APPENDIX 4: CHAPTER 4 APPENDICES

4A: Esvelt Environmental Engineering Technical Memorandum, 1996

4B: City of Yelm Water Reclamation Facility Operational Review

4C: DOE Inspection Report

4D: Effluent Metals Sampling Data

4E: Not Used

4F: RIVPLUM6 Results

4G: Reasonable Potential Analysis

4H: DRAFT SBR Modeling Evaluation

4I: Drain-Pro Solids Handling Contract

4A: Esvelt Environmental Engineering Technical Memorandum, 1996

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City of Yelm, Wastewater Reuse Project

Technical Memo E3 - Revised Design Criteria

Date: January 3. 1996

By: Allison Esvelt, MS, EIT, Esvelt Environmental Engineering

Reference: Revised Design Criteria

Background

The City of Yelm has an approved Facilities Plan for a Water Reuse Project (Skillings~Connolly Inc, September 1995). The Water Reuse Project will consist of treatment of wastewater from the City's collection system for reuse in a variety of water reuse demonstration scenarios, including golf course and landscape area irrigation, recreational impoundments, wetlands, groundwater recharge, and industrial use.

The facilities improvements planned by Yelm will address future needs in phases, with Phase 1 to provide capacity for needs through 2005, and Phase 2 to increase the capacity to meet the capacity needs through 2015. Wastewater treatment facilities are planned to include activated sludge advanced secondary treatment using sequencing batch aeration, followed by equalization, chemical coagulation, granular media filtration, disinfection by chlorination, dechlorination or partial dechlorination, and pumping to the areas for reuse.

This Technical Memorandum addresses the revised design criteria for the Yelm Water Reuse Project as the criteria apply to the various plant unit processes. The first section of the memorandum will discuss the original design criteria as outlined in the Facilities Plan and the revised design criteria based on the 1995 flow profile. The second section of this memorandum will address how the revised design criteria will apply to the initial portion of the treatment process: the headworks, sequencing batch reactors (SBRs), and Pond No. 2 equalization capacity. Following treatment in the SBRs, the wastewater will be decanted to Pond No. 2 where the wastewater flow will be equalized. The final section of this memorandum will discuss how the equalized flow profile from Pond No. 2 will apply to the second portion of the treatment process: the intermediate pump station, flocculation basin, effluent polishing filters, chlorine contact basin, and the reclaimed water pumping station (RWPS).

Facilities Plan Design Criteria

The design criteria presented in the Facilities Plan were determined based on an evaluation of flow data over a three month period in 1994. The Facilities Plan design criteria are as follows:

Table TM-E3-1. Existing Design Criteria

Parameter	1995	2005	2015
Minimum Daily Flow (mgd)	0.04	0.3	0.6
Annual Average Flow (mgd)	0.140	1.0	2.2
Maximum Month Flow (mgd)	0.190	1.1	2.4
Maximum Daily Flow (mgd)	0.210	1.5	3.3
Peak Flow (mgd)	0.350	2.5	5.5
Average BOD (ppd)	200	1500	3300
Maximum BOD (ppd)	294	2000	4400
Average TSS (ppd)	33	330	730
Maximum TSS (ppd)	50	430	940

Revised Design Criteria

Since the Facilities Plan was originally drafted, wastewater flow and loading data from the City of Yelm Wastewater Plant Monitoring Reports has been evaluated over a period of one full year of operation (October 1994 to October 1995). The attached graph TM-E3-1 presents the average day, average 3-day, average week, average month, and average annual flow record for this period. The maximum day, maximum 3-day, maximum week, maximum month, and minimum day flow are pointed out on the graph and are presented in the table below.

Table TM-E3-2. 1995 Flow Peaking Factors

Parameter	Flow (mgd)	Peaking Factor
Minimum Day Flow	0.066	0.47
Annual Average Flow	0.140	1.0
Maximum Month Flow	0.148	1.06
Maximum Week Flow	0.153	1.10
Maximum 3-Day Flow	0.160	1.14
Maximum Day Flow	0.190	1.36

The attached graphs, TM-E3-2 and TM-E3-3 present the concentrations and daily loading values for BOD_5, TSS, and NH_3-N for the same time period. Samples were collected on a weekly basis for BOD_5 and TSS, and on a bimonthly basis for NH_3-N. On graph TM-E3-2, best fit lines determined by a regression analysis of the data show that the average loading values of BOD_5, TSS, and NH_3-N are gradually increasing. Thus, each loading peak factor is the maximum ratio of the daily loading value and the corresponding average daily loading value determined by the regression line.

The average and maximum daily values of concentration and loading for BOD_5, TSS, and NH_3-N are presented in Table TM-E3-3.

Table TM-E3-3. 1995 BOD, TSS, NH3-N Loadings

Parameter	Concentration (mg/L)	Loading (ppd)
Average BOD	168	200
Maximum BOD	215	265
Average TSS	28	33
Maximum TSS	52	51
Average NH3-N	42	49
Maximum NH3-N	52	62

The revised design criteria, based on the flow peaking factors in Table TM-E3-2, the loadings in Table TM-E3-3, and the loading peaking factors on Graph TM-E3-2, are presented in Table TM-E3-4.

Table TM-E3-4. Revised Design Criteria

Parameter	2005	2015
Minimum Day Flow (mgd)	0.47	1.03
Annual Average Flow (mgd)	1.0	2.2
Maximum Month Flow (mgd)	1.06	2.33
Maximum Week Flow (mgd)	1.10	2.42
Maximum 3-Day Flow (mgd)	1.14	2.51
Maximum Day Flow (mgd)	1.36	2.99
Average BOD (ppd)(1)	1410	3110
Maximum BOD (ppd) (2)	1750	3860
Average TSS (ppd)(1)	230	510
Maximum TSS (ppd)(2)	370	820
Average NH3-N (ppd)(1)	350	780
Maximum NH3-N (ppd) (2)	435	970

(1) Phase I and II loading values are based on 1995 loading data divided by the 1995 average annual flow and multiplied by the Phase I and Phase II design flows.
(2) Phase I and II maximum loading values are based on the average daily design loading values multiplied by the Phase I and Phase II design peak factors as presented on Graph TM-E3-2.

City of Yelm, Wastewater Reuse Project

Addendum to Technical Memo E3 - Revised Design Criteria

Date: January 10. 1996

By: Allison Esvelt, MS, EIT, Esvelt Environmental Engineering

Reference: Revised Design Criteria

Background

The City of Yelm has an approved Facilities Plan for a Water Reuse Project (Skillings~ Connolly Inc, September 1995). The Water Reuse Project will consist of treatment of wastewater from the City's collection system for reuse in a variety of water reuse demonstration scenarios, including golf course and landscape area irrigation, recreational impoundments, wetlands, groundwater recharge, and industrial use.

The facilities improvements planned by Yelm will address future needs in phases, with Phase 1 to provide capacity for needs through 2005, and Phase 2 to increase the capacity to meet the capacity needs through 2015. Wastewater treatment facilities are planned to include activated sludge advanced secondary treatment using sequencing batch aeration, followed by equalization, chemical coagulation, granular media filtration, disinfection by chlorination, dechlorination or partial dechlorination, and pumping to the areas for reuse.

This Technical Memorandum is the addendum to TM-E3 which outlined the revised design criteria as they applied to the various planned unit treatment processes for the Yelm Wastewater Treatment Plant. Specifically, this memorandum addresses the equalization capacity of Pond No. 2 to equalize the maximum daily flow to a discharge rate equal to the maximum 3-day average flow.

Pond No. 2 Equalization Capacity

As outlined in TM-E3, Pond No. 2 is required to have enough equalization capacity to equalize the maximum daily flow, 1.36 million gallons per day (mgd), to the maximum

3-day average flow, 1.14 mgd. The required equalization volumes and discharge rates for Phase I and II were determined in technical memorandum TM-E3 and are provided in Table TM-E3-6 below.

Table TM-E3-6. Equalization Volume Requirement and Discharge Rate

Parameter	2005	2015
Maximum Discharge Rate (gpm)	800	1750
Required Equalization Volume (mgal)	0.288	0.631

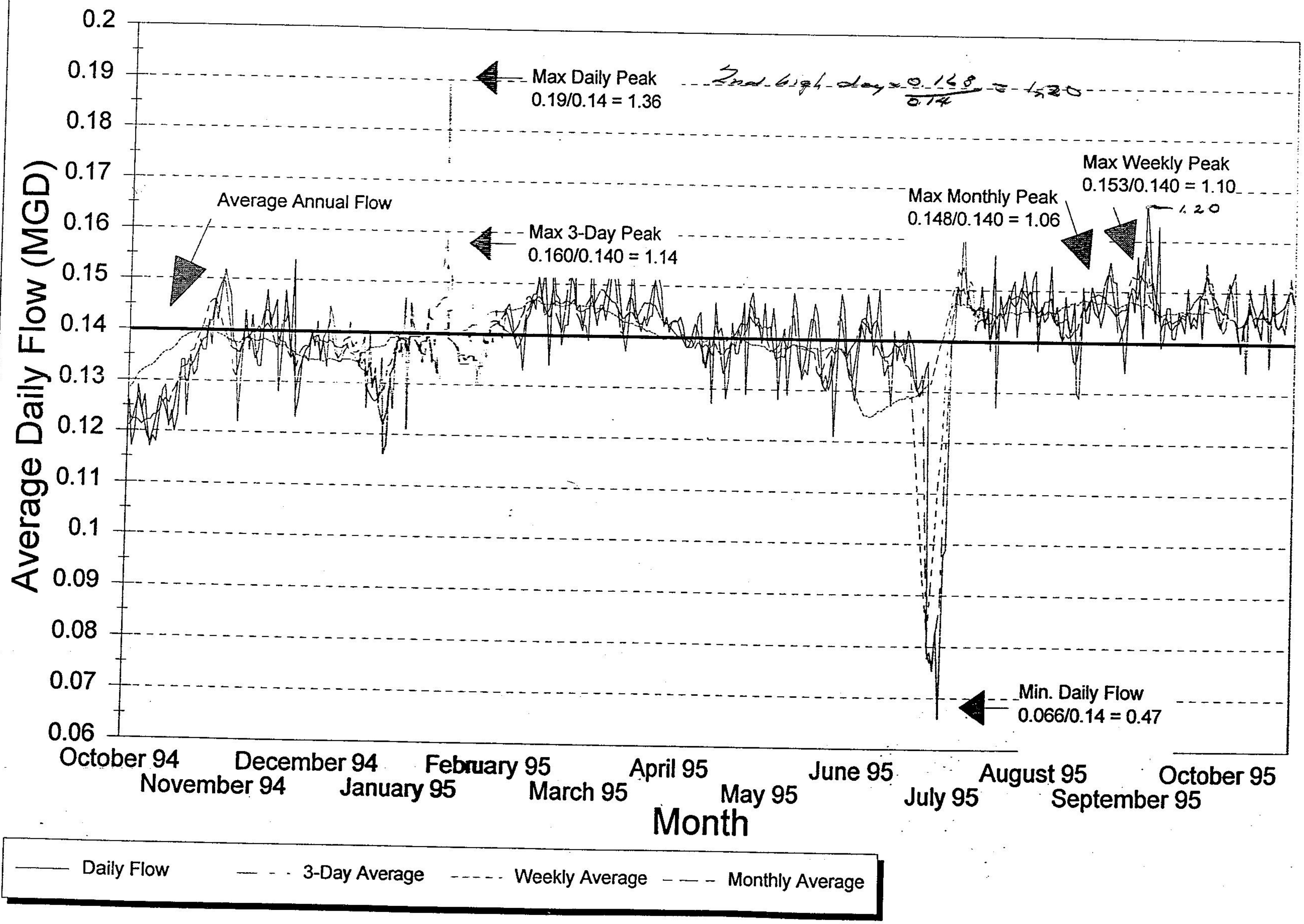
Since the hydraulics of the treatment plant will be designed to accommodate Phase II flows, the equalization capacity of Pond #2 is required to be a minimum of 0.631 mgal. The available equalization volume when Pond No. 2 is operating at the maximum water surface elevation is 1.144 mgal, approximately 1.8 times the maximum required equalization volume for Phase II. The available equalization volumes at the minimum and maximum operating water surface elevations are provided in Table TM-E3-7.

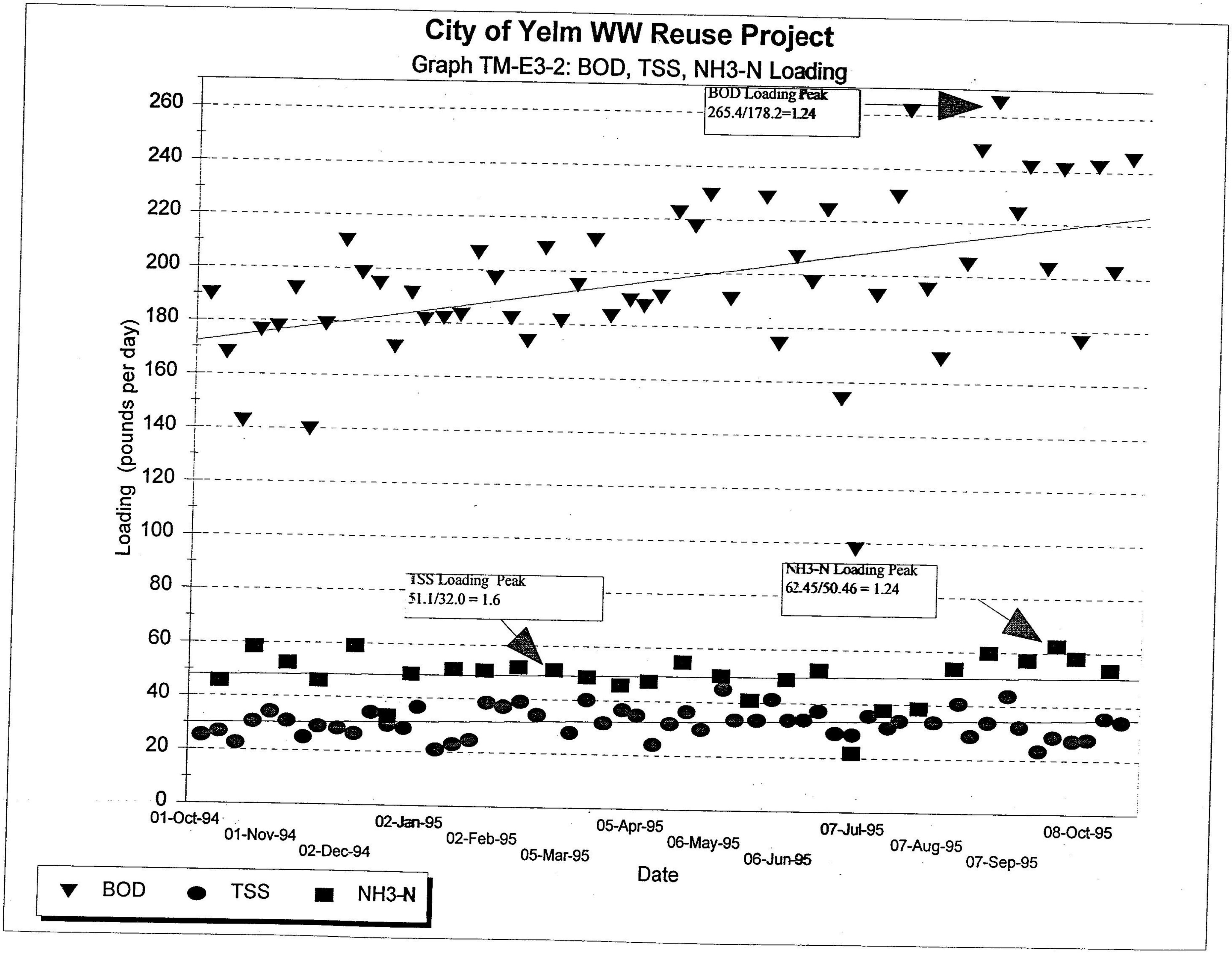
Table TM-E3-7. Pond No. 2 Water Surface Elevation Versus Equalization Volume

Parameter	Water Surface Elevation (feet)	Volume of Pond #2 Utilized (mgal)	Volume Available for Equalization (mgal)
Minimum Operating	330.0	0.732	1.606
Maximum Operating	332.0	1.186	1.144
Maximum Equalization	336.0	2.330	0

1.186
− .631
.555

City of Yelm WW Reuse Project
Graph TM-E3-1: Daily Flow Profile

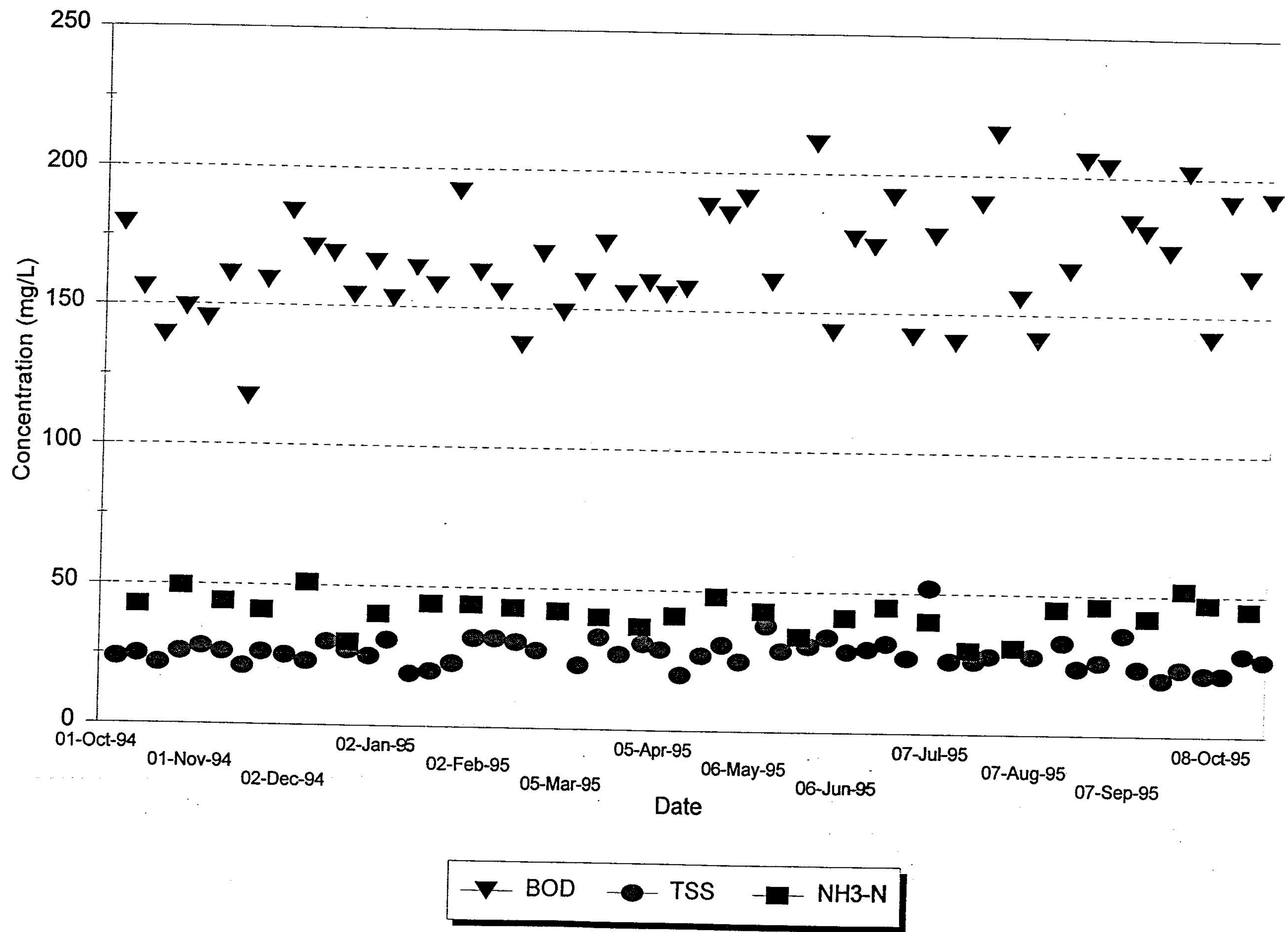




City of Yelm WW Reuse Project
Graph TM-E3-2: BOD, TSS, NH3-N Loading
BOD Loading Peak
265.4/178.2=1.24
TSS Loading Peak
51.1/32.0 = 1.6
NH3-N Loading Peak
62.45/50.46 = 1.24
Loading (pounds per day)
260
240
220
200
180
160
140
120
100
80
60
40
20
0
01-Oct-94
01-Nov-94
02-Dec-94
02-Jan-95
02-Feb-95
05-Mar-95
05-Apr-95
06-May-95
06-Jun-95
07-Jul-95
07-Aug-95
07-Sep-95
08-Oct-95
Date
BOD
TSS
NH3-N

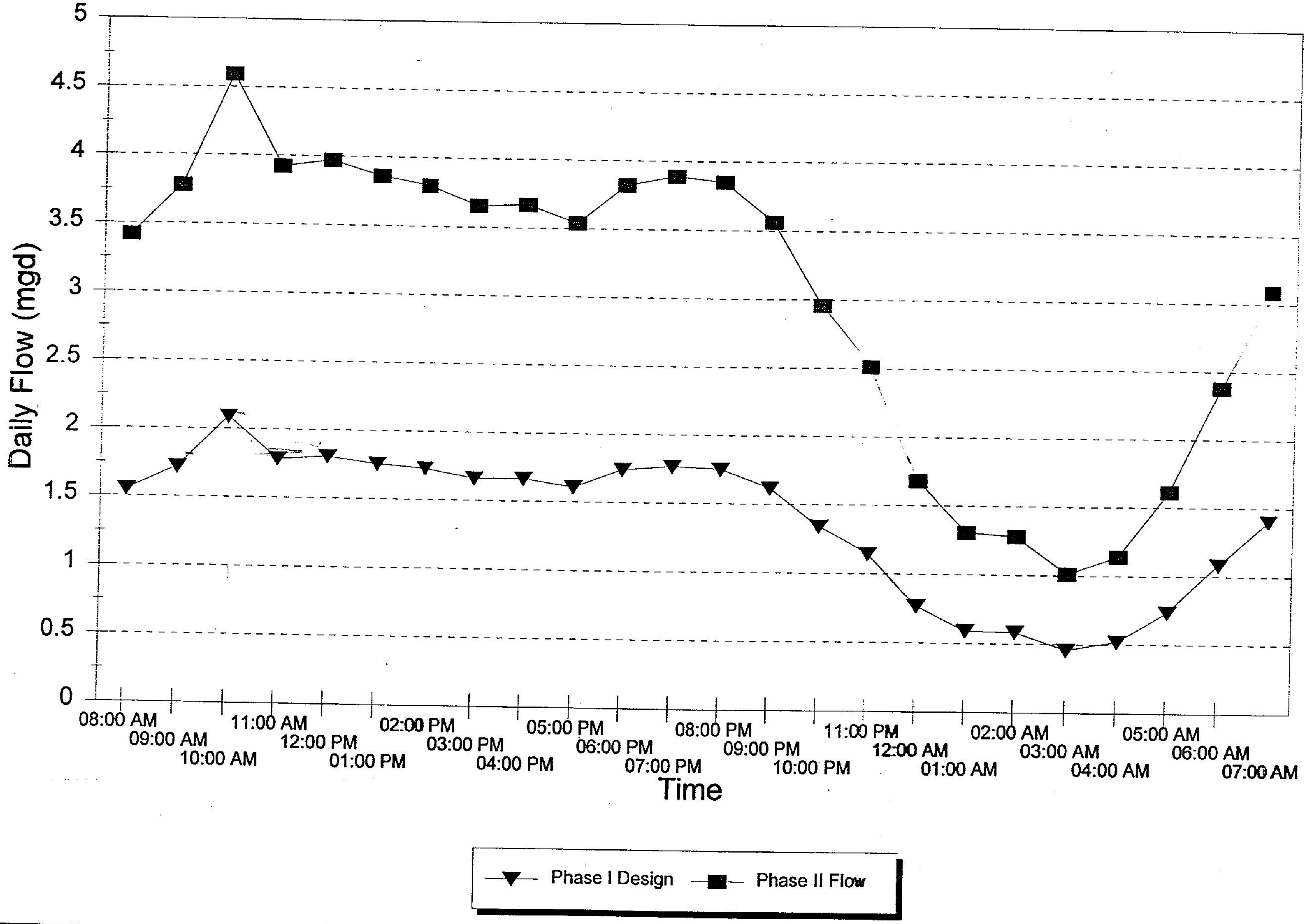
City of Yelm WW Reuse Project

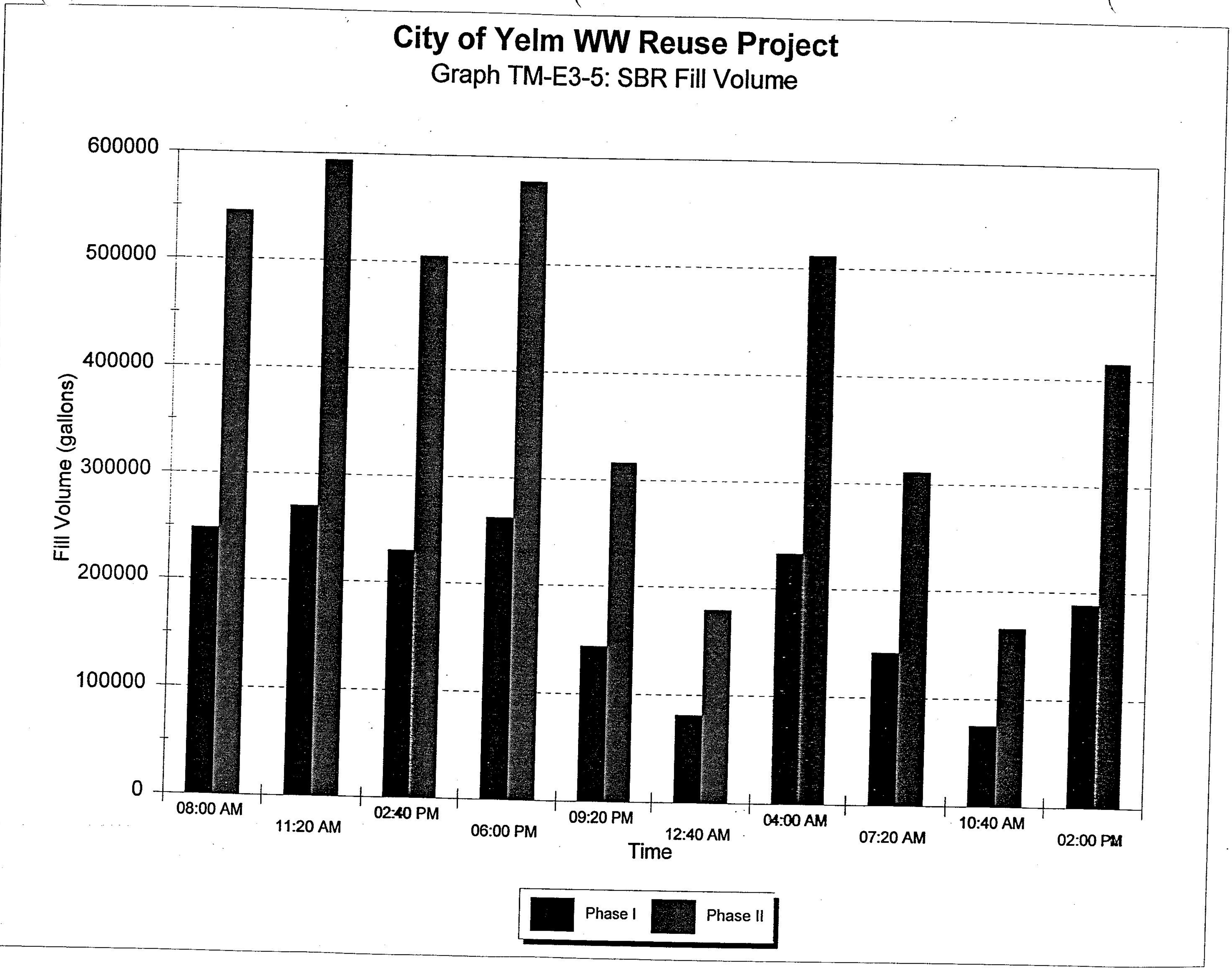
Graph TM-E3-3: BOD, TSS, NH3-N Conc.



