLUENT PUMP STATION

It will be necessary to pump influent flow to the new EQB. An influent pump station will be constructed to accommodate the projected buildout peak hour flows and projected buildout peak hour flow of 6.9 mgd. An influent pump station will be required; however, the details of the design and location of the pump station will be completed in the design phase. The influent flow will be conveyed by gravity where feasible.

CONSTRUCT A NEW 50-FOOT-DIAMETER CLARIFIER

A fourth 50-foot-diameter clarifier will be constructed in Phase 2 to accommodate projected buildout flows and loadings. Clarifier No. 4 will have a side water depth of 14 feet, and a total volume of 206,000 gallons and will be located directly east of Clarifier No. 3.

INCREASE EFFLUENT FILTRATION, FLOCCULATION AND UV DISINFECTION CAPACITY

Additional filter disks will be installed to provide sufficient capacity for Phase 2 flows. One four disk cloth filter will be installed and one additional 12 foot diameter circular flocculation tank will be installed to provide 20 minutes detention time for a maximum month design flow of 2.23 mgd. Additional banks of low pressure, high intensity lamps will be provided.

PROJECT COSTS

Planning level cost estimates for the Phase 2 improvements listed above are outlined in Table 4-9. As shown, the estimated cost is $11.2 million (2012 dollars).

Table 4-9 WRF Phase 2 Expansion Improvements

No.	Item	Quantity		Escalated Unit Price	Amount
1	Mobilization/Demobilization (8%)	1	LS	$552,000	$552,000
2	Mechanical Fine Screen with Headworks Channel	1	LS	$240,000	$240,000
3	Grit Removal System	1	LS	$300,000	$300,000
4	Convert Existing EQB to AB	1	LS	$603,600	$603,600
5	Influent Pump Station	1	LS	$210,000	$210,000
6	Construct a New EQB	1	LS	$600,000	$600,000
7	Aeration Diffuser System	2,462	SCFM	$60	$147,720
8	Submersible Mixers	6	EA	$24,000	$144,000
9	Blower	2	EA	$54,000	$108,000
10	Construct New 50-Foot Dia. Sec Clarifier	1	LS	$600,000	$600,000
11	Internal Recycle Pumps	2	EA	$44,400	$88,800
12	RAS/WAS Pump Station	1	EA	$216,000	$216,000
13	Additional UV	1	LS	$120,000	$120,000
14	Coagulation/Flocculation System	1	LS	$60,000	$60,000
15	Additional Filters	1	LS	$408,000	$408,000
16	Dewatering	1	LS	$90,000	$90,000
17	Site Work	1	LS	$345,000	$345,000
18	Miscellaneous Metals	1	LS	$138,000	$138,000
19	Painting	1	LS	$207,000	$207,000
20	Mechanical/Yard Piping	1	LS	$691,000	$691,000
21	Electrical	1	LS	$1,036,000	$1,036,000

Subtotal $6,905,120
Construction Contingency (20%) $1,381,024
Subtotal $8,286,144
Washington State Sales Tax (8.6%) $712,608
Total Estimated Construction Cost $8,998,800
Engineering, Administrative and Legal Services $2,249,700

TOTAL ESTIMATED PROJECT COST $11,249,000

REGIONAL WATER RECLAMATION FACILITY ANALYSIS

As previously mentioned, the City, in collaboration with Clallam County, is interested in developing a regional approach to wastewater treatment and reclaimed water use. There are three main areas near the City that are potential candidates for connection to the City's collection system: SunLand, Blyn, and Carlsborg. The connection of any or all of these regions could have significant implications to available treatment capacity at the WRF. These potential impacts are further described below.

SUNLAND

As described in Chapter 1, SunLand is a small residential community located approximately 2 miles north of Sequim. Wastewater from this community is currently treated at the SunLand Water Reclamation Facility located on Woodcock Road. As noted in Chapter 2, maximum month and peak hour flow projections for SunLand in the year 2032 are 90,000 and 270,000 gpd, respectively.

Combining this 2032 projected maximum month flow with the projected maximum month 2032 flow for Sequim would result in a flow of approximately 1,540,000 gpd. While this value does not exceed the WRF design capacity, it does exceed the 85 percent threshold set by Ecology at which plans must begin for increasing the capacity of a wastewater treatment facility. Thus, it is likely that the Sequim WRF will require capacity upgrades prior to the year 2032 in order to accommodate the additional flows from the SunLand community.

BLYN

As described in Chapter 1, Blyn is a small community located approximately 7 miles south of Sequim along Highway 101. The Jamestown S'Klallam Tribe area currently operates a small MBR treatment plant that serves the gas station and Longhouse Market, the Tribal Headquarters, and several residences. The region also includes the Seven Cedars Casino, Jamestown/S'Klallam Tribal Headquarters, other small retailers, and residential wastewater producers.

The *2011 Feasibility Study* estimates that current maximum month and peak hour flows from Blyn would be approximately 48,000 gpd

and 134,000 gpd, respectively. These design flows would climb to 121,000 gpd and 356,000 gpd, respectively, for the year 2032.

Currently, the combined maximum month flows for the City of Sequim and Blyn is approximately 953,000 gpd, while peak hour flow is estimated to be 2,890,000 gpd. Projected flow estimates for the City combined with the Blyn area for the year 2032 are 1,570,000 gpd and 4,120,000 gpd for maximum month and peak hour flows, respectively. The WRF has adequate capacity to treat current and projected combined 2032 flows from both the City and the Blyn region. While the combined maximum month projected flows do not exceed the WRF design capacity, they do exceed the 85 percent threshold set by Ecology. Thus, it is likely that the Sequim WRF will require capacity upgrades prior to the year 2032 in order to accommodate the additional flows from the Blyn community.

CARLSBORG

Carlsborg, the largest of the surrounding areas, is located approximately three miles west across the Dungeness River, and has various commercial, multi-use, school, and residential wastewater generators. Carlsborg residents currently use on-site septic systems for wastewater treatment.

The impacts and capital costs of collecting wastewater within Carlsborg in a new collection system, conveying it across the Dungeness River, and connecting it to the City of Sequim collection system are discussed in the *2011 Feasibility Study*. In the *2010 Facilities Plan*, three primary wastewater treatment options were compared, and the feasibility of constructing a collection system within Carlsborg that connects to the City's collection system was investigated.

Current estimates for maximum month and peak hour flows for Carlsborg are 30,000 and 90,000 gpd, respectively. Projected maximum month and peak hour flows for Carlsborg in the year 2032 are approximately 98,000 and 327,000 gpd, respectively. The *2011 Feasibility Study* and *2012 Feasibility Study Addendum* indicate that the WRF will have adequate capacity to treat wastewater flows from Carlsborg through the planning period (2032). However, planning and design to add additional capacity will need to begin before then, when the WRF will reach 85 percent

of its design capacity. At this point, planning for Phase 2 construction modifications should begin, which would increase the WRF capacity from 1,670,000 gpd to 2,230,000 gpd. This new, larger, facility would then have sufficient capacity to treat combined Carlsborg and Sequim flows until approximately the year 2050.

SUMMARY

Flow and loading projections are compared to the WRF design capacity in Figures 4-9 and 4-10. Based on projections, no additional WRF capacity will be required for projected Sequim-only wastewater flows until approximately the year 2036. However, depending on the number of outside regions that connect to the City's collection system and WRF, additional WRF capacity could be required as early as the year 2025.

Based on projected flows and loads, implementation of the Phase 2 improvements will be adequate to successfully treat the projected wastewater from both Sequim and the entire Greater Dungeness Region through 2038. In addition, to the liquid stream improvements, the biosolids treatment improvements (new rotary screen thickener and second parallel FKC solids treatment system) will need to be constructed earlier if the entire Greater Dungeness Region is served. Construction of these improvements should provide sufficient capacity through 2050.

Table 4-10 Projected Flows and Loadings for Sequim and Regions Outside the Current UGA

Region/Parameter	2012	2018	2032	Buildout	85% Phase 1A/1B Capacity	Phase 1A/1B Capacity	Phase 2 Capacity
Sequim Annual Average Flows	659,000	809,000	1,221,000	2,837,000	-	-	-
Carlsborg Annual Average Flows	25,000	41,000	82,000	639,000	-	-	-
SunLand Annual Average Flows	116,000	121,000	131,000	131,000	-	-	-
Blyn Annual Average Flows	40,000	61,000	100,000	161,000	-	-	-
Combined Annual Average Daily Flow (gpd)	840,000	1,032,000	1,534,000	3,768,000	1,275,000	1,500,000	2,033,000
Combined Maximum Month Flow (gpd)	1,123,000	1,295,000	1,830,000	4,063,000	1,419,500	1,670,000	2,234,000
Combined Peak Day Flow (gpd)	1,754,000	1,992,000	2,719,000	5,300,000	2,091,000	2,460,000	3,158,000
Combined Peak Hour Flow (gpd)	3,406,000	3,751,000	4,910,000	10,089,000	3,948,250	4,645,000	5,770,000
BOD (lb/day) (1)	2,700	3,253	4,865	11,329	3,431	4,036	5,507
TSS (lb/day) (1)	2,629	3,137	4,403	10,963	3,277	3,855	5,261
Combined ERUs	6,725	8,182	12,115	27,567	-	-	-

(1) Maximum month loads.

Figure 4-9 WRF Flow Capacity Implications for Regional Wastewater Connections

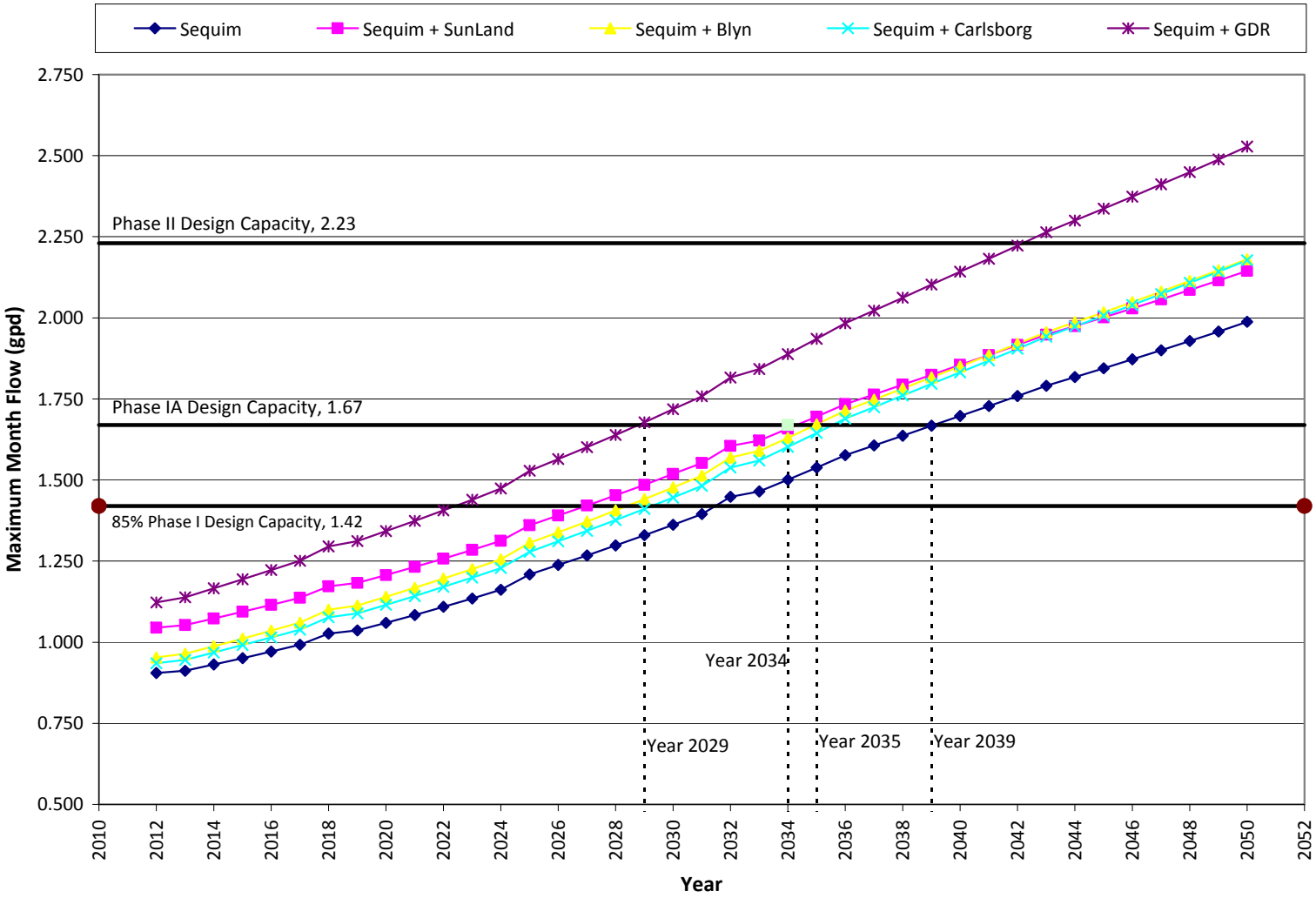
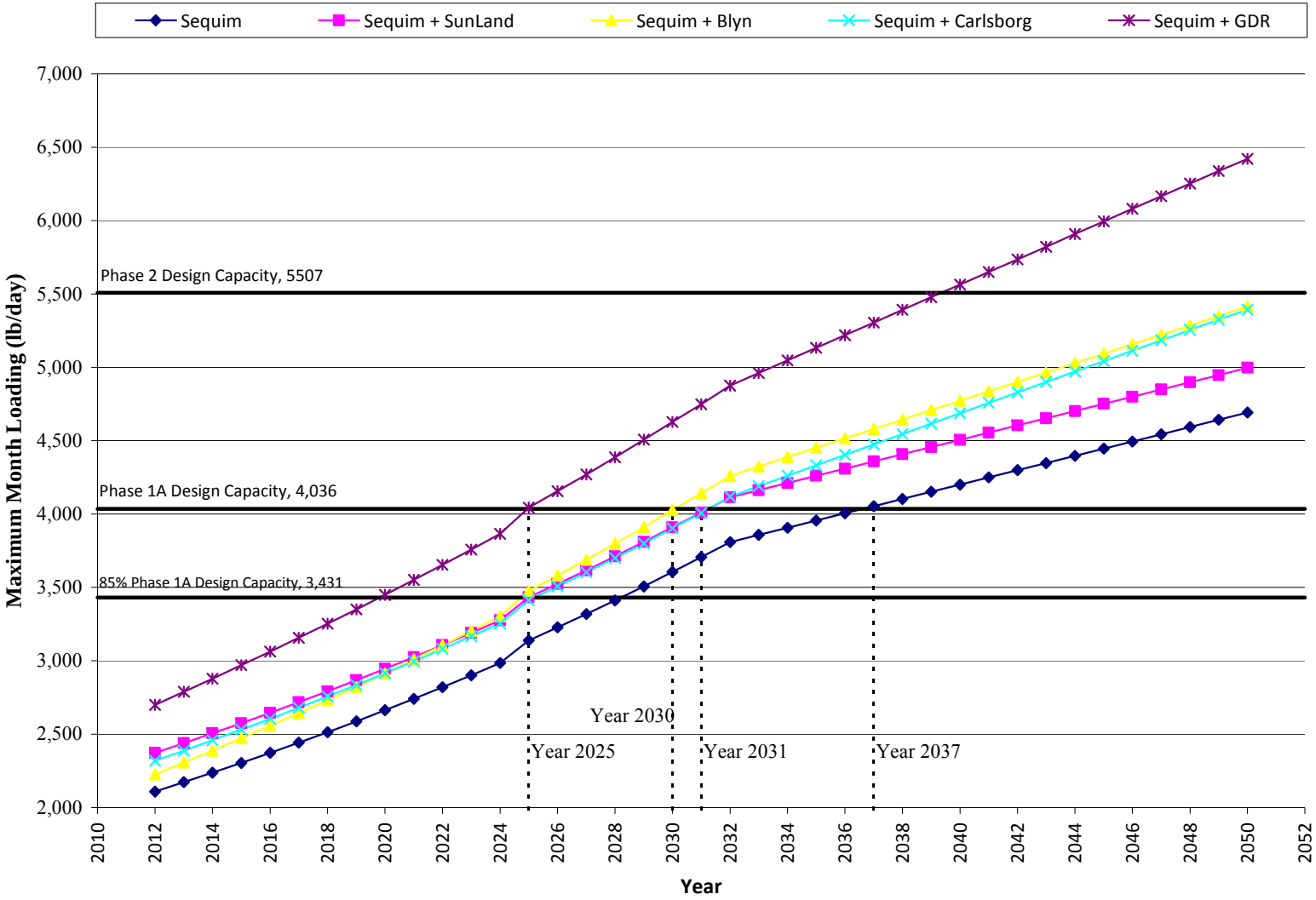


Figure 4-10 WRF BOD_5 Loading Capacity Implications for Regional Wastewater Connections



Additional WRF capacity beyond that provided in the Phase 2 improvements could be realized by construction of Phase 3 improvements including primary clarifiers and anaerobic digesters. Two circular primary clarifiers could be installed to remove grit and other settleable solids from the screened wastewater, reducing solids and organic loading to the aeration basins. In the proposed anaerobic digesters, the organic material in mixtures of settled primary and waste activated sludge is converted biologically in the absence of oxygen to a variety of end products including methane (CH_4) and carbon dioxide (CO_2). The process is carried out in a heated, mixed, airtight reactor which receives solids from the underdrains of the primary and secondary clarifiers. Sludge, introduced continuously or intermittently, is retained in the reactor for varying periods of time. Converting from the current partial aerobic digestion process to anaerobic digestion would significantly reduce the amount of solids loading to the FKC biosolids treatment system; typical volatile solids reduction of 40 to 50 percent is achievable. The stabilized sludge, withdrawn continuously or intermittently from the digester reactor, is reduced in organic and pathogen content, non-putrescible, and amenable for further treatment with the FKC lime stabilization-heat pasteurization process into a desirable Class A product. Biogas generated from the anaerobic digester could then be utilized as a potential heat source for the FKC boiler, or even a potential source of electricity through cogeneration. The estimated cost for the Phase 3 improvements is $7 million (2011 dollars).