City of Yelm WW Reuse Project

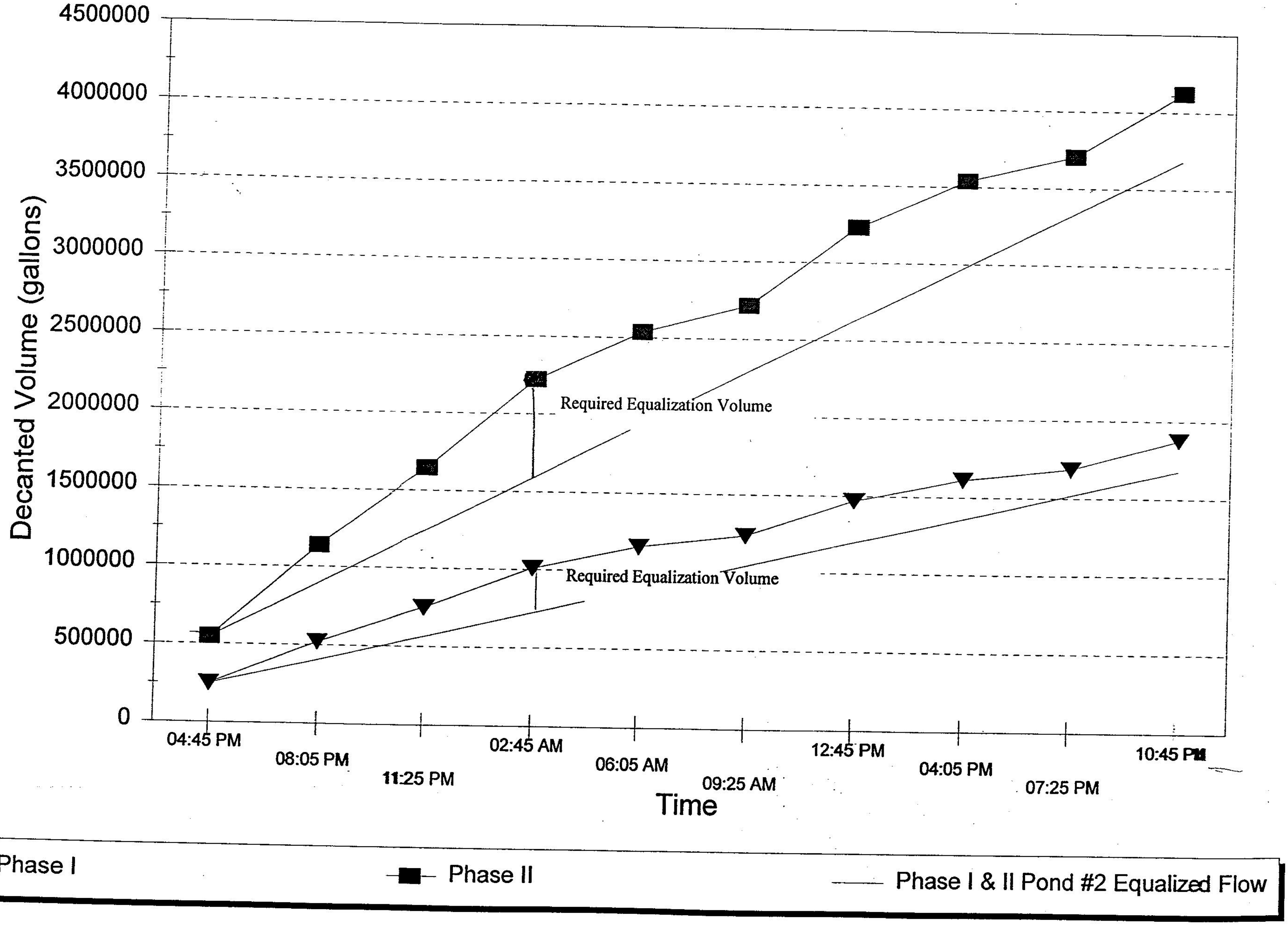
Graph TM-E3-4:Max Daily Flow Variation




City of Yelm WW Reuse Project
Graph TM-E3-5: SBR Fill Volume
Fill Volume (gallons)
600000
500000
400000
300000
200000
100000
0
08:00 AM
11:20 AM
02:40 PM
06:00 PM
09:20 PM
12:40 AM
04:00 AM
07:20 AM
10:40 AM
02:00 PM
Time
Phase I
Phase II

City of Yelm WW Reuse Project

Graph TM-E3-6: Decant Flow Profile



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YELM, WA

U.S. FILTER/JET TECH OMNIFLO® SEQUENCING BATCH REACTOR

DESIGN CALCULATIONS

U.S. FILTER/JET TECH FILE NO. JTS-98056

10 Hour Cycles

I. DESIGN PARAMETERS:

Influent & Effluent Characteristics			English Units	Metric Units
Flow	=	1.06	MGD average	4,012 m^3/d
	=	2.15	MGD peak (storm)*	8,138 m^3/d
Influent BOD to SBR	=	215	mg/l at avg flow (Specified)	
	=	1,750	lbs./day (Specified)	794 kg/d
Influent COD to SBR	=	430	mg/l at avg flow*	
	=	3,801	lbs./day	1,724 kg/d
Effluent BOD	=	5.0	mg/l	
		15	***mg/l required max week***	
BOD removed	=	1,856	lbs./day	842 kg/d
TSS to SBR	=	52	mg/l (Specified)	
	=	370	lbs./day (Specified)	168 kg/d
Inert TSS fraction	=	50	% *	
Effluent TSS	=	5.0	mg/l	
		15	***mg/l required max month avg.***	
	=	44	lbs./day	20 kg/d
Influent NH4-N	=	52	mg/l	
	=	485	lbs./day	220 kg/d
(Minimum BOD:NH3 Ration Should Be 4:1)				
Influent TKN	=	57	mg/l*	
	=	500	lbs./day	227 kg/d
(Minimum BOD:TKN Ratio Should Be 3.3:1)				

(*notes assumed values, which may need to be confirmed)

Effluent NH3-N	=	1.0	mg/l			
		3.0	***mg/l required max week***			
Effluent Total Nitrogen	=	10	mg/l			
		15	***mg/l required max week***			
Influent Phosphorus	=	6.0	mg/l			
	=	53	lbs./day	24	kg/d	
Effluent Phosphorus	=	2.0	mg/l			
		6.0	***mg/l required max week***			
Influent dissolved solids, TDS	=	500	mg/l *			

Reactor & Process Characteristics

Design MLSS	=	2,500	mg/l			
Hydr. Retention Time provide(	=	39	hours HRT			
Biosolids yield factor	=	0.60	#TSS/#BODr/d	0.60	gTSS/gBODr/d	
F:M Unadjusted for aer. time	=	0.08	#BOD/#MLSS/d	0.08	gBOD/gMLSS/d	
Elevation	=	344	ft. MSL	105	m	
Avg. barometric press.	=	14.51	psia*	100.0	kPa	1.00 bar

II. PROCESS PARAMETERS:

Avg BOD removed	=	1,856	lbs/d	842	kg/d
Avg Biosolids yield, WAS	=	1,114	lbs/d dry weight*	505	kg/d

III. BASIN DESIGN:

SBR Basins

Number of SBR basins	=	3			

Option #1

Length/Width Ratio	=	2.51	: 1		
Length	=	100	ft.	30.57	m
Width	=	40	ft.	12.20	m

(*notes assumed values, which may need to be confirmed)

Maximum Water Level	=	19.0	ft.	5.79 m
Nominal Top Water Level	=	19.0	ft.	5.79 m
TWL at Design Average Flow	=	19.0	ft.	5.79 m
LWL at Design Average Flow	=	14.1	ft.	4.30 m
Minimum Water Level	=	9.0	ft.	2.74 m
Total Volume in SBR's	=	1.71	MG (Nominal)	6,472 m^3/d
Total HRT in SBR's	=	39	hrs. (Nominal)	1.6 days (Nom.)

IV. OXYGEN REQUIREMENT:

lbs. O2/lb. BOD removed	=	1.25	= kg O2 /kg BOD rem.	
lbs. O2/lb. TKNoxidized	=	4.6	= kg O2 /kg TKNox	
lbs.O2/lb.NO_3x denitrified	=	*2.86*	Denite efficiency = 0 %	
Denitrification Oxygen credit	=	0	lbs O2/day	0 kg/d
Actual Oxygen Req'd, AOR	=	4,201	lbs O2/day	1,905 kg/d

Convert Process, or Actual Oxygen Requirement (AOR), to Standard Oxygen (SOR) :

Conversion Formula from ASCE Manual of Practice :

$$SOR = \frac{AOR * Cs}{a * (ßCsd - DO) * Ø^{(T-20)}}$$

Where:

Cs = DO saturation at Stnd Conditions
= 9.07*(1+0.4*D/34)
= 11.1 mg/l

Csd = DO saturation at design conditions
= Cst*(Fe+0.4*D/34)
where : Cst = DO satur. at liq. Temp & 1 atm
= 8.3 mg/l

Elev. Factor, Fe = 0.98

Therefore, Csd = 10.0 mg/l

Alpha, a = 0.60 *

SWD, D = 19 ft

(*notes assumed values, which may need to be confirmed)

Dissolved O2, mg/l = 2.0   Beta, ß = 0.95 *

Liquid Temp, T = 25 °C   Theta, Ø = 1.024

Therefore:

Standard Oxygen Required, SOR	=	9,215	lbs O2/day	4,183 kg/d

V. PROCESS DESIGN:

CYCLE TIMES

Nominal Fill time	=	3.33	hrs. per basin	
Complete Cycle time	=	10.0	hrs. per basin	
Fill time at Design Flow	=	3.34	hrs.	
Anoxic Fill time	=	3.33	hrs.	*100 % of FILL is anoxic.*
Aerated Fill	=	0.00	hrs.	
React time	=	1.78	hrs.	*18 % of cycle is aerated.*
Settle time	=	1.00	hrs.	
Decant time	=	0.49	hrs.	
Denitrification / Idle time	=	3.39	hrs.	

VI. AERATION SYSTEM DESIGN:

Aerator elevation	=	1.0	ft.	0.30 m
Avg aerator submergence	=	18.0	ft.	5.49 m
Total aeration time	=	1.78	hrs./cycle	
	=	4.28	hrs./basin/day	
SOR for aeration design	=	718	lbs./hr/basin	326 kg/hr
Design gassing rate	=	4.9	SCFM / dif	0.14 m^3/min/dif
Site gassing rate	=	4.9	ICFM / dif	0.14 m^3/min/dif
Absorption efficiency	=	26.7	%	

(*notes assumed values, which may need to be confirmed)

Note - page 3 missing - JRM

U.S. FILTER JETTECH **CHECK SET**

05/18/00

YELM, WA

U.S. FILTER/JET TECH OMNIFLO® SEQUENCING BATCH REACTOR

DESIGN CALCULATIONS

U.S. FILTER/JET TECH FILE NO. JTS-98056

6 Hour Cycles

I. DESIGN PARAMETERS:

Influent & Effluent Characteristics			English Units	Metric Units
Flow	=	1.06	MGD average	4,012 m^3/d
	=	2.15	MGD peak (storm)*	8,138 m^3/d
Influent BOD to SBR	=	215	mg/l at avg flow (Specified)	
	=	1,750	lbs./day (Specified)	794 kg/d
Influent COD to SBR	=	430	mg/l at avg flow*	
	=	3,801	lbs./day	1,724 kg/d
Effluent BOD	=	5.0	mg/l	
		15	***mg/l required max week***	
BOD removed	=	1,856	lbs./day	842 kg/d
TSS to SBR	=	52	mg/l (Specified)	
	=	370	lbs./day (Specified)	168 kg/d
Inert TSS fraction	=	50	% *	
Effluent TSS	=	5.0	mg/l	
		15	***mg/l required max month avg.***	
	=	44	lbs./day	20 kg/d
Influent NH4-N	=	52	mg/l	
	=	485	lbs./day	220 kg/d
(Minimum BOD:NH3 Ration Should Be 4:1)				
Influent TKN	=	57	mg/l*	
	=	500	lbs./day	227 kg/d
(Minimum BOD:TKN Ratio Should Be 3.3:1)				

(*notes assumed values, which may need to be confirmed)

Effluent NH3-N	=	1.0	mg/l			
		3.0	***mg/l required max week***			
Effluent Total Nitrogen	=	10	mg/l			
		15	***mg/l required max week***			
Influent Phosphorus	=	6.0	mg/l			
	=	53	lbs./day	24	kg/d	
Effluent Phosphorus	=	2.0	mg/l			
		6.0	***mg/l required max week***			
Influent dissolved solids, TDS	=	500	mg/l *			

Reactor & Process Characteristics

Design MLSS	=	2,500	mg/l			
Hydr. Retention Time provide(	=	39	hours HRT			
Biosolids yield factor	=	0.60	#TSS/#BODr/d	0.60	gTSS/gBODr/d	
F:M Unadjusted for aer. time	=	0.08	#BOD/#MLSS/d	0.08	gBOD/gMLSS/d	
Elevation	=	344	ft. MSL	105	m	
Avg. barometric press.	=	14.51	psia*	100.0	kPa	1.00 bar

II. PROCESS PARAMETERS:

Avg BOD removed	=	1,856	lbs/d	842	kg/d
Avg Biosolids yield, WAS	=	1,114	lbs/d dry weight*	505	kg/d

III. BASIN DESIGN:

SBR Basins

Number of SBR basins	=	3			

Option #1

Length/Width Ratio	=	2.51	: 1		
Length	=	100	ft.	30.57	m
Width	=	40	ft.	12.20	m

(*notes assumed values, which may need to be confirmed)

Dissolved O2, mg/l = 2.0 Beta, ß = 0.95 *

Liquid Temp, T = 25 °C Theta, Ø = 1.024

Therefore:

Standard Oxygen Required, SOR = 9,215 lbs O2/day 4,183 kg/d

V. PROCESS DESIGN:

CYCLE TIMES

Nominal Fill time	=	2.00	hrs. per basin	
Complete Cycle time	=	6.0	hrs. per basin	
Fill time at Design Flow	=	2.00	hrs.	
Anoxic Fill time	=	2.00	hrs.	*100 % of FILL is anoxic.*
Aerated Fill	=	0.00	hrs.	
React time	=	1.07	hrs.	*18 % of cycle is aerated.*
Settle time	=	1.00	hrs.	
Decant time	=	0.29	hrs.	
Denitrification / Idle time	=	1.64	hrs.	

VI. AERATION SYSTEM DESIGN:

Aerator elevation	=	1.0	ft.	0.30 m
Avg aerator submergence	=	18.0	ft.	5.49 m
Total aeration time	=	1.07	hrs./cycle	
	=	4.28	hrs./basin/day	
SOR for aeration design	=	718	lbs./hr/basin	326 kg/hr
Design gassing rate	=	4.9	SCFM / dif	0.14 m^3/min/dif
Site gassing rate	=	4.9	ICFM / dif	0.14 m^3/min/dif
Absorption efficiency	=	26.7	%	

(*notes assumed values, which may need to be confirmed)

Design air flow	=	2,600	SCFM	74 m^3/min	
Diffusers req'd per basin	=	528	24" Tube		
Manifolds per basin	=	4			
Diffusers per manifold	=	132			

VII. BLOWER DESIGN CALCULATIONS:

Operating blowers	=	1	per aerating basin		
Type of Blowers :	=	1	*1 = Rotary, positive displacement* *2 = Multistage Centrifugal* *3 = Variable-vane centrifugal*		
Total Number of Blowers	=	4	including a spare		
Air flow per blower	=	2,600	SCFM	73.7 m^3/min	
Inlet losses	=	0.3	psig *	2.07 kPa	0.02 bar
Net inlet pressure	=	14.21	psia (absolute)	97.96 kPa	0.98 bar
Discharge piping losses	=	1.41	psig *	9.72 kPa	0.10 bar
Static head + Aerator loss	=	8.29	psig average	57.17 kPa	0.57 bar
	=	8.29	psig at Max. W.L.	57.17 kPa	0.57 bar
	=	7.02	psig at Min. W.L.	48.39 kPa	0.48 bar
Total discharge pressure	=	10.00	psig average	68.97 kPa	0.69 bar
		10.00	psig maximum	68.97 kPa	0.69 bar
		8.73	psig minimum	60.18 kPa	0.60 bar
Design ambient temp.	=	90	°F maximum	32 °C	
		20	°F minimum	-7 °C	
Site air flow required	=	2,802	ICFM average	79.38 m^3/min	
Equiv. sea level pressure	=	10.63	psig average	73.29 kPa	0.73 bar
Nominal blower efficiency	=	66	% *		
Blower BHp/aerating basin	=	149	BHp	111.1 BkW 123.4 kW @ 90% ME	

(*notes assumed values, which may need to be confirmed)

VIII AERATION SYSTEM SUMMARY:

Standard Oxygen Required	=	9,215	lbs./day	4,188	kg/d
Avg. BHp for 24 hrs.	=	80	BHp**	66	kW
			Daily Usage	1,583	kWhrs/d
Assume Cost of Power	=	0.05	$/kW		
Max. Annual Cost of Power**	=	28,892	$/yr, (assuming 90% motor efficiencies)		

** *Actual power draw is typically less due to Demand-Proportional aeration process control*

IX. DECANTER SIZING:

Cycles per day	=	12			
Volume per decant	=	88,333	Gal. at Design Flo'	334	m^3
		88,333	Gal. Decantable V(	334	m^4
Decant time	=	0.29	hrs.		
Decant flow	=	5,000	GPM	315	l/s

(*notes assumed values, which may need to be confirmed)

XI. PHOSPHORUS REMOVAL

BOD vs Phosphorus :

Assume TSSi inert fraction is as shown under 'DESIGN PARAMETERS'.
Check BOD to P ratios :

Based on total influer Based on soluble influent values :

BODi:P = 36:1 **SBODi:P = 32:1**

Approximate mg BODi/mg P reqr'd = **27:1** at oxic SRT selected

Assuming only bio-P removal :

Effluent P conc. achievable biologically = **< 1 mg/l**

Chemical phosphorus removal required = **0.0 mg/l**

Approximate Alum dosage required = **0 mg/l** (as Al2(SO4)3)
= **0 gpd** @ 49% Al2(SO4)3

or

Approximate ferric chloride dosage reqr'(= **0 mg/l** (as FeCl3)
= **0 gpd** @ 30% FeCl3

(*notes assumed values, which may need to be confirmed)

FINAL

WASTEWATER TREATMENT PLANT DESIGN CRITERIA

WASTEWATER FLOW AND LOADING

PARAMETER	CONDITION	PRESENT	DESIGN (PHASE 1)
FLOW	ANNUAL AVERAGE	0.140 MGD	1.0 MGD
	MAXIMUM MONTH	0.148 MGD	1.06 MGD
	MAXIMUM DAY	0.190 MGD	1.36 MGD
	PEAK	0.35 MGD	2.5 MGD
BOD	AVERAGE	168 MG/L	169 MG/L
	MAXIMUM	215 MG/L	200 MG/L
	AVERAGE	200 PPD	1410 PPD
	MAXIMUM	265 PPD	1750 PPD
TSS	AVERAGE	28 MG/L	28 MG/L
	MAXIMUM	52 MG/L	42 MG/L
	AVERAGE	33 PPD	230 PPD
	MAXIMUM	51 PPD	370 PPD
AMMONIA NH3-N	AVERAGE	42 MG/L	42 MG/L
	MAXIMUM	52 MG/L	50 MG/L
	AVERAGE 2 (1 EACH CELL)	49 PPD	350 PPD
	MAXIMUM	62 PPD	435 PPD

EFFLUENT REQUIREMENTS

* CLASS A RECLAIMED WATER
* TREATMENT PLANT RELIABILITY CLASS I

SEQUENCING BATCH REACTORS

NUMBER	3
VOLUME EACH	568,480 GAL
CYCLE TIME	6–10 HR
DECANT RATE	5,000 GPM

EFFLUENT	MAX. MONTH AVG	MAX. WEEKLY AVG
BOD (MG/L)	10	15
TSS	10	15
AMMONIA (MG/L)	1	3
TOTAL NITROGEN (MG/L)	10	15
TOTAL PHOSPHOROUS (MG/L)	4	6

EQUALIZATION STORAGE

MIN. VOLUME	0.72 MG AT 4' DEPTH
MAX. VOLUME	2.3 MG AT 10' DEPTH
AERATION	TWO 10 HP
AERATION	THREE 7.5 HP

INTERMEDIATE PUMP STATION

NUMBER OF PUMPS	3 (2 INSTALLED, 1 STORED)
TYPE	SUBMERSIBLE
SIZE	4"
CAPACITY EACH	380 GPM AT 23' TDH
DRIVE MOTOR	7.5 HP (W/VFD)
WET WELL	96" DIA MH (3 PUMPS; PH II)

STATIC IN-LINE MIXER #1 – 6"

FLOW RANGE	130–300 GPM
VISCOSITY AT MAXIMUM FLOW, CENTIPOISE	1–5
PIPE DIAMETER, INCHES	6"
MAXIMUM HEADLOSS, PSI	5
MAXIMUM OPERATING PRESSURE, PSIG	50
NUMBER OF ELEMENTS	4

STATIC IN-LINE MIXER #2 – 10"

FLOW RANGE	300–600 GPM
VISCOSITY AT MAXIMUM FLOW, CENTIPOISE	1–5
PIPE DIAMETER, INCHES	10"
MAXIMUM HEADLOSS, PSI	5
MAXIMUM OPERATING PRESSURE, PSIG	50
NUMBER OF ELEMENTS	4