WATER REUSE FACILITIES AND CONVEYANCE SYSTEM

Reclaimed water is provided to the City Shops facility, to a landscape irrigation system along Sequim Avenue, to Lofgrin Road and Washington Harbor Loop Road, and to the Reuse Demonstration Site. Reclaimed water is also supplied to a fire hydrant at the City Shops for truck filling or local use, and can be stored in the City Shop detention pond. The locations of the transmission pipeline and reuse facilities are shown in Figure 1-6 and Figure 3-1. The water reuse pipeline consists of a 2.54-mile trunk pipeline the runs from the WRF to the City Shop, a 0.46-mile branch line to the City's Reuse Demonstration Site and a 0.96-mile branch line to the U.S. 101 Highway Rest Area. Reuse facilities include a distribution station at the City Shop and the irrigation

and streamflow augmentation facilities at the Reuse Demonstration Site.

The WRF Expansion project has been designed to operate and produce Class A reclaimed water that meets or exceeds the NPDES permit limits full time and year round. In the event of the loss of a vital treatment process, component, or piece of equipment the WRF is permitted to discharge to the outfall in the Strait of Juan de Fuca. Reliability features were incorporated into the design to achieve high standards of reliability for producing reclaimed water.

The ultimate goals of the construction and operation of the City of Sequim Water Reuse Facilities were to reopen an existing shellfish closure area to benefit state and tribal resources, improve streamflows in the Dungeness River, and provide a sustainable water supply for irrigation purposes.

Shellfish beds are protected by greatly reducing the volume of and improving the quality of the treatment plant effluent discharged via the City's outfall into the Strait of Juan de Fuca. The State has reduced the shellfish closure zone around the outfall as the City has reduced fecal coliform in the treated wastewater to essentially non-detectable levels.

Dungeness River streamflows are improved by a combination of the following:

- Reducing surface diversions from the Dungeness River by placing a portion of the reclaimed water into Bell Creek; and
- Reducing subsurface diversions from the Dungeness River by substituting reclaimed water for potable water for non-potable uses at the various reuse facilities.

The Reuse Demonstration Site is a 29-acre parcel of land located directly north of Carrie Blake Park, on the eastern edge of the City of Sequim. Reclaimed water is used at the demonstration site for landscape irrigation, streamflow augmentation to Bell Creek, and for toilet flushing in the Reuse Interpretive Center.

The Reuse Demonstration Site has four irrigation systems:

1. A mobile surface spray irrigation system that irrigates the majority of the site;
2. A fixed surface spray irrigation system that serves landscaped areas near the Reuse Interpretive Center;
3. A surface drip system to irrigate bushes and trees throughout the site; and
4. A subsurface drip system to irrigate a grassed area near the Irrigation Pump House.

These four systems are designed to demonstrate different irrigation management techniques using reclaimed water. The irrigation systems are also designed to conserve the reclaimed water by optimizing irrigation efficiency (defined as the ratio of water that reaches the plant to the water pumped to the irrigation systems). Irrigation efficiency is optimized by minimizing subsurface losses by employing agronomic irrigation practices, and minimizing above ground losses by employing drip systems that minimize evaporative losses and eliminate aerosol losses by wind movement.

Subsurface losses are minimized with the aid of a vadose zone monitoring system (to measure soil moisture levels in the irrigated areas) and groundwater monitoring wells (to monitor static water level and groundwater quality in and around the reuse site).

Outside of the Reuse Demonstration Site, reclaimed water is also used for a number of non-potable water uses at the WRF and as wash-down water and construction water at the City Shop facility.

FUTURE WATER REUSE POSSIBILITIES

Future uses of reclaimed water would include all of the following:

- Additional expansion of existing commercial use;
- Additional landscape irrigation;
- Additional City non-potable water use (flushing, hydrants, etc.);
- Groundwater recharge;
- Leaky pipes or additional streamflow/Dungeness River augmentation.

Additional Commercial Uses

The DRAFT *Reclaimed Water Engineering Plan for Aquifer Recharge and Distribution System Expansion* (2011 *Reclaimed Water Report,* Skillings Connolly) identified several potential reclaimed water users within the city limits. These included the Sequim school district, Elk's Lodge and several other facilities in North Sequim, the Cedarbrook and Purple Haze Lavender Farms, as well as a large future residential parcel in east Sequim south of West Sequim Bay Road. Table 6-1 from the 2011 *Reclaimed Water Report* lists alternative uses for reclaimed water.

The City's current reclaimed water permit requires a binding Service and Use Area Agreement with third parties when the distribution system or area of use is not under direct control of the City. Ecology will be consulted prior to involvement of third party commercial reclaimed water users with the City's reclaimed water. Furthermore, copies of these Agreements will be submitted for Ecology approval prior to project implementation or distribution of reclaimed water.

Additional Landscape Irrigation

As with the additional commercial users listed above, the 2011 *Reclaimed Water Report* suggested potential areas that could receive reclaimed water. These include a large section of West Washington Street west of South Sequim Avenue, as well as an area near the intersection of East Washington Street and North Blake Avenue. The areas golf courses also represent a potential end user for reclaimed water.

Groundwater Recharge

The 2011 *Reclaimed Water Report* analyzed the soil conditions within the City and their potential for groundwater recharge. The report indicated that while the soils are amenable to groundwater recharge through infiltration, the typically high groundwater levels would restrict infiltration to specific areas. The 2011 *Reclaimed Water Report* identified potential recharge areas near the Port Williams Wellfield and a redevelopment of the Reuse Development Site to include additional infiltration ponds.

Streamflow/Riverflow Augmentation

An alternative infiltration scenario proposed by the City involves the use of perforated pipes installed within City owned right of way. The concept of a Leaky Pipe would function as a steady, controllable outlet for reclaimed water discharge that would infiltrate into the pipe trench and perform the same functions as an infiltration basin, but in a lineal fashion. The City and its developers will follow the minimum separation requirements for potable water and sanitary sewers included in Section C1-9.1 of Ecology's *Criteria for Sewage Works Design* ("Orange Book") for separation between leaky pipes and potable water pipes.

An alternative concept that could function much the same as Leaky Pipe is to provide additional augmentation into a losing reach of an adjacent stream.

Bell Creek is currently augmented with reclaimed water at a rate of 45 gpm (0.1 cfs) at the Reuse Demonstration Site. Observations noted during the latter half of 2010 showed that the reach of Bell Creek located between the City Shop Site and Reuse Site did not contain flowing water for a large portion of the year. Flows were observed above the City Shop Site and below the point of existing augmentation. This indicates that this portion of Bell Creek is a losing reach. Therefore, augmentation of Bell Creek at the City Shop Site would likely be lost to groundwater prior to reaching the Reuse Site. Streamflow augmentation, at or near the City Shop Site, could provide additional aquifer recharge at a natural level.

For stream augmentation projects or recharge projects within a stream channel, the City will collect receiving water data to evaluate the use's compliance with state water quality standards. An evaluation of the suitability of the reclaimed water for this use will be submitted to Ecology for review. An NPDES permit will be required to authorize the discharge of reclaimed water to surface waters.

Proposed Reclaimed Water Projects

The Re*claimed Water Engineering Plan for Aquifer Recharge & Distribution System Expansion* (*2011Reclaimed Water Plan,* Draft April 2011, Skillings Connolly) recommends five capital improvement projects to help the City achieve its goal of 100 percent reuse of reclaimed water, a reduction in potable water use for irrigation and an overall improvement to the Dungeness

River Watershed. The recommended capital improvements are summarized below. The cost estimates presented in the *2011Reclaimed Water Plan* developed in December 2010 (ENR Construction Cost Index – 8,952) have been updated to October 2012 dollars (ENR Construction Cost Index – 9,376).

A. **Project Name:** WRF Pumping System Reconfiguration
Project Number: RW-1

Project Description: This project includes reconfiguration of the reclaimed water pump system at the WRF to utilize the potential storage of the existing flow-through channel. This project is estimated to cost $513,000 and is recommended to be designed and constructed in the year 2019.

B. **Project Name:** Rapid Infiltration Basin Improvements
Project Number: RW-2

Project Description: This project consists of the construction of infiltration basins, flow control and distribution improvements, relocation of the existing storage/fish pond and miscellaneous site work at the Carrie Blake Park Reuse Demonstration Site. Two alternative distribution system methodologies were proposed. Alternative 1 would use low-pressure nozzles to distribute reclaimed water to the infiltration basins and would cost approximately $1,030,000.

Alternative 2 would use slotted/perforated pipe to distribute reclaimed water to the infiltration basins. The estimated cost of this project alternative is $1,221,000.

C. **Project Name:** High Pressure Zone Expansion
Project Number: RW-3

Project Description: This project consists of refurbishing the existing modifications, construction of a booster pump station at the City Shops and approximately 7,700 LF of 8-inch-diameter distribution system piping from the City Shop to the refurbished reservoir. This project is estimated to cost approximately $1,045,000.

D. **Project Name:** Overall Network Expansion
Project Number: RW-4

Project Description: This project consists of expansion of the current reclaimed water pipe network. The complete project would install approximately 23,100 LF of 6-inch and 13,600 lf of 8-inch distribution system piping to serve the following areas:

- South Blake Avenue Pipeline and East Maple Street Loop (estimated cost - $248,300);
- North 2nd Avenue - North Sequim Avenue Pipeline (estimated cost - $398,900);
- North 2nd Avenue - North 5th Avenue Pipeline (estimated cost - $338,700);
- South 7th Avenue - Silberhorn Road Pipeline (estimated cost - $559,400);
- South 7th Avenue - West Washington Street Pipeline (estimated cost - $383,600);
- South 7th Avenue - South 9th Avenue Pipeline (estimated cost - $233,800);
- West Washington Street – Priest Road Pipeline (estimated cost - $316,900); and
- West Hemlock Street and West Maple Street (estimated cost - $385,700).

If all the above listed projects are implemented, the total project cost is estimated to be $2,525,000.

REGIONAL WATER REUSE POTENTIAL

Several small communities are near the City of Sequim, and as such could be cost effective users of reclaimed water produced at the WRF. The potential for conveying reclaimed water to, and reusing water in, each of these communities is discussed below.

SunLand

Currently, the SunLand golf course uses municipal water from the SunLand Water and Sewer District to irrigate the turf. Reclaimed water has been shown as a feasible, cost-effective, and safe alternative to using municipal irrigation water on golf courses, and

several courses around the country already irrigate using reclaimed water.

In order to use reclaimed water for golf course irrigation, piping, pumping, and valving would be required for connection to the City's existing reclaimed piping system. An additional booster station would likely be required in order to pump the reclaimed water the approximately 4 miles to the SunLand community.

Carlsborg

Carlsborg is the largest of the three potential reclaimed water candidates and is located directly across the Dungeness River to the west.

The 2011 *Facilities Plan* addresses potential uses for reclaimed water within Carlsborg. This includes an infiltration gallery and groundwater recharge area, school and public facility irrigation, landscape irrigation, and non-potable water uses at commercial facilities, among other uses.

As Carlsborg currently has no wastewater or reclaimed water infrastructure, new piping, pumping, valving, and storage capacities would be required in order for Carlsborg to use reclaimed water produced at the WRF. The City's existing reclaimed water trunkline could likely be extended across Highway 101 to a new storage facility, from which reclaimed water could be pumped to users within the Carlsborg UGA. The length of new piping required to reach the new storage facility within Carlsborg would be approximately 3 miles.

Blyn

Blyn is the smallest of the three potential reclaimed water users, and is also the furthest distance from the City's existing reclaimed water facilities. This small community includes residential customers, some small commercial properties, and the Seven Cedars Casino and Jamestown S'Klallam Tribal Center. Also included in the Blyn region is Sequim Bay State Park.

Potential reclaimed water uses in Blyn might include commercial heating and cooling, toilet flushing within the Tribal Center, and landscape irrigation uses. Sequim Bay State Park may also use reclaimed water for toilet flushing and other non-potable uses. However, Blyn is approximately 6.5 miles south of the City. This

distance suggests that reclaimed water delivery to the region would not be cost-effective for a region with such small uses for reclaimed water.

REFERENCES

1. *Comprehensive Wastewater Facilities Plan*, City of Sequim, Brown and Caldwell, August 1992.

2. *Wastewater Treatment Plant Phase 2 Improvements, Engineering Report - Final*, *City of Sequim* (Amendment to 1992 *Comprehensive Wastewater Facility Plan*), Brown and Caldwell, April 1993.

3. *Facility Plan Amendment, City of Sequim Wastewater Treatment Plant Effluent Treatment Facility*, CH2M-HILL, September 1995.

4. *City of Sequim Class A Reclaimed Water – 100 Percent Upland Reuse Plan. Amendment to Comprehensive Facilities Plan*, Gray & Osborne, 1998.

5. *Ultraviolet Disinfection Guidelines for Drinking Water and Reuse,* National Water Research Institute/American Water Works Research Foundation (NWRI/AwwaRF), 2003.

6. *Water Reclamation Facility Expansion Engineering Report*, Gray & Osborne, 2007.

7. *DRAFT Reclaimed Water Engineering Plan for Aquifer Recharge and Distribution System Expansion*, Skillings Connolly, April 2011.

8. *Carlsborg Wastewater Conveyance, Treatment, and Capital Cost Feasibility Study*, Gray & Osborne Inc., 2011.

9. *Draft Washington State Reclaimed Water Facilities Manual*, Gray and Osborne, Inc., 2011.

Chapter 5
INFILTRATION AND INFLOW EVALUATION



INTRODUCTION

This chapter presents a discussion of I/I within the City's collection system. Previous I/I reduction efforts are briefly described, a summary of monitoring methods and results are listed, estimates for I/I based on flow measured at the WRF are summarized, and lastly, recommendations for methods to decrease I/I are given.

Infiltration is groundwater entering a sewer system by means of defective pipes, pipe joints or manhole walls and exhibits seasonal variation in response to groundwater levels. Storm events or irrigation can trigger a rise in the groundwater levels and increase infiltration. As a result, the greatest infiltration is observed following significant storm events during prolonged periods of precipitation. The unit quantity generally used is gallons per acre per day (gpad), or gallons per capita per day (gpcd).

Inflow is surface water entering the sewer system from yard, roof and footing drains, from cross connections with storm drains and through holes in manhole covers. Peak inflow occurs during heavy storm events when storm sewer systems are taxed beyond their capacity, resulting in hydraulic backups and local ponding and

discharge into the sanitary sewer. Inflow is typically expressed in terms of gallons per acre per day or gallons per capita per day.

PREVIOUS I/I REDUCTION EFFORTS

The City has made significant efforts to decrease the amount of I/I within their collection system. Some examples of this effort include:

- In 2005, the City lined approximately 1 mile of pipeline in the vicinity of 5th Avenue to Sunnyside along West Maple Street, West Bell Street, and West Washington Street.
- The City has been actively reducing I/I by diverting storm water entering the sewer system from roof drains connected to the sanitary sewer system.
- The City has used newer technology and methods such as specialized grouts and fabricated items to seal leaks within manholes and manhole inlet pipes, as well as to seal manhole rings.
- Existing sewer pipe along Fir Street between 2nd Avenue and 5th Avenue was lined in 2008.
- A high definition closed-circuit television (CCTV) camera was purchased and is continually used to inspect the existing sewer pipes for locations where I/I is present.