FILTERS

NUMBER OF CELLS	3
FILTERS PER CELL	2
TOTAL FILTER UNITS	6
FILTER AREA (EACH UNIT)	50 SF.
TOTAL FILTER AREA	300 SF.
LOADING RATE	1.2–3.0 GPM/SF.
FILTER SIZE	7'-1"X14'-2"
DEPTH	18.25'

DISINFECTION

CHLORINATORS (EXISTING)	
NUMBER	2
CAPACITY EACH	2,000 PPD
CONTROL	FLOW PACED

RAPID MIX

VOLUME	750 GAL
DEPTH	4.8'
MIXER	1.0 HP
HYDRAULIC DETENTION TIME	26–30 SEC.
VELOCITY GRADIENT	175–350 S^-1

CHLORINE CONTACT TANK

NUMBER	2
OPERATION	PARALLEL
VOLUME EACH	34,000 GAL
DETENTION TIME	
AT 1.0 MGD (ADF)	97 MIN.
AT 1.36 MGD (PDF)	36 MIN.
(1 TANK 0-0-S)	
DEPTH	4.5'
L:W RATIO	50:1
L:D RATIO	50:1

DECHLORINATION

AGENT	SULFER DIOXIDE
NUMBER	2
CAPACITY EACH	500 PPD
CONTROL	FLOW PACED WITH RESIDUAL TRIM

RECLAIMED WATER PUMP STATION

NUMBER OF PUMPS	2 – 7.5 HP MAINTENANCE PUMPS
TYPE	SUBMERSIBLE
CAPACITY EACH	70 GPM @ 165' TDH
CONTROL	VFD / PRESSURE SENSOR
NUMBER OF PUMPS	2– 15 HP SUPPLY PUMPS
TYPE	CLOSE COUPLED TURBINE
CAPACITY EACH	600 GPM @ 165' TDH
CONTROL	VFD / PRESSURE SENSOR
WET WELL VOLUME	3,956 CU. FT. / 29,591 GAL
WET WELL DEPTH	11.5' TO OVERFLOW ELEVATION

SBR AERATION

NUMBER	3
TYPE	ROTARY LOBE
CAPACITY (EA)	2,600 CFM
PRESSURE	10 PSI
DRIVE MOTOR	150 HP (W/VFD)

WASTE ACTIVATED SLUDGE STORAGE

VOLUME	331,700 GAL
RETENTION	28 DAYS
AERATION TYPE	COURSE BUBBLE DIFFUSERS
BLOWER:	
NUMBER	1
CAPACITY	660 CFM @ 8 PSIG
TYPE	ROTARY LOBE
DRIVE MOTOR	40 HP (W/VFD)

SLUDGE THICKENING

NUMBER	1
TYPE	GRAVITY BELT THICKENER
SIZE	1 METER
CAPACITY	400 LB DS/HR AND 80 GPM
OUTPUT	5% DS
VOLUME PER WEEK	16,400 GAL (@5%)

WAS PUMP STATION

NUMBER OF PUMPS	2
TYPE	SELF PRIMING CENTRIFUGAL
SIZE	3"
CAPACITY EACH	150 GPM @ 45' TDH
DRIVE MOTOR	7.5 HP

SLUDGE LOADING

VIA SLUDGE TRUCKS
ON BOARD VACUUM PUMP

ALUM/POLYMER FEED (COAGULATION)

SOLUTION DOSE RATE	1–10 GPH
MINIMUM SOLUTION STRENGTH	0.1%
TYPE	PRE MIXED LIQUID
CONTAINER	55 GAL DRUM

POLYMER FEED (SLUDGE)

SOLUTION DOSE RATE	14–180 GPH
MIN. SOLUTION STRENGTH	0.25%
TYPE	LIQUID
CONTAINER	55 GAL DRUMS

CAUSTIC SODA

SOLUTION DOSE RATE	350 GPH @ 5%
SOLUTION STRENGTH	50%
TYPE	LIQUID
CONTAINER	33 GAL DRUMS

DATE	REVISION	BY	DESIGNED BY M. MARSHALL	
			ENTERED BY T. SATER	AS-BUILT
			CHECKED BY TS 9/19/96	CHECKED BY

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4B: City of Yelm Water Reclamation Facility Operational Review

DRAFT Technical Memorandum

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Technical Memorandum [No. 1]

Subject: City of Yelm Water Reclamation Facility Operational Review

Date: June 26, 2011

To: Shelly Badger, City Administrator

From: Henryk Melcer and Alan Smith, Brown and Caldwell

Prepared by: ______________________________

Henryk Melcer, P.E., Ph.D., Washington Engineering License No. 36173,
Expiration 8/10/2012

Prepared by: ______________________________

Alan Smith, Operational Specialist

Reviewed by: ______________________________

Jeff Morgan, P.E.

Limitations:

This is a draft memorandum and is not intended to be a final representation of the work done or recommendations made by Brown and Caldwell. It should not be relied upon; consult the final report.

This document was prepared solely for City of Yelm in accordance with professional standards at the time the services were performed and in accordance with the contract between City of Yelm and Brown and Caldwell dated April 5, 2011. This document is governed by the specific scope of work authorized by City of Yelm; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by City of Yelm and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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1. EXECUTIVE SUMMARY

The City of Yelm's (City's) Water Reclamation Facility (Plant) utilizes a sequencing batch reactor (SBR) treatment process with Dynasand continuous backwash granular filters for effluent filtration to produce Class A reclaimed water. The Plant stopped producing reclaimed water on December 21, 2010 due to a failure to meet the NPDES permit limit for reclaimed water total nitrogen (TN) concentration of 10 mg/L. In addition, the Plant did not meet its monthly average effluent ammonia limit of 3 mg/L for discharges to the Centralia Power Canal for the period from January until early June of this year. As of June 24th, testing showed that the reclaimed water permit TN limit was again being met; additional testing was being performed to confirm this.

Table 1-1 summarizes recent Plant performance for reclaimed water total nitrogen concentration and Plant effluent ammonia concentration (discharge to the Centralia Power Canal) compared to the associated NPDES permit limits.

Table 1-1. Reclaimed Water and Treated Effluent Quality, July 2010 – April 2011(1)

	Reclaimed Water Total Nitrogen(2), (3) (mg/L)	Treated Effluent(4) Ammonia(5) (mg/L)
NPDES Permit Limit	10	3
July 2010	6.6	<0.01
August 2010	6.6	<0.01
September 2010	7.2	0.08
October 2010	7.5	<0.01
November 2010	6.9	<0.01
December 2010	12.6	0.7
January 2011	16.9	6.8
February 2011	32.2	20
March 2011	No sample	38.7
April 2011	No sample	26.2
May 2011	No sample	7.15

Notes

Gray areas indicate value exceeds NPDES permit

(1) *Data from Daily Monitoring Report (DMR)forms; all data are monthly averages*

(2) *Total nitrogen = sum of TKN-, nitrite- and nitrate-nitrogen concentrations. TKN represents the total nitrogen content from ammonia and organic nitrogen*

(3) *One sample collected per month*

(4) *Discharge to Centralia Power Canal or Nisqually River*

(5) *Monthly average of multiple samples*

The technical analysis of plant operations that follows this Executive Summary describes the reasons for the decline in Plant performance that began in December 2010. In summary, the decline was due to unseasonably cold weather in late November, combined with the failure of Plant operations staff to build up the necessary inventory of biomass in the sequencing batch reactor (SBR) treatment system in anticipation of winter operating conditions. Without the necessary biomass, the Plant was unable to achieve the removal of ammonia (nitrification) and nitrate (denitrification) required to meet permit limits.

1.1 Recommendations for Improving Performance

Once the treatment process lost the ability to nitrify and denitrify, a number of existing conditions at the Plant that limit operational flexibility prevented the process performance from being improved. These conditions, and recommendations to address them, include the following. Additional details and recommendations are provided in the following technical analysis; the recommendations here are presented as an initial package of improvements that could be implemented relatively quickly.

The City is currently preparing a General Sewer Plan (GSP) which is scheduled to be submitted to Ecology in April, 2012. The GSP will include a Capital Improvement Program (CIP) which will represent a schedule of improvements to the City's wastewater utility, including the Plant.

1.1.1 Lack of Standard Operating Procedures

The operation of an SBR to achieve low total nitrogen concentrations is a complex process with a large number of variables to monitor, adjust, and control, including cycle times, dissolved oxygen concentration, and alkalinity concentration. The Plant's operations staff are knowledgeable and dedicated, but the complexity of this operation makes it difficult to bring the process back into line once it is upset.

Recommendation: Prepare a comprehensive set of standard operating procedures (SOPs) for typical modes of operation to prevent Plant upsets and prepare for winter operation. In addition, contingency plans for operation following a Plant upset should be prepared. Brown and Caldwell (BC) is currently developing a computerized model of Plant processes that will assist with operations and the development of these SOPs.

Immediate Action: BC has prepared a proposed scope of work and budget for the preparation of a number of SOPs. Preparation of the SOPs would include time on-site for a BC operations specialist to evaluate and understand current operations.

An initial process model has been developed but has not been calibrated. The scope and budget for the SOPs includes effort to finalize the model after a characterization of the incoming wastewater is completed. This characterization should be performed by the laboratory the City typically uses, based on samples collected by Plant operators. A list of recommended tests to be performed will be prepared by BC.

Follow-up Action: As part of the CIP to be prepared for the General Sewer Plan, the need for a completely revised and updated O&M manual will be assessed. If a new O&M manual is warranted, the cost for its preparation will be programmed into the CIP.

1.1.2 Over-Design of Aeration System

When operating at high speed, the existing blowers produce too much air and prevent accurate control of the SBR process. The blowers are provided with a low speed setting that may provide more control, but Plant operators have indicated that the blowers are not operated in this mode.

Recommendation: The operational capabilities of the blowers should be investigated. The operators should determine if they can be operated at the low speed setting and, if this is not possible, the blower controls should be evaluated. If it is determined that the blowers are simply oversized for current operating conditions, a smaller blower with less capacity should be installed.

Immediate Action: BC has included scope and budget in the proposal for preparation of the SOPs to work with the operators to evaluate performance of the blowers and associated controls.

Follow-up Action: If it is determined that a smaller blower is required, costs for the design and installation of the new equipment will be incorporated into the CIP.

1.1.3 Inability to Maintain Alkalinity in the SBRs

Without adequate alkalinity in the wastewater, the nitrification process cannot take place. Low alkalinity can also contribute to problems with the corrosivity of the reclaimed water that is produced. There is an existing caustic soda addition system at the Plant that was originally intended to provide alkalinity control for the treatment process but it has not been used for several years. The operators currently control alkalinity by manually adding bags of lime to the system and measuring alkalinity on a monthly basis. Better control of the alkalinity in the treatment process is required.

Recommendation: Determine if caustic soda is the best chemical to use for alkalinity control. If caustic soda is suitable for use, rehabilitate or replace the existing caustic soda system and provide better alkalinity control through more frequent sampling and testing. If a different chemical is found to be more suitable, design and install a new chemical feed system. Finally, new instrumentation to monitor alkalinity on a continuous basis should be evaluated.

Immediate Action: Include testing of the reclaimed water as part of the wastewater characterization described above to determine what chemical is best suited for alkalinity control. Rehabilitate the system, if feasible and cost-effective (repair cost less than about $10,000); evaluation of the condition of the existing caustic soda system is part of the proposed scope of work and budget for the preparation of the SOPs. Increase the frequency of testing for alkalinity in the SBR decant to three times per week.

Follow-up Actions: Design and install a new caustic soda system if the existing system cannot be rehabilitated; or, if lime is better suited for use to control alkalinity, design and install a new lime feeder system. In either case, include the cost for design and installation in the General Sewer Plan CIP. In addition, evaluate the costs and benefits of installing instrumentation to provide on-line continuous monitoring of alkalinity.

1.1.4 Manual Measurement of Ammonia and Nitrate Concentrations

Precise control of the nitrification/denitrification process requires frequent measurement of ammonia and nitrate concentrations. Samples for these measurements are taken twice-weekly, but daily sampling is typically used at plants with similar permit limits.

Recommendation: Install online ammonia and nitrate analyzers to provide continuous monitoring and control. In addition, existing pH and dissolved oxygen (DO) instrumentation is more than 10 years old and should be replaced.

Immediate Action: Increase frequency of testing for ammonia and nitrate to daily (minimum of five times per week).

Follow-up Action: Evaluate cost and benefits of installing online ammonia and nitrate analyzers and program costs into the General Sewer Plan CIP. In addition, include costs in the CIP for replacement of existing pH and DO instrumentation.

1.2 Overall Plant Condition

As part of the operational review, BC staff visited the Plant on June 7, 2011 to visit with Jim Doty, Plant Manager and Tim Peterson, Public Works Director to take a tour of the Plant and discuss current operational challenges. Over the course of the visit, the condition of the facility was noted to be clean, orderly and well maintained. Even areas that are difficult to maintain, such as the solids dewatering area, are in excellent condition.

Jim Doty expressed his opinion that the amount of time it takes to perform laboratory tests has impacted the amount of time available to dedicate to plant operations. The cost of contracting out some laboratory work, installing online measuring equipment or hiring a dedicated part-time laboratory technician, should be evaluated relative to the amount of plant operator time that would be freed up for other duties.

1.3 Reclaimed Water Use during Permit Non-Compliance

Although the Plant did not produce Class A reclaimed water between December and June, water billing records indicate that reclaimed water was still being used by as many as seven reclaimed water customers. According to the billing records, the significant users included the Public Works shop, the Yelm School District bus garage, and a City-owned street median landscape irrigation use. Total usage for the period from January to March was approximately 212,000 gallons. The daily monitoring reports (DMRs) that were submitted to Ecology during this period incorrectly indicated that no reclaimed water was being discharged to the system. Ecology should be notified as soon as possible that the DMRs were in error.

The cause of the water entering the reclaimed water distribution system that did not meet permit was attributed to the failure of severely corroded isolation valves at the Plant that could not be fully closed. It is our understanding that once the situation was discovered, all reclaimed water meters throughout the system were closed to prevent further use and a SOP was written and distributed to Public Works staff requiring that meters be closed in the event that reclaimed water standards are not met in the future.

Recommendation (Immediate Action): Prepare a comprehensive SOP to address the actions to be taken in the event that the plant is producing reclaimed water that does not meet permit limits. This SOP is included in the proposed scope and budget for preparation of Plant-wide SOPs that has been submitted to the City by BC.

2. INTRODUCTION

The City of Yelm (City) Wastewater Treatment Plant (Plant) has experienced difficulties in meeting its total nitrogen (TN) limit since mid-December 2010. As a result, it has not been able to produce reclaimed water (RW) since that time. The City engaged BC to review treatment plant operations to determine the reason(s) for not being able to achieve RW standards and to assess overall plant condition and performance. To this end, Henryk Melcer and Alan Smith of Brown and Caldwell met with Jim Doty and Tim Petersen at the Plant on June 7, 2011 to conduct a review. This Technical Memorandum provides a summary of the findings of the review and recommendations for improved Plant operation.

3. PLANT DESCRIPTION

The City has a Septic Tank Effluent Pump (STEP) collection system in which septic tank overflow from nearly 2,000 septic tanks in the City is pumped to the Plant. The raw sewage receives secondary treatment in a sequencing batch reactor (SBR), followed by coagulation, filtration, and chlorine disinfection to produce RW. There is no primary treatment. Waste activated sludge is stored for a few days before being thickened in a gravity belt thickener and trucked to the Tacoma Central Treatment Plant.

There are three SBR cells at 0.6 million gallons each. Only two cells are used and the third is used as a standby. Decant water from the SBRs flows by gravity to a section of the old lagoon that has been walled off to serve as the effluent equalization basin. Equalized flow is dosed with polyaluminum chloride (PAX) and pumped to the Dynasand continuous upflow granular media filters. Polymer is dosed just prior to the filters. The filter backwash is returned to the head of the plant.

Filtered effluent is chlorinated and passes through a 34,000 gallon contact chamber before flowing to the RW wet well. The wet well contains four pumps, two at 300 gpm and two at 5 gpm. They serve to distribute RW to the City upon demand. Also, a 500,000 gallon tank at the Plant provides storage capacity; during high demand periods in the summer, the rate of RW production is not high enough and so is supplemented with the reserve RW from the storage tank. The contents of the storage tank are turned over by maintaining a constant flow of 50 gpm from the tank to supplement the flow from the Plant. This practice causes the tank level to fall until it reaches a set point 1.0 ft below the maximum storage depth, at which point the wet well pumps direct flow into the storage tank to restore the level to the maximum. If there is insufficient demand for the RW or it does not meet the RW standards, the water is dechlorinated and discharged through the standby outfall in the Centralia Power Canal. In emergency situations, secondary effluent can be discharged to an outfall located on the Nisqually River.

4. NPDES PERMIT IMPLICATIONS

In 1994, the City installed the STEP collection system and a lagoon secondary treatment facility to comply with the Department of Ecology (Ecology) requirements to reduce the levels of nitrate that had migrated to groundwater from the City's septic tanks and drainfields. A longer term objective was to move the City to produce RW so that treated effluent would no longer be discharged to the Nisqually River. The treatment plant was constructed with an outfall to both the Centralia Power Canal as the primary discharge point, and to the Nisqually River as a standby discharge point. The new treatment plant did not meet RW standards and also, the plant was under-sized. Consequently, in 2001, the treatment plant was upgraded by installing SBRs as the secondary treatment technology with effluent coagulation, filtration and disinfection facilities to meet the turbidity requirements in RW standards. Table 4-1 describes how the NPDES permit requires different standards be met according to the fate of the treated effluent.

Depending on the demand for RW, the treated effluent can be directed for irrigation and infiltration purposes, or it will be directed to discharge to the Centralia Power Canal. In emergencies, the treated effluent may be discharged to the Nisqually River. The discharge requirements for each application are designated in blue, pink and green, respectively, in Table 4-1. The most stringent characteristics that the Plant has to achieve are identified in yellow in Table 4-1; they are associated with the residual nitrogen species in the treated effluent. For RW quality, the Plant has to produce a monthly average effluent total nitrogen (TN) concentration of 10 mg/L, where TN is the sum of Total Kjeldahl Nitrogen (TKN, which is the total of ammonia-nitrogen and organic-nitrogen), nitrite-nitrogen and nitrate-nitrogen. The Plant has to minimize the concentrations of these four species so that the sum of the residuals is < 10 mg/L. For discharge to the Centralia Power Canal and the Nisqually River, the Plant has to produce a monthly average effluent ammonia-nitrogen concentration of 3.0 mg/L. In both cases, the Plant has to maintain these requirements on a year-round basis. It is clear that the RW application has the most stringent requirement for the Plant to achieve.

Table 4-1. Summary of Plant Discharge Requirements		
Parameter	Effluent Limits	
Reclaimed Water – Outfall No. 1		
	Average Monthly	*Average Weekly*
Biochemical oxygen demand, BOD (mg/L)	30	N/A
Total suspended solids, TSS (mg/L)	30	N/A
Dissolved oxygen (mg/L)	Shall be measurably present in discharge at all times	
pH	Daily minimum $\geq$6.0, daily maximum $\leq$9.0	
	7-day Limit	*Sample Maximum*
Total coliform bacteria (count/100 mL)	2.2	23
	Average Monthly	*Sample Maximum*
Turbidity (NTU)	2	5
	Average Monthly	*Daily Maximum*
Total nitrogen, TN (sum of TKN, NO_2-N & NO_3-N) (mg/L)	10	15
Centralia Power Canal – Outfall No. 2		
	Average Monthly	*Average Weekly*
BOD	30 mg/L, 250 lb/day, 85% rem.	45 mg/L, 375 lb/day
Total suspended solids, TSS (mg/L)	30 mg/L, 250 lb/day, 85% rem.	45 mg/L, 375 lb/day
Fecal coliform bacteria (count/100 mL)	100	200
pH	Daily minimum $\geq$6.0, daily maximum $\leq$9.0	
Total residual chlorine (mg/L)	0.5	0.75
Total ammonia (mg/L)	3	4.5
Nisqually River – Outfall No. 3		
	Average Monthly	*Average Weekly*
BOD	30 mg/L, 250 lb/day, 85% rem.	45 mg/L, 375 lb/day
Total suspended solids	30 mg/L, 250 lb/day, 85% rem.	45 mg/L, 375 lb/day
Fecal coliform bacteria (count/100 mL)	100	200
pH	Daily minimum $\geq$6.5, daily maximum $\leq$9.0	
Total ammonia (mg/L)	3.0	4.5
	Average Monthly	*Daily Maximum*
Total residual chlorine (mg/L)	0.047	0.124
Total lead (µg/L)	10	15

5. SBR TREATMENT TECHNOLOGY

The permit plays an important part in the operation of the Plant because it requires that nitrogen be removed on a year-round basis. The process of removing nitrogen is carried out in two stages, ammonia oxidation to nitrate-nitrogen by the process of nitrification followed by the reduction of nitrate-nitrogen to nitrogen gas by the process of denitrification.

There are different ways of designing treatment facilities to carry out nitrification-denitrification. Briefly, the SBR differs from most treatment plants because it treats batches of influent wastewater unlike other plants in which influent flows continuously through the plant. This practice is where it derives its name: the sequencing batch reactor. The influent is divided into batches, each of which is treated separately by one of the SBR cells. The treatment of each batch is referred to as a cycle of events. There are four major components of a cycle: a mixed fill un-aerated phase (where denitrification occurs), an aerated phase (where nitrification occurs), a settling phase and a decanting phase. The purpose of the settling phase is to allow the organisms that carry out the process of nitrification/denitrification to separate from the treated effluent by gravity settling. The purpose of the decanting phase is to remove the treated effluent from the SBR in batches.

There are several considerations steps in the SBR process. The first concerns the growth of the organisms required to carry out the nitrification/denitrification process. The nitrifying organisms (nitrifiers) are sensitive to temperature, pH, alkalinity, oxygen concentration and to inhibitory compounds (such as chlorine). Similarly, denitrifying organisms (denitrifiers) are sensitive to organic carbon (measured as BOD) and oxygen concentration.

The second concerns the ability of the mixed liquor (this is the term given to the conglomeration of microorganisms used by the SBR) to settle quickly during the settling phase. If the mixed liquor cannot settle within the designated period permitted during the cycle, non-settled solids are discharged in the decant, which leads to operational problems with downstream processes and also, the loss of excess solids can constrain the operation of the SBR.

Thirdly, the influent wastewater characteristics have an important impact on SBR operation: there needs to be sufficient alkalinity to allow nitrification to occur successfully, and there needs to be sufficient carbon (as BOD) present to allow denitrification to occur. The return streams from the other processes within the plant that are returned to the head of the plant will affect influent characteristics. Temperature will affect the growth rate of the organisms. While the influent temperature stays relative constant during the year, once in the SBR cells it is cooled significantly in the winter because of the very large surface area of the SBR cells. The lower temperatures cause the organisms to grow more slowly and so they respond more slowly to changes in operation.

6. PLANT OPERATIONAL HISTORY

In the first few years of operation after the startup of the SBR in 2001, the Plant was not able to meet the NPDES requirements given in Table 4-1 during winter operating periods. There were two reasons for this: the first was the inability to nitrify successfully during the winter low temperatures and the second was the inability of the mixed liquor to settle adequately during the settling phase. In 2004, Brown and Caldwell were asked to seek a remedy to this situation.

It was determined that the poor mixed liquor settleability was caused by the growth of a foaming filamentous organism, *Microthrix parvicella*. This is not an unusual occurrence; it is found in many plants. Its growth is stimulated by the presence of oil and grease that floats on the surface of aerated mixed liquor, by high sludge retention times (SRT) (this is a measure of how long the mixed liquor organisms reside in the treatment system), low temperatures and an inadequate ability to remove floating solids and scum from the surface of aerated mixed liquor. The latter three reasons are why this organism was found in the Yelm SBR.

To combat the low growth rate of nitrifiers during low temperature operating conditions, the length of time that the organisms reside in the SBR is increased (the Plant is operated at a high SRT). Nitrifiers will grow relatively well at temperatures to as low as 120C. Below that temperature, it is imperative for the SRT to be increased. Unfortunately, the elevation of SRT at low temperatures also allows the *Microthrix* organism to grow, too. This organism prefers to live in a foam or scum on mixed liquor surfaces and from that position, continuously seeds the mixed liquor and proliferates in the system. The mechanism of scum removal offered by SBR vendors is not efficient and is recognized in the industry as a weak point of design of SBRs. Consequently, organisms like *Microthrix* can grow unimpeded in SBR systems. Operations staff pursued standard methods of ridding the system of this organism by spreading calcium hypochlorite over the mixed liquor surface. While this action did destroy *Microthrix*, it also eliminated the nitrifiers, precluding the ability of the SBR to achieve nitrification/denitrification until the spring when mixed liquor temperatures increased to levels at which the nitrifiers could re-establish themselves.

An alternative approach to removing *Microthrix* is to lower the SRT to the point at which they cannot grow in the system. That method is not available to the Yelm SBR because they are significantly over-sized. The amount by which the mass of mixed liquor would need to be reduced to lower the SRT would result in the mixed liquor suspended solids concentration being lower than is required for the solids to flocculate. The process of flocculation or coalescence of the solids is critical for settling to be successfully deployed during the settling phase of the SBR cycle. Consequently, the operation of the SBR is constrained by the lack of this flexibility in mixed liquor inventory control.

The solution that was arrived at to this dilemma was to dose the mixed liquor with a specific type of polyaluminum chloride (PAX-14). This compound has the ability to inhibit the growth of *Microthrix* such that, while is it still remains in the system, it does not achieve a concentration that impedes mixed liquor settleability. A successful trial was conducted during the 2006-07 winter during which the sludge volume index (SVI – this is a measure of mixed liquor settleability where low values [<150 mL/g] are considered a reasonable settling performance) was reduced from very high values of 300+ mL/g to <150 mL/g. Although nitrification was not restored until the spring, a method of controlling settleability was successfully demonstrated. This paved the way to early application of PAX in the subsequent fall that prevented the growth of *Microthrix* and allowed nitrification to be maintained through the 2007-08 winter period for the first time since startup of the SBR. Seasonal PAX dosing has been practiced since that time and the Plant has managed to produce RW year round except for September 2009 and April-May 2010 until the past winter of 2010-11.

It was unseasonably cold during the Thanksgiving period of 2010, with the Plant experiencing much lower temperatures than normal. By Thanksgiving week, the mixed liquor temperature had fallen quickly to 110C, below the critical low temperature where nitrifier growth declines rapidly. Normally, Plant staff would have been building up mixed liquor inventory to elevate the SRT to prepare for such low temperatures that are typically not experienced until January. However, the inventory was not at the level to meet this low temperature demand with the result that nitrification was impeded significantly. Plant staff responded by increasing the period of aeration in the cycle and managed to maintain nitrification until the end of December 2010. A 4,000 gallon load of nitrifying sludge was brought from the Budd Inlet Plant in Olympia on February 18, 2011 to help re-seed the SBR with more nitrifiers. Unfortunately, the sludge also contained *Microthrix*, which caused the mixed liquor settling to deteriorate. No further sludge was brought into the Plant. The Plant staff continued to increase the period of aeration; but this action reduced the period of mixed non-aeration and denitrification began to decline until the residual nitrate-nitrogen caused the effluent TN to exceed the limit for RW production.

In late March 2011, Brown and Caldwell were asked to devise an approach to restoring nitrification. It was discovered that the waste activated sludge that was stored on site was nitrifying because it was housed in a covered tank that was not subject to the same cooling effect that the SBR cells are. A program of transfer of this sludge back to the SBR cells was initiated on April 15, 2011 so as to use these nitrifiers to seed growth in the SBR.

Another observation was that the waste sludge tank was limited in alkalinity. Alkalinity limitations will constrain the nitrification process causing the pH to decline to values < 6.0. This alerted staff to the possibility that the SBR was also limited with respect to alkalinity and subsequent analysis showed this to be the case. This had not come to light before because the system had not been stressed to the extent that it was during this period. To rectify this situation, lime was added to both the waste sludge tank and the SBR cells. Lime addition was initiated on March 8, 2011 at the rate of one-half bag per SBR; this rate was doubled two weeks later. Lime addition to the waste storage tank was initiated on April 15, 2011. These actions slowly induced nitrification in the SBR cells as can be seen in the decline in ammonia-nitrogen concentration in Figure 6-1.

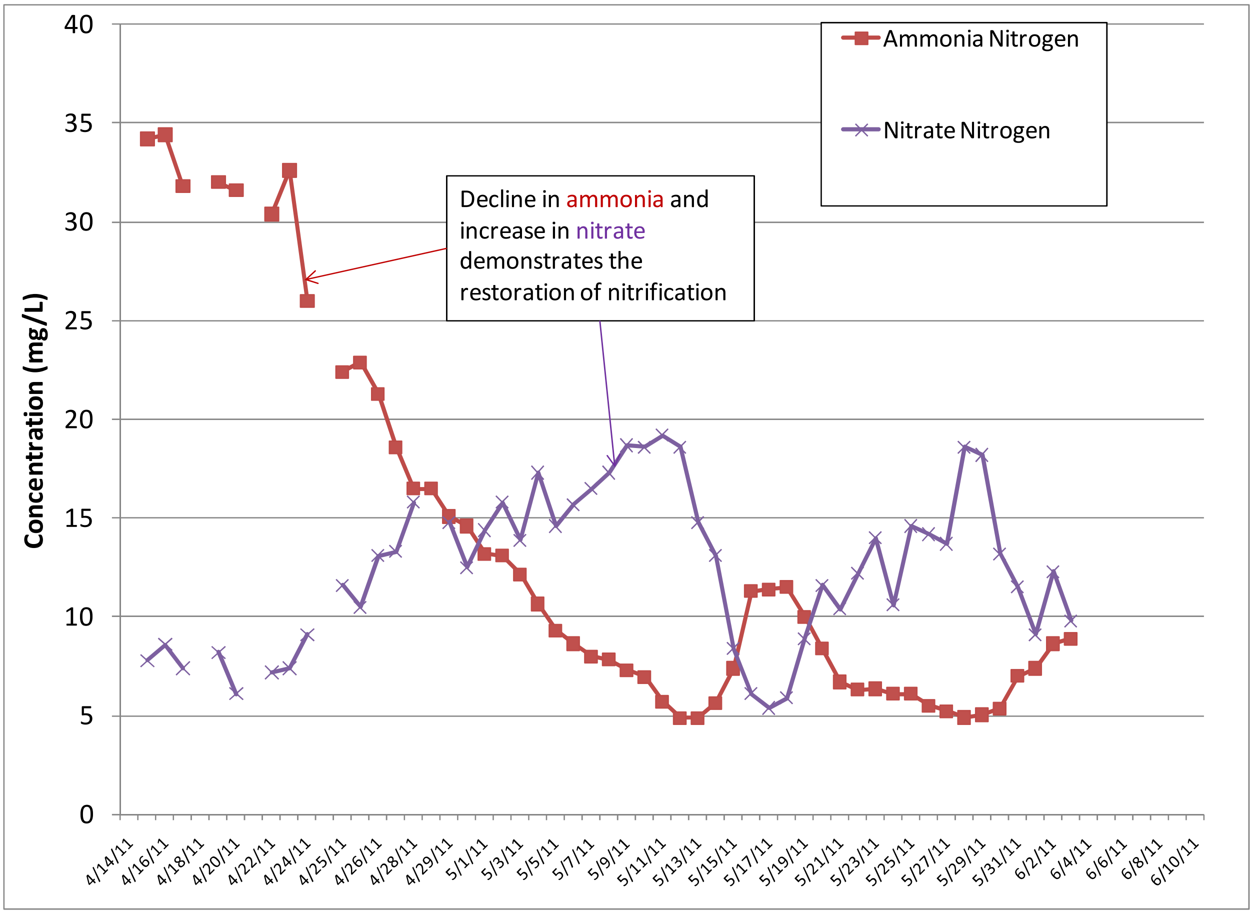

Figure 6-1. Re-establishment of Nitrification-Denitrification in the Yelm SBR

The recovery process took a long time because of the high SRT that the Plant was operating at and the low temperatures that persisted through the spring. The turnover of organisms at high SRTs is slow; the Plant SRT was approximately 30 days, which means that it takes 30 days to effect one turnover of the organisms. Also, the mixed liquor temperature persisted at below 120°C until the middle of April.

Why the Plant remained out of compliance even though the system was nitrifying well by the end of May was that there was still a significant level of nitrate remaining in the effluent. This was because the aeration period had been extended to favor the nitrifiers with the result that the denitrifiers did not have sufficient time to complete the reduction of nitrate. Subsequently, Plant staff continued to increase the mixed un-aerated fill period gradually while reducing the aeration period to bring them into normal bounds.

The extended period of time that the plant has experienced in returning to normal operating conditions prompted City staff to initiate a review of operational practices. BC was engaged to visit the plant to conduct such an inspection. With the above background information, the remainder of this report provides an analysis of the findings of this review and recommendations on ways to improve Plant operation.

7. PLANT VISIT – JUNE 7, 2011

Alan Smith, BC operations specialist and Henryk Melcer, BC senior process engineer, met with Jim Doty, Plant Superintendent and Tim Peterson, Public Works Director, at the Plant on June 7, 2011. The above Plant history was discussed as well as other operational issues outlined below. This was followed by a tour of the facility. In general, the condition of the facility is excellent. Good housekeeping is apparent and the equipment appears to be well maintained. The laboratory is well equipped to measure pertinent operational parameters such as BOD, TSS, mixed liquor solids, settling rate, and nitrogen species. The sludge dewatering area was impressive in its cleanliness.

7.1 Control of SBR Performance

The following subsections describe specific control aspects that Plant staff report impact the performance of the Plant.

7.1.1 Alkalinity

Alkalinity is essential to the process of nitrification because seven parts of alkalinity are required per part of ammonia oxidized. As alkalinity is used during this process, the residual concentration of alkalinity can decline to the point that the mixed liquor buffering capacity is reduced and the pH begins to decline. Alkalinity in the range of 50-80 mg/L as $CaCO3$ is a limiting condition for nitrification. The optimum pH for nitrification is 7.2. Historically, the Plant has operated in the range of pH 6.5 to 6.9, somewhat lower than optimum. Typically, alkalinity equilibrium is maintained by the denitrification process because approximately half of the alkalinity used during nitrification is given back during the denitrification process. Only when these two processes are not synchronous does the resulting alkalinity decline from an optimum value.

Historically, the Plant has maintained good performance in terms of the residual ammonia- and nitrate-nitrogen concentrations despite operating at a sub-optimal pH. Alkalinity measurements during the past two months have shown that the residual alkalinity has been at very low levels, which has compromised the process of restoring nitrification. This, in turn, has been difficult because of the emphasis on extending the aeration period to promote nitrification at the expense of reducing the period of non-aeration for denitrification. With the reduced level of denitrification, less alkalinity has been restored to the system.

A further operational issue that has contributed to the lower level of denitrification is the high oxygen concentration remaining in the mixed liquor once aeration has been turned off. The blower system has been designed without much flexibility to turn down the rate of aeration. This results in the residual oxygen concentration being raised to saturation, 8-10 mg/L, depending upon mixed liquor temperature. The time required to dissipate this excess oxygen reduces the time for the denitrification period and further reduces the amount of alkalinity recovered. Observation of DO trends on the computer screen showed this to be a concern.

Plant staff have looked for alternatives to blow off the excess air. The third SBR cell has been suggested as a possible location but it would need to be filled with water to the same operating level as the other SBR cells to provide sufficient head that would prevent loss of all the air to the third SBR. Given the propensity for algae growth in the treated effluent, this approach has not been used because of the difficulty of minimizing algae growth. Modifying the aeration blower configuration would minimize this effect and assist the plant in exercising dissolved oxygen control in the SBR. One approach might be to use the low speed blower setting that might reduce the rate of oxygen supplied to the aeration basin. If this is not successful, an alternative approach would be to purchase a small blower that would be more suited to the low oxygen demand of the influent (compared to the design loading) under current operating conditions. A third approach would be to investigate the blower control system to determine if the blowers could be turned off and on to control dissolved oxygen concentration. This approach would need an evaluation of the impact on the nitrification denitrification process, which can be done readily using computer simulation.

Other observations made during the tour that may impact mixed liquor alkalinity include the return of the backwash from the effluent filters and the filtrate from waste sludge dewatering to the head of the plant. A polyaluminum chloride coagulant is used to assist filtration. While the alkalinity demand of PAX compounds is small, there may be unused PAX that is returned to the head of the plant that could reduce the overall alkalinity of the influent wastewater. Plant staff measured the alkalinity of the waste sludge filtrate before lime addition and demonstrated that the alkalinity was very low, 20-30 mg/L as $CaCO_3$. While dewatering occurs only twice per week ordinarily, the filtrate is returned as a slug and will have a temporary depressing impact on the mixed liquor alkalinity. Measurement of the residual alkalinity and flow rates of these return streams would determine the extent to which they contribute to alkalinity reduction.

The Plant has a caustic soda delivery system that has not been used. It offers a method of supplementing alkalinity if this is what is determined to be required. Previously, in 2007, BC was asked to review causes of suspected RW corrosivity properties. At the time, preliminary calculations in the absence of data on specific anions and cations showed that adding a source of alkalinity such as caustic could minimize the corrosive properties of the RW but corroboration of this recommendation required measurement of the missing water characteristics. The matter was not taken any further at that time. Given the concern over a potential alkalinity shortfall and observations of corrosion of valves in the RW distribution system, it would seem prudent that a thorough analysis of the influent and RW chemistry be carried out.

The alkalinity of neither the influent nor the mixed liquor is measured on a regular basis. The permit calls for a monthly measurement of alkalinity of the disinfected RW and the treated effluent hardness is measured only on a monthly basis. Given the impact that alkalinity has been observed to have on the stability of the SBR, it would seem prudent to measure the treated effluent alkalinity on a regular basis; at least three times per week is recommended. The influent alkalinity too should be determined but given the stability of the STEP influent characteristics, once per month would be sufficient. The method of measurement is laborious so it might be more cost effective to use an online measurement of alkalinity for the treated effluent.

7.1.2 Ammonia- and Nitrate-Nitrogen

The NPDES permit calls for monthly measurements of ammonia- and nitrate-nitrogen concentrations of the disinfected RW. The Plant staff measure these parameters twice-weekly in the decant. Most plants measure these parameters on a more regular basis, usually daily or at least five days per week. This is because nitrification is viewed as a sensitive process that needs to be monitored closely. Given the extensive monitoring schedule called for in the permit, it might be more cost effective to monitor these parameters on an online basis than manually. The stability of the STEP influent characteristics suggests that a two-weekly determination of TKN (a measure of ammonia- and organic-nitrogen) would suffice to monitor the overall nitrogen load to the system.

7.1.3 Dissolved Oxygen Concentration and pH Instrumentation

The field instrumentation for measuring pH and DO concentration is more than 10 years old and does not appear to be reliable. Differences are observed between the measurements recorded by field instruments versus those with laboratory instruments. Weathering of face plates has rendered local observations in the field difficult. Spare parts are no longer available for these instruments. As has been indicated above, pH and DO control are critical to the success of nitrification/denitrification. Inaccurate measurement of pH and DO concentration reduces the operator’s ability to control these processes. It is recommended that these instruments be replaced with new ones that are more robust than the previous generation of instruments. Often a pH probe is available together with a reduction oxidation potential (redox) probe. The redox probe measures the oxidative state of the mixed liquor and provides clear indication to operational staff of the degree to which truly anoxic conditions are being achieved in the SBR cells. A packaged unit of pH and redox probes is recommended as a replacement of the existing pH probes.

7.1.4 Waste Sludge Management

Waste activated sludge produced by the SBR is directed to covered aerated storage basins on site prior to being dewatered and trucked off site for disposal. The covers prevent rapid cooling of the sludge as occurs in the SBR cells. Nitrification is not inhibited by temperature as it is in the SBR cells during the winter season. The waste sludge could serve as a source of nitrifiers in the event that a loss of nitrification that occurred this past winter is experienced again. Preserving nitrification would be improved if alkalinity could be controlled in the storage basins. The basins serve to effect partial aerobic digestion of the waste sludge during which cells are broken down to their constituent BOD and ammonia products of the digestion process. The release of ammonia stimulates more nitrification, which causes a rapid decline in alkalinity and then of pH. The City of Tacoma receives waste sludge from the Yelm Plant and has noted that the sludge pH is often <6.0. Measurements by Plant staff have confirmed the City of Tacoma's claims and have also shown alkalinity values as low as 20-30 mg/L as $CaCO_3$.

A simple way of controlling alkalinity is to impose an on-off aeration regime in the storage basins. During air off periods, denitrification occurs and returns sufficient alkalinity to the process to maintain an equilibrium condition. This is an established practice in aerobic sludge digester operation. The Plant lacks the control equipment to implement on-off control of the blower supplying air to the basins. Installation of such equipment would improve alkalinity control and ensure the availability of an emergency seed of nitrifiers for the SBR.

Other sources of nitrifier supplements include the City of Puyallup treatment plant, which operates a nitrification-denitrification activated sludge system on year-round basis.

7.1.5 Standard Operating Procedures

It became apparent during the visit that while Plant staff knew that certain procedures needed to be enacted at given times during the year, there was no written SOP in place. For example, it is necessary to build up sludge inventory in the fall in preparation for the high SRT operation that ensures nitrification can be sustained during the winter period. No written SOP is available nor is there a calendar reminder. Similarly, there is no SOP available to reverse the process in the spring, once *Microthrix* has dissipated, when sludge inventory can be reduced so as to minimize the aeration cost to maintain it. There are several operational procedures that would benefit the Plant staff to have SOPs put in place.

7.1.6 Mechanical Improvements

There were several instances of equipment that, while maintained, would benefit from replacement or upgrading so as to improve safety and/or operational efficiency. For example, the PAX delivery equipment was installed in 2007 on a temporary basis to demonstrate the viability of the PAX to control *Microthrix* growth. While the demonstration was successful, the temporary nature of the delivery equipment is still in place and should be permanently installed to provide improved reliability and a safe passage between the SBR cells and the blower building.

A second example is the pump for delivering PAX to the effluent filters. The pump seal is not suited to the PAX material. The PAX compound crystallizes and the crystals cause abrasion of the seals such that they need to be replaced every few months. An alternative pump that is tailored to this type of duty would eliminate the repetitive need for maintenance and improve reliability.

The field instrumentation and blower control in the waste sludge storage basins have been commented on above.

7.1.7 *Microthrix* Control

The control of *Microthrix* with PAX-14 has been described. While this control method has been successfully deployed over the past few years, it does not eliminate the occurrence of the *Microthrix* organism. Two non-chemical alternatives exist that will minimize the presence of the organism. The first uses scum removal equipment that is reliable. The current scum removal equipment provided by the SBR vendor is not reliable. Removal of scum and foam from the surface of the mixed liquor on a continuous basis will achieve an equilibrium condition in which the concentration of *Microthrix* is maintained at a very low level where it has no impact on mixed liquor settleability. This is referred to as a classifying selector approach to *Microthrix* control.

Another alternative is to waste the *Microthrix* from the system by operating at a low SRT. To do this, the reactor volume would need to be reduced to allow a lower sludge inventory to be carried. This may be feasible by dividing a SBR cell into two by placing a baffle wall across the center of a SBR cell. The operation of the SBR could be improved by placing another baffle wall at 900 to the influent flow thereby creating a biological selector cell. This approach utilizes the Australian version of the SBR technology called ICEAS (Intermittent Cycle Extended Aeration System). The computerized process model that is being developed could be used to simulate the effectiveness of this approach.

7.1.8 Staffing

The Plant staff have many duties to perform and have recently lost one member of their staff. Their duties include inspection of the STEP tanks as well as operating the treatment plant and completing the sampling, measurement and administrative duties associated with their permit. The staffing requirements of the facility will be reviewed to determine if they are adequate in the light of the loss of the most recent staff member as the General Sewer Plan is prepared.

7.1.9 Potential Sources of Toxicity

Nitrifying organisms are relatively sensitive to a wide range of compounds. The City provides a facility for recreational vehicles (RV) to dispose of their effluent at the Plant. This is an unsupervised facility and is a potential source of entry into the plant of materials that could be toxic to nitrifiers in the Plant. Given the importance of maintaining nitrification to produce reclaimed water, it may be prudent to examine the manner in which the RV waste is introduced to the Plant or whether it is a practice that should be continued.

8. BIOLOGICAL PROCESS SIMULATION

As part of this investigation, a biological process simulator was used to model the SBR so as to investigate the efficacy of alternative modes of operation of the SBR and provide Plant staff with “what if” simulations of operating conditions that led to loss of nitrification and what measures could be implemented to prevent loss or restore nitrification.

The BioWin simulator was used for this purpose. It is an industry standard commercially available from EnviroSim Ltd in Flamborough Ontario Canada and is widely used for activated sludge modeling work. It will model carbonaceous BOD removal, ammonia and nitrite oxidation and denitrification of nitrate.

The model was constructed to represent the operation of two SBR cells with lime addition and sludge wasting. Reactor dimension data were inputted to the simulator from data provided by Jim Doty. Because of the SBR reactor being a constantly changing system, it can only be modeled in a dynamic state. Diurnal variability in influent COD, TKN and TP was estimated from our understanding of the diurnal flow variability and limited characterization data on influent TKN, BOD, and total phosphorus. A flow schematic representation of the simulator model is given in Figure 8-1.

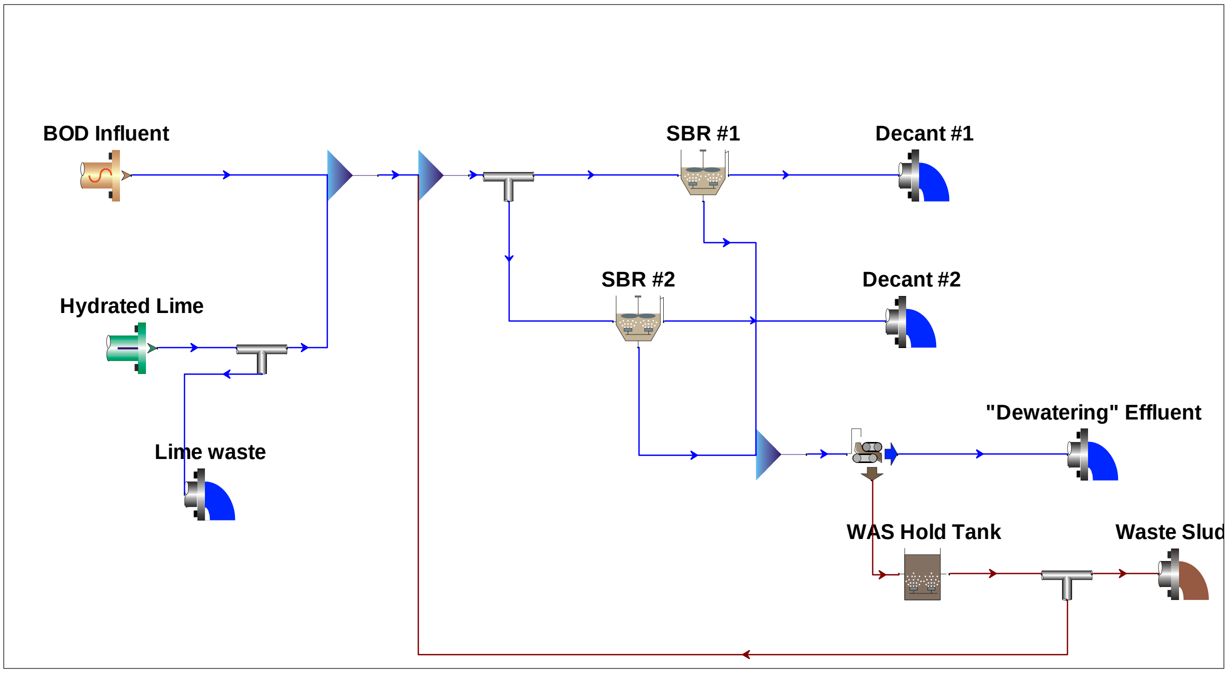

Figure 8-1. Flow Schematic Representation of the Simulation Model of the Yelm SBR

Modeling and data analysis are still in progress as of June 27, 2011 and will be finalized once a wastewater characterization is completed. Results of the modeling will be submitted to supplement this operational review.

9. RECOMMENDATIONS

Based on the findings of the visit and analysis of historical Plant data, the following are recommendations that will improve the operability and control of the Plant processes.

9.1 Standard Operating Procedures

Written standard operating procedures (SOPs) should be written for all major operations within the plant. This will ensure that correct procedures are followed in an emergency and that on-duty staff can implement tasks in the absence of staff that may have been responsible for a specific duty. Coupled to a calendar-based indicator, SOPs will ensure that they are implemented in time to meet weather-related changes such as building up solids inventory in the winter. A qualified WWTP operator should be assigned to the plant to review existing SOPs, identify any outstanding SOPs and then, with the Plant staff cooperation, write them and make them available in electronic and paper forms. This task could be implemented over the course of 4-6 weeks so as not to interfere significantly with the normal day's operational schedule.

9.2 Alkalinity Control

The dependence of Plant performance on alkalinity indicates that more frequent measurement be undertaken on a regular basis. Alkalinity should be measured at least three times per week in the SBR decant and at least once per month in the influent.

If it is determined that alkalinity addition is required on a regular basis, the existing caustic addition system should be inspected to assess if it can still be used and if not, what needs to be done in order to bring it into operation. Depending upon the results of the analysis of influent wastewater and RW, an alternative source of alkalinity other than caustic might be required to eliminate the corrosive nature of the RW. This will likely require alternative storage and metering than what is presently available.

9.3 Online Instrumentation

The importance of having timely knowledge of the SBR effluent ammonia- and nitrate-nitrogen concentrations has been identified above. They should be measured at least five times per week in the SBR decant. The influent nitrogen load, measured as TKN, should be measured at least twice per month. These measurements and the alkalinity measurements detailed above will add to the current load of analytical duties performed by Plant staff and warrants a cost benefit analysis of installing on-line monitors for these parameters versus increasing staffing at the Plant.