I/I MONITORING SUMMARY

There are several methods by which collection system staff can investigate the sources and extent of I/I within a collection system. These include visual inspection, smoke testing, and flow monitoring.

VISUAL INSPECTION

Visual inspection is a key method to identify collection system defects, including issues with the City's sewer system, and also private connections. This can be done manually, or with CCTV inspection. Manual inspection might include searching for loose or ill-fitting manhole covers, leaking manholes, clogged or defective

storm drains, or evidence of illegal side-sewer connections. Visual inspection efforts can be supported by monitoring of pump station run-time data, and by comparing the run-time data with the number of connections that discharge to the pump station. If either of these values change abruptly, or do not compare favorably with values from other similar systems, then a problem with I/I might exist. The City's collection system staff continually monitor and note changes or issues with the system during regularly scheduled maintenance operations, and should continue this practice in the future.

City staff regularly inspects the collection system using CCTV technology. This method can be used to locate pipe separations, breaks, tree/root intrusion, or illegal connection points. CCTV data can be an extremely useful tool in finding and eliminating I/I within a collection system, and the City should continue its approach of inspecting the collection system.

The City recently completed a full CCTV inspection of the collection system. It is the City's goal to inspect the entire collection system via CCTV on an annual basis.

Results from the CCTV inspection were not available at the time of this Plan, but specific areas that need repair or rehabilitation as a result of the inspection should be addressed in a timely fashion. Funding for these projects should be from the annual oversizing and maintenance budget.

SMOKE TESTING

Smoke testing involves the injection of non-toxic smoke into the sanitary sewer system to identify breaks, leaks, or illegal connections to the sewer collection system. Smoke testing was conducted in August and September of 2012, and full results are on file with the Public Works Department. A summary of smoke testing results is listed below in Table 5-1.

Table 5-1 Summary of 2012 Smoke Testing Results

Date	Priority	Manhole	Invert	Repair Completed	Notes
7/31/2012	Low	21-2-06	5' - 5"	Grouted leaks with JetSet	
7/31/2012	Low	21-2-03	6' - 5"	Grouted leaks with JetSet	
7/31/2012	Low	21-1-08	9' - 10"	Grouted leaks with JetSet	
8/7/2012	Medium	19-4-51	-		Manhole between 19-4-51 and 19-4-45 is not on map. Should be numbered.
8/9/2012	High	30-1-15	-		Storm drain leaks into Manhole
8/13/2012	Low	30-3-02	-		Should be regrouted.
8/13/2012	Low	30-1-05	-		Should be regrouted.
8/13/2012	Low	30-1-47	4' -11"		Line should be jetted and flushed.
8/13/2012	Medium	30-3-05	4' - 6"		Top ring is pushed aside.
8/16/2012	Medium	30-2-37	-	Manhole raised with concrete rings	Finish pouring concrete.
8/21/2012	Medium	29-3-37	9' - 0"		Bricks, lid, and frame must be reset
8/21/2012	Low	00-0-00	8' - 1"		Manhole near 29-2-20 is not on map. Should be numbered.
9/13/2012	Medium	29-4-35	-		Should be raised.
9/25/2012	Medium	29-4-33	-		Manhole near 241 Hawks Way is not on map. Should be numbered.
9/25/2012	Medium	29-4-44	-		Should be regrouted.
9/25/2012	Medium	29-4-46	-		Should be regrouted.
9/25/2012	Medium	29-4-47	-		Should be regrouted.
9/25/2012	Medium	00-0-01	-		Manhole east of 1763 Doe Run is not on map. Should be numbered. Manhole also has leaky grout rings.
9/27/2012	Medium	32-2-25	7' - 3"		Should be regrouted.
9/27/2012	Medium	32-2-19	-		Should be regrouted.

Smoke testing is an important part of any preventative maintenance program as a method to spot leaks, defects, breaks, or illegal connections to the sewer system. This is important because these defects in the sewer collection system are significant contributors to I/I. It is recommended that the City continue the practice of smoke testing the entire sanitary sewer system every two years.

FLOW MONITORING

Flow monitoring is an excellent way to gather specific information about the distribution of I/I within the collection system. Monitoring typically entails installing a flow meter inside a manhole, and periodically downloading the electronically stored data for analysis. In an attempt to gather data on flows and potential I/I problem areas, Flo-Dar flow monitoring devices were installed by the City during the last week of February 2012. These devices continually measure flow velocity and depth, and are calibrated to the internal diameter of the pipe.

The City installed these flow monitors at various locations throughout the collection system in an attempt to isolate specific areas to assess the extent of I/I. Flow monitoring locations were selected to isolate specific areas of the collection system. Locations where the monitors were installed are shown on Figure 5-1. Data on velocity (fps), level (in), and flow (gpm) were collected every 15 minutes between February 21 and March 31. Information regarding the flow monitor locations is listed in Table 5-2.

Table 5-2 Flow Monitor Installation Summary

Station No.	Area No.	Manhole No.	Inlet/Outlet	Dates of Data Collection(1)	Area of Interest
1	1	19-4-01	Inlet	2/29 - 3/21	West Washington Street west of South Sequim Avenue
2	2 (Sta. 2 – Sta. 1)	20-3-04	Outlet	2/29 - 3/13, 3/17 - 3/21	Region south of West Washington Street, west of South Sunnyside Avenue and Bell Hill
3	3	20-2-38	West inlet	2/29 - 3/21	West of North Sunnyside Avenue between West Washington Street and West Fir Street
4	4	17-2-10	Inlet	3/10 - 3/21	PWPS drainage basin, North of Fir Street and west of North Sequim Avenue(2)
5	5	20-1-38	Outlet	2/29 - 3/21	Bell Hill/Bell Gates drainage basin
6	6	21-2-11	Inlet	2/29 - 3/21	East of North Rhodefer Road, including Solana

(1) All collection dates are for 2012.
(2) PWPS = Port Williams Pump Station.

Flow monitoring in sewers is inherently difficult due to limitations of the equipment, variances in flows within the collection system,

the presence of fouling sensors, debris, and challenges with the installation and calibration of the equipment.

As is often the case with flow monitoring in gravity sewers, these issues may have influenced the results of the flow monitoring efforts. A detailed discussion of the results is presented in Appendix G and Table 5-3 summarizes the results of the flow monitoring. Peak day I/I for the period of monitoring for each of the basins shown in Figure 5-1 was estimated based on subtracting the low precipitation baseline flows from the high precipitation peak day flows for each basin.

Figure 5-2 and Figure 5-3 show the results for data collected between March 10-14 and March 17-22, 2012. These results show that the City does not exhibit a typical diurnal flow pattern that might be seen in other medium to large sewer systems. The remaining monitoring periods also did not show a significant diurnal pattern. A typical diurnal pattern would show peaking flow at two times each day (typically during morning and evening) and drop to a lower baseline level between 9:00 p.m. and 4:00 a.m. Station 2 in Figure 5-3 shows a slight diurnal flow pattern.

Also evident from these figures is that Station No. 2, which is near the intersection of South Sunnyside Street and Etta Street, flows are significantly greater than any of the other stations. The reason this flow is so high is that due to the installation of the flow meter on the outlet side of Manhole 20-3-04, this monitor measured flows for both Area No. 1 and Area No. 2 instead of the desired measurement of Area No. 2 only. Data for Area No. 2 was back-calculated by subtracting the data from Station No. 1 from the data collected at Station No. 2.

Based on the available data summarized in Table 5-3, the following conclusions can be made:

- The total I/I measured in the six areas constituted 71 percent of the total I/I measured at the WRF. The remainder may be in the areas not measured in this monitoring, including the area between the WRF and downtown Sequim.

- Infiltration and inflow appears to be distributed throughout the City's collection system.

STATION 4
MH # 17-2-10
INLET SIDE

STATION 3
MH # 20-2-38
WEST INLET SIDE

STATION 2
MH # 20-3-04
OUTLET SIDE

CITY OF SEQUIM
WRF

STATION 5
MH # 20-1-38
OUTLET SIDE

STATION 6
MH # 21-2-11
INLET SIDE

STATION 1
MH # 19-4-01
INLET SIDE

AREA 1

AREA 2

AREA 3

AREA 4

AREA 5

AREA 6

N

0 1,000 2,000 4,000 Feet

LEGEND:

- FLOW METERS
- MANHOLES
- LIFT STATION
- SEWER LINES:
- SEWER SERVICE AREA
- URBAN GROWTH AREA
- FLOW METER BASINS
- CITY LIMITS
- AREA LABEL

CITY OF SEQUIM

2012 GENERAL SEWER PLAN
FIGURE 5-1
2012 PORTABLE FLOW METER
INSTALLATION LOCATIONS

Gray & Osborne, Inc.
CONSULTING ENGINEERS

- Area 2 appeared to have the highest amount of I/I (20 percent of that measured by the WRF influent flow meter), followed by Areas 6 (13%), 4 (12%) and 5 (12%).

Table 5-3 Summary of Flow Monitoring Results

Parameter	Precipitation (in)	Station 1 (mgd) Area 1	Station 2 - Station 1 (mgd) Area 2	Station 3 (mgd) Area 3	Station 4 (mgd) Area 4	Station 5 (mgd) Area 5	Station 6 (mgd) Area 6	Station Sum (mgd)	WRF Influent (mgd)
Low Precipitation Baseline	< 0.1 in.	0.0660	0.2212	0.1110	0.1473	0.0631	0.0921	**0.6713**	0.6337
High Precipitation Peak Day	0.9(1)	0.0899	0.2946	0.1374	0.1904	0.1080	0.1397	**0.9600**	1.0012
I/I Peak Day		0.0239	0.0734	0.0264	0.0431	0.0448	0.0476	**0.2592**	0.3675
Percent of WRF Influent I/I		6%	20%	7%	12%	12%	13%	**71%**	

(1) Over a period of 2 days.

Figure 5-2 Flow Monitoring Data for March 10 – 14, 2012

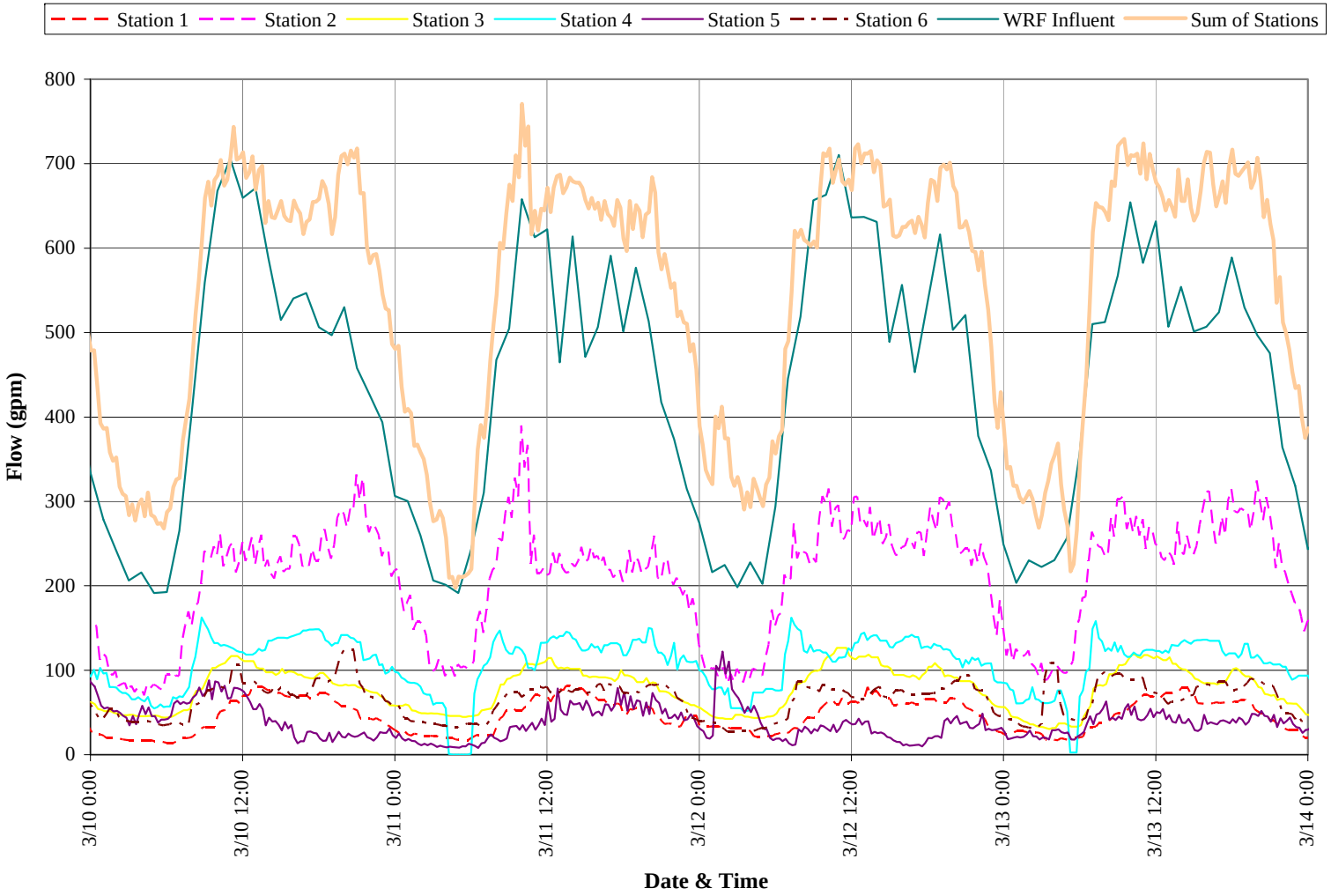
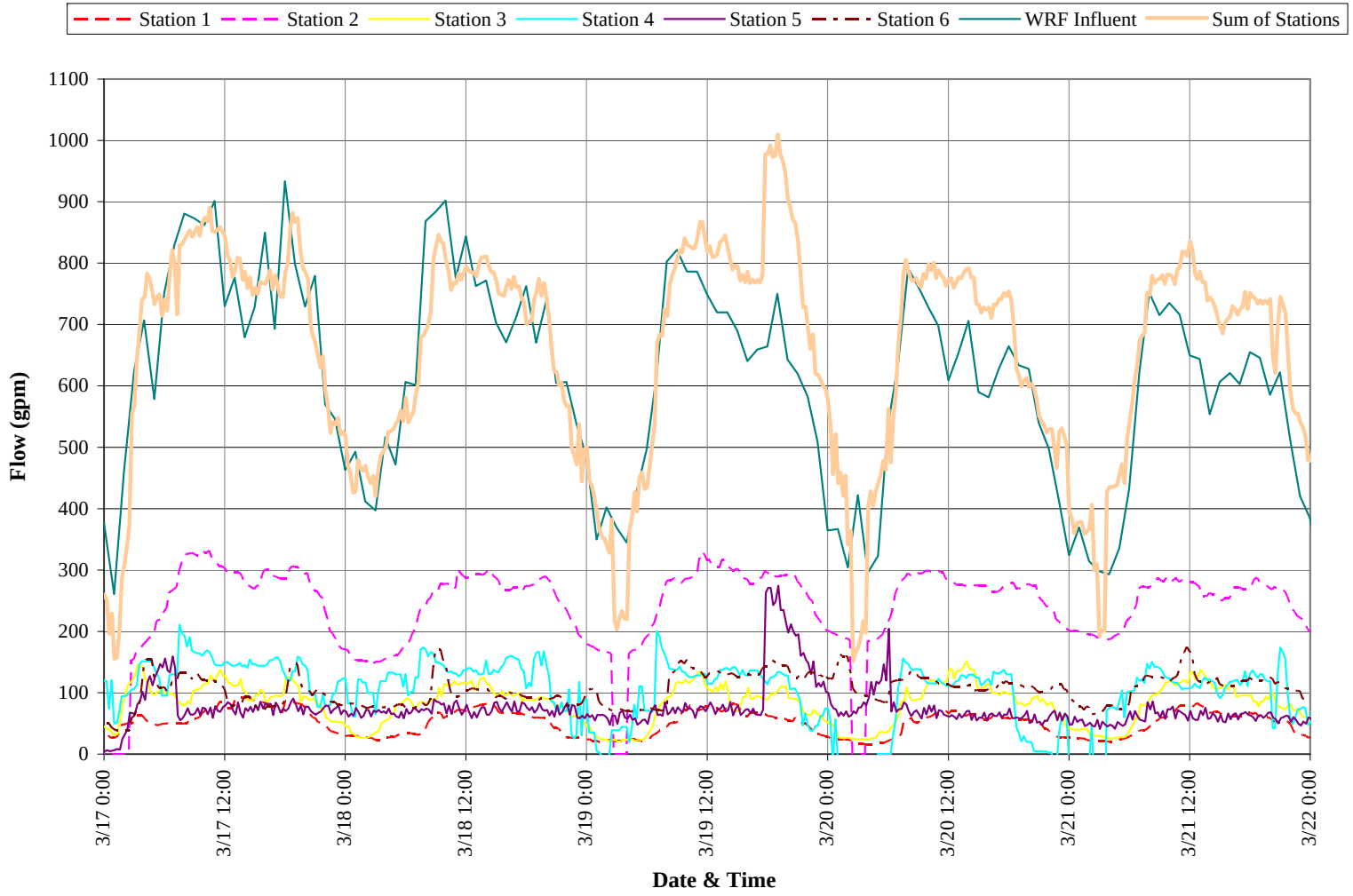


Figure 5-3 Flow Monitoring Data for March 17 - 22, 2012



The City should continually monitor various areas within the collection system using flow monitors in an attempt to isolate and eliminate areas prone to excessive I/I. It is especially important to monitor particular basins through the winter months in order to capture data during peak storm events, which are typically when the effects of I/I are most significant.