Replacement of online pH and DO probes, transmitters and meters should be undertaken to replace the aging current equipment. A redox probe should also be added to the pH probe assembly to assist in measuring the degree to which anoxic conditions are truly being achieved in the SBR cells.

There is likely to be merit in purchasing all the online instrumentation from one vendor since a greater degree of discount may be negotiated in such a purchase. Servicing of the probes will also be simpler with one vendor.

9.4 Wastewater and Reclaimed Water Characterization

To quantify the degree to which the Plant RW is corrosive, a more complete analysis of the RW should be undertaken than is currently required by the permit. This should include calcium and carbonate ions to allow the calculation of one of the indices (such as the Langelier or Ryznar indices) that will quantify the extent of corrosiveness and which anion or cation would need to be added to eliminate the corrosivity. This analysis will also define the level and type of alkalinity that will need to be allowed for in item 9.2.

To provide for a more accurate simulation model for the Plant, a one-time detailed wastewater characterization should be undertaken to fully calibrate the simulation model that was developed for the Yelm plant. Specific parameters that we have almost no information on include total COD, soluble COD, floc/filtered COD, total and soluble phosphorus, and total and soluble TKN. Of these, the most critical values are total and floc/filtered COD and soluble phosphorus. The approximate cost for this characterization is estimated to be $4,000.

9.5 Data Management

A significant amount of time is spent on recording operational and analytical data manually and electronically. These recommendations, if enacted, will generate even more data. To ensure timely recording and analysis of the performance data, development is recommended of spreadsheets that are linked to chronological plots and summary tables that would provide the operators of timely trending information upon which they could base more timely operational decisions.

9.6 Blower Control

The over-designed blowers have prevented Plant staff from implementing DO control since startup and have periodically been penalized by over-aeration that reduces the potential of fully utilizing the anoxic period to achieve full denitrification. If it is not feasible to modify blower control to allow one of them to operate at a slower speed, it is recommended that the City buy one small blower that can accommodate current oxygen demand and allow Plant staff to implement adequate control of the blower such that DO control can be achieved in concert with the concomitant energy savings that accrue from DO control. This investment will last for many years unless the City expects rapid population growth to occur in the next few years.

9.7 Mechanical Improvements

A more permanent installation should be carried out of the PAX delivery equipment that was temporarily installed in 2007 to provide improved reliability and a safe passage between the SBR cells and the blower building.

The effluent filter PAX delivery pump should be replaced with one that is suited to handling PAX to eliminate the repetitive need for pump seal maintenance and improve pump reliability.

9.8 Waste Sludge Management

Further to item 9.6, installation of on-off controls on the blower providing air to the waste sludge storage basins will allow control of alkalinity and pH of the waste sludge such that nitrifier growth can be maximized and the resulting nitrifiers can act as an emergency seed in the event of nitrifier loss in the SBR.

9.9 SBR Modeling

A model was constructed to simulate the operation of the SBR cells. The model has been useful in evaluating alternative operating strategies. The accuracy of the model can be improved by carrying out a more detailed wastewater characterization as described in 9.4 so that it can continue to provide support to Plant staff in trouble-shooting any operating problems and during training classes.

9.10 SBR Modification

The simulation model developed in 9.9 could be used to evaluate the potential for modifying the SBR cells so that they could be operated in a different mode. The ICEAS mode of operating SBRs was discussed above as an approach to overcome the over-design of the SBR and allow it to be operated with a lower mixed liquor inventory. The ICEAS technology provides a baffle that is located across the influent end of the SBR, thereby dividing the SBR into two components. The first part acts as a biological selector which is mixed but not aerated; denitrification is carried out in the selector. The other part of the SBR is aerated and serves as the nitrifying part of the SBR. This second part of the SBR is taken through several cycles of aeration and non-aeration to optimize the nitrification and denitrification process. The baffle also serves to prevent influent flow from mixing with the mixed liquor at the effluent end of the SBR and therefore permits decanting to occur while influent flows into the selector continuously. Operation in this manner allows one SBR cell to be operated continuously, which would allow the other two cells to be taken off line. This would reduce the reactor volume by two-thirds and bring it in line with the current loading experienced by the Yelm facility.

9.11 Operator Training

The SBR system, particularly when operated in a biological nutrient removal (BNR) mode is a complex process to operate. Training classes are recommended to allow the staff to gain an improved understanding of the SBR technology and of BNR technology. The simulation model developed in 9.9 would be used during training to simulate different operational scenarios and the impact of changes to operational parameters on effluent quality.

4C: DOE Inspection Report

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300

AUG 17 2011

August 15, 2011

The Honorable Ron Harding
Mayor, City of Yelm
105 Yelm Avenue West
Yelm, WA 98597

Re: Class I Inspection of the Yelm Water Reclamation Facility, National Pollutant Discharge Elimination System (NPDES) Permit No. WA0040762

Dear Mayor Harding:

Ecology conducted a class I (announced) inspection of the Yelm Water Reclamation Facility (WRF) on June 29, 2011. Few items need your attention:

- Although the WRF was operating well during my inspection, we are concerned about the frequent process upsets at the facility. We ask that the City investigate the issue quickly and thoroughly to find the cause and an appropriate remedy. Ecology understands that the city takes this problem seriously.
- The City should close the unmonitored RV dump station near the treatment plant. If the City wants to have this service, it should use a proper septage receiving station and develop a septage management program that includes sampling and monitoring. Hauled waste, if not controlled, can upset the treatment system of a POTW. At a minimum, the city should secure the RV dump station and allow its use only when plant staff is available to assist.
- It seemed there was confusion about reporting sanitary sewer overflows. The City should report all overflows from its collection system whether these overflows reached surface water or not.

Please see the attached inspection report for other findings and detail discussion. I would like to thank Jim Doty for his help and cooperation during the inspection.

If you have any questions, please contact me at 360-407-6318 or by email at mahbub.alam@ecy.wa.gov .

Sincerely,

Mahbub Alam, Ph.D., P.E.
Municipal Facility Engineer
Southwest Regional Office
Water Quality Program

Enclosure

cc: Jim Doty, Plant Manager, City of Yelm
Tim Petersen, Public Works Director, City of Yelm
Pat Bailey, Ecology

EPA

United States Environmental Protection Agency
Washington D.C. 20460

Water Compliance Inspection Report

Section A: National Data System Coding (i.e., PCS)

Transaction Code	NPDES	yr/mo/dy	Inspection Type	Inspector	Facility Type
1 N 5	WA0040762	110629	C	S	1

Remarks

21 | | 66

Inspection Work Days	Facility Self-Monitoring Evaluation Rating	B1	QA	Reserved	
67 4.5 69	70 4	71 N	72 N	73 74	75 80

Section B: Facility Data

Name and Location of Facility Inspected *(For industrial users discharging to POTW, also include POTW name and NPDES permit number)* City of Yelm Water Reclamation Facility 931 N. P. Road Yelm, WA 98597	Entry Time/Date 9:30 am 06/29/2011	Permit Effective Date 08/01/2011
	Exit Time/Date 1:15 pm 06/29/2011	Permit Expiration Date 07/31/2016
Name(s) of On-Site Representative(s)/Title(s)/Phone and Fax Number Jim Doty Plant Manager Phone: 360-458-8411; Fax 360-458-8166	Other Facility Data *(e.g., SIC NAICS, and other description information)*	
Name, Address of Responsible Official/Title/Phone and Fax Number The Honorable Ron Harding, Mayor 105 Yelm Avenue West, Yelm, WA 98597 Phone: 360-458-8401; Fax: 360-458-4348 Contacted ☐ Yes ☒ No		

Section C: Areas Evaluated During Inspection *(Check only those areas evaluated)*

☒ Permit	☒ Self-Monitoring Program	☐ Pretreatment	☐ MS4
☒ Records/Reports	☐ Compliance Schedules	☐ Pollution Prevention	
☒ Facility Site Review	☒ Laboratory	☐ Stormwater	
☐ Effluent/Receiving Waters	☒ Operations & Maintenance	☐ Combined Sewer Overflow	
☐ Flow Measurement	☒ Sludge Handling/Disposal	☐ Sanitary Sewer Overflow	

Section D: Summary of Findings/Comments

(Attach additional sheets of narrative and checklists, including Single Event Violation codes, as necessary)

The following are the conclusions and recommendations of the inspection. See the narrative report for details.

1. The POTW was operating well during my inspection. The final effluent looked clear.

2. Ecology is concerned that Yelm WRF is not able to meet total nitrogen and ammonia limits consistently. Ecology strongly recommends that the City investigate the issue quickly and thoroughly to find the cause and an appropriate remedy. Ecology understands that the city takes this problem seriously.

3. The City should close the unmonitored RV dump station near the treatment plant. If the City wants to have this service, it should use a proper septage receiving station and develop a septage management program that includes sampling and monitoring. Hauled waste, if not controlled, can upset the treatment system of a POTW. At a minimum, the city should secure the RV dump station and allow its use only when plant staff is available to assist.

4. Records review indicated Yelm does not keep all required information on sampling events and analysis of samples collected. Records must contain all necessary information as required by permit section S3.C.

5. The City should prepare a document that contains all POTW staff's full name and their initials so that these can be easily cross-referenced.

6. The City keeps loose records in a file folder that could be easily lost or removed. Yelm should use notebooks or bound loose records to ensure appropriate recordkeeping.

7. The operation & maintenance had no Ecology seal of approval. The City agreed to look for the Ecology approval

letter in the file. If Ecology has not reviewed and approved the O&M manual, the City will need to send one for Ecology approval.

8. The influent and effluent sampling refrigerator had thermometers but no temperature logs. The City should keep a temperature log for each refrigerator in service.

9. It was not clear how Yelm WRF is measuring effluent for different discharge options. Mr. Doty agreed to send me a flow schematic describing different flow paths and their measurement.

10. The City should inspect commercial customers for proper operation and maintenance of the pretreatment devices such as grease interceptors.

11. It seemed there was confusion about reporting sanitary sewer overflows. The City should report all overflows from its collection system whether these reached surface water or not. See permit section S3.E for details.

Verify Latitude and Longitude		☒ Announced ☐ Unannounced
Name(s) and Signature(s) of Inspector(s) Mahbub Alam, Ph.D., P.E.	Agency/Office/Hone and Fax Numbers Ecology/SWRO (360) 407-6318	Date 8/3/14
Signature of Management A Q Reviewer Gregory S. Zentner, P.E.	Agency/Office/Phone and Fax numbers Ecology/SWRO (360) 407-6368	Date 8/4/2011

EPA FORM 3560-3 (Rev 1-06) Previous editions are obsolete

Narrative Inspection Report

Introduction

The City of Yelm (City) owns and operates a publicly owned treatment works (POTW) that produces Class A reclaimed water from municipal wastewater. A portion of the reclaimed water is used for beneficial purposes such as irrigation and ground water recharge while the rest of the reclaimed water is discharged to the Centralia Power Canal.

On June 29, 2011, I performed an inspection of the POTW. I called the POTW a week before the inspection and spoke with Randy Hatch, an Operator of the Plant, to let him know that I would inspect the facility on June 29, 2011.

Purpose & Scope

The purpose of this inspection was to review the treatment facility for proper operation and maintenance and compliance with the national pollutant discharge elimination system (NPDES) permit.

Opening Conference

I arrived at the site at 9:30 am. I introduced myself to Aris McClelland, a Group II Operator, who was present in the laboratory/office building. After a few minutes, plant Manager Jim Doty along with Public Works Director Tim Petersen came inside the building. After introductions, Mr. Petersen left the site but asked me to contact him if I had any questions for him later in the day.

At the beginning, I explained the inspection process to Mr. Doty and discussed what to expect throughout the inspection. He accompanied me throughput the inspection. Later I met two other operators Bob Rhoades (Group III) and Randy Hatch (Group III) in the laboratory.

Inspection Organization

We sat down in the lunch/conference area where I did a Q&A session and reviewed documents/reports as necessary. I provided an opportunity for the staff to ask questions about their facility, permit, and any other issues. I later made a walk through inspection of the facility. After the walk-through, I discussed our findings with Mr. Doty in a closing conference. I told him that I would prepare a written report of the inspection and send a copy the report to the City.

POTW Treatment Process

The City of Yelm water reclamation facility (WRF) is an advanced wastewater treatment facility that produces Class A reclaimed water (RW). The City has a STEP (septic tank effluent pumping) collection system where wastewater treatment begins at the individual sites with septic tanks. Septic tank effluent is pumped to the City's main treatment facility. The City uses sequencing batch reactors (SBRs) for secondary treatment and nitrogen removal. Secondary effluent is filtered and then disinfected with chlorine to produce reclaimed water.

Sludge generated from the SBRs goes to an aerated holding tank. A gravity belt thickener (GBT) thickens the sludge before hauling offsite for further treatment.

The plant is an EPA minor facility designed for a maximum month flow of 1.0 mgd. It serves a population of 6848[1].

Records Review

Before the inspection, I reviewed the POTW Permit, Application, Fact Sheet, and results of the previous inspection. There were no outstanding issues with this facility from the previous inspection.

I asked Mr. Doty to provide a copy of the current NPDES permit, monthly DMRs for the last two years, and other reports required by the permit. He brought the records to the conference room. I found Yelm has submitted all permit required reports during this timeframe. Mr. Doty keeps the records/reports in his office.

DMR data indicated the facility was out of compliance with total nitrogen and ammonia since December 2010. Yelm WRF laboratory staff Aris McClelland showed me recent lab test results that show ammonia levels below 1.0 and nitrate levels below 10. The facility needs to meet the total nitrogen level (less than 10 mg/L) in the effluent to make reclaimed water. As of writing this report, Yelm managed to produce reclaimed water for about two weeks before it fell into another upset situation.

These upsets, one of which lasted for more than 6 months, raised questions about the facility's performance and ability to meet the total nitrogen limit in the future, especially during winter months. I had prior conversations with Plant Manager Mr. Doty about the upset and its cause. The plant staff tried process control including adjusting SBR cycle times to the extent possible and alkalinity addition without any luck. They tried seeding

[1] Source: 2010 Annual treatment facility review report (wasteload assessment), dated April 26, 2011.

with nitrifier bugs in the past without any improvement. So the staff did not try nitrifier seeding this time. They thought spring season temperature, which was lower than normal this year was the culprit. Mr. Doty told me the City has taken the following steps to tackle the nitrogen removal issue in the future.

1. The City has contracted with a consultant, Brown & Caldwell, to do a performance analysis including process modeling of its wastewater treatment system. Brown & Caldwell will prepare an engineering report following its evaluation. Mr. Doty will provide a copy of the report to Ecology.

2. The City has started the process of updating its general sewer plan/comprehensive sewer plan, which would incorporate the findings of the wastewater treatment system evaluation study. Brown & Caldwell was hired to do the update. Mr. Doty expects that the process of updating will take 18 months starting in April this year. The previous general sewer plan was prepared in 1994 and it was followed by a facility plan in 1995 to construct the existing WRF.

Records review indicated that Yelm does not maintain a sample collection form/chain of custody for analyzing samples in-house. Bench sheets did not show the following: person taking sample, time of sampling, method of sampling, and analysis method. I recommended that Yelm develop an internal chain of custody/sample collection form to document the sample collection process and reference the sample ID in the bench sheets for analysis of various parameters. The records should identify the following: date of sampling, time of sampling, place of sampling, method of sampling, person taking sample, preservation method (if applicable), date of analysis, analysis method, person doing analysis, and results of analysis. See permit section S3.C for details on recording of results.

Yelm WRF staff use initials instead of full names on POTW records. While this practice is OK, it cannot identify a person without a cross-reference. The City should prepare a document that contains all staff's full name and their initials so that these can be easily cross-referenced.

The City keeps loose records (bench sheets, calibration sheets, temperature logs) in a hanging file folder. These records could be easily lost or removed. Yelm should use bound notebooks for these types of records to ensure appropriate recordkeeping. The City can also assemble all loose records for a month/year (as appropriate) and bind them together for permanent storage and retrieval.

Operation & Maintenance

Yelm WRF has an operation and maintenance (O&M) manual dated 1999. The manual seems to be complete but I could not find any Ecology approval seal or letter. Mr. Doty agreed to look for the Ecology approval letter in his file. If Ecology has not reviewed and approved the O&M manual, the City will need to send one for Ecology approval.

The City uses "equipment O&M regulator", a task based application on Microsoft Outlook platform, to track preventive maintenance activities. Preventive maintenance includes daily cleaning, weekly and seasonal maintenance, and routine calibration. Staff prints the task sheet for each maintenance activity. When the task is complete, staff signs, dates, and stores the sheet in the file. All the treatment components appear to be in a state of good repair. The plant staff keeps spare parts on hand for immediate replacement. The plant has redundancy on each equipment to meet RW redundancy requirements.

For standby power, Yelm has a 500 kW generator that can run the essential treatment components without disrupting the reclaimed water production.

The City has four certified operators (one Group IV, two Group III, and one Group II) to run the facility. The staffing level is up to the requirements of the O&M manual. Operators' certifications were posted in the wall.

No emergencies have occurred in/near the facility during the last five years.

Sludge and Solid Waste Handling & Disposal

There is no screening of influent wastewater at the treatment facility as the City uses a STEP collection system. Large objects and solids are removed at individual septic tanks. The City owns and maintains the septic tanks. Staff checks the scum and sludge level in each septic tank routinely. When necessary (more than 24 inches of sludge or more than 12 inches of scum), a septage hauler under contract with the City pumps the sludge for treatment and disposal at a different facility.

Secondary sludge generated from the biological treatment process goes to an aerated storage. The sludge is thickened with a gravity belt thickener (GBT) to about 5% solids. Thickened sludge goes to the City of Tacoma Central Treatment Plant for further digestion and treatment. Yelm has a biosolids general permit from Ecology's Waste 2 Resources Program and provides an annual report.

The POTW does not accept septic tank sludge but it takes recreational vehicle (RV) wastes (one type of septage) at a dump station near the facility. I was surprised to learn that the dump station is not secured and monitored. Yelm provides this free service to its citizens. While this may be a good gesture from the City to its citizens, it is a dangerous practice and it poses serious risk to the POTW and its treatment system. If septage addition is not properly controlled, there is a potential for plant upset. Note that Yelm WRF is experiencing frequent upsets sometimes lasting for more than 6 months.

Ecology is asking the City to stop this uncontrolled practice voluntarily. If the City wants to keep the service, it should use a proper septage receiving station to control the load to the treatment system. It should develop a comprehensive septage management program (SMP) that includes records of septage sources and volumes, and routine sampling of septage loads. The SMP can deter septage haulers from discharging inappropriate materials, such as industrial wastes, and can assist in determining the source of the load if an upset occurs in a subsequent treatment process. Operators can also prevent the discharge of illegal wastes by observing the odor, color, and appearance of the load. For guidance, see the following 1994 EPA handbook: *Guide to Septage Treatment and Disposal, Publication number EPA/625/R-94/002, Office of Research and Development, Washington DC 20460.* At a minimum, the city should secure the RV dump station and allow its use only when plant staff is available to assist.

In addition, Yelm should develop a cost recovery system for the septage management program.

Facility Site Review

After the records review and Q/A session, I made a walk-through inspection of the facility. The weather was cloudy with a temperature in the 60s. The level of odor in the WRF compound was very low or non-significant.

Influent wastewater comes to a covered chamber for temporary storage before it is pumped to one of the SBR tanks' fill cycle. There are no screens at the headworks. A magnetic flow meter measures the influent flow and connects to a totalizer.

Influent samples are collected from the discharge pipe on a flow-paced interval. On a composite sampling day, an operator turns on the sampler between 8 and 8:30 in the morning and turns off the sampler the next day around the same time. Mr. Doty noted the sampler has automatic functions. I asked whether he could set up the sampler from 12 AM to 12 AM next day for a correct sampling period. Mr. Doty said he would look into the matter.

I looked into the sampling refrigerator. The inside temperature of the refrigerator was 2 degrees Celsius, a thermometer indicated. There was no temperature log. I asked Mr. Doty to record the inside temperature in a bound logbook.

The wastewater moved into the sequencing batch reactors (SBR) for biological treatment. There were three SBR tanks, two of which were in operation. One cycle of the SBR treatment system takes about 6 hours and 10 minutes. The cycle time consists of the following phases: anoxic fill, aerated fill, react, settling, decant, sludge wasting, and Idle time. One tank was in anoxic fill phase while the other was in settling phase.

Mr. Doty always runs two SBR tanks and has not run three tanks together. Given the amount of flow and wasteload (less than 50% of design), it may be appropriate to run only two tanks. However, the last December's upset has put a dent on the plant's ability to do nitrogen removal in the winter. The issue is very important as the plant took six months to recover from the upset. Whether adding a third basin and increasing cycle times with more time for aeration and anoxic fill would have made a difference, remains an open-ended question. Surely, Yelm needs to investigate and explore other options so that it can meet nitrogen limits year round.

I saw a fair amount of foam floating in the SBR tanks. Mr. Doty told me the skimmers designed to remove foam during settling do not work well. Foam does not go with the decanted flow because the water is drawn from two feet below the top level. The minimum water level in the tank was 15 feet and the top level was 18 feet. Fine bubble diffusers at the bottom supplied process air to the mixed liquor suspended solids (MLSS) while two mixers kept the MLSS in suspension.

Secondary effluent from the SBR treatment process goes to an equalization basin. Air is supplied to increase the DO of the effluent. The processed wastewater is filtered with a Dynasand filter (Parkson Corporation). Yelm uses an upflow model, which is continuously cleaned and backwashed. There were three units but only one was in operation given the volume of flow. Staff uses PAC (poly aluminum chloride) as a coagulant to aid flocculation before filtration. Operators are happy with the performance of the filters. The last known incident occurred in 2005 when the WRF had to bypass a filter for repair.

I inspected the solids thickening and chemical storage building. The gravity belt thickener concentrated sludge to about 5% as noted by Mr. Doty. The odor level was low. The surrounding room had several tanks for chemical storage, one of which contained PAC for filter coagulant and microthrix control. One tank was for caustic soda feed system which is not used. The chlorine gas used for disinfection is stored in 150 lbs cylinders in the adjacent building. The facility also uses sulfur dioxide gas cylinders for dechlorination.

Filtered effluent travels all the way to a location near the headworks for disinfection. Yelm WRF uses chlorine gas for disinfection and for maintaining residual chlorine in the

RW supply line. There were two chlorine contact basins, one of which was in operation. The chlorine contact tanks were covered with black cloth to prevent photo-reactivation of coliform bacteria. This setup also cools the effluent during summertime for river/canal discharge.

If the disinfected effluent meets reclaimed water standards, it can be pumped to a RW distribution line for immediate use or to a 500,000 gallons RW storage tank when there is less or no demand. The excess reclaimed water not used for beneficial purposes or effluent not meeting class A RW standards go over a V-notch weir for Centralia Power Canal or Nisqually River discharge. There are several magnetic flow meters and a V-notch weir to measure the flow. It was complicated to understand how effluent flow was routed for different discharge options and how it was accounted for. Mr. Doty agreed to send me a flow schematic describing different flow paths and their measurement.

Due to difficulty in meeting total nitrogen limit in the final effluent, Yelm could not produce reclaimed water for beneficial use for more than six months. Staff just started using reclaimed water the day before the inspection when they met the total nitrogen limit. As of writing this report, Yelm had to stop production of reclaimed water due to an increase in nitrogen (ammonia) level in the effluent. This recurring event (loss of nitrification) is a concern to us. Ecology recommends that the City investigate the matter quickly and thoroughly to find the cause and an appropriate remedy. Ecology understands that the city takes this problem seriously.

When the city is discharging to surface water, it needs to remove residual chlorine from the effluent. The facility has a sulfonator feed system that uses sulfur dioxide solution in the discharge pipe to remove the residual chlorine before discharge. Since the dechlorination reaction is very quick, there is no need for separate detention tanks. The City takes samples from the discharge pipe to verify the dechlorination process.

Yelm has several locations for sampling effluent depending on discharge options. The 24-hour composite sampling point is after the chlorine contact chamber where samples are collected on a flow-paced interval. Similar to influent sampling, an operator turns on the sampler between 8 and 8:30 in the morning and turns off the sampler the next day around the same time. I asked Mr. Doty whether he could set up the sampler from 12 AM to 12 AM next day for a correct sampling period as with the influent sampler. Mr. Doty agreed to explore the option.

I looked into the sampling refrigerator. Similar to influent sampling, there was a thermometer inside the refrigerator but there was no temperature log. I asked Mr. Doty to record the inside temperature in a bound logbook.

Laboratory

The POTW has an Ecology accredited laboratory where staff perform analysis of most permit required monitoring and other process control tests. Mr. Doty showed me the accreditation, which was current. All lab instruments were serviceable. Staff keep calibration records for scales, pH meter, thermometer, and different probes. However, they did not maintain temperature logs for refrigerators and incubators. I told them to keep temperature logs for all temperature sensitive instruments. I suggested that they use a bound notebook for all calibration records and temperature logs.

The laboratory area appeared clean and had adequate counter space and sinks. Chemicals were properly stored. Lab ware, sampling bottles, tubing, and equipment appeared to be clean.

Staff sometimes run ammonia test in duplicate with the same sample for QA/QC but they never tried splitting samples with an outside-accredited lab. It may be a good idea to split samples with an outside lab and run samples in duplicates/triplicates to improve QA/QC of the POTW lab.

The City contracts with an outside laboratory for total nitrogen, priority pollutant metals and organics, and bioassay testing. Priority pollutants records show chain of custody and other necessary information.

Pretreatment

Yelm does not have a delegated pretreatment program. There are no industrial discharges but there are some commercial and business customers in the service area. General pretreatment provisions apply to these dischargers. The industrial user survey (IUS) was done in 2008 and it is reviewed every year. The POTW becomes aware of a new industry when a new sewer customer requests for connection.

The City has a grease ordinance that requires grease traps/interceptors for new restaurants. Only new installations are inspected but existing installations are not checked for proper operation and maintenance. The City should develop a program that requires regular inspection. Mr. Doty noted the new general sewer planning process would have a new updated pretreatment program.

Stormwater and I/I

The City has a STEP collection system that consists of small diameter forcemains (1-inch and 2-inch) installed in shallow depths. These small diameter pressure lines join a sewer main that increases to a 10-inch line before entering the treatment plant. Given the type of the collection system, Yelm does not experience inflow and infiltration (I/I) that can be present in a gravity sewer system. As long as the septic tanks are free from leaks and other extraneous flows such as roof drain and sump pump, I/I are minimal. The City's 2010 I/I report showed no correlation of WWTP flow and rainfall[2].

CSO/SSO

The City has a separate sanitary sewage collection system so there are no combined sewer overflow (CSO) points. It has a collection system maintenance program that includes maintenance of septic tanks (checking sludge depth, pumping of septage), and STEP pumps. The City contracts with a septage hauler to pump the sludge from the septic tanks. The septage does not go the Yelm WWTP rather it goes to a different septage treatment facility at the haulers discretion.

There are possibilities of sanitary sewer overflows (SSO) due to leaks in the pressure main or failure of STEP pump system. In my file review, I found no SSO notifications from the Yelm sewer system in the last 3 years. When asked about SSO notifications Mr. Doty remembered an SSO event around a house in Fall 2010 when the septic tank overflowed. This happened because the STEP pump power was connected to a bank owned property, which had no power. But the septic tank was getting flow from another house. It is common in Yelm to have two houses share a single septic tank. The City corrected the problem by putting back power on the pump and cleaned the affected area. Ecology was not notified of the SSO event. I told Mr. Doty that it was a reportable event and directed him to review permit section S3.E. In the future, Yelm must report SSOs per the permit and submit a written report within five days.

Closing Conference

At the end, I discussed my inspection findings with Mr. Doty. The facility was running well but some issues needed the City's attention. I told him that he should get a written inspection report from Ecology in next few weeks.

Mr. Doty had no other questions or concerns. I left the facility at 1:15 pm.

Conclusions and Recommendations

1. The POTW was operating well during my inspection. The final effluent looked clear.

2. Ecology is concerned that Yelm WRF is not able to meet total nitrogen and ammonia limits consistently. Ecology strongly recommends that the City

[2] Source: 2010 Annual Inflow and Infiltration Report, dated April 25, 2011.

investigate the issue quickly and thoroughly to find the cause and an appropriate remedy. Ecology understands that the city takes this problem seriously.

3. The City should close the unmonitored RV dump station near the treatment plant. If the City wants to have this service, it should use a proper septage receiving station and develop a septage management program that includes sampling and monitoring. Hauled waste, if not controlled, can upset the treatment system of a POTW. At a minimum, the city should secure the RV dump station and allow its use only when plant staff is available to assist.

4. Records review indicated Yelm does not keep all required information on sampling events and analysis of samples collected. Records must contain all necessary information as required by permit section S3.C.

5. The City should prepare a document that contains all POTW staff's full name and their initials so that these can be easily cross-referenced.

6. The City keeps loose records in a file folder that could be easily lost or removed. Yelm should use notebooks or bound loose records to ensure appropriate recordkeeping.

7. The operation & maintenance had no Ecology seal of approval. The City agreed to look for the Ecology approval letter in the file. If Ecology has not reviewed and approved the O&M manual, the City will need to send one for Ecology approval.

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10. The City should inspect commercial customers for proper operation and maintenance of the pretreatment devices such as grease interceptors.

11. It seemed there was confusion about reporting sanitary sewer overflows. The City should report all overflows from its collection system whether these reached surface water or not. See permit section S3.E for details.

4D: Effluent Metals Sampling Data

4E: Not Used

4F: RIVPLUM6 Results

RIVPLUM6

Spread of a plume from a point source in a river with boundary effects from the shoreline based upon the method of Fischer et al. (1979) with correction for the effective origin of effluent.

Revised 17-Oct-2007

INPUT	Max Day Flow (Acute)	Max Month Flow (Chronic)	Plume Width Limitation for Chronic Condition (19.7 feet) Max Month Flow (Chronic)
1. Effluent Discharge Rate (MGD):	1.48	1.22	1.22
1. Effluent Discharge Rate (cfs):	2.29	1.89	1.89
2. Receiving Water Characteristics Downstream From Waste Input			
Stream Flow (cfs):	370	370	370
Stream Flow + Effluent Discharge Rate (cfs):	372.29	371.89	371.89
Stream Depth (ft):	1.83	1.83	1.83
Stream Velocity (fps):	1.80	1.80	1.80
Channel Width (ft):	113.0	113.0	113.0
Stream Slope (ft/ft) or Manning roughness "n":	0.025	0.025	0.025
0 if slope or 1 if Manning "n" in previous cell:	1	1	1
3. Discharge Distance From Nearest Shoreline (ft):	12	12	12
4. Location of Point of Interest to Estimate Dilution			
Distance Downstream to Point of Interest (ft):	30.15	301.5	127.5
Distance From Nearest Shoreline (ft):	12	12	12
5. Transverse Mixing Coefficient Constant (usually 0.6):	0.6	0.6	0.6
6. Original Fischer Method (enter 0) or *Effective Origin* Modification (enter 1)	1	1	1

OUTPUT			
1. Source Conservative Mass Input Rate			
Concentration of Conservative Substance (%):	100	100	100
Source Conservative Mass Input Rate (cfs*%):	229	189	189
2. Shear Velocity			
Shear Velocity based on slope (ft/sec):	#N/A	#N/A	#N/A
Shear Velocity based on Manning "n": using Prasuhn equations 8-26 and 8-54 assuming hydraulic radius equals depth for wide channel			
Darcy-Weisbach friction factor "f" (ft/sec):	0.059	0.059	0.059
Shear Velocity from Darcy-Weisbach "f" (ft/sec):	0.155	0.155	0.155
Selected Shear Velocity for next step (ft/sec):	0.155	0.155	0.155
3. Transverse Mixing Coefficient (ft2/sec):	0.170	0.170	0.170
4. Plume Characteristics Accounting for Shoreline Effect (Fischer *et al.*, 1979)			
Co	0.615	0.508	0.508
x'	0.000235	0.002240	0.000952
y'o	0.10619	0.10619	0.10619
y' at point of interest	0.10619	0.10619	0.10619
Solution using superposition equation (Fischer eqn 5.9)			
Term for n= -2	0	0	0
Term for n= -1	0	1.3369E-194	0
Term for n= 0	1.00000	1.00651	1.00001
Term for n= 1	0	1.3076E-155	0
Term for n= 2	0	0	0
Upstream Distance from Outfall to *Effective Origin* of Effluent Source (ft)	1.626	1.107	1.107
Effective Distance Downstream from Effluent to Point of Interest (ft)	31.776	302.607	128.607
x' Adjusted for *Effective Origin*	0.000235	0.002240	0.000952
C/Co (dimensionless)	18.393	5.999	9.143
Effluent Concentration at Point of Interest (Fischer Eqn 5.9)	11.312	3.045	4.640
Unbounded Plume Width at Point of Interest (ft)	9.804	30.254	19.723
Unbounded Plume half-width (ft)	4.902	15.127	9.862
Distance from near shore to discharge point (ft)	12	12	12
Distance from far shore to discharge point (ft)	101	101	101
Plume width bounded by shoreline (ft)	9.80	27.13	19.72
Approximate Downstream Distance to Complete Mix (ft):	43168	43168	43168
Theoretical Dilution Factor at Complete Mix:	162.6	197.0	197.0
Calculated Flux-Average Dilution Factor Across Entire Plume Width:	14.1	47.3	34.4
Calculated Dilution Factor at Point of Interest:	8.8	32.8	21.6
Volumetric Calculation	5.04	50.01	50.01

4G: Reasonable Potential Analysis

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
1-Jan-06	11		9.3	7.2			0.01	
2-Jan-06	12		8.6	7.3			0.03	
3-Jan-06	11		8.9	7.4			0.01	7.2
4-Jan-06	10		9	7.3			0.02	
5-Jan-06	12		8.9	7.3	68.6		0.01	
6-Jan-06	13		7.8	7.2			0.02	
7-Jan-06	13		8.1	7.2			0.02	
8-Jan-06	10		9.2	7.3			0.02	
9-Jan-06	11		9.3	7.3			0.04	
10-Jan-06	12		9.5	7.4			0.03	
11-Jan-06	11		9.8	7.3			0.02	
12-Jan-06	10		10	7.3			0.01	
13-Jan-06	11		10.4	7.4			0.02	8.7
14-Jan-06	11		10.2	7.6			0.02	
15-Jan-06	10		10.2	7.4			0.01	
16-Jan-06	10		10.3	7.6			0.01	
17-Jan-06	11		10.4	7.6			0.02	
18-Jan-06	10		10.8	7.6			0.03	
19-Jan-06	10		10.6	7.7			0.02	
20-Jan-06	13		10.3	7.7			0.01	7.1
21-Jan-06	11		11.2	7.7			0.01	
22-Jan-06	10		10.4	7.7			0.03	
23-Jan-06	11		10.4	7.8			0.01	
24-Jan-06	10		9.8	7.5			0.01	
25-Jan-06	10		10.4	7.8			0.01	
26-Jan-06	9		10.3	7.6			0.02	
27-Jan-06	11		10.3	7.8			0.02	
28-Jan-06	10		10.5	7.9			0.02	
29-Jan-06	10		10.6	7.3			0.01	
30-Jan-06	12		9.7	7.8			0.03	4.6
31-Jan-06	11		9.6	7.8			0.02	
1-Feb-06	10		9.9	7.6			0.01	
2-Feb-06	11		10	7.8			0.01	
3-Feb-06	10		9.8	7.8			0.02	
4-Feb-06	10		9.7	7.2			0.01	
5-Feb-06	10		10.1	7.4			0.03	
6-Feb-06	9		10.1	7.3			0.01	1.4
7-Feb-06	9		10.1	7.3			0.01	
8-Feb-06	10		9.8	7.4			0.03	
9-Feb-06	10		9.3	7.3			0.01	
10-Feb-06	10		9.4	7.3			0.01	0.85

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
11-Feb-06	9		10.2	7.4			0.02	
12-Feb-06	9		9.3	7.3			0.02	
13-Feb-06	10		8.6	7.3	75.7	136	0.02	
14-Feb-06	10		8.1	7.3			0.01	
15-Feb-06	8		8.4	7.3			0.02	
16-Feb-06	9		8.6	7.4			0.01	
17-Feb-06	8		8	7.3			0.02	
18-Feb-06	7		8.2	7.4			0.01	
19-Feb-06	6		9	7.5			0.02	
20-Feb-06	8		9.4	7.4			0.02	
21-Feb-06	8		8.2	7.3			0.02	
22-Feb-06	9		8.2	7.3			0.01	
23-Feb-06	10		7.7	7.3			0.03	
24-Feb-06	10		7.7	7.3			0.02	
25-Feb-06	9		6.9	7.4			0.02	
26-Feb-06	9		8	7.3			0.03	
27-Feb-06	11		7.1	7.3			0.01	
28-Feb-06	10		6.9	7.3			0.04	
1-Mar-06	10		7.1	7.3			0.03	
2-Mar-06	11		6.8	7.4			0.02	
3-Mar-06	10		7.5	7.4			0.02	10.1
4-Mar-06	11		7	7.4			0.02	
5-Mar-06	11		6.8	7.3			0.02	
6-Mar-06	11		6.4	7.3			0.02	8
7-Mar-06	11		6.6	7.3			0.03	
8-Mar-06	10		6.5	7.3			0.02	
9-Mar-06	10		6.6	7.3			0.02	
10-Mar-06	10		6.7	7.3			0.02	10.3
11-Mar-06	10		6.9	7.3			0.02	
12-Mar-06	9		7	7.3			0.01	
13-Mar-06	9		7	7.3			0.03	11.4
14-Mar-06	10		6.8	7.3			0.02	
15-Mar-06	10		6.9	7.3	74.6		0.02	
16-Mar-06	11		6.2	7.3			0.01	
17-Mar-06	12		6.6	7.3			0.03	12.9
18-Mar-06	11		6.9	7.4			0.01	
19-Mar-06	10		6.2	7.3			0.02	
20-Mar-06	10		6.2	7.3			0.01	10.2
21-Mar-06	11		6.2	7.3			0.02	
22-Mar-06	11		6	7.3			0.01	
23-Mar-06	11		6	7.2			0.02	
24-Mar-06	13		6	7.3			0.02	8.4