SUMMARY OF INFILTRATION AND INFLOW DATA

Estimates for I/I were developed in Chapter 2, but are summarized below. To estimate rates of I/I, the average dry weather flow was subtracted from the annual average day, maximum month, peak day, and peak hour flows. All flows were influent measurements taken from WRF influent flow monitoring reports (DMRs). The I/I value was then multiplied by the estimated service area to generate a value of I/I in gallons per acre per day for all flow measurements. Estimates for these values from three recent plans are shown in Table 5-4. Peak hour I/I was calculated by taking the peak hour influent flow measured at the WRF, which occurred at approximately noon on May 15, 2011, and subtracting the peak hour flow from the same time of day on a day that had followed several days of no measurable precipitation (noon on May 13, 2011).

Table 5-4 Infiltration and Inflow Estimation Summary

Flow Type	Flow (mgd)(1)	Dry Weather Flow (mgd)	I/I (mgd)	Service Area (acre)(2)	2013 GSP I/I (gpad)(3)	2003 WCP I/I (gpad)(4)	2008 WRF ER I/I (gpad)(5)
Annual Average Daily Flow	0.630	0.564	0.066	3,541	19	3.3	9.1
Average Daily Wet Weather(6)	0.676	0.564	0.112	3,541	32	-	-
Maximum Month (March 2011)	0.856	0.564	0.292	3,541	82	50	41
Peak Day (May 15, 2011)	1.890	0.564	0.133	3,541	374	354	189
Peak Hour (May 15, 2011)	2.700	0.90(7)	1.800	3,541	508	539	478

(1) Based on flow data from January 2009 – December 2011
(2) Total area includes parks and open spaces. Estimated 2008 sewer service area.
(3) GSP = General Sewer Plan
(4) WCP = Wastewater Comprehensive Plan
(5) WRF ER = Water Reclamation Facility Engineering Report
(6) Average Daily flows for November, December, January, and February for 2011
(7) Average dry weather flow at 12:00 p.m. from selected May 2011 daily flow records (the time of peak hour flow on May 15, 2011).

INFILTRATION AND INFLOW ANALYSIS USING EPA CRITERIA

Another analysis of infiltration and inflow was performed in order to compare estimates of per capita I/I to EPA criteria. The U.S. EPA manual entitled *I/I Analysis and Project Certification* provides recommended guidelines for determining if infiltration and/or inflow are excessive.

1. To determine if excessive *infiltration* is occurring, a threshold value of 120 gallons per capita per day (gpcd) is used. This infiltration value is based on an average daily flow over a seven to fourteen day non-rainfall period during seasonal high ground water conditions.

2. To determine if excessive *inflow* is present in a collection system, the USEPA uses a threshold value of 275 gpcd. If the average daily flow (excluding major commercial and industrial flows greater than 50,000 gpd each) during periods of significant rainfall exceeds 275 gpcd, the amount of inflow is considered excessive.

Rainfall records from the WRF between December 22, 2009 and December 30, 2009 show an 8-day period in which no measurable rainfall was recorded. This is also expected to be a period of relatively high groundwater due to a total rainfall of 1.52 inches for the ten days prior to December 22, 2009. The average daily flow recorded during this time period is 747,000 gallons per day, while the highest daily flow was 941,000 gpd. Using an estimated sewer population of 6,742 (Table 2-1), and dividing it into the average day flow of 747,000 gpd, the estimated per capita I/I value is 110 gpcd. Because this value is smaller than the EPA guideline of 120 gpcd, the City is not considered to have excessive infiltration by EPA criteria.

The maximum month influent flow to the WRF occurred on May 15, 2011. This was during a period in which 2.1 inches of rain was measured over a period of 6 days (May 11-May 16). The average WRF influent period during this time period was 1,001,000 gpd. Dividing this value by an estimated 6,742 sewer customers results in a per capita flow of 149 gpd. Because this

value is smaller than the EPA guideline of 275 gpcd, the City is not considered to have excessive inflow by EPA criteria.

I/I MONITORING AND REDUCTION RECOMMENDATIONS

In an attempt to reduce overall I/I within the collection system, the City should focus on the following objectives. A description of I/I reduction projects is included in Chapter 8, while detailed cost estimates are located in Appendix F.

- Continue regular visual and CCTV inspections of the entire collection system on an annual basis.
- Continue to perform smoke testing every 2 years.
- Analyze the existing smoke testing data to focus on specific areas where I/I can be reduce/eliminated through maintenance or repair.
- Perform all recommended improvements listed in Table 5-1.
- Perform any/all recommended improvements as a result of CCTV inspection.
- Continually collect data from flow monitors placed strategically within the collection system to elucidate specific I/I problem areas.

Chapter 6
OPERATION AND MAINTENANCE



INTRODUCTION

It is important for sewer utilities to have a program in place that ensures successful operation of the wastewater collection system and continuous reliability of critical system components. To address this need, this chapter discusses the components of the operation and maintenance program for the City's wastewater collection system. Operation and maintenance for the City's Water Reclamation Facility and Water Reuse Facilities were addressed separately in the *City of Sequim Wastewater Treatment Plant Reclamation Facilities Operations and Maintenance Manual* (CH2M Hill, May 1998), and *Water Reclamation Facility Operation and Maintenance Manual* (Gray & Osborne, February 2011). This chapter addresses responsibility and authority, normal system operation, routine and preventive maintenance, staffing and equipment requirements, discharge policy, new construction, records, safety, emergency response procedures, and regional sewer plans.

When a sewer is constructed, a design capacity is established. As with any other structure, physical deterioration begins almost immediately. Capacity is reduced through use and can only be maintained or restored by regularly scheduled maintenance. One

purpose of an operation and maintenance (O&M) program is to maintain design functionality and to restore the system components to their original condition or maintain their current condition. Added benefits of a comprehensive O&M Program include increased reliability, superior customer service, and lower maintenance costs.

RESPONSIBILITY AND AUTHORITY

The City is governed by a City Manager and a seven member City Council. The Public Works Director manages the Public Works Office and directs the Public Works staff. The Public Works Director is also responsible for the implementation of the Capital Improvement Plan and formulates the City budget for approval by the City Council.

There are 24 public works staff members including managers, engineers, operators, field staff, and office staff; all of whom report to the Public Works Director. Public Works staff with regards to wastewater includes:

- Utilities Manager
  - Oversees water and wastewater utilities for the City
- Four WRF operations personnel
  - Includes lead WRF operator
- Three City collection system personnel

The field staff performs operation and maintenance on wastewater conveyance systems, water reuse systems, water distribution systems, roads and parks. The current work structure is flexible, which allows for intradepartmental cooperation and prompt response to emergency and unscheduled tasks.

In 2011, the Utilities Department was reorganized slightly to shift responsibility of the water reuse facilities including upkeep of Carrie Blake Park, the City Shop, and all reclaimed water conveyance piping to the WRF staff. The reuse facilities and equipment had formerly been maintained by collection system staff.

The City has recently started compiling maintenance information in a data management system. This allows for work orders, scheduled maintenance, parts inventories, and labor tracking to be

centralized and combined for both the water, wastewater, and reclaimed water personnel. This new technology will increase efficiency, aid in customer response, and reduce maintenance costs for both water and wastewater utilities in the long term.

NORMAL SYSTEM OPERATION

The existing system of pump stations, wastewater force mains, reclaimed water lines, and gravity sewer lines within the UGA are shown in Figure 3-1 and on the base map provided in Appendix H. All wastewater collected within the City's collection system is conveyed to the WRF, which is ultimately discharged to the Strait of Juan de Fuca or to water reclamation sites within the City limits.

Collection system pump station information is listed in Table 3-2 while the lengths of sewer pipe are listed in Table 3-1. The collection system staff is responsible for operation and maintenance for all four pump stations, pressure mains and associated valves, and gravity sewer pipes. Detailed operating instructions for each of the pump stations are provided in the equipment supplier O&M manuals which are on file at the maintenance shop. Although septic tank effluent pump station at the Sequim Bay Lodge is owned, operated and maintained by Sequim Bay Lodge, City staff is often called to deal with maintenance and clogging issues when they arise.

Overall, the pump stations and collection system piping are in good working order and operate without significant maintenance issues. No major surcharging events have been recorded in the past 2 years and City staff perform regular routine preventive maintenance of the pump stations and collection system to keep the system in good working order. Preventive maintenance techniques employed by the collection system staff are described in subsequent sections.

ROUTINE AND PREVENTIVE MAINTENANCE CRITERIA

Planning for future maintenance of wastewater system facilities should be considered as important as capital improvement planning or system expansion. If maintenance efforts are not expanded proportionately to system expansion, the reliability and efficiency of the system will be diminished. The City's goals for its collection system maintenance program are to preserve the value

of the physical infrastructure and to ensure that all wastewater is conveyed safely, efficiently, and reliably. To accomplish these goals a planned preventive maintenance program provides the most cost-effective method for performing the optimum level of maintenance activities at the lowest cost. In addition to the actual maintenance tasks for system facilities, scheduling, administration, inventory, and record-keeping are key components of the City's maintenance program.

For the purposes of the following discussions, references are made to 'typical' collection systems. These comparisons are based on an EPA-funded study from the Office of Water Programs at California State University, Sacramento, entitled *"Collection Systems: Methods for Evaluation and Improving Performance."* Data from thirteen municipalities was collected and analyzed with respect to O&M procedures, staffing, and costs. The results of this study could serve as a future benchmark for assessing the efficiency of the City's O&M procedures.

PUMP STATION AND GENERATOR MAINTENANCE

An inventory of the mechanical equipment at each of the City's sewage pump stations is summarized in the Pump Station O&M Manual for each station. A maintenance logbook is kept at each pump station in order to record pumping equipment alarms or errors and the action taken to resolve them. This log book is an important piece of information for tracking maintenance and overall equipment condition. This information should also be integrated into the new information management system as soon as possible.

In addition, the City records pump run time, wet well level, and pump amperage to track operation of the pump stations.

Table 6-1 from the *Wastewater Collection Systems Management: Manual of Practice 7* (WEF, 2004) summarizes recommended preventive maintenance tasks for pump stations. The WEF table is extensive, but can be used as a guideline for the scheduling of maintenance tasks. Current City procedures should be compared to those recommended in this table and fortified wherever possible.

Table 6-1 Typical Maintenance Tasks Record for Pump Stations

Task	Daily	Weekly	Monthly	Quarterly	Yearly
Electrical					
Medium-voltage switchgear				Yes	Yes
Incoming service				Yes	Yes
Main circuit breaker/disconnect				Yes	Yes
Bus, vertical, and horizontal					Yes
Motor starters		Yes		Yes	
Motor overload relays		Yes		Yes	
Relays					Yes
Indicating lights	Yes		Yes		
Voltage/current readings	Yes				Yes
Supervisory Control					
Relays				Yes	
Wiring			Yes	Yes	
Fuses		Yes		Yes	
Circuit breakers				Yes	
Pump sequencing		Yes		Yes	
Pump operating levels		Yes		Yes	
Piping, valves				Yes	Yes
Pressure switches		Yes		Yes	
Alarms and levels	Yes			Yes	
Indicating lights	Yes				Yes
Floats	Yes				Yes
Pumps					
Bearings (vibration)		Yes			Yes
Alignment				Yes	Yes
Coupling				Yes	Yes
Packing					Yes
Lubrication					Yes
Mechanical seals		Yes			Yes
Mounting					Yes
Balance					Yes
Impeller Clearance					Yes
Capacity		Yes			
Suction Pressure		Yes			
Dicharge Pressure		Yes			
Station calibration					Yes
Running time	Yes				
Overhaul					As needed
Motors					
Bearings			Yes		Yes
Balance					Yes
Conduit box connections					Yes

Table 6-1 Typical Maintenance Tasks Record for Pump Stations – (continued)

Task	Daily	Weekly	Monthly	Quarterly	Yearly
Lubrications					Yes
Insulation resistance					Yes
Running temperatures		Yes			
Full load amperes		Yes			
Voltage		Yes			
Vibration analysis					Yes
Alignment					Yes
Coupling					Yes
Overhaul					As needed
Valves					
Suction				Yes	Yes
Discharge				Yes	Yes
Check		Yes			Yes
Pressure relief		Yes			Yes
Gate				Yes	Yes
Plug				Yes	Yes
Miscellaneous					
Piping					Yes
Pipe restraints				Yes	Yes
Auxiliary systems					As needed
Water	Yes			Yes	
Blowers/fans	Yes			Yes	
Heating system	Yes			Yes	
Cooling system	Yes			Yes	
Engine gererator sets	Yes		Yes		
Lighting	Yes			Yes	

Auxiliary and portable generators function as key backup systems for pump stations. All four pump stations are equipped with auxiliary power supplies. Jeannie's Meadow pump station utilizes a permanent propane generator, Cedar Ridge and Port Williams utilize a permanent diesel generator, and Doe Run currently uses a portable diesel generator.

Manufacturer's information on auxiliary generators is also available and contains standard maintenance recommendations. Maintenance of auxiliary and portable generators should be conducted as recommended in the O&M manuals for the individual generator units. Maintenance for the generators entails weekly run tests to ensure the operational ability during a power outage. Fuel, water, and oil levels should be checked and recorded

as part of routine maintenance tasks. Mechanical maintenance should include service at regular intervals of approximately 6 months. Collection system staff should run each auxiliary generator for approximately 15 minutes each week.

Pump station staffing requirements vary greatly depending on the size and complexity of the station as well as the scheduled maintenance routine. Inspection and maintenance staffing needs typically range from 0.05 to 0.5 full-time equivalent (FTE) per station. The City's pump stations are operated and maintained by a single primary collection staff member, and other collection staff members are called as needed. One FTE for the inspection and maintenance of the City's pump stations is consistent with the staffing requirements given in the WEF Manual.

COLLECTION SYSTEM INSPECTION

The major maintenance activities with respect to gravity sewers and manholes are periodic inspections and flushing. Inspections are typically done through visual investigation or closed circuit television (CCTV) technology. To provide these inspections the City recently acquired a high definition CCTV camera. The City has been diligently inspecting sewer pipe using CCTV as the maintenance schedule allows and will likely finish a complete inspection of the entire collection system by the end of 2012. Inspection rates for the City staff typically range from 25 - 75 percent of the system per year. Cleaning and flushing of sewer pipe is performed at regular intervals, while troublesome areas that have high rates of debris accumulation are cleaned or flushed more frequently. This flushing addresses the accumulation of debris or other matter within pipes and manholes, thus limiting the potential for surcharging or flooding.

Although the amount of sewer pipe that can be inspected each day varies depending on work schedules, the amount of cleaning required, time of day, and other physical limitations, the collection staff can inspect an average of approximately 1,000 to 1,200 feet per day. Structural conditions that should be evaluated during the inspection include: collapsed pipes, cracked pipes with or without deflection, pipe sags, cracked or open joints, holes in pipes, root intrusion, signs of pipe corrosion, protruding joint material, protruding lateral sewers, pipes with excessive debris, and side sewers with active I/I. In the future, the City's goal is to completely inspect the collection system once each year.

Manholes should be inspected and cleaned along with the CCTV pipe inspection. Deteriorating or non-functioning manholes should be replaced as soon as possible to prevent further system damage and I/I.

A primary maintenance issue with regards to a wastewater collection system is the accumulation of fats, oils, and grease (FOG). These contaminants are prevalent in the waste streams of restaurants, laundromats, and other commercial entities, and to a lesser extent, residential connections. The SMC addresses the requirement for specific businesses and waste producers to maintain adequate pretreatment for FOG prior to discharge into the sanitary sewer system. However, the City no longer employs a pretreatment FOG trap inspector on staff, and as a result, FOG traps within the city limits have not been inspected since late 2011. It is recommended that the City add 0.5 FTE to bolster and enforce the City's stated pretreatment requirements for FOG.

Cleaning the collection system typically includes flushing/jetting with high pressure water. Although there is no well-established industry standard for cleaning intervals, a review of current literature suggests that cleaning between 5 and 40 percent of the system per year is acceptable. Cleaning is performed more often than inspection because it addresses the accumulation of debris which can occur randomly and cause hydraulic disruptions in a short period of time. The older portions of the City's sewer collection system should be given special attention, because the potential for breaks in sewer lines or accumulated solids is higher in these areas. Odor complaints from residents can help identify areas in need of more frequent flushing or other maintenance. The deterioration of the older areas within the sewer collection system can be tracked through accurate maintenance records and continual updating of the new software-based O&M tracking system. Maintenance records can also be used to budget necessary repair and replacement projects.

City collection staff currently flushes out the collection system pipes on a regular rotation, and responds to high priority issues as needed. Currently, the staff responds to customer issues with FOG every 30 to 45 days. Prior to the implementation of a routine system flushing plan, the staff responded to calls regarding FOG every 10 to 14 days.

The staff has also identified areas that are prone to FOG blockages and flushes these pipe sections more frequently than the remaining system pipes. These trouble areas include sewers serving various restaurants within the downtown core that require flushing or special attention on a weekly basis. Using these types of preventive measures, the City has not experienced any overflow events in many years.

Wastewater staff have reported that significant manhole deterioration is occurring at the manhole downstream of the forcemain discharge from the Sequim Bay Lodge. It is suspected that this corrosion is due to hydrogen sulfide generated by septic conditions that develop within the force main. Hydrogen sulfide corrodes the concrete in manholes and contributes to leaks and maintenance requirements. City staff is currently investigating options such as regular injections of Bioxide® at Sequim Bay State Park, which discharges into the Sequim Bay Lodge pump station, as a way to combat this chemical deterioration.

Typical rates of inspection and cleaning vary form 10 to 100 and 30 to 1,000 feet per hour, respectively. Table 6-2 estimates the staffing requirements for the current system. An inspection and cleaning rate of 1,000 feet per day (125 feet/hour) was used to estimate the number of FTE's required. A two man crew was assumed for cleaning and inspection. This analysis assumed the target inspection and cleaning interval is every 2 years.

Table 6-2 summarizes recommended gravity sewer inspection and cleaning rates and staffing.

Table 6-2 Recommended Gravity Sewer Inspection and Cleaning Staffing

Task	Length of Gravity Sewer (miles)	Target Interval (years)	Length per Year (feet)	Rate per Crew (Feet/hour	Required Number of crew hours (manhours)	Required Number of Employees
Video Inspection	66	2	350,000	125	1,400 (2,800)	2 @ 0.65 FTE(1)
Line Cleaning	66	2	350,000	125	1,400 (2,800)	2 @ 0.65 FTE(2)
FOG Program Implementation	--	--	--	--	--	1 FTE

(1) Includes truck driver and camera operator.
(2) Includes truck driver and jet operator.

MAINTENANCE PERSONNEL TRAINING

A well-trained staff is an essential part of an effective O&M program. Maintenance personnel should be familiar with maintenance equipment and procedures, as well as safety requirements and regulations. Training and certification criteria should be established for each job description and training conducted accordingly. Training activities should be considered to be as important as any other maintenance activity and should be included and budgeted into the regularly scheduled tasks. It is recommended that annual training and education be included in the annual budget amount.

COLLECTION SYSTEM STAFFING AND EQUIPMENT REQUIREMENTS

Based on the above analysis, it appears the City of Sequim requires 1 FTE to inspect, clean, and maintain the pump stations, 1.3 full time employees to inspect and clean the gravity collection system, 1.3 FTEs to perform video inspection of the sewer system, 0.5 FTE to enforce FOG pre-treatment requirements, and one 1 FTE in a supervisory and support role. Table 6-3 is a summary of the recommended staffing for the current sewer collection system based on the criteria presented in the previous sections.

Table 6-3 Summary of Recommended Operations and Maintenance Personnel for Existing Collection System

Parameter	Units	Current Quantity	Required Staff
Gravity Sewer – Routine O&M	Miles	66	2.6
Pump Stations – Routine O&M	Each	4	0.5
FOG Program Implementation	-	-	0.5
Special Projects and Emergency O&M	-	-	0.5
Supervisory Personnel (1 per 4.0 FTE)	-	-	1.0
Total			5.1

The City currently owns a vactor truck, CCTV video inspection truck and trailer, a jet/flushing truck, a 5-yard dump truck, and three utility trucks

The City is anticipating purchasing a new vactor truck that will be shared with the Water Department. The estimated cost of the vactor truck is $450,000. No other equipment is needed at this time, but depending on collection system expansion, an additional CCTV truck and jet truck will eventually be required.

Future Staffing Needs

To estimate future staffing needs, system growth was correlated to population growth. The two parameters based on population used as a basis for future estimates of the size of the system were population per mile of sewer and the estimated number of pump stations at build-out. The target sewered population developed in Chapter 2 was used for the population estimates.

Currently there are approximately 100 people per mile of gravity sewer in the Sequim system and (6,742 people divided by 66 miles of gravity sewer) approximately 1,684 people per pump station, not including the Sequim Bay Lodge Pump station (6,742 people/four pump stations). This analysis assumes six pump stations will be required to serve the build-out population of 28,800 which would correspond to approximately 4,800 people per pump station.

Table 6-4 presents an estimate for the collection system staffing needs for the 20-year planning period.

Table 6-4 Estimation of Future Collection System Staffing Needs

Year	2011	2018	2032
Target Sewered Population(1)	6,742	8,772	14,119
Miles of Sewer(2)	66	80	122
Persons per Mile	102	109	115
Pump Stations	4	4	5
Pump Station Maintenance FTEs	0.5	0.5	1.25
Gravity Sewer Maintenance FTEs	2.6	3.2	4.9
Other Support and Emergency FTEs	0.5	0.7	1
FOG Program Implementation	0.5	1.0	1.5
Total Maintenance FTEs	4.1	5.4	8.7
Supervisory FTEs(3)	1.0	1.3	2.2
Total FTEs	**5.1**	**6.7**	**10.7**

(1) Based on domestic-only ERUs and residents per ERU developed in Chapter 2.
(2) Based on 100 people per mile of gravity sewer.
(3) A minimum of 1, or 1 per 4.0 FTEs, whichever is more.

DISCHARGE POLICY

Policies regarding the pretreatment and discharge of industrial waste are set by the City in Chapter 13.48 of the SMC. A copy of this document is provided in Appendix I. There are established policies regarding the prohibited discharge of:

- Stormwater or other unpolluted water,
- Liquids with a temperature over 140 degrees F.
- Fats, oils, and greases (maximum of 150 parts per million)
- Flammable and explosive materials
- Debris potentially obstructing the sewer
- Corrosive materials (or having a pH outside of the range of 5.5-8.5)
- Toxic or poisonous substances that could cause interference or injury
- Waste containing solids that are unusually difficult to handle
- Waste with a obnoxious or malodorous gas or substance
- State Dangerous Wastes

Also defined in this chapter is the requirement for certain facilities to provide grease traps/interception prior to wastewater entering

the sanitary sewer. While the City's pretreatment program is adequate, without a full time inspector to investigate wastewater customers for compliance, there is not a consistent method to determine if dischargers are adhering to the program's requirements. As such, increasing the number of inspectors should increase compliance with the pretreatment program, especially involving fats, oils, and grease.

A discussion of industrial users was included in Chapter 2 – Basic Planning Information. Industrial flow does not possess the characteristics of typical domestic wastewater and may include higher levels of metals, organics, chemicals, or other deleterious constituents. These constituents can often disrupt the normal treatment processes of a wastewater plant and; therefore, the City is in the process of developing rules to regulate their release into the sanitary sewer system. An inventory of the City's most prominent industrial users includes:

- Fourteen dental clinics;
- Five medical clinics;
- A plumbing service which handles portable toilet waste and chemicals;
- Six auto-body repair shops;
- Two dry cleaning establishments;
- The school district vehicle maintenance facility;
- Two funeral homes;
- Two car washes; and
- The City shop facility.

The City is currently in the process of rewriting their industrial pretreatment program to include standards for pretreatment prior to discharge to the sanitary sewer system, and outlining actions or penalties the City may impose if violators are identified. It is likely that existing industrial dischargers will be expected to comply with the new regulations after a reasonable time period, however, any new industrial development that takes place after the new pretreatment program is enacted would be required to adhere to the new regulations. This would also include industrial dischargers located in any of the surrounding communities that may discharge to the City's municipal sewer system. The new pretreatment program will include a review of wastewater testing results and monitoring history for any establishment prior to

connection to the City's sanitary sewer to ensure that the proposed discharge will not interfere with operations at the WRF.

NEW CONSTRUCTION

A major step towards preventing problems within the sewer collection system is proper installation at the time of construction. The City has adopted Developer Standards pertaining to the sanitary sewer system in the City's Municipal Code. These standards should be continually reviewed and updated by engineering and maintenance personnel. Standard designs should be developed to minimize total life cycle costs which include capital, O&M, and financing costs. Also, as the system becomes more complex, special attention should be given to its ability to function during emergency situations.

Developer standards for the wastewater system are discussed in Chapter 7 – Design and Construction Standards, while standards for both the water and wastewater system, along with design drawings, and located in the separate developer standards document developed in conjunction with this plan.

RECORDS

The implementation of an effective and efficient O&M program requires accurate record-keeping. Accurate maintenance records provide many benefits to the City, including the following:

- Identifying recurring problems and problem areas
- Tracking pump station mechanical components
- Estimation of man-hours required for various maintenance tasks
- Identification of collection system components that are nearing capacity or the end of their useful life
- Diagnosing and addressing inflow and infiltration issues

The City should maintain their current record keeping procedures with regards to pump stations, collection system maintenance (jetting/flushing), WRF maintenance, and water reuse facilities maintenance. These and all future records should be incorporated into the new information management system software as soon as possible.

SAFETY

An important consideration of any successful maintenance program is the safety and well being of all employees. The City's safety program addressing accidents, fall protection, confined spaces, and lockout/tagouts based on the standards of the Washington State Department of Labor and Industries (L&I). The safety program addresses the situations that employees may encounter during the performance of operation and maintenance tasks. Field employees meet monthly for safety meetings, which include training and discussion of safety issues.

The following section includes applicable recommended and required safety provisions for confined spaces, electrical and mechanical equipment, fire hazards, and health hazards.

CONFINED SPACES

The principle hazards associated with confined spaces, including wet wells, sewer manholes, and pump stations, are oxygen deficiency, explosions, and toxic gases. Oxygen deficiency occurs whenever air is displaced by some other gas, which may or may not be toxic.

L&I has established regulations governing entrance into confined spaces in WAC 296-809. The regulations include the completion of a Confined Space Entry Permit, the establishment of Safe Operating Procedures, and the completion of a Confined Space Pre-Entry Checklist.

A minimum of two individuals are required when any work is to be accomplished within pump stations, wet wells, or sewer manholes that are considered confined spaces. A gas monitor is required for measuring oxygen levels, explosion potential (LEL), and toxic gases. The gas monitor must be used to continually monitor gas levels while any person is within the confined space. Rapid changes in gas levels can occur in sewage effluent due to upstream spills or discharges which can lead to rapid atmospheric changes. The gas monitor will sound an alarm if a critical level for a measured gas is reached.

A portable air blower should be available to the operator whenever work in manholes or wet wells is performed. The air blower can be used to provide ventilation in confined spaces, but the motor

should be kept away from the opening to the space to avoid the ignition of explosive gases that may be present.

City confined space procedures should be reviewed with maintenance personnel on a regular basis and revised as new regulations and equipment evolve.

Besides manholes and wet wells, the Port Williams Pump Station pump equipment room is classified as a confined space and would require specific safety precautions before performing pumping equipment maintenance. The remaining three pump stations have valves and controls that are readily accessible and not considered to be in confined spaces.

ELECTRICAL AND MECHANICAL EQUIPMENT

The presence of electrical mechanical equipment at the pump stations may present hazards to personnel during the performance of operation and maintenance tasks. Precautions should be taken whenever working on or near the pump station mechanical and electrical equipment.

Rubber mats should be placed on the floor in front of all electrical control panels. When working on any piece of electrical equipment, the operator should ensure that all switches are opened and tagged, all electrical equipment is grounded, and all exposed wire is taped. All portable power tools, extension cords, and lights should be of the three-wire grounding type.

Exposed shafts and belts are hazardous items of mechanical equipment that can be found in pump stations. Belts and shafts should be enclosed in sheet metal or wire guards. When work is being conducted on any piece of equipment with exposed shafts or belts, the item of equipment should be taken off line so that it will not start.

Other safety precautions that should be observed by City personnel are to avoid contact with energized circuits or rotating parts, to avoid bypassing or rendering inoperative any safeguards or protective devices, and to avoid extended exposure in close proximity to machinery with high noise levels.

FIRE HAZARDS

Fires are possible in any area of a pump station if debris is allowed to accumulate. Precautions should be taken to reduce the possibility of a fire. Oily rags should be kept in a tightly sealed metal can, preferably at a location away from the pump station. All areas should be kept free of clutter or debris, especially if flammable in nature. Gasoline or solvents should only be used in well-ventilated areas, away from sources of ignition. A carbon dioxide type, dry chemical, or foam fire extinguisher should be permanently mounted at each pump station. The extinguisher should be tagged and checked semi-annually to ensure that it is operational.

HEALTH/SAFETY

The possibility exists that any particle of wastewater may contain disease causing bacteria. Operators should take precautions to avoid disease at all times. Principle water-borne diseases include typhoid fever, dysentery, Giardia, Cryptosporidium, infectious jaundice, and tetanus. Immunization against some of the diseases is possible and all operators should be vaccinated periodically. Operators should take individual precautions to avoid disease, including the following:

- Keep hands below collar when working at sewer facilities.
- Wear rubber gloves whenever directly handling sewage.
- Disinfect hands with hot water and soap or antibacterial location before eating.
- Treat minor cuts and wounds immediately.

Additionally, an emergency first aid kit should be kept in each City vehicle and other convenient locations, so as to be readily available to operators.

EMERGENCY RESPONSE

The operation of the sewer system under emergency conditions is an important responsibility of the City's staff. Emergency response procedures should be rehearsed and reviewed by personnel on a regular basis.

An overview of the potential effects and recommended actions for emergency situations is presented in Table 6-5. The five emergency situations considered are power loss, flooding, hazardous waste spill, earthquake, and sabotage/vandalism. The potential effects and recommended actions are identified for sewage pump stations, force mains, and the gravity sewer system.

It is important to estimate the degree in which system facilities may be vulnerable to various types of emergency situations in order to identify system weaknesses. The following sections provide information regarding which facilities would be vulnerable to various types of emergency events and recommended actions that City staff could take to help mitigate the problem. Chapter 2.60 of the Sequim Municipal Code establishes an emergency management plan for the City. Also, the field staff have established a procedure for after-hours and emergency service calls.

The Port William Pump Station as well as the WRF are equipped with autodialer technology which notifies City Staff of an alarm and provides some basic information regarding the alarm. Future modifications of pump station equipment should include autodialer alarm notification so that staff may appropriately take action in the event of an emergency.

Table 6-5 Emergency Response Actions for Collection System Components

Pump Stations		
Emergency	**Potential Effects**	**Recommended Actions**
Power Loss	Pumps rendered inoperable, auxiliary generators activated to run pumps.	Transport portable generators to pump stations that do not have auxiliary power, check other pump stations to ensure generators are operating.
Flooding	Station overflow.	Pump to trucks until flooding effects subside.
Hazardous Waste Spill	Spill enters wet well at a pump station.	Isolate pump station receiving spill, pump out of wet well and dispose of hazardous materials, notify Clallam County, DOH, and DOE of situation.
Earthquake	Wet well damaged, inlet and outlet piping severed or damaged.	Pump to trucks while repairs are made.
Sabotage/Vandalism	One or more pumps rendered inoperable.	Isolate damaged pump station area, operate other pumps while repairs are made.
Force Mains		
Emergency	**Potential Effects**	**Recommended Actions**
Power Loss	No anticipated effects	No actions anticipated
Flooding	No anticipated effects	No actions anticipated
Hazardous Waste Spill	No anticipated effects	No actions anticipated
Earthquake	Breaks in force main pipes	Bypass pumping where necessary
Sabotage/Vandalism	Force mains plugged or broken	Isolate damaged area, pump from affected pump station to trucks until affected area is functional.
Gravity Sewers		
Emergency	**Potential Effects**	**Recommended Actions**
Power Loss	No anticipated effects	No actions anticipated
Flooding	Manholes surcharged	Implement bypass pumping at critical areas.
Hazardous Waste Spill	Spill enters sewer system	Isolate pump station receiving spill, pump out of wet well and dispose of hazardous material, notify Clallam County Health, and DOE of situation.
Earthquake	Breaks in sewer lines. Damaged manholes	Isolate damaged area, implement bypass pumping until affected area is repaired.
Sabotage/Vandalism	Gravity sewers plugged or broken. Manholes damaged	Isolate damaged area, implement bypass pumping until affected area is repaired.