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
25-Mar-06	11		5.9	7.3			0.01	
26-Mar-06	11		7.6	7.2			0.01	
27-Mar-06	11		6	7.2			0.01	
28-Mar-06	12		6.1	7.2			0.01	
29-Mar-06	13		6.1	7.2			0.01	
30-Mar-06	12		6.1	7.2			0.02	
31-Mar-06	13		7	7.2			0.02	2.6
1-Apr-06	12		5.9	7.2			0.02	
2-Apr-06	12		5.9	7.2			0.01	
3-Apr-06	12		6.1	7.2			0.01	4.4
4-Apr-06	12		6.2	7.2			0.02	
5-Apr-06	12		9.9	7.3			0.02	
6-Apr-06	14		10.2	7.4			0.03	
7-Apr-06	14		9.8	7.3			0.01	4.2
8-Apr-06	13		9.2	7.4			0.02	
9-Apr-06	13		9.8	7.4			0.03	
10-Apr-06	13		9.8	7.4			0.02	3.4
11-Apr-06	13		10	7.4			0.02	
12-Apr-06	14		9.6	7.4			0.02	
13-Apr-06	14		9.4	7.4			0.02	
14-Apr-06	14		9.5	7.4			0.02	1.52
15-Apr-06	13		9.6	7.5			0.02	
16-Apr-06	11		9.9	7.5			0.01	
17-Apr-06	12		9.6	7.5			0.02	3.48
18-Apr-06	13		9.2	7.5			0.02	
19-Apr-06	13		8.9	7.4			0.02	
20-Apr-06	13		8.4	7.4			0.02	
21-Apr-06	15		8.3	7.3			0.01	1.76
22-Apr-06	13		8.1	7.4			0.03	
23-Apr-06	13		8	7.4			0.02	
24-Apr-06	14		7.8	7.3	69	117	0.02	0.18
25-Apr-06	14		7.1	7.2			0.03	
26-Apr-06	15		7.4	7.2			0.02	
27-Apr-06	15		8	7			0.02	
28-Apr-06	15		8	7			0.02	
29-Apr-06	16		8	7.1			0.01	
30-Apr-06	14		8.9	7.1			0.02	
1-May-06	14		8.6	7.1			0.02	
2-May-06	14		9	7.2			0.03	
3-May-06	14		8.4	7.2			0.02	
4-May-06	15		8.8	7.2			0.02	
5-May-06	16		8.9	7.2			0.01	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
6-May-06	16		9	7.2			0.02	
7-May-06	15		8.4	7.2			0.02	
8-May-06	16		8.3	7.2			0.02	
9-May-06	15		8.5	7.2			0.02	
10-May-06	15		8.2	7.2	69	113	0.01	
11-May-06	16		7.9	7.2			0.02	
12-May-06	16		7.7	7.2			0.02	0.04
13-May-06	15		9.4	7.2			0.03	
14-May-06	16		9.7	7.1			0.01	
15-May-06	17		8.4	7.1			0.02	
16-May-06	18		8.3	7.1			0.02	
17-May-06	18		8	7.1			0.02	
18-May-06	19		7.5	7			0.02	
19-May-06	19		7.6	7			0.02	0.06
20-May-06	18		7.4	6.9			0.02	
21-May-06	18		6.6	6.9			0.02	
22-May-06	19		6.7	7			0.02	0.26
23-May-06	18		5.6	6.9			0.02	
24-May-06	18		5.9	6.9			0.02	
25-May-06	17		5.7	6.9			0.02	
26-May-06	17		6.6	7			0.01	
27-May-06	17		6.5	7			0.02	
28-May-06	17		6.7	7			0.02	
29-May-06	17		7.3	7			0.02	
30-May-06	17		6.8	7			0.02	
31-May-06	18		6.8	7.1			0.02	
1-Jun-06	19		6.8	7.1			0.03	
2-Jun-06	19		8.3	7.1			0.02	
3-Jun-06	19		8.3	7.2			0.02	
4-Jun-06	19		8.2	7.2			0.02	
5-Jun-06	19		7.9	7.1			0.02	
6-Jun-06	19		7.6	7.2			0.02	
7-Jun-06	18		7.7	7.2			0.03	
8-Jun-06	19		8.2	7.2			0.02	
9-Jun-06	18		7.6	7.2			0.02	0.06
10-Jun-06	18		7.4	7.2			0.02	
11-Jun-06	18		7.8	7.2			0.02	
12-Jun-06	19		7.6	7.2	67	115	0.02	
13-Jun-06	19		7.6	7			0.03	
14-Jun-06	19		7.8	7.1			0.01	
15-Jun-06	18		7.7	7.2			0.02	
16-Jun-06	19		7.5	7.2			0.03	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
17-Jun-06	19		7.9	7.2			0.02	
18-Jun-06	19		8	7.2			0.02	
19-Jun-06	18		7.9	7.2			0.02	
20-Jun-06	18		7.8	7.2			0.02	
21-Jun-06	18		8.3	7.2			0.02	
22-Jun-06	19		8.3	7.2			0.02	
23-Jun-06	19		8.9	7.2			0.03	
24-Jun-06	19		8.6	7.1			0.02	
25-Jun-06	21		8.5	7.2			0.03	
26-Jun-06	21		7.7	7.3			0.03	
27-Jun-06	22		7.4	7.2			0.02	
28-Jun-06	20		7.4	7.2			0.02	
29-Jun-06	20		7.7	7.2			0.01	
30-Jun-06	21		7.6	7.3			0.02	
1-Jul-06	21		7.2	7.1			0.01	
2-Jul-06	22		7.8	7.2			0.02	
3-Jul-06	21		7.2	7.3			0.02	
4-Jul-06	21		7	7.3			0.02	
5-Jul-06	20		7.3	7.3			0.01	
6-Jul-06	20		7	7.3			0.01	
7-Jul-06	20		7.4	7.3			0.02	0.04
8-Jul-06	21		7.3	7.3			0.03	
9-Jul-06	21		6.5	7.3			0.02	
10-Jul-06	21		7	7.3			0.02	
11-Jul-06	20		6.8	7.3			0.01	
12-Jul-06	21		6.9	7.2	55.9	116	0.02	
13-Jul-06	20		6.1	7.3			0.01	
14-Jul-06	21		6.7	7.4			0.02	
15-Jul-06	21		6	7.2			0.01	
16-Jul-06	21		6.7	7.3			0.01	
17-Jul-06	21		6.2	7.4			0.01	
18-Jul-06	21		7.4	7.1			0.01	
19-Jul-06	21		6.4	7.1			0.01	
20-Jul-06	21		5.8	7.1			0.02	
21-Jul-06	22		6	7.1			0.01	
22-Jul-06	23		7.2	7.1			0.02	
23-Jul-06	23		7	7			0.01	
24-Jul-06	24		7	7.1			0.01	
25-Jul-06	23		7	7.1			0.01	
26-Jul-06	23		6.9	7.1			0.01	
27-Jul-06	22		7.9	7.1			0.01	
28-Jul-06	22		7.3	7.1			0.01	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
29-Jul-06	22		7.7	7.1			0.01	
30-Jul-06	21		7.8	7			0.01	
31-Jul-06	20		6.8	6.9			0.01	
1-Aug-06	20	20	6	6.9			0.01	
2-Aug-06	20	20	6	7.1			0.01	
3-Aug-06	21	21	7.2	7			0.01	
4-Aug-06	20	20	7.3	7			0.03	0.07
5-Aug-06	21	21	6.9	7			0.01	
6-Aug-06	21	21	6.4	7			0.02	
7-Aug-06	21	21	7	7			0.01	
8-Aug-06	21	21	7.6	7.1	69.1	120		
9-Aug-06	22	22	7.4	7			0.02	
10-Aug-06	21	21	7.2	7.2			0.01	
11-Aug-06	20	20	7.4	7.3			0.02	0.06
12-Aug-06	20	20	7.3	7.3			0.02	
13-Aug-06	21	21	7.8	7.3			0.01	
14-Aug-06	20	20	7.5	7.2				
15-Aug-06	21	21	7.6	7.3				
16-Aug-06	20	20	7.8	7.3				
17-Aug-06	20	20	7.7	7.3			0.01	
18-Aug-06	20	20	8.1	7.3			0.01	
19-Aug-06	21	21	7.3	7.3			0.02	
20-Aug-06	21	21	7.2	7.3			0.02	
21-Aug-06	20	20	7.9	7.2				
22-Aug-06	20	20	8	7.2				
23-Aug-06	20	20	8	7.3				
24-Aug-06	20	20	8.2	7.2				
25-Aug-06	20	20	7.9	7.2			0.01	
26-Aug-06	20	20	8.2	7.3			0.02	
27-Aug-06	21	21	8.2	7.3			0.01	
28-Aug-06	21	21	8.2	7.2			0.01	
29-Aug-06	21	21	8.1	7.2			0.03	
30-Aug-06	20	20	8.2	7.1			0.02	
31-Aug-06	19	19	8.9	7.3			0.01	
1-Sep-06	19	19	8.8	7.3			0.02	0.05
2-Sep-06	20	20	8.3	7.2			0.01	
3-Sep-06	20	20	8.2	7.2			0.01	
4-Sep-06	20	20	7.9	7.3			0.01	
5-Sep-06	20	20	7.6	7.1			0.01	
6-Sep-06	20	20	8	7.1			0.03	
7-Sep-06	20	20	8	7.2			0.01	
8-Sep-06	20	20	8.2	7.3			0.02	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
9-Sep-06	20	20	8	7.2			0.02	
10-Sep-06	19	19	8.2	7.2			0.01	
11-Sep-06	19	19	7.7	7.2			0.01	
12-Sep-06	19	19	8.1	7.1			0.01	
13-Sep-06	20	20	7.9	7			0.01	
14-Sep-06	19	19	8.6	7.1			0.01	
15-Sep-06	19	19	8.5	7.1			0.02	
16-Sep-06	18	18	8.3	7.1			0.01	
17-Sep-06	18	18	8.4	7.1			0.01	
18-Sep-06	19	19	8.6	7.1			0.02	
19-Sep-06	19	19	8.2	7			0.01	
20-Sep-06	18	18	8.2	7.2			0.01	
21-Sep-06	17	17	7.9	7.1			0.03	
22-Sep-06	18	18	8.5	7			0.02	
23-Sep-06	17	17	8.4	7.1			0.01	
24-Sep-06	17	17	8.6	7.1			0.01	
25-Sep-06	19	19	8.3	7.2	78.8	91	0.01	
26-Sep-06	18	18	8.5	7			0.01	
27-Sep-06	18	18	8.8	7			0.02	
28-Sep-06	18	18	8.3	7			0.01	
29-Sep-06	20	20	7.8	7			0.01	
30-Sep-06	18	18	7.9	7.1			0.01	
1-Oct-06	18	18	8.1	7			0.01	
2-Oct-06	18	18	8.2	7			0.01	
3-Oct-06	17	17	8.8	7			0.01	
4-Oct-06	17	17	8.8	7			0.01	
5-Oct-06	17	17	8.6	7.1			0.01	
6-Oct-06	18	18	8.2	7			0.01	
7-Oct-06	18	18	8.3	7.1			0.01	
8-Oct-06	17	17	8.6	7			0.01	
9-Oct-06	17	17	8.6	7			0.02	
10-Oct-06	15	15	8.8	7			0.01	
11-Oct-06	16	16	8.6	7			0.02	0.3
12-Oct-06	16	16	9	6.9			0.01	
13-Oct-06	16	16	8.5	7			0.01	
14-Oct-06	17	17	8.5	7.1			0.01	
15-Oct-06	16	16	8.7	7			0.01	
16-Oct-06	17	17	8.4	7			0.05	
17-Oct-06	16	16	9.1	7			0.01	
18-Oct-06	16	16	8.8	7.1			0.01	
19-Oct-06	17	17	8.8	7	73.7	111	0.01	
20-Oct-06	17	17	8.5	7.1			0.01	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
21-Oct-06	16	16	9	7.2			0.01	
22-Oct-06	15	15	9	7.1			0.01	
23-Oct-06	15	15	8.8	7.1			0.01	0.01
24-Oct-06	15	15	8.9	7.2			0.01	
25-Oct-06	15	15	8.8	7			0.01	
26-Oct-06	15	15	9.2	6.7			0.01	
27-Oct-06	17	17	8.6	6.7			0.01	
28-Oct-06	15	15	8.8	6.6			0.01	
29-Oct-06	15	15	9.4	6.6			0.01	
30-Oct-06	13	13	9.4	6.7			0.01	
31-Oct-06	12	12	9.7	7.1			0.01	
1-Nov-06	11		9.8	7.1			0.01	
2-Nov-06	13		9.4	7.2			0.01	
3-Nov-06	16		9.7	7.1			0.01	
4-Nov-06	16		9.6	7.2			0.02	
5-Nov-06	15		9.4	7.1			0.02	
6-Nov-06	17		9.1	7.1			0.01	
7-Nov-06	16		9.2	7			0.01	
8-Nov-06	15		9.5	7.1			0.02	
9-Nov-06	14		9.5	7.1			0.01	
10-Nov-06	13		9.3	7.2			0.02	
11-Nov-06	13		9.5	7.1			0.01	
12-Nov-06	13		10.5	7			0.01	
13-Nov-06	13		10.2	7			0.01	
14-Nov-06	12		10.1	7.1			0.02	0.05
15-Nov-06	14		10.5	7.1			0.01	
16-Nov-06	13		9.9	7.1			0.02	
17-Nov-06	14		10.1	7.2			0.02	
18-Nov-06	12		9.3	7.1			0.02	
19-Nov-06	13		10.1	7.2			0.01	
20-Nov-06	13		9.5	7.2			0.01	0.01
21-Nov-06	13		9.9	7.2			0.01	
22-Nov-06	12		10.1	7.1			0.01	
23-Nov-06	12		9.8	7.1			0.01	
24-Nov-06	11		9.8	7.2			0.02	
25-Nov-06	11		10.2	7.2			0.02	
26-Nov-06	11		10.7	7.2			0.01	
27-Nov-06	10		9.7	7.1			0.02	
28-Nov-06	10		10.2	7.3			0.01	
29-Nov-06	9		11.5	7.3	72.9	111	0.01	
30-Nov-06	12		11.2	7.4			0.03	
1-Dec-06	11		10.7	7.1			0.01	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
2-Dec-06	10		10.8	7.3			0.01	
3-Dec-06	9		11	7.2			0.01	
4-Dec-06	10		10.6	7.2	72.3	110	0.01	0.02
5-Dec-06	10		10.7	7.2			0.01	
6-Dec-06	11		10.5	7.2			0.01	
7-Dec-06	12		10.8	7.2			0.01	
8-Dec-06	11		10.4	7.3			0.01	
9-Dec-06	12		10	7.3			0.01	
10-Dec-06	10		10.7	7.3			0.01	
11-Dec-06	11		9.4	7.2			0.01	
12-Dec-06	12		10.4	7.2			0.01	
13-Dec-06	12		10.5	7.1			0.01	
14-Dec-06	11		10.7	7.1			0.01	
15-Dec-06	11		10.4	7.3			0.01	
16-Dec-06	9		10.4	7.2			0.01	
17-Dec-06	8		8.8	7			0.01	
18-Dec-06	9		8.7	7			0.02	
19-Dec-06	9		8.9	7.1			0.02	
20-Dec-06	9		8.7	7.1			0.01	
21-Dec-06	11		7.4	7.1			0.01	
22-Dec-06	10		7.5	7.1			0.01	
23-Dec-06	10		9.1	7.2			0.01	
24-Dec-06	9		9.2	7.1			0.02	
25-Dec-06	10		8.9	7.1			0.01	
26-Dec-06	10		9.7	7.1			0.01	
27-Dec-06	9		9.7	7.2			0.01	
28-Dec-06	8		9.7	7.2			0.01	
29-Dec-06	10		9.7	7.2			0.01	
30-Dec-06	8		8.6	7.4			0.01	
31-Dec-06	8		8.7	7.1			0.01	
1-Jan-07	9		8.6	7.1			0.01	
2-Jan-07	12		7.4	7.1			0.01	0.03
3-Jan-07	11		7.8	7			0.01	
4-Jan-07	9		7	6.9	55.1	85	0.02	
5-Jan-07	9		7.4	6.9			0.01	
6-Jan-07	9		7.6	6.9			0.01	
7-Jan-07	11		8.2	7.1			0.02	
8-Jan-07	10		6.7	6.9			0.01	
9-Jan-07	11		6.8	7			0.01	
10-Jan-07	9		6.8	7			0.01	
11-Jan-07	8		7.1	6.8			0.01	
12-Jan-07	6		7.1	6.9			0.01	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
13-Jan-07	7		6.8	7.1			0.01	
14-Jan-07	6		7	7.1			0.01	
15-Jan-07	6		7.6	7			0.01	
16-Jan-07	7		7.1	7.1			0.01	
17-Jan-07	7		6.9	7.1			0.01	
18-Jan-07	9		7.2	7			0.02	
19-Jan-07	8		6.6	7.1			0.01	
20-Jan-07	9		6.6	7.1			0.01	
21-Jan-07	10		7	7.1			0.01	
22-Jan-07	9		6.7	7.1			0.01	
23-Jan-07	10		6.4	7			0.01	
24-Jan-07	9		6.6	6.9			0.01	
25-Jan-07	8		6.5	7.2			0.01	
26-Jan-07	9		7.7	7.2			0.01	
27-Jan-07	9		7.6	7.3			0.01	
28-Jan-07	8		7.7	7.3			0.01	
29-Jan-07	8		8.3	7.1			0.01	
30-Jan-07	8		8.5	7.1			0.01	
31-Jan-07	7		9.5	7.2			0.01	
1-Feb-07	7		9.2	7.2			0.02	
2-Feb-07	7		9.8	7.1			0.01	
3-Feb-07	8		8.9	7.3			0.02	
4-Feb-07	10		9.2	7.3			0.01	
5-Feb-07	10		8.5	7.2			0.01	
6-Feb-07	10		8.4	7.3			0.01	
7-Feb-07	10		8.4	7.3			0.01	
8-Feb-07	10		8.6	7.2			0.01	
9-Feb-07	10		8.8	7.3			0.01	
10-Feb-07	10		9.3	7.2			0.01	
11-Feb-07	11		9.7	7.2			0.01	
12-Feb-07	12		10.2	7.2			0.01	
13-Feb-07	11		8.7	7.2			0.01	
14-Feb-07	11		8.8	7.1			0.01	
15-Feb-07	11		8.8	7.1			0.01	
16-Feb-07	11		9.1	7.2			0.02	
17-Feb-07	11		10.3	7.2			0.02	
18-Feb-07	12		10.2	7.3			0.02	
19-Feb-07	11		9.6	7.2			0.01	
20-Feb-07	11		9.2	7.3			0.01	
21-Feb-07	10		10.6	7.2			0.01	
22-Feb-07	10		10.4	7.2			0.04	
23-Feb-07	10		10	7.2			0.02	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
24-Feb-07	10		10.1	7.2			0.02	
25-Feb-07	11		10.4	7.2			0.01	
26-Feb-07	10		10.5	6.9	63.6	72	0.01	
27-Feb-07	10		10.7	6.9			0.01	
28-Feb-07	9		10.6	6.9			0.01	4.5
1-Mar-07	9		10.6	6.9			0.01	
2-Mar-07	9		11	6.9			0.01	
3-Mar-07	11		10.5	6.9			0.01	
4-Mar-07	12		9.4	7			0.01	
5-Mar-07	12		9.2	6.9			0.02	
6-Mar-07	11		9.3	6.9			0.02	
7-Mar-07	12		9	7			0.02	
8-Mar-07	12		9.2	6.8			0.01	
9-Mar-07	12		9	7			0.01	12.3
10-Mar-07	13		8.4	6.8			0.01	
11-Mar-07	14		9.9	7			0.02	
12-Mar-07	13		9.5	6.9			0.02	11.5
13-Mar-07	12		9.8	6.8			0.01	
14-Mar-07	12		10.2	6.9			0.01	
15-Mar-07	11		9.3	6.8			0.01	
16-Mar-07	13		10	6.6			0.02	8.8
17-Mar-07	14		9.3	6.4			0.01	
18-Mar-07	14		9.7	6.5			0.01	
19-Mar-07	14		9.2	6.5			0.01	7.2
20-Mar-07	13		9.9	6.5			0.01	
21-Mar-07	11		9.8	6.6			0.01	
22-Mar-07	12		9.8	6.5			0.01	
23-Mar-07	13		9.7	6.5			0.01	
24-Mar-07	13		9.4	6.6			0.02	
25-Mar-07	13		10	6.4			0.01	
26-Mar-07	12		9.5	6.4	72.1	21	0.01	5.3
27-Mar-07	13		9.3	6.2			0.01	
28-Mar-07	12		9.8	6.1			0.01	
29-Mar-07	12		9.5	6.4			0.01	
30-Mar-07	13		9.4	6.4			0.01	1.6
31-Mar-07	13		9.5	6.6			0.01	
1-Apr-07	12		9.3	6.7			0.01	
2-Apr-07	13		9.5	6.4			0.01	0.48
3-Apr-07	11		10	7			0.02	
4-Apr-07	13		10	7			0.01	
5-Apr-07	14		10	7			0.01	
6-Apr-07	13		9.5	7			0.01	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
7-Apr-07	15		8.8	7			0.01	
8-Apr-07	15		9.3	7			0.01	
9-Apr-07	13		9	7	62.5	86	0.01	
10-Apr-07	14		9	6.7			0.01	
11-Apr-07	13		9.3	6.7			0.01	
12-Apr-07	13		7.7	6.9			0.01	
13-Apr-07	13		8.9	7			0.01	
14-Apr-07	13		8.9	7			0.01	
15-Apr-07	14		9.1	7.2			0.01	
16-Apr-07	15		9	7			0.01	
17-Apr-07	13		9	7.2			0.01	
18-Apr-07	13		9.2	7			0.01	
19-Apr-07	13		8.7	6.9			0.01	
20-Apr-07	13		9.4	6.9			0.01	
21-Apr-07	13		9	6.9			0.01	
22-Apr-07	14		9.3	6.7			0.01	
23-Apr-07	14		8.9	6.9			0.01	
24-Apr-07	15		9	6.8			0.01	
25-Apr-07	14		9.5	6.9			0.01	
26-Apr-07	15		9.5	6.9			0.01	
27-Apr-07	15		9.3	6.7			0.01	
28-Apr-07	15		9.2	6.8			0.01	
29-Apr-07	16		9.6	7			0.01	
30-Apr-07	14		9.4	6.8			0.01	
1-May-07	15		9.2	6.8			0.01	
2-May-07	15		9.1	6.8			0.01	
3-May-07	14		9.5	6.7			0.02	
4-May-07	14		9.2	6.5			0.01	0.02
5-May-07	15		9.7	6.9			0.01	
6-May-07	15		9.5	6.7			0.01	
7-May-07	16		9.1	6.6	62.1	139	0.01	
8-May-07	17		8.6	6.7			0.02	
9-May-07	14		8.6	6.2			0.01	
10-May-07	15		8.7	6.6			0.02	
11-May-07	16		8.8	6.7			0.03	
12-May-07	16		9.1	6.8			0.01	
13-May-07	15		9.1	6.9			0.01	
14-May-07	15		8.9	6.7			0.01	
15-May-07	16		8.5	6.7			0.01	
16-May-07	17		8.5	6.6			0.01	
17-May-07	17		8.6	6.6			0.01	
18-May-07	17		8.1	6.5			0.01	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
19-May-07	17		8.9	6.8			0.02	
20-May-07	17		8.8	6.9			0.02	
21-May-07	16		8.4	6.6			0.01	
22-May-07	16		8.4	6.6			0.03	
23-May-07	16		8.7	6.7			0.01	
24-May-07	17		8.4	6.7			0.01	
25-May-07	17		8.2	6.5			0.01	
26-May-07	18		8.5	6.7			0.02	
27-May-07	17		8.4	6.7			0.02	
28-May-07	17		8.3	6.7			0.02	
29-May-07	17		7.6	6.5			0.01	
30-May-07	18		7.5	6.4			0.01	
31-May-07	19		7.6	6.6			0.01	
1-Jun-07	18		8	6.6				
2-Jun-07	19		7.7	6.7			0.01	
3-Jun-07	20		7.4	6.7			0.01	
4-Jun-07	20		6.4	6.5			0.01	
5-Jun-07	19		6.9	6.7			0.01	
6-Jun-07	18		6.2	6.5			0.01	
7-Jun-07	17		6.4	6.5			0.01	
8-Jun-07	18		6.5	6.5			0.01	0.01
9-Jun-07	18		6.7	6.7			0.02	
10-Jun-07	18		7	6.7			0.03	
11-Jun-07	18		6.5	6.6			0.01	
12-Jun-07	17		7.2	6.7			0.01	
13-Jun-07	18		8	6.7			0.02	
14-Jun-07	18		8.4	6.8			0.01	
15-Jun-07	18		8.2	6.7			0.02	
16-Jun-07	19		7.2	6.8			0.01	
17-Jun-07	18		8.2	6.8			0.02	
18-Jun-07	17		8.4	6.7			0.02	
19-Jun-07	17		8.2	6.5	62	89	0.02	
20-Jun-07	19		8.1	6.7			0.02	
21-Jun-07	20		8.2	6.7			0.03	
22-Jun-07	19		8	6.6			0.01	
23-Jun-07	19		8.3	6.9			0.02	
24-Jun-07	19		8.5	6.9			0.01	
25-Jun-07	18		8.3	6.7			0.02	
26-Jun-07	18		8.6	6.8			0.01	
27-Jun-07	19		8.5	6.8			0.02	
28-Jun-07	19		7.8	6.7			0.01	
29-Jun-07	19		8.1	6.8			0.04	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

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30-Jun-07	19		8.5	6.9			0.03	
1-Jul-07	19		8.3	6.8			0.03	
2-Jul-07	20		7.9	6.8			0.02	
3-Jul-07	20		7.8	6.9			0.02	
4-Jul-07	21		8.3	6.7			0.01	
5-Jul-07	21		7.8	6.8			0.01	
6-Jul-07	21		7.8	7			0.02	0.04
7-Jul-07	20		7.8	7			0.03	
8-Jul-07	20		8.1	7			0.03	
9-Jul-07	20		7.9	6.9	67.9	94		
10-Jul-07	22		7.6	6.9				
11-Jul-07	22		7.3	7				
12-Jul-07	22		7.5	6.9				
13-Jul-07	22		7.7	6.9				
14-Jul-07	21		7.9	6.9				
15-Jul-07	22		7.5	6.8			0.05	
16-Jul-07	22		7.3	6.9			0.01	
17-Jul-07	21		7.5	6.8			0.01	
18-Jul-07	21		7.5	6.8			0.01	
19-Jul-07	21		7.8	6.9			0.01	
20-Jul-07	21		7.8	6.8			0.01	
21-Jul-07	21		7.7	7			0.02	
22-Jul-07	21		7.8	6.7			0.03	
23-Jul-07	21		7.9	6.9			0.01	
24-Jul-07	20		8	6.9			0.01	
25-Jul-07	20		8.1	6.8			0.01	
26-Jul-07	20		7.8	6.9			0.01	
27-Jul-07	20		7.6	7.1			0.01	
28-Jul-07	21		7.5	6.8			0.01	
29-Jul-07	21		7.5	6.8			0.01	
30-Jul-07	20		7.9	6.9			0.01	
31-Jul-07	20		7.7	6.9			0.01	
1-Aug-07	20	20	7.6	6.7			0.01	
2-Aug-07	20	20	7.7	6.9			0.01	
3-Aug-07	21	21	7.5	6.9			0.01	
4-Aug-07	21	21	7.7	7			0.02	
5-Aug-07	20	20	7.6	6.8			0.01	
6-Aug-07	20	20	7.5	6.8			0.01	
7-Aug-07	20	20	7.6	6.8	68.7	99	0.01	
8-Aug-07	20	20	7.7	6.8			0.01	
9-Aug-07	20	20	7.6	6.9			0.01	
10-Aug-07	20	20	7.6	6.8			0.01	0.02

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
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11-Aug-07	19	19	8.1	6.9			0.01	
12-Aug-07	20	20	8.6	6.9			0.02	
13-Aug-07	19	19	7.7	6.8			0.01	0.01
14-Aug-07	20	20	7.9	6.8				
15-Aug-07	20	20	8	6.8				
16-Aug-07	21	21	7.6	6.9				
17-Aug-07	20	20	8	7.1				
18-Aug-07	20	20	8.2	7.1				
19-Aug-07	20	20	7.9	7			0.01	
20-Aug-07	20	20	7.7	7			0.02	
21-Aug-07	20	20	7.6	6.9			0.02	
22-Aug-07	20	20	7.9	7			0.02	
23-Aug-07	20	20	8	6.7			0.02	
24-Aug-07	20	20	7.5	6.8			0.01	
25-Aug-07	21	21	7.8	7.1			0.01	
26-Aug-07	20	20	7.8	7			0.02	
27-Aug-07	20	20	8.2	7.1			0.01	
28-Aug-07	19	19	8	7			0.01	
29-Aug-07	20	20	8	7			0.02	
30-Aug-07	20	20	8	6.9				
31-Aug-07	21	21	8	7			0.02	
1-Sep-07	20	20	7.9	7.1			0.02	
2-Sep-07	20	20	8	6.9			0.02	
3-Sep-07	20	20	8.1	7			0.03	
4-Sep-07	21	21	7.8	7			0.03	0.04
5-Sep-07	21	21	7.9	6.8	69.8	108	0.02	
6-Sep-07	21	21	8.2	7			0.04	
7-Sep-07	20	20	8	7.1			0.01	
8-Sep-07	20	20	7.9	7			0.04	
9-Sep-07	19	19	8	7			0.01	
10-Sep-07	19	19	8.1	6.9			0.03	
11-Sep-07	19	19	8.1	7			0.01	
12-Sep-07	20	20	8	7			0.01	
13-Sep-07	19	19	8	7.1			0.01	
14-Sep-07	20	20	8.1	6.9			0.02	
15-Sep-07	20	20	8.2	7.1			0.03	
16-Sep-07	19	19	8	7			0.01	
17-Sep-07	20	20	8	7.1			0.02	
18-Sep-07	19	19	8	7.2			0.01	
19-Sep-07	18	18	8.3	7			0.01	
20-Sep-07	18	18	8.4	7			0.01	
21-Sep-07	18	18	8.6	7			0.02	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
22-Sep-07	18	18	8.3	7.2			0.02	
23-Sep-07	18	18	8.5	7.1			0.02	
24-Sep-07	17	17	8.4	7			0.01	
25-Sep-07	17	17	8.6	7.3			0.04	
26-Sep-07	17	17	8.5	7.1			0.05	
27-Sep-07	16	16	8.5	7.1			0.01	
28-Sep-07	18	18	8.6	7			0.02	
29-Sep-07	17	17	8.7	7.1			0.02	
30-Sep-07	17	17	8.8	7.1			0.02	
1-Oct-07	16	16	9	6.9			0.01	0.02
2-Oct-07	17	17	8.6	6.9			0.01	
3-Oct-07	16	16	8.7	6.9			0.01	
4-Oct-07	16	16	8.8	7.1			0.02	
5-Oct-07	17	17	8.9	7			0.02	
6-Oct-07	17	17	8.6	6.9			0.02	
7-Oct-07	17	17	8.8	6.9			0.01	
8-Oct-07	16	16	8.8	6.8	63.7	93	0.01	
9-Oct-07	16	16	8.8	6.9			0.02	
10-Oct-07	16	16	8.7	6.8			0.01	
11-Oct-07	16	16	8.9	6.8			0.02	
12-Oct-07	16	16	9.4	6.9			0.02	
13-Oct-07	15	15	9.2	7			0.01	
14-Oct-07	15	15	8.9	6.9			0.02	
15-Oct-07	16	16	8.9	6.8			0.02	
16-Oct-07	16	16	8.7	6.8			0.02	
17-Oct-07	15	15	8.8	6.8			0.02	
18-Oct-07	15	15	9	6.8			0.01	
19-Oct-07	16	16	8.9	6.7			0.02	
20-Oct-07	15	15	9.1	7			0.02	
21-Oct-07	15	15	9.1	6.8			0.03	
22-Oct-07	15	15	9.1	6.8			0.03	
23-Oct-07	15	15	9.1	7			0.01	
24-Oct-07	16	16	8.6	6.9			0.02	
25-Oct-07	14	14	8.9	6.8			0.01	
26-Oct-07	13	13	8.6	6.9			0.02	
27-Oct-07	13	13	9.7	7.1			0.01	
28-Oct-07	13	13	9.8	6.9			0.03	
29-Oct-07	13	13	9.8	6.9			0.01	
30-Oct-07	13	13	9.6	6.9			0.01	
31-Oct-07	12	12	10	6.9			0.01	
1-Nov-07	13		10	6.8			0.01	
2-Nov-07	12		9.9	6.8			0.01	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
3-Nov-07	13		10	7			0.01	
4-Nov-07	14		9.6	6.9			0.01	
5-Nov-07	14		9.6	6.9			0.02	
6-Nov-07	13		9.7	6.9			0.01	
7-Nov-07	13		9.5	6.9			0.01	
8-Nov-07	14		9.2	6.9			0.01	
9-Nov-07	14		9.7	6.8			0.02	
10-Nov-07	15		9.8	7.1			0.01	
11-Nov-07	14		9.3	6.9			0.01	
12-Nov-07	13		10.2	6.9			0.01	
13-Nov-07	13		9.1	6.8			0.01	0.01
14-Nov-07	12		9.7	6.8	64.7	96	0.01	
15-Nov-07	13		10	7			0.02	
16-Nov-07	14		9.7	6.8			0.02	
17-Nov-07	14		9.9	7.1			0.01	
18-Nov-07	13		9.8	6.9			0.02	
19-Nov-07	12		9.4	6.9			0.01	
20-Nov-07	12		10	6.8			0.02	
21-Nov-07	12		9.8	6.9			0.02	
22-Nov-07	11		10.1	7			0.02	
23-Nov-07	10		10.2	6.9			0.03	
24-Nov-07	10		9.9	6.9			0.02	
25-Nov-07	11		10.5	7			0.01	
26-Nov-07	10		10.6	6.9			0.01	
27-Nov-07	10		10.8	6.9			0.01	
28-Nov-07	11		10.7	6.9			0.02	
29-Nov-07	11		10.2	6.8			0.01	
30-Nov-07	10		10.7	6.8			0.01	
1-Dec-07	10		10.8	7.1			0.01	
2-Dec-07	10		10.8	6.9			0.01	
3-Dec-07	12		10	6.7	70.2	95	0.03	0.03
4-Dec-07	13		10.1	6.8			0.01	
5-Dec-07	11		10.4	6.8			0.02	
6-Dec-07	11		10.5	7			0.02	
7-Dec-07	11		10.8	6.9			0.01	
8-Dec-07	10		10.3	6.8			0.02	
9-Dec-07	9		11.7	7			0.01	
10-Dec-07	10		11.4	7			0.02	
11-Dec-07	10		11.8	7			0.01	
12-Dec-07	9		11.2	6.8			0.01	
13-Dec-07	10		11	6.8			0.01	
14-Dec-07	10		11	6.8			0.02	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
15-Dec-07	11		11.2	7			0.01	
16-Dec-07	10		11.3	6.6			0.03	
17-Dec-07	10		11.2	6.8			0.01	
18-Dec-07	10		10.2	6.8			0.01	
19-Dec-07	11		9.9	6.9			0.01	
20-Dec-07	10		10.9	6.7			0.01	
21-Dec-07	9		11.3	6.7			0.01	
22-Dec-07	10		9.7	6.8			0.02	
23-Dec-07	9		11.4	6.8			0.01	
24-Dec-07	9		11.3	6.9			0.01	
25-Dec-07	9		9.6	6.9			0.02	
26-Dec-07	9		12.1	6.8			0.01	
27-Dec-07	9		11.5	6.9			0.01	
28-Dec-07	10		11.7	6.9			0.02	
29-Dec-07	10		11.8	6.9			0.01	
30-Dec-07	9		11.2	6.8			0.01	
31-Dec-07	9		10	6.8			0.01	
1-Jan-08	9		9.8	6.9			0.02	
2-Jan-08	9		11.1	6.6			0.01	
3-Jan-08	10		10.9	6.8			0.02	
4-Jan-08	12		11.6	6.9			0.01	0.03
5-Jan-08	10		10.9	6.8			0.01	
6-Jan-08	9		11.6	6.8			0.01	
7-Jan-08	9		10.4	6.6	61	102	0.01	
8-Jan-08	9		11	6.6			0.04	
9-Jan-08	9		10.7	6.7			0.01	
10-Jan-08	9		12	6.7			0.03	
11-Jan-08	10		11.4	6.7			0.03	
12-Jan-08	11		11.4	6.9			0.01	
13-Jan-08	10		11.3	6.6			0.02	
14-Jan-08	9		11.7	6.7			0.01	
15-Jan-08	9		11.7	6.6			0.02	
16-Jan-08	8		11.7	6.7			0.03	
17-Jan-08	8		12	6.8			0.02	
18-Jan-08	9		12.1	6.8			0.02	
19-Jan-08	9		11.9	7			0.02	
20-Jan-08	9		11.5	6.7			0.01	
21-Jan-08	8		10.9	6.7			0.02	
22-Jan-08	7		11.9	6.6			0.02	
23-Jan-08	7		12.4	6.6			0.02	
24-Jan-08	7		12.3	6.7			0.02	
25-Jan-08	7		12.2	6.6			0.01	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
26-Jan-08	7		12	6.9			0.01	
27-Jan-08	7		12.6	6.8			0.03	
28-Jan-08	8		12.2	6.7			0.04	
29-Jan-08	8		11.6	6.7			0.02	
30-Jan-08	9		12.1	6.8			0.01	
31-Jan-08	8		12.3	6.7			0.01	
1-Feb-08	8		12.5	6.7			0.02	0.01
2-Feb-08	8		12.2	6.9			0.02	
3-Feb-08	8		12.2	6.8			0.02	
4-Feb-08	8		12	6.9	66.9	101	0.01	
5-Feb-08	9		12.2	7			0.02	
6-Feb-08	8		12.1	7.2			0.01	
7-Feb-08	8		11.4	7.1			0.02	
8-Feb-08	10		12.1	7.1			0.01	
9-Feb-08	10		11.8	7.1			0.02	
10-Feb-08	10		11.1	6.9			0.01	
11-Feb-08	10		11.5	7			0.02	
12-Feb-08	9		11	7.2			0.01	
13-Feb-08	9		10.5	7			0.01	
14-Feb-08	9		11.9	7			0.01	
15-Feb-08	10		11.7	7			0.01	
16-Feb-08	10		11.5	7			0.01	
17-Feb-08	9		11	6.9			0.01	
18-Feb-08	9		10.6	6.9			0.02	
19-Feb-08	9		11.7	6.9			0.01	
20-Feb-08	10		12.2	7.1			0.01	
21-Feb-08	9		11.3	6.9			0.01	
22-Feb-08	10		12.1	6.8			0.02	2
23-Feb-08	10		11.5	7			0.01	
24-Feb-08	10		11.1	6.8			0.01	
25-Feb-08	11		10.9	7			0.02	
26-Feb-08	10		11.5	6.9			0.01	
27-Feb-08	11		12	6.7			0.01	
28-Feb-08	12		11.3	6.9			0.01	
29-Feb-08	12		11.7	6.9			0.02	
1-Mar-08	11			6.9			0.01	
2-Mar-08	10			6.8			0.01	
3-Mar-08	10			6.9	59.1	100	0.01	0.77
4-Mar-08	11			6.9			0.01	
5-Mar-08	10			6.8			0.01	
6-Mar-08	10			6.8			0.01	
7-Mar-08	11			6.8			0.01	