REGIONAL SEWER PLANS

As mentioned previously in this Plan, the City along with Clallam County are interested in developing a regional approach to water and wastewater infrastructure. With regards to wastewater, there are three primary areas outside of the Sequim UGA who most likely convey wastewater to the Sequim WRF.

Implications to the O&M program should SunLand, Blyn, or Carlsborg connect to the City's collection system are discussed below.

Recommendations and estimates for FTEs are dependent on timing of system connection, type of system installed, and the existing City staff at the time of connection. The recommendations and estimates below should be reviewed further once specific connection system information is developed.

SUNLAND

The impact of SunLand connecting to the City's collection system O&M would vary depending on the location and type of connection. Most likely, a pump station would be required at the SunLand water reclamation facility that would pump wastewater to the Port Williams pump station where it would enter the Sequim collection system. There is also the possibility that SunLand could pump wastewater directly to the Sequim WRF. In either situation, the piping and pumping equipment associated with these connection alternatives would require regular maintenance.

Depending on the connection point and methods, it is estimated that between 0.25 and 2.0 additional FTEs would be required to operate and maintain the associated pumping equipment and piping system. Additional cleaning and jetting of lines would be minimal, although the additional piping would require CCTV inspection according to the City's desired schedule. There may also be issues with odors associated with septic conditions that often develop within long force mains.

BLYN

If Blyn were to connect to the City's collection system, it would most likely do so at the Sequim Bay State Park. This connection would require a pump station in Blyn and a forcemain from the pump station location to the pump station located at the State Park.

As with SunLand, the associated piping and pumping equipment would require regular maintenance.

Depending on the equipment used, it is estimated that between 0.25 and 1.0 additional FTEs would be required to maintain and operate the equipment. Increases in regular maintenance would be minimal, but additional CCTV inspection would be required. As with SunLand, odors associated with septic conditions that typically develop within long forcemains may require regularly scheduled maintenance or chemical addition.

CARLSBORG

The *2011 Feasibility Study* proposed five options for connection of Carlsborg to the City collection system. These options included connection at various existing manholes within the City, as well as a direct forcemain from the Carlsborg PUD complex. All of these options present different O&M requirements, but the overall impact to the City's collections system O&M program would be similar. These alternatives were based on the installation of a PVC gravity collection system within Carlsborg, and pumping of the collected wastewater at an appropriately sized facility in Carlsborg.

Depending on the alternative chosen as well as the extent to which Carlsborg residents connect to the gravity sewer system, additional maintenance work will be required. It is estimated that between 0.25 and 1.0 additional FTEs would be required to maintain the Carlsborg collection system at buildout. As with the Sequim collection system, the Carlsborg collection system piping should be cleaned and inspected regularly. Emergency maintenance issues would be handled by the staff. It is likely that the addition of Carlsborg to the City's collection system would increase the need for additional maintenance equipment such as hydro-jetting trucks, vactor trucks, or general maintenance vehicles.

Water reuse facilities would also require regular maintenance and monitoring to ensure proper operation and prevention of cross-connection in order to protect public safety.

Table 6-6 summarizes the estimated required FTEs for Sequim and surrounding potential sewer partners. Maintenance FTEs are based off existing and projected population data, while 1 supervisory FTE is assumed for every 4 maintenance FTE.

Table 6-6 Estimated Regional Sewer Planning of Future Wastewater Staffing Needs

Year	2011	2018	2032
Maintenance FTEs			
Sequim	5.1	5.4	8.7
SunLand	0.25	0.25	0.5
Blyn	0.25	0.25	0.5
Carlsborg	0.25	0.25	1.0
Subtotal	**5.85**	**6.15**	**10.7**
Supervisory FTEs			
Sequim	1.0	1.3	2.2
SunLand	0.25	0.25	0.25
Blyn	0.25	0.25	0.25
Carlsborg	0.25	0.25	0.25
Subtotal	**1.75**	**2.05**	**2.95**
Total FTEs	**7.6**	**8.2**	**13.6**

Chapter 7

COLLECTION SYSTEM DESIGN AND CONSTRUCTION STANDARDS



This chapter summarizes developer standards, design criteria, and municipal code requirements for the City of Sequim sewer system. Title 13, Division II of the City's municipal code outlines statutes regarding sewer system connection, use, and regulation. A summary of these sections are provided below while a copy of the associated municipal code is included in Appendix I.

Following the summary of the City's municipal code standards regarding sewer systems, Clallam County Code Title 13 regulations are summarized. Thirdly, sewer system design standards and requirements developed by the Department of Ecology (Ecology) are outlined. The City's municipal code, Clallam County code, and the *Criteria for Sewage Works Design*

Manual (Orange Book) will be used in the design of future sewer collection system improvements to ensure successful operation of the collection system and the safety and health of residents in the City.

A complete set of wastewater developer standards and drawings are located in Appendix J. The complete set of developer standards (water and wastewater) is provided as a stand-alone document that can be used by developers for informational purposes during sewer project execution.

CITY OF SEQUIM MUNICIPAL CODE STANDARDS REGARDING SEWER SYSTEMS

CHAPTER 13.32 – DEFINITIONS AND STANDARDS

This chapter outlines the legal definitions for terms associated with water and sewer systems within the City's jurisdiction. It states that all wastewater monitoring processes are to follow the guidelines listed in the most current edition of *Standard Methods for the Examination of Water and Sewage* (American Public Health Association).

CHAPTER 13.36 – ADMINISTRATION AND ENFORCEMENT

This chapter outlines the duties of the sewer system administrator, who is responsible for the coordination of sewer system activities with the guidance of the City Council. The chapter also outlines procedures for inspection of work involving sewer systems.

This chapter outlines the promulgation and advertisement of new laws, codes, and/or ordinances with regards to sewer systems. It also states the penalties for unlawful removal of notices or failure to comply with the regulations set forth in the municipal code with regard to sewer systems.

CHAPTER 13.40 – SEWER CONNECTION REQUIRED

This chapter outlines information regarding when a property owner must connect to the sewer system and in what manner they must connect to the sewer system. It states that a property owner

must connect to the sewer system "whenever such a sewer or drain is located within 200 feet of the closest point of the building site or premises "to be served." This requirement is based on the condition that:

> "1. Sanitary plumbing outlets must be connected to combined or sanitary sewers,"
>
> "2. Residences, multiple residences, churches, schools, hotels, motels, industrial and commercial buildings, planned developments, hospitals and all similar installations and appurtenances thereto; storm plumbing outlets, downspouts, parking lot drainage, footing drains, and unpolluted water must be connected to any storm drain existing on the same side of the centerline of the abutting street and within 60 feet of a side property line," and
>
> "3. Residences, multiple residences, churches, schools, hotels, motels, industrial and commercial buildings, planned developments, hospitals and all similar installations or appurtenances thereto which are being connected to a combined sewer when there is no accessible storm drain: downspouts, storm plumbing outlets, parking lot drainage, unpolluted water and footing drains must be carried in a side sewer pipe separate from the sanitary side sewer pipe to the property line, as designated by the city engineer, and shall be joined with the sanitary side sewer at that point and then connected to the combined sewer; provided, that the city engineer may permit or require storm drainage to discharge upon the surface of a public place or into a natural outlet or dry wells, even though a combined sewer is accessible, when it is planned to provide a storm relief sewer in the vicinity of said combined sewer."

The chapter also outlines processes by which City staff must notify the property owner of the requirement to connect and the

process by which the property owner may apply for an extension to allow more time to connect to the sanitary sewer system.

CHAPTER 13.44 – SEWER CONNECTION PERMITS

This chapter states that it is unlawful to connect to the City's municipal sewer system without a permit and also lists the information required to apply for a sanitary sewer connection permit. The chapter states that a temporary connection permit may be issued by the City Engineer, but this permit may be revoked at any time after 60 days from issuance if there is failure to comply with the long-term requirements for connection to an approved sewer collection location. Fees associated with violation of a sewer permit or temporary connection permit are also discussed.

CHAPTER 13.48 – PUBLIC SEWER USE REGULATIONS

This chapter discusses provisions to eliminate the discharge of potentially harmful substances into the City's sewer system. Regulations and specifications of equipment and procedures meant to reduce the discharge of fats, oils, and greases (FOG) are discussed. The chapter states that grease traps and/or interceptors shall be required in "restaurants, bakeries, nursing homes, school kitchens, or any other facility providing more than 10 meals per day, or such facilities, as in the opinion of the director of the public works department, require such interceptors for the proper handling of liquid wastes containing grease in excessive amounts, or any flammable wastes, sand, or other ingredients potentially harmful to the efficient operation of the city sanitary sewage treatment system." The chapter then outlines financial penalties for non-compliance with FOG pretreatment policies.

The chapter further states that discharge of any of the following items to the sanitary sewer system is prohibited:

1. Subsoil foundation, footing, window well, door well, yard, or unroofed basement drains;

2. Overflows from unpolluted water storage facilities;

3. Clear water from refrigeration, reverse-cycle heat pumps, and cooling or air conditioning equipment

installed after December 31, 1996, except for periodic maintenance of such systems;

4. Roof drains or downspouts from areas exposed to rainfall or other precipitation;

5. Surface or underground waters from any non-municipal domestic water system source;

6. Any liquid or vapor having a temperature higher than 140 degrees Fahrenheit;

7. Any waste that contains more than 150 parts per million by weight of fat, oil, or grease;

8. Any gasoline, benzene, naphtha, oil, or other flammable or explosive liquid, solid or gas;

9. Any sand, mud, straw, hair, shaving, metal, glass, rags, feathers, tar, plastic, wood, paunch manure, or any other solid or substance capable of causing obstruction to the flow in sewers or improper operation of the sewage works;

10. Any waste having a pH lower than 5.5 or higher than 8.5 or having any other corrosive property capable of causing damage or hazard to the structures, equipment, or personnel of the City;

11. Any waste containing a toxic or poisonous substance in sufficient quantity to injure or interfere with any sewage treatment process;

12. Any waste containing suspended solids of such character and quantity that unusual attention or expense is required to handle such materials in the public sewer system or at the sewage treatment plant;

13. Any obnoxious or malodorous gas or substance capable of creating a public nuisance; and

14. Materials defined as dangerous waste under Chapter 173-303 WAC as now enacted or hereafter amended.

CHAPTER 13.52 – SEWER MAINTENANCE REGULATIONS

This chapter outlines the procedures taken if a sanitary side sewer is deemed "inadequate" by City personnel. It states that the City may require the property owner to bear the financial cost of such repairs as necessary to render the sewer fully functional. It discusses the placement and requirement for backwater sewage valves to lessen the potential for backups in the sewer system.

Also, this chapter states that "it is unlawful to plant within 30 feet of any sanitary sewer, side sewer or storm drain any willow, poplar, cottonwood, soft maple, gum tree or any other tree or shrub whose roots are likely to enter and obstruct the flow of the sewers."

CHAPTER 13.56 – REPAIR AND CONSTRUCTION REGULATIONS

This chapter outlines the safety and public notice requirements for construction projects involving sewer system components. Specifically, signage and barricades for exposed trenches are discussed.

CHAPTER 13.60 – SIDE SEWER REGULATIONS

This chapter discusses information regarding the process of constructing a new side sewer connection. Specific information regarding permit application, construction, acceptable materials, inspection, minimum requirements, appurtenances, and mitigation/restoration is presented.

CHAPTER 13.64 – STORM DRAINAGE

This chapter states that "Hard-surfaced or graded areas such as parking lots, service station yards and storage yards shall be drained in such a manner as will protect adjacent public and private property from damage and such drainage shall enter the public sewer system or other outlet approved by the city engineer and as required (SMC 13.40.010). Such storm drainage shall not be connected to enter a sanitary sewer."

CHAPTER 13.72 – INSTALLATION AND CONNECTION FEES

This chapter outlines the installation and connection fees for both municipal sewer and water systems, general facility charges for both sewer and water systems, and the collection of fees.

CHAPTER 13.76 – FEES FOR CONNECTION TO MAINS

This chapter states that "In addition to the connection charges set forth in other chapters of this division, persons or firms connecting to water or sewer mains constructed at the sole cost of the city and not pursuant to local improvement district bonds or through developer funding, shall pay the actual cost of the construction of the main serving the applicant's property, plus 10 percent as overhead for city administration unless such charges have been paid under other provisions of the code."

CHAPTER 13.80 – SEWER RATES AND CHARGES

This chapter outlines current sewer rates and charges, potential reduction in charges for certain facilities, and the capacity for the Public Works Director to adopt procedures "necessary for the efficient and equitable administration of the residential volume-based sewer rate structure."

CHAPTER 13.98 – DEVELOPER REIMBURSEMENT COLLECTION AGREEMENTS

The aim of this chapter is to "establish a uniform methodology and process for the administration of reimbursement contracts applied for after June 1, 2010, for developers in circumstances where a developer uses private funds to construct a public utility and/or street system improvement(s) and desires to be compensated by property owners benefited by the improvements."

Legal authority and various administrative topics regarding the developer, the City, the funding agency, and the implementation of a contract are discussed.

CHAPTER 13.100 – UTILITY EXTENSIONS

This chapter discusses specific requirements of the developer and the City when extensions to City owned utility pipes are made. Topics include approval of plans, costs, connection testing,

permits, transfer of title, conformance with ordinances and penalties for violation of associated regulations.

CHAPTER 13.112 – RECLAIMED WATER

This chapter discusses the use of reclaimed water within the City of Sequim. Important definitions are listed, acceptable uses are outlined, and rates for reclaimed water use are shown. Also included in this chapter is the designation of authority for reclaimed water, and inspection and connection policies.

CLALLAM COUNTY CODE STANDARDS REGARDING SEWER SYSTEMS

CHAPTER 13.08 – PORT ANGELES EASTERN URBAN GROWTH AREA (EUGA) SEWER SYSTEM

Clallam County also has developed sewer and water standards that are used in various smaller communities within the region. These codes are used to govern infrastructure standards in areas without large scale development regulations or standards.

The Clallam County code briefly discusses regulations that govern water and sewer connections for select areas under the County's jurisdiction. These areas include Clallam Bay/Sekiu and the Port Angeles Eastern Urban Growth Area. County standards only affect these entities and have no bearing on the water and sewer system operations for the City. County standards closely match the City's requirements and processes for sewer and water connections, as well as for developing sewer and water rates. Additional information on Clallam County standards is available at www.clallam.net/bocc/countycode.html.

DEPARTMENT OF ECOLOGY DESIGN STANDARDS REGARDING SEWER SYSTEMS

The following information is taken from the Department of Ecology's "*Criteria for Sewage Works Design Manual* (Orange Book)."

The contents and requirements for design of sewer systems are outlined in Chapters G1-4.2.2A and G1-4.2.2B. Briefly, these sections list the need for labels, dates, locations of manholes,

manhole elevations, a site plan, and a detail sheet indicating specific design parameters and dimensions used to design the system.

Typically, the Orange Book suggests that sewers be designed based on per capita daily average flow (Organic Book, Table G2-2) and peak hour flows using a peaking factor developed by Ecology (Orange Book, Table C1-1). This estimate would include normal infiltration and inflow (I/I) for a sewer system built with modern construction techniques. Other factors to consider when designing a sewer collection system include:

1. Peak sewage flows from residential, commercial, institutional, and industrial sources;
2. Additional or excessive I/I;
3. Topography and depth of excavation;
4. Treatment plant location;
5. Soil condition;
6. Flow impacts from upstream pump stations (if applicable);
7. Maintenance;
8. Existing sewers;
9. Existing and future surface improvements;
10. Controlling service connection elevations;
11. Flow from existing combined systems (if applicable); and
12. Potential surcharge in downstream sewers.

In general, sewer lines should not be less than 8 inches in diameter unless a specific qualification (listed in the Organic Book) is met. Depth of sewer lines should be at least 3 feet, and a Manning coefficient of $n = 0.013$ should be used for all newly

constructed sewer pipes. Collection system pipes should be designed to give a minimum linear velocity of 2 feet per second. This is achieved by adjusting the pipe elevations and slope. Table C1-1 in the Orange Book lists the minimum slope for various pipe diameters as a guide to achieving the minimum wastewater velocity.

Pipe materials and joining techniques should adhere to the current ASTM, ASSA, WEF, and/or APWA standards for the design and construction of sewer collection systems.

The Orange Book also discusses minimum requirements for separation of utility pipes. A 10-foot minimum horizontal separation between water and sewer pipes is required. Exceptions to this may be allowed if the sewer pipe is placed below the water supply pipe by at least 18 inches, and a minimum of 5 feet of horizontal separation between the two pipes is maintained.

The Orange Book also lists various pipe materials, their attributes, the advantages and disadvantages of using a particular pipe material (Orange Book, Table C 1-3), and describes standard design requirements for special conditions such as:

1. Perpendicular vertical separation,
2. Differences in requirements based on pipe type (pressure or gravity),
3. Stream crossings,
4. Inverted siphons,
5. Minimum separation from water supply wells,
6. Odor control,
7. Corrosion control,
8. Trenchless technologies, and
9. Pipe casing.

DEVELOPER STANDARDS

A version of the wastewater developer standards which contain written regulations and requirements, standard design drawings for water and sewer system components, and sample forms for such items as permit applications, contracts, cost estimates, and easement applications can be found in Appendix J. This information is also submitted as a stand-alone document which can be used by developers during sewer system project execution. This document also include standards for modifications to the City's water system.

The City Developer Standards with regard to the wastewater system are included in Appendix J. Any sewer line extensions or pump stations constructed in accordance with the Developer Standards need not be submitted for Ecology review and approval prior to construction (see WAC 173-240-030(5)). However, any project using alternate specifications must be submitted for Ecology's review and approval. The Developer Standards will be used for all future City infrastructure projects.

Chapter 8
CAPITAL IMPROVEMENT PLAN



INTRODUCTION

This Chapter presents the Capital Improvement Plan (CIP) for the 6- and 20-year planning periods. For the proposed projects identified in this Chapter, individual project descriptions and preliminary project cost estimates (rounded) are provided, while detailed cost estimates for the individual projects are available in Appendix F. Figure 8-1 shows the locations of proposed WRF, collection system, and reclaimed water in the 6-year improvement plan.

In the future, other projects may arise which are not identified as part of the City's CIP. Such projects may be deemed necessary for ensuring successful wastewater treatment, lift station operation, or addressing unforeseen problems with the City's wastewater system. Additional projects may also be warranted based on the status of road improvement projects over buried sewer pipes. Due to budgetary constraints, the completion of these projects may require that the proposed completion date for projects in the CIP be rescheduled. The City retains the flexibility to reschedule proposed projects and to expand or reduce the scope of proposed projects, as best determined by the City Staff and Council when new information becomes available. Each capital improvement project should be re-evaluated to consider the most current planning efforts as the proposed completion date for the project approaches.

IDENTIFICATION OF SYSTEM IMPROVEMENTS

PROPOSED WASTEWATER SYSTEM IMPROVEMENTS

These projects were developed from improvement recommendations in previous planning reports, from requests by the City, and from the results of collection system modeling described in Chapter 3 – Collection System Evaluation.

All projects described below include the name of the project, the project number which remains consistent throughout all chapters in this report, an estimated cost, the proposed year of project initiation, and an estimated project duration that includes project management and construction activities.

Cost estimates have been prepared for CIP projects and are summarized in subsequent tables. These estimates are presented in 2012 dollars with 8.6 percent sales tax, 20 percent contingency and a 25 percent engineering and administrative cost. Detailed cost estimates are provided in Appendix F.

PORT WILLIAMS LIFT STATION

JEANNIE'S MEADOW LIFT STATION

CITY OF SEQUIM WRF

DOE RUN LIFT STATION

CEDAR RIDGE LIFT STATION

NEW LIFT STATION

CS-1
CS-2
CS-3
CS-4
CS-5
CS-6
CS-7
CS-8
CS-9
CS-10
CS-11
CS-12
CS-13

W-1
W-2
W-3
W-4
W-5
W-6
W-7
W-8
W-9
RW-1

N

0 1,000 2,000 4,000 Feet

LEGEND:

- LIFT STATION

SEWER PIPE DIAMETER:

- 6" OR LESS
- 8"
- 10"
- 12"
- 15"
- 18"
- CAPITAL IMPROVEMENT PROJECTS
- SEWER SERVICE AREA
- URBAN GROWTH AREA
- CITY LIMITS
- PARCELS

CITY OF SEQUIM

2012 GENERAL SEWER PLAN
FIGURE 8-1
CAPITAL IMPROVEMENT PROJECTS

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Recommended WRF Capital Improvement Project List

A. **Project Name:** Auxiliary Generator Loadbanks
Project Number: W-1
Estimated Cost: $55,000
Proposed Design Year: 2014
Proposed Construction Year: 2014

Project Description: This project includes acquisition of a trailer mounted portable load bank to enable the auxiliary generators within the City's water and wastewater infrastructure facilities to be tested under load. This load bank will have a capacity of 400 kW, which is appropriately sized for current equipment and contains extra capacity for future equipment.

B. **Project Name:** WRF Headworks Modifications #1
Project Number: W-2
Estimated Cost: $270,000
Proposed Design Year: 2014
Proposed Construction Year: 2014

Project Description: This project will replace the existing manual bar screen in the headworks area with a new mechanical fine screen system to conform with new regulations for influent wastewater and biosolids screening (WAC 173-308). The new orifice size must be less than or equal to 3/8-inch wide to prevent the passage of larger items. This project includes an evaluation of screening alternatives, purchase and installation of a new mechanical fine screen, and channel modifications required to accommodate the new equipment. Following its installation, this new screen will serve as the primary headworks screen, and the current HYCOR fine screen will serve as the auxiliary screen.

C. **Project Name:** Equalization Basin Aeration System Improvements
Project Number: W-3
Estimated Cost: $54,000
Proposed Design Year: 2014
Proposed Construction Year: 2014

Project Description: This project will improve the mixing capability of the Equalization Basin by refurbishing an existing Aeromix submersible mixer. This unit is not currently used and has had parts removed for use with other functioning equipment. The unit will be sent to a manufacturer or repaired onsite, and reinstalled within the existing equalization basin.

D. **Project Name:** Grit Removal System Replacement
Project Number: W-4
Estimated Cost: $279,000
Proposed Design Year: 2014
Proposed Construction Year: 2014

Project Description: This project will replace the existing John Meunier cyclone grit collection system immediately after the mechanical fine screen at the WRF headworks. The existing system was installed in 1984 and has reached the end of its useful life. This project includes an evaluation of grit removal alternatives, installation of a new grit removal system, and system modifications required to accommodate the new equipment.

E. **Project Name:** Aerobic Digester Aeration System Improvements
Project Number: W-5
Estimated Cost: $595,000
Proposed Design Year: 2013
Proposed Construction Year: 2014

Project Description: This project will address the need for higher oxygen transfer and more energy efficient aeration within the existing aerobic digesters located at the WRF. This project will replace the existing aeration equipment with a fine bubble diffusion system that will

increase the availability of oxygen within the digester. The removal of more ammonia from the biosolids is also a goal of this project. New high efficiency blowers will be installed to supply air to the tanks.

F. **Project Name:** Purchase Land Near WRF
Project Number: W-6
Estimated Cost: $195,000
Proposed Year: 2014-2015

Project Description: This project includes the purchase of land at the west and east ends of the existing WRF to provide space for future WRF expansion as well as a new biosolids handling and distribution center listed in Project W-8.

G. **Project Name:** Class A Biosolids Distribution Center
Project Number: W-7
Estimated Cost: $1,320,000
Proposed Design Year: 2016-2017
Proposed Construction Year: 2019

Project Description: This project will include construction of new facilities to increase public access to the Class A biosolids produced at the WRF. Facilities will include a large, covered area for raw biosolids storage, smaller holding areas for biosolids and various amendments, and a small area for public access and biosolids loading. Facilities will be designed to minimize odors and will include appropriate stormwater controls.

H. **Project Name:** Aerobic Digester Capacity Upgrades
Project Number: W-8
Estimated Cost: $1,950,000
Proposed Design Year: 2016
Proposed Construction Year: 2019

Project Description: This project will increase the capacity of the existing aerobic digestion system by adding additional tank space. It is anticipated that two new 100,000-gallon cells will be constructed with additional blowers and diffusers for aeration, and a rotary screen

thickener will be provided to thicken WAS upstream of the digester.

I. **Project Name:** WRF Headworks Modifications #2
Project Number: W-9
Estimated Cost: $285,000
Proposed Design Year: 2019
Proposed Construction Year: 2019

Project Description: This project will replace the existing HYCOR mechanical fine screen at the WRF headworks. The existing screen was installed in 1998 and will be nearing the end of its useful life. The unit will be replaced with a new mechanical fine screen model that meets the requirements set forth in WAC 173-308. Following its installation, this new screen will serve as the primary headworks screen, and the mechanical screen described in Project W-2 above will serve as the auxiliary screen.

Table 8-1 WRF Improvement Projects

Project No.	Project Description	Construction Year	Estimated Cost	Funding Source
W-1	Auxiliary Generator Loadbanks	2014	$58,000	Sewer utility
W-2	Headworks Modifications #1	2014	$270,000	Sewer utility
W-3	Equalization Basin Aeration System Improvements	2014	$54,000	Sewer utility
W-4	Grit Removal System Replacement	2014	$279,000	Sewer utility
W-5	Aerobic Digester Aeration System Improvements	2014	$595,000	Sewer utility
W-6	Purchase Land Near WRF	2015	$195,000	Sewer utility
W-7	Class A Biosolids Distribution Center	2019	$1,320,000	Sewer utility
W-8	Aerobic Digester Capacity Upgrades	2019	$1,950,000	Sewer utility
W-9	Headworks Modifications #2	2019	$285,000	Sewer utility
Total			**$5,006,000**	**-**

Proposed Reclaimed Water System Capital Improvement Project List

Skillings Connolly Inc. prepared the *Reclaimed Water Engineering Plan for Aquifer Recharge & Distribution System Expansion (Draft April 2011)*. The plan recommends five capital improvements projects to help the City achieve its goal of 100 percent reuse of reclaimed water, a reduction in potable water use

for irrigation, and an overall improvement to the Dungeness River Watershed. The recommended capital improvements are summarized below. The cost estimates presented in the Skillings Connolly report developed in December 2010 (ENR Construction Cost Index – 8,952) have been updated to October 2012 dollars (ENR Construction Cost Index – 9,376).

A. **Project Name:** WRF Recirculation Booster Pump
Project Number: RW-1
Estimated Cost: $25,000
Proposed Design Year: 2013
Proposed Construction Year: 2014

Project Description: This project includes modifying the existing reclaimed water channel and installing a new booster pump.

B. **Project Name:** Rapid Infiltration Basin Improvements
Project Number: RW-2
Estimated Cost: See below
Proposed Design Year: 2019
Proposed Construction Year: 2019

Project Description: This project consists of the construction of infiltration basins, flow control and distribution improvements, relocation of the existing storage/fish pond and miscellaneous site work at the Carrie Blake Park Reuse Demonstration Site. Two alternative distribution system methodologies were proposed. Alternative 1 would use low-pressure nozzles to distribute reclaimed water to the infiltration basins. The estimated cost of this project alternative is $ 1,030,000.

Alternative 2 would use slotted/perforated pipe to distribute reclaimed water to the infiltration basins. The estimated cost of this project alternative is $1,221,000. The cost for Alternative 2 will be used in the development of the CIP and financing alternatives.

C. **Project Name:** High Pressure Zone Expansion
Project Number: RW-3
Estimated Cost: $1,045,000
Proposed Design Year: 2019
Proposed Construction Year: 2019

Project Description: This project consists of refurbishing the existing reservoir, construction of a booster pump station at the City Shops and approximately 7,700 LF of 8-inch-diameter distribution system piping from the City Shop to the refurbished reservoir.

D. **Project Name:** Overall Network Expansion
Project Number: RW-4
Estimated Cost: $2,525,000 (Full project costs)
Proposed Design Year: 2019+
Proposed Construction Year: 2019+

Project Description: This project consists of expansion of the current reclaimed water pipe network. The complete project would install approximately 23,100 LF of 6-inch and 13,600 lf of 8-inch distribution system piping to serve the following areas:

- South Blake Avenue Pipeline and East Maple Street Loop (estimated cost - $248,300),
- North 2nd Avenue - North Sequim Avenue Pipeline (estimated cost - $398,900),
- North 2nd Avenue - North 5th Avenue Pipeline (estimated cost - $338,700),
- South 7th Avenue - Silberhorn Road Pipeline (estimated cost - $559,400),
- South 7th Avenue - West Washington Street Pipeline (estimated cost - $383,600),
- South 7th Avenue - South 9th Avenue Pipeline (estimated cost - $233,800),
- West Washington Street – Priest Road Pipeline (estimated cost - $316,900), and
- West Hemlock Street and West Maple Street (estimated cost - $385,700).

E. **Project Name:** WRF Reclaimed Water Pumping Facility Improvements
Project Number: RW-5
Estimated Cost: $537,500
Proposed Design Year: 2018
Proposed Construction Year: 2019

Project Description: This project would continue the work performed in RW-1 and would reconfigure the reclaimed water pumping system at the WRF to utilize the potential storage of the existing flow through channel.

Table 8-2 Reclaimed Water System Improvement Projects

Project No.	Project Description	Construction Year	Estimated Cost	Funding Source
RW-1	WRF Recirculation Booster Pump	2014	$25,000	Sewer utility
RW-2	Rapid Infiltration Basin System Improvements	2019	$1,221,000	Sewer utility
RW-3	High Pressure Zone Expansion	2019	$1,045,000	Sewer utility
RW-4	Overall Network Expansion	2019	$2,525,000	Sewer utility
RW-5	WRF Reclaimed Water Pumping Facility Improvements	2019	$537,500	Sewer utility
Total			**$5,353,500**	-

Recommended Collection System Capital Improvement Project List

A. **Project Name:** Cedar Street Sewer Improvements
Project Number: CS-1
Estimated Cost: **$**1,181,000
Proposed Design Year: 2014
Proposed Construction Year: 2015

Project Description: This project would replace existing sewer pipe located in the alley between West Cedar Street and West Spruce Street between North Seal Street and North 7th Avenue. This project includes installing approximately 3,900 LF of 12-inch pipe and is recommended to accommodate anticipated peak hour flows from the Carlsborg UGA as well as increased City flows for the downtown corridor.

B. **Project Name:** Etta Street Sewer Rehabilitation
Project Number: CS-2
Estimated Cost: $156,000
Proposed Design Year: 2014
Proposed Construction Year: 2014

Project Description: This project will address the deteriorating concrete sewer line along Etta Street between North Sequim Avenue and Sunnyside Avenue. This line was identified in the *2006 Comprehensive Plan* to be in need of replacement due to deteriorating aggregate, however, this pipe has not been rehabilitated. While the line currently has sufficient capacity, it is in the downtown corridor and is projected to need upsizing to accommodate the projected flows for the City and Carlsborg. This project will install approximately 550 LF of 12-inch pipe between South Sequim Avenue and South Sunnyside Avenue.

C. **Project Name:** Doe Run Lift Station Modifications
Project Number: CS-3
Estimated Cost: $574,000
Proposed Design Year: 2014
Proposed Construction Year: 2015

Project Description: The existing Doe Run Lift Station consists of a Smith and Loveless package lift station equipped with two 100 gpm, 25-hp non-clog centrifugal pumps which pump sewage from the south and southwest areas of Bell Hill to a manhole in the gravity sewer run on Fox Hollow Road. This project would include construction of a new lift station to serve the existing service area, as well as add capability to serve additional areas west or south of the Bell Hill/Bell Gates community.

D. **Project Name:** Outfall Pipeline Repair/Replacement
Project Number: CS-4
Estimated Cost: $1,040,000
Proposed Design Year: 2019
Proposed Construction Year: 2019

Project Description: This project will first assess the condition of the existing outfall line between the WRF and

the new bridge across the Sequim Bay tidal flats immediately east of the WRF. The existing concrete line was installed in 1965. If deemed in poor condition or in need or replacement, the project would include replacing the concrete outfall pipe. If replacement is required approximately 3,400 LF of 24-inch pipe will be installed and the existing pipe will be abandoned in place or wastehauled.

E. **Project Name:** East Sequim Sewer Improvement #1
Project Number: CS-5
Estimated Cost: $871,000
Proposed Design Year: 2019
Proposed Construction Year: 2019+

Project Description: This project will provide sewer service to East Sequim and the Batelle Laboratories complex. The project will install approximately 3,750 LF of 8-inch gravity sewer from the intersection of Independence Drive and West Sequim Bay Road to the south edge of the Battelle property.

F. **Project Name:** Sequim Bay Lodge and State Park Pressure Main Improvements
Project Number: CS-6
Estimated Cost: $90,000
Proposed Design Year: 2014
Proposed Construction Year: 2014

Project Description: This project will include the installation of additional valves along the pressure main that carries wastewater from Sequim Bay State Park and Sequim Bay Lodge to the WRF. Also included in this project would be rehabilitation/replacement of manholes near this pressure main that are required for system maintenance.

G. **Project Name:** WRF Influent Trunk Pipeline Repair/Replacement
Project Number: CS-7
Estimated Cost: $1,378,000
Proposed Design Year: 2015
Proposed Construction Year: 2016

Project Description: This project will address the condition of the existing primary trunk line between North Blake Street and the WRF. The project should include examination, repair, and/or replacement of the primary trunk line to ensure continuous transmission of treated wastewater effluent. The existing pipeline should be removed and replaced with approximately 5,000 LF of 24-inch HDPE pipe in order to accommodate projected flows for the City and surrounding areas. Pipe bursting is the recommended method of replacement for this pipeline. The project would also include the installation of new manholes approximately every 500 feet along the new pipe section.

H. **Project Name:** West Fir Street Sewer Improvement
Project Number: CS-8
Estimated Cost: $1,033,000
Proposed Design Year: 2014-2015
Proposed Construction Year: 2016-2017

Project Description: This project includes replacing the existing sewer line along Fir Street between North 4th Avenue and North Sequim Avenue with approximately 2,800 LF of 12-inch pipe. Installation of new sewer pipe between North 5th Avenue and North 4th Avenue. Although the results of the sewer system modeling suggest Fir Street contains adequate capacity for 2018 projected flows, City staff has expressed an interest in upsizing and/or rehabilitating Fir Street between 2nd Avenue North and North Sunnyside Street. A detailed hydraulic evaluation of Fir Street sewer pipe should be completed prior to instigation of any additional sewer pipe replacement projects in this area.

I. **Project Name:** Sunnyside Street Sewer Improvements
Project Number: CS-9
Estimated Cost: $673,000
Proposed Design Year: 2014
Proposed Construction Year: 2015

Project Description: This project will replace the sewer line along both North and South Sunnyside Avenue. This is a troublesome area that is undersized for existing flows, especially in an area designated for significant proposed commercial growth. As part of this project, sewer pipe north of Washington Avenue along Sunnyside Avenue would be moved to within the Sunnyside right-of-way. Approximately 1,500 LF of 18-inch HDPE sewer pipe would be installed in the north and south Sunnyside Avenue right-of-way.

J. **Project Name:** East Sequim Sewer Improvements #2
Project Number: CS-10
Estimated Cost: $651,000
Proposed Design Year: 2019
Proposed Construction Year: 2019

Project Description: This project would extend the 8-inch sewer line described in Project CS-5 approximately 1,800 LF westward to the intersection of West Sequim Bay Road and Washington Harbor Loop Road.

K. **Project Name:** East Sequim Sewer Improvements #3
Project Number: CS-11
Estimated Cost: $2,093,000
Proposed Design Year: 2019
Proposed Construction Year: 2019

Project Description: This project would extend approximately 1,350 LF of 8-inch sewer from the project described in Project CS-5 above southward to the intersection of West Sequim Bay Road and Forrest Road. This project also includes the construction of a 400-gpm lift station near this same intersection that is capable of handling the combined flows for East Sequim until approximately 2030. Lastly, this project includes the

installation of approximately 5,100 LF of 8-inch force main from the lift station at Forrest Road to the gravity sewer system at approximately Independence Drive and West Sequim Bay Road.

L. **Project Name:** Hammond Street Sewer Extension
Project Number: CS-12
Estimated Cost: $358,000
Proposed Design Year: 2013
Proposed Construction Year: 2013

Project Description: This project will install an 8-inch sewer from South Sequim Avenue to a point of connection with the existing 8-inch sewer on Hammond Street east of Sunnyside Street. Construction will consist of approximately 1,000 LF of 8-inch sewer main along East Hammond Street and the unopened right-of-way of East Hammond Street.

M. **Project Name:** North Blake Street Sewer Improvements
Project Number: CS-13
Estimated Cost: $156,000
Proposed Design Year: 2016
Proposed Construction Year: 2017

Project Description: This project will replace sewer pipe along North Blake Street between East Willow and East Oak Avenues. The existing pipe is 15-inch and lacks capacity to convey both the projected City and Carlsborg peak hour flows for the year 2018. This project would install approximately 300 LF of 18-inch HDPE sewer pipe via open cut or pipe bursting methods.

N. **Project Name:** East Fir Street Sewer Improvements
Project Number: CS-14
Estimated Cost: $1,671,000
Proposed Design Year: 2016 & 2018
Proposed Construction Year: 2017 & 2019

Project Description: This project would replace approximately 4,600 LF of aging sewer pipe along East Fir Street with new 18-inch-diameter PVC sewer pipe. This

work will coordinate with planned street improvements for Fir Street.

Table 8-3 Collection System Improvement Projects

Project No.	Project Description	Pipe Size (in)	Pipe Length (ft)	Construction Year	Estimated Cost	Funding Source
CS-1	Cedar Street Sewer Improvement	12	3,900	2015	$1,181,000	Sewer utility
CS-2	Etta Street Sewer Improvement	12	550	2014	$156,000	Sewer utility
CS-3	Doe Run Lift Station	N/A	N/A	2015	$574,000	Sewer utility
CS-4	Outfall Pipeline Repair/Replacement	24	3,400	2019	$1,040,000	Sewer utility
CS-5	East Sequim Sewer Improvement #1	8	3,750	2019	$871,000	Developer
CS-6	Sequim Bay Lodge and State Park Pressure Main Improvements	N/A	N/A	2014	$90,000	Sewer utility
CS-7	WRF Influent Trunk Line Pipeline Repair/Replacement	24	5,000	2016	$1,378,000	Sewer utility
CS-8	Fir Street Sewer Improvement	12	2,800	2017	$1,033,000	Sewer utility
CS-9	Sunnyside Street Sewer Improvement	18	1,500	2015	$673,000	Sewer utility
CS-10	East Sequim Sewer Improvement #2	8	1,800	2019	$651,000	Developer
CS-11	East Sequim Sewer Improvement #3	8\8	1,350\5,100	2019	$2,093,000	Developer
CS-12	Hammond Street Sewer Extension	8	1,000	2013	$358,000	Developer
CS-13	Blake Street Sewer Improvements	18	300	2017	$156,000	Developer
CS-14	East Fir Street Sewer Improvements	18	4,600	2017 & 2019	$1,671,000	Sewer utility
Total					**$11,925,000**	-

(1) Includes gravity pipe\force main diameters and lengths.

Proposed Operation and Maintenance Improvements

The proposed operation and maintenance projects are discussed in the following section. Additional discussion regarding the operation and maintenance improvements can be found in Chapter 6.

A. **Project Name:** Vactor Truck Replacement
Project Number: OM-1
Estimated Cost: $450,000
Proposed Year: 2013

Project Description: The City currently owns and operates a single vactor truck for use in cleaning and maintaining the collection system. The truck is near the end of its useful life and should be replaced.

B. **Project Name:** Collection System Survey / GIS Mapping
Project Number: OM-2
Estimated Cost: $40,000
Proposed Year: 2014

Project Description: During the course of modeling the City's collection system, some inconsistencies and missing data points were identified. It is recommended that the City hire a licensed surveyor to survey the entire collection system, including manhole rim elevations, pipe invert elevations, spatial reference data, and pump stations. This project would address the current data deficiencies and result in a complete and accurate geographical data set that can be used as an accurate starting point for future system modeling.

C. **Project Name:** I/I Reduction Maintenance
Project Number: OM-3
Estimated Cost: $38,000
Proposed Year: Annual

Project Description: This project would include completing the necessary I/I reduction repairs outlined in Chapter 5. The project includes re-grouting of manholes, realignment of manhole lids and frames, concrete work, and other maintenance activities required to further reduce I/I to the City's collection system. Funding for this project can be taken from the major repair allotment.

D. **Project Name:** Fixed Base Automatic Meter Reading System
Project Number: MI-1
Estimated Cost: $115,000
Proposed Year: 2013 & 2014

Project Description: This project is in conjunction with the water system staff and the installation of Sensus® water system meter reading equipment. This equipment will offer near real-time usage data and will give the City better ability to track leaks, unauthorized usage, or to notify customers of potential leaks within their residential piping. The costs above will include work by the utility staff to implement, upgrade, and troubleshoot the meter reading system.

C. **Project Name:** Major Repair/Oversizing
Project Number: MI-2
Estimated Cost: $200,000
Proposed Year: Annual

Project Description: This project provides budgetary funds for upsizing or unanticipated repairs to pipes within the City sewer system. These funds are precautionary and will be used by staff to help fund emergency repairs or the cost difference for large pipe size in anticipation of commercial or other significant growth.

Table 8-4 Operations & Maintenance Improvement Projects

Project No.	Project Description	Construction Year	Estimated Cost	Funding Source
OM-1	Vactor Truck Replacement	2014	$450,000	Sewer rates
OM-2	Collection System Survey\GIS Mapping	2014	$40,000	Sewer rates
OM-3	I/I Reduction Maintenance	Annual	$38,000	Sewer rates
MI-1	Fixed Base Automatic Meter Reading System	2013 & 2014	$115,000	Sewer rates
MI-2	Major Repair/Oversizing	Annual	$200,000	Sewer rates
Total			**$2,386,000**	-

SCHEDULE OF PROJECTS

Table 8-5 shows a proposed schedule for projects in the 6-year planning period. Projects recommended in the 20-year planning horizon are also included for planning purposes.

Table 8-5 Capital Improvement Project Schedule

Project No.	Description	2013	2014	2015	2016	2017	2018	2019	Sum
W-1	Auxiliary Generator Loadbanks	-	$30,000	-	-	-	-	-	**$30,000**
W-2	WRF Headworks Modifications #1	-	$270,000	-	-	-	-	-	**$270,000**
W-3	Equalization Basin Aeration System Improvements	-	$54,000	-	-	-	-	-	**$54,000**
W-4	Grit Removal System Replacement	-	$279,000	-	-	-	-	-	**$279,000**
W-5	Aerobic Digester Aeration System Improvements	$300,000	$295,000	-	-	-	-	-	**$595,000**
W-6	Purchase Land near WRF	-	$29,500	$165,500	-	-	-	-	**$195,000**
W-7	Class A Biosolids Handling and Distribution Center	-	-	-	$75,000	$78,000	-	$1,167,000	**$1,320,000**
W-8	Aerobic Digester Capacity Upgrades	-	-	-	$220,000	-	-	$1,730,000	**$1,950,000**
W-9	WRF Headworks Modifications #2	-	-	-	-	-	-	$285,000	**$285,000**
RW-1	WRF Recirculation Booster Pump	-	$25,000	-	-	-	-	-	**$25,000**
RW-2	Rapid Infiltration Basin Improvements	-	-	-	-	-	-	$1,221,000	**$1,221,000**
RW-3	High Pressure Zone Expansion	-	-	-	-	-	-	$1,045,000	**$1,045,000**
RW-4	Overall Network Expansion	-	-	-	-	-	-	$2,525,000	**$2,525,000**
RW-5	WRF Pumping Facility Improvements	-	-	-	-	-	-	$537,500	**$537,500**
CS-1	Cedar Street Sewer Improvement	-	$142,000	$1,039,000	-	-	-	-	**$1,181,000**
CS-2	Etta Street Sewer Improvement	-	$156,000	-	-	-	-	-	**$156,000**
CS-3	Doe Run Lift Station	-	$64,000	$510,000	-	-	-	-	**$574,000**
CS-4	Outfall Pipeline Repair/Replacement	-	-	-	-	-	-	$1,040,000	**$1,040,000**
CS-5	East Sequim Sewer Improvement #1	-	-	-	-	-	-	$871,000	**$871,000**
CS-6	Sequim Bay Lodge and State Park Pressure Main Improvements	-	$90,000	-	-	-	-	-	**$90,000**
CS-7	WRF Influent Trunk line Pipeline Repair/ Replacement	-	-	$154,000	$1,224,000	-	-	-	**$1,378,000**
CS-8	Fir Street Sewer Improvement	-	$64,000	$64,000	$605,000	$300,000	-	-	**$1,033,000**
CS-9	Sunnyside Street Sewer Improvement	-	$81,000	$592,000	-	-	-	-	**$673,000**
CS-10	East Sequim Sewer Improvement #2	-	-	-	-	-	-	$651,000	**$651,000**
CS-11	East Sequim Sewer Improvement #3	-	-	-	-	-	-	$2,093,000	**$2,093,000**
CS-12	Hammond Street Sewer Extension	$358,000	-	-	-	-	-	-	**$358,000**
CS-13	Blake Street Sewer Improvements	-	-	-	-	$156,000	-	-	**$156,000**
CS-14	East Fir Street Sewer Improvement	-	-	-	-	$201,000	$970,000	$500,000	**$1,671,000**
Subtotal		**$658,000**	**$1,579,500**	**$2,524,500**	**$2,124,000**	**$735,000**	**$970,000**	**$13,665,500**	**$22,256,500**

Table 8-5 Capital Improvement Project Schedule – (continued)

Project No.	Description	2013	2014	2015	2016	2017	2018	2019	Sum
OM-1	Vactor Truck Replacement	$450,000	-	-	-	-	-	-	**$450,000**
OM-2	Collection System Survey	$40,000	-	-	-	-	-	-	**$40,000**
OM-3	Collection System I/I Reduction	$,000	$38,000	$38,000	$38,000	$38,000	$38,000	$38,000	**$266,000**
MI-1	Fixed Base Automatic Meter Reading System	$115,000	$115,000	-	-	-	-	-	**$230,000**
MI-2	Major Repair/Oversizing	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	**$1,400,000**
Subtotal		**$843,000**	**$353,000**	**$238,000**	**$238,000**	**$238,000**	**$238,000**	**$238,000**	**$2,386,000**
TOTAL		**$1,501,000**	**$1,932,500**	**$2,762,500**	**$2,362,000**	**$973,000**	**$1,208,000**	**$13,903,500**	**$24,642,500**

Chapter 9
FINANCIAL ANALYSIS



INTRODUCTION

This chapter includes a summary of the *DRAFT Water and Sewer Rate Study* ("Financial Analysis") performed by Peninsula Financial Consulting in conjunction with the City's General Sewer Plan. The Financial Analysis consists of two chapters that analyze the financial status of the City's wastewater utility with regard to existing costs, as well as how the projects proposed in Chapter 8 – Capital Improvement Program will impact the cost of providing sewer service to existing and future customers within the Sequim service area. A full copy of the Financial Analysis is provided in Appendix K.

SUMMARY

Chapter 1 of the Financial Analysis the policies and various regulations that govern the financial planning process for cities, municipalities, and/or other special improvement districts that provide wastewater infrastructure services. The data in this chapter provide information for calculating the general finance charge (GFC), which is used to equitably distribute costs of wastewater infrastructure between existing and new customers.

The total wastewater system assets included in the GFC calculation include data from the 2007 GFC Rate Study, accumulated interest, and an adjustment for the WRF expansion project which was completed in 2009. By dividing the total wastewater system assets by the estimated number of ERUs, a value of $7,235/ERU for the existing facility component of the GFC is calculated – which represents the per unit cost for existing wastewater facilities. In addition to the existing facility component, there is also a future asset component which attempts to equalize future growth among existing and new customers. The future component is further divided into two sub-groups: assets that benefit all customers equally, and assets that preferentially benefit new customers. By dividing the projected number of ERUs in a certain year - 2032 in this case - into the total monetary value of proposed capital improvement projects that will benefit all customers equally and are required to serve this projected number of ERUs, a GFC value of $1,526/ERU is calculated. Similarly, by dividing the projected increase in ERUs between 2013 and 2032 into the total monetary value of proposed capital improvement projects that will benefit new customers preferentially a GFC of $285/ERU is calculated. The total GFC includes these three values, the cost of participation in the existing facilities, the cost of participation in future facilities benefiting the entire utility and the cost of participation in future facilities that are primarily benefiting new customers. The total GFC is calculated to be $9,050. The City has proposed implementing a phased GFC increase from the current cost of $7,800/ERU to the recommended value of $9,050/ERU in 2018.

Chapter 2 of the Financial Analysis analyzes the City's projected cash flow with regard to operating revenues, operating expenditures, capital revenues, and capital expenditures to determine the sewer utility rate. The primary components of this

analysis are the City's revenues from rate funds, revenues from fund transfers from other accounts, expenditures for operational items such as salaries and benefits and facilities operations, and expenditures of proposed capital improvement projects.

The Financial Analysis shows that at current rates, the City could not maintain sufficient cash flow and reserves beyond 2014 to implement the proposed capital improvement projects. In order to fund these projects and maintain adequate cash flow, the City will need to increase service rate charges, acquire new debt, or a combination of both these actions.

The Financial Analysis concludes that the City could maintain adequate cash flow and reserves by increasing wastewater rate charges by 4 percent annually through 2018 and funding at least 50 percent of the proposed capital improvement projects through new debt service. Additional recommendations are available in the full Financial Analysis available in Appendix K.