City of Yelm Effluent Data
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From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
8-Mar-08	11			6.9			0.01	
9-Mar-08	11			6.8			0.02	
10-Mar-08	12			6.8			0.01	
11-Mar-08	12			6.8			0.01	
12-Mar-08	11			6.8			0.01	
13-Mar-08	11			6.8			0.01	
14-Mar-08	12			6.7			0.01	
15-Mar-08	11			6.9			0.01	
16-Mar-08	11			6.9			0.01	
17-Mar-08	11			6.8			0.02	
18-Mar-08	12			6.9			0.01	
19-Mar-08	12			7			0.01	
20-Mar-08	11			6.8			0.01	
21-Mar-08	11			6.7			0.01	
22-Mar-08	11			6.8			0.02	
23-Mar-08	11			6.7			0.01	
24-Mar-08	10			6.8			0.01	
25-Mar-08	11			6.9			0.01	
26-Mar-08	11			6.8			0.01	
27-Mar-08	10			6.9			0.01	
28-Mar-08	10			6.7			0.01	
29-Mar-08	10			6.9			0.01	
30-Mar-08	10			6.8			0.01	
31-Mar-08	10			6.8			0.01	
1-Apr-08	10		10.2	6.9			0.02	
2-Apr-08	11		10.1	6.9			0.01	
3-Apr-08	10		10	6.9			0.01	
4-Apr-08	12		10.8	6.9			0.01	
5-Apr-08	11		10.7	6.7			0.02	
6-Apr-08	11		9.7	6.7			0.01	
7-Apr-08	11		10	6.7	61.3	94	0.02	0.48
8-Apr-08	11		9.9	6.8			0.01	
9-Apr-08	12		9.8	6.9			0.02	
10-Apr-08	12		9.9	6.9			0.01	
11-Apr-08	12		10.3	6.8			0.01	
12-Apr-08	13		9.9	7			0.01	
13-Apr-08	14		9.6	6.9			0.02	
14-Apr-08	12		9.8	6.7			0.01	
15-Apr-08	12		9.9	6.5			0.01	
16-Apr-08	12		10.1	6.5			0.01	
17-Apr-08	13		10.3	6.6			0.02	
18-Apr-08	12		10.1	6.6			0.07	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
19-Apr-08	11		10.2	6.8			0.01	
20-Apr-08	12		9.7	6.5			0.01	
21-Apr-08	12		10	6.6			0.01	
22-Apr-08	12		9.8	6.6			0.02	
23-Apr-08	12		10	6.5			0.01	
24-Apr-08	13		9.1	6.6			0.01	
25-Apr-08	13		10.1	6.6			0.02	
26-Apr-08	13		10.4	6.8			0.01	
27-Apr-08	13		10.7	6.8			0.02	
28-Apr-08	14		9	6.7			0.01	
29-Apr-08	13		8.6	6.6			0.01	
30-Apr-08	13		9	6.6			0.02	
1-May-08	14		9.8	6.7			0.02	
2-May-08	14		9.9	6.6			0.03	
3-May-08	14		10.1	6.6			0.03	
4-May-08	14		10	6.8			0.05	
5-May-08	15		9.4	6.7	61.5	97	0.02	0.02
6-May-08	15		8.9	6.6			0.02	
7-May-08	14		9.7	6.7			0.01	
8-May-08	14		8.8	6.7			0.01	
9-May-08	14		10	6.6			0.01	
10-May-08	15		9.56	6.6			0.02	
11-May-08	14		9.4	6.7			0.01	
12-May-08	14		9.5	6.7			0.01	
13-May-08	15		9	6.7			0.01	
14-May-08	15		8.8	6.6			0.01	
15-May-08	16		8.7	6.6			0.01	
16-May-08	17		8.6	6.6			0.02	
17-May-08	18		8.6	6.6			0.01	
18-May-08	18		7.6	6.7			0.02	
19-May-08	18		7.5	6.8			0.01	
20-May-08	18		7.8	6.7			0.02	
21-May-08	17		7.3	6.7			0.01	
22-May-08	17		8	6.7			0.01	
23-May-08	16		9.3	6.7			0.02	
24-May-08	16		9.3	6.7			0.02	
25-May-08	18		8.9	6.7			0.02	
26-May-08	18		9	6.9			0.01	
27-May-08	17		8.9	6.8			0.01	
28-May-08	17		8.6	6.8			0.01	
29-May-08	16		8.9	6.8			0.02	
30-May-08	17		9.3	6.9			0.02	

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From DMR data (Jan 2006 - December 2011)

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31-May-08	16		9.3	6.9			0.01	
1-Jun-08	17		8.9	6.9			0.01	
2-Jun-08	16		9.2	6.9			0.01	0.02
3-Jun-08	16		9.3	6.9			0.01	
4-Jun-08	16		9.1	6.9	67.9	103	0.02	
5-Jun-08	15		9.3	6.9			0.01	
6-Jun-08	15		9.5	6.9			0.01	
7-Jun-08	15		9.9	6.8			0.02	
8-Jun-08	14		9.4	6.8			0.01	
9-Jun-08	15		9.6	7			0.01	
10-Jun-08	15		10	7			0.01	
11-Jun-08	15		9.8	6.9			0.02	
12-Jun-08	15		9.8	6.8			0.01	
13-Jun-08	16		9.7	6.8			0.02	
14-Jun-08	16		6.6	6.8			0.02	
15-Jun-08	17		9.5	6.9			0.02	
16-Jun-08	16		8.5	7			0.01	
17-Jun-08	17		8.8	6.8			0.01	
18-Jun-08	16		9	6.9			0.01	
19-Jun-08	17		9.3	7.1			0.01	
20-Jun-08	17		8.8	6.9			0.02	
21-Jun-08	19		8.6	6.9			0.02	
22-Jun-08	18		8.8	7			0.01	
23-Jun-08	17		8.8	7			0.01	
24-Jun-08	17		9.1	7			0.02	
25-Jun-08	18		8.7	7			0.01	
26-Jun-08	18		8.4	7			0.02	
27-Jun-08	18		8.7	6.9			0.01	
28-Jun-08	19		8.2	7			0.01	
29-Jun-08	21		7.6	6.9			0.02	
30-Jun-08	21		8.4	7			0.01	
1-Jul-08	20		7.4	7.1			0.01	
2-Jul-08	20		7	7			0.01	
3-Jul-08	20		7.7	6.9			0.01	
4-Jul-08	21		7.8	6.8			0.02	
5-Jul-08	20		7.7	6.9			0.02	
6-Jul-08	19		8	7			0.01	
7-Jul-08	18		8	7			0.02	
8-Jul-08	19		8	6.9	69.6	110	0.01	
9-Jul-08	20		8	6.9			0.01	
10-Jul-08	20		8	6.9			0.01	
11-Jul-08	19		8.4	6.9			0.01	0.05

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12-Jul-08	20		8.4	7			0.01	
13-Jul-08	20		8.2	6.9			0.03	
14-Jul-08								
15-Jul-08	20		7.9	6.9			0.01	
16-Jul-08	20		8	6.9			0.01	
17-Jul-08								
18-Jul-08	20		7.9	7			0.01	
19-Jul-08	19		8	6.9			0.02	
20-Jul-08	20		8	6.9			0.02	
21-Jul-08								
22-Jul-08	20		8.7	7			0.02	
23-Jul-08								
24-Jul-08	18		8.4	7			0.01	
25-Jul-08								
26-Jul-08	19		8.2	6.9			0.03	
27-Jul-08	20		8.1	6.9			0.01	
28-Jul-08	19		8.2	7			0.02	
29-Jul-08	19		7.8	6.9			0.01	
30-Jul-08	19		9	6.9			0.01	
31-Jul-08	18		9	6.9			0.01	
1-Aug-08	19	19	8.9	6.9			0.01	
2-Aug-08	19	19	8.9	6.6			0.01	0.01
3-Aug-08	19	19	8.7	6.7			0.01	
4-Aug-08	19	19	8.2	6.8	72	90	0.01	
5-Aug-08	20	20	7.9	6.9			0.01	
6-Aug-08	20	20	7.9	6.9			0.01	
7-Aug-08	20	20	7.8	7			0.02	
8-Aug-08	21	21	8	6.9			0.01	
9-Aug-08	20	20	8.1	6.9			0.01	
10-Aug-08	19	19	8.2	6.7			0.01	
11-Aug-08	20	20	8.2	6.7			0.01	
12-Aug-08	20	20	8.3	6.7			0.01	
13-Aug-08	20	20	8.2	6.7			0.01	
14-Aug-08	21	21	8.2	6.7			0.02	
15-Aug-08	21	21	8	6.6			0.01	
16-Aug-08	22	22	7.8	6.6			0.01	
17-Aug-08	22	22	7.3	6.5			0.02	
18-Aug-08	21	21	7.1	6.6			0.01	
19-Aug-08	20	20	7.7	6.5			0.01	
20-Aug-08	20	20	7.5	6.6			0.01	
21-Aug-08								
22-Aug-08								

City of Yelm Effluent Data
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Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
23-Aug-08								
24-Aug-08								
25-Aug-08								
26-Aug-08								
27-Aug-08								
28-Aug-08								
29-Aug-08								
30-Aug-08								
31-Aug-08								
1-Sep-08	18	18	8.2	6.6			0.04	
2-Sep-08	17	17	7.7	6.7			0.01	0.07
3-Sep-08	18	18	7.4	6.6			0.01	
4-Sep-08	18	18	7.2	6.6			0.01	
5-Sep-08	18	18	7.3	6.5			0.01	
6-Sep-08	19	19	7	6.5			0.01	
7-Sep-08	18	18	7.4	6.6			0.02	
8-Sep-08	18	18	7.7	6.6			0.01	
9-Sep-08	18	18	7.2	6.7			0.01	
10-Sep-08	18	18	7.4	6.9	79.6	77	0.01	
11-Sep-08	18	18	8	6.9			0.01	
12-Sep-08	18	18	7.7	6.8			0.02	
13-Sep-08	18	18	8	7			0.02	
14-Sep-08	17	17	7.4	6.9			0.01	
15-Sep-08	18	18	7.3	6.7			0.01	
16-Sep-08	19	19	7.5	6.8			0.01	
17-Sep-08	19	19	7.2	6.7			0.01	
18-Sep-08	20	20	7.5	6.7			0.01	
19-Sep-08	19	19	7.9	6.8			0.02	
20-Sep-08	19	19	7.6	6.9			0.01	
21-Sep-08	18	18	7.4	6.8			0.01	
22-Sep-08	18	18	7.1	6.8			0.01	
23-Sep-08	17	17	7.4	6.8			0.01	
24-Sep-08	18	18	8.3	6.7			0.01	
25-Sep-08	18	18	7.5	6.8			0.02	
26-Sep-08	18	18	7.8	6.8			0.01	
27-Sep-08	19	19	7.4	6.8			0.01	
28-Sep-08	17	17	7	6.6			0.01	
29-Sep-08	17	17	6.9	6.6			0.01	
30-Sep-08	18	18	6	6.7			0.01	
1-Oct-08	18	18	6.7	6.8			0.01	
2-Oct-08	19	19	8.2	6.8			0.01	
3-Oct-08	19	19	8.1	6.7			0.01	0.04

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
4-Oct-08	19	19	8.2	6.7			0.01	
5-Oct-08	18	18	7.6	6.5			0.02	
6-Oct-08	18	18	8.5	6.5	73.2	81	0.01	
7-Oct-08	18	18	8.1	6.7			0.02	
8-Oct-08	16	16	8	6.7			0.02	
9-Oct-08	16	16	8.5	6.6			0.02	
10-Oct-08	16	16	7.9	6.6			0.03	
11-Oct-08	15	15	8.9	6.7			0.02	
12-Oct-08	15	15	8.5	6.6			0.01	
13-Oct-08	16	16	8.6	6.6			0.02	
14-Oct-08	16	16	8.7	6.5			0.01	
15-Oct-08	14	14	8.8	6.6			0.02	
16-Oct-08	15	15	8.8	6.6			0.01	
17-Oct-08	17	17	8.6	6.7			0.01	
18-Oct-08	17	17	8.1	6.8			0.02	
19-Oct-08	14	14	8.4	6.6			0.02	
20-Oct-08	16	16	8.4	6.7			0.01	
21-Oct-08	15	15	8.3	6.8			0.01	
22-Oct-08	14	14	8.3	6.9			0.01	
23-Oct-08	15	15	8.3	6.9			0.01	
24-Oct-08	14	14	8.5	7			0.01	
25-Oct-08	15	15	7.7	7.1			0.01	
26-Oct-08	14	14	7.6	6.8			0.02	
27-Oct-08	14	14	7.2	6.9			0.01	
28-Oct-08	14	14	7.1	6.9			0.01	
29-Oct-08	14	14	6.6	6.9			0.01	
30-Oct-08	14	14	5.8	6.8			0.01	
31-Oct-08	15	15	6.1	6.8			0.01	
1-Nov-08	16		7.1	6.8			0.01	
2-Nov-08	15		8	6.2			0.02	0.01
3-Nov-08	15		7.8	6.8	63.3	91	0.01	
4-Nov-08	14		8.3	6.7			0.01	
5-Nov-08	14		8.9	6.9			0.01	
6-Nov-08	14		9.1	6.9			0.01	
7-Nov-08	16		8.6	6.8			0.01	
8-Nov-08	16		8.6	7			0.01	
9-Nov-08	15		8.6	6.9			0.01	
10-Nov-08	14		8.9	6.9			0.01	
11-Nov-08	14		9.4	6.8			0.01	
12-Nov-08	15		8.4	6.5			0.01	
13-Nov-08	14		8.6	6.8			0.01	
14-Nov-08	14		8.8	6.8			0.01	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
15-Nov-08	14		9.9	7			0.01	
16-Nov-08	13		8.6	6.8			0.01	
17-Nov-08	13		8.5	6.8			0.02	
18-Nov-08	14		8.5	6.8			0.01	
19-Nov-08	13		8.6	6.8			0.01	
20-Nov-08	13		8.8	6.8			0.01	
21-Nov-08	12		9.2	6.8			0.02	
22-Nov-08	13		8.7	7			0.01	
23-Nov-08	12		8.7	6.8			0.01	
24-Nov-08	11		9.3	6.9			0.02	
25-Nov-08	11		9.7	6.9			0.02	
26-Nov-08	12		8.6	6.9			0.02	
27-Nov-08	11		9.1	6.9			0.02	
28-Nov-08	12		9	6.9			0.01	
29-Nov-08	14		9	6.9			0.01	
30-Nov-08	14		8.4	6.9			0.01	
1-Dec-08	14		8.5	6.8			0.02	
2-Dec-08	14		8.4	6.8			0.01	
3-Dec-08	13		8.5	6.9			0.01	
4-Dec-08	12		8.6	6.9			0.01	
5-Dec-08	11		9.2	6.9			0.01	0.02
6-Dec-08	12		8.9	7			0.01	
7-Dec-08	12		9	6.8			0.01	
8-Dec-08	12		8.6	6.8		98	0.01	
9-Dec-08	12		8.6	6.8	71.2		0.01	
10-Dec-08	13		9.2	6.9			0.02	
11-Dec-08	12		8.9	6.8			0.02	
12-Dec-08	12		8.9	6.9			0.01	
13-Dec-08	12		9.4	7.1			0.02	
14-Dec-08	10		9.5	6.9			0.02	
15-Dec-08	8		9	6.9			0.01	
16-Dec-08	7		10	6.9			0.01	
17-Dec-08	9		9.6	6.9			0.01	
18-Dec-08	9		10.2	7			0.01	
19-Dec-08	8		9.6	6.9			0.02	
20-Dec-08	8		11	7			0.02	
21-Dec-08	8		9.9	6.9			0.01	
22-Dec-08	8		10.2	6.8			0.02	
23-Dec-08	9		9.8	7			0.02	
24-Dec-08	9		9.5	7			0.02	
25-Dec-08	9		9.8	6.9			0.02	
26-Dec-08	9		10.1	7			0.02	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
27-Dec-08	11		9.4	7			0.02	
28-Dec-08	10		9.3	6.9			0.01	
29-Dec-08	10		8.5	6.7			0.01	
30-Dec-08	9		9.1	6.8			0.01	
31-Dec-08	9		9.1	6.8			0.02	
1-Jan-09	10		10	6.9			0.01	
2-Jan-09	9		9.8	6.8	65.2		0.01	0.01
3-Jan-09	9		10.6	6.9			0.02	
4-Jan-09	8		8.9	6.8			0.01	
5-Jan-09	9		8.5	6.8			0.02	
6-Jan-09	10		8.8	6.8		111	0.03	
7-Jan-09	11		9.2	6.8			0.01	
8-Jan-09	11		8.8	6.7			0.01	
9-Jan-09	10		10.1	6.8			0.02	
10-Jan-09	10		10	6.9			0.01	
11-Jan-09	10		9.8	6.9			0.01	
12-Jan-09	11		9.1	6.8			0.02	
13-Jan-09	11		9.4	7			0.02	
14-Jan-09	10		9.7	6.8			0.01	
15-Jan-09	11		10.1	7			0.01	
16-Jan-09	9		10	6.8			0.02	
17-Jan-09	10		10.5	7			0.01	
18-Jan-09	9		9.5	6.7			0.02	
19-Jan-09	9		9.6	6.8			0.01	
20-Jan-09	8		9.4	6.9			0.02	
21-Jan-09	9		9.9	6.8			0.01	
22-Jan-09	9		9.3	6.9			0.01	
23-Jan-09	9		9.8	6.8			0.01	
24-Jan-09	9		10.3	7			0.01	
25-Jan-09	9		10	6.9			0.01	
26-Jan-09	8		9.9	6.9			0.01	
27-Jan-09	8		9.5	6.6			0.01	
28-Jan-09	10		9.3	6.9			0.01	
29-Jan-09	9		10	6.9			0.01	
30-Jan-09	9		10.2	6.7			0.02	
31-Jan-09	10		10.6	6.8			0.01	
1-Feb-09	9		10.2.	6.8			0.01	
2-Feb-09	10		9.5	6.9			0.01	
3-Feb-09	9		10.2	6.9			0.02	
4-Feb-09	9		10.4	6.8			0.02	
5-Feb-09	8		10.2	6.9	71.1	108	0.01	
6-Feb-09	11		10.2	7			0.01	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
7-Feb-09	11		10.4	7.1			0.01	
8-Feb-09	9		10.5	6.9			0.01	
9-Feb-09	9		8.6	6.8			0.01	
10-Feb-09	9		8.3	6.8			0.01	
11-Feb-09	8		8.4	6.8			0.01	
12-Feb-09	8		8.4	6.8			0.02	
13-Feb-09	9		8.1	6.9			0.02	
14-Feb-09	10		8.7	6.8			0.01	
15-Feb-09	8		8	6.7			0.01	
16-Feb-09	9		8.7	6.8			0.01	
17-Feb-09	9		8	6.9			0.01	
18-Feb-09	9		8	6.6			0.01	
19-Feb-09	9		7.3	6.7			0.01	
20-Feb-09	8		7.2	6.7			0.02	
21-Feb-09	10		6.9	6.7			0.01	
22-Feb-09	10		6.9	6.6			0.01	
23-Feb-09	11		6.6	6.6			0.01	
24-Feb-09	11		7.5	6.7			0.02	
25-Feb-09	11		7.3	6.7			0.02	
26-Feb-09	10		8	6.7			0.01	0.01
27-Feb-09	9		8.6	6.7			0.01	
28-Feb-09	10		8.7	6.8			0.01	
1-Mar-09	10		8.4	6.8			0.01	
2-Mar-09	12		8.7	6.8			0.01	0.01
3-Mar-09	10		8.1	6.6			0.01	
4-Mar-09	12		7.1	6.5	72	97	0.01	
5-Mar-09	12		8.3	6.8			0.01	
6-Mar-09	11		8.2	6.8			0.02	
7-Mar-09	11		9.6	6.9			0.01	
8-Mar-09	9		9.1	6.6			0.01	
9-Mar-09	10		8.4	6.8			0.01	
10-Mar-09	9		8	6.6			0.01	
11-Mar-09	10		9.8	6.9			0.01	
12-Mar-09	9		10.7	6.7			0.01	
13-Mar-09	9		11	6.9			0.01	
14-Mar-09	11		10.4	6.8			0.03	
15-Mar-09	9		10.3	6.8			0.01	
16-Mar-09	10		10.3	6.7			0.02	
17-Mar-09	10		11.1	6.9			0.02	
18-Mar-09	10		10.7	6.9			0.01	
19-Mar-09	11		10.4	6.8			0.02	
20-Mar-09	12		10.1	6.9			0.02	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
21-Mar-09	11		10	7			0.02	
22-Mar-09	10		10	6.8			0.01	
23-Mar-09	10		10.2	6.8			0.02	
24-Mar-09	11		9.3	6.7			0.01	
25-Mar-09	11		10.3	6.9			0.01	
26-Mar-09	10		10.3	6.9			0.01	
27-Mar-09	11		9.8	6.9			0.01	
28-Mar-09	11		9.4	6.9			0.01	
29-Mar-09	10		10.1	6.8			0.01	
30-Mar-09	11		9.9	6.8			0.01	
31-Mar-09	11		9.7				0.01	
1-Apr-09	10		9.7	6.8			0.01	
2-Apr-09	11		10.1	6.8			0.01	
3-Apr-09	10		10.1	6.8			0.01	
4-Apr-09	11		10	6.9			0.01	
5-Apr-09	10		9.6	6.7			0.01	
6-Apr-09	11		9.6	6.8	64.7	107	0.01	
7-Apr-09	12		9.4	6.8			0.01	
8-Apr-09	13		9.1	6.8			0.01	
9-Apr-09	13		9.2	6.8			0.01	
10-Apr-09	13		8.8	6.7			0.01	
11-Apr-09	13		8.8	6.8			0.01	
12-Apr-09	13		8.4	6.7			0.01	
13-Apr-09	12		9.2	6.7			0.01	0.78
14-Apr-09	12		8.9	6.7			0.01	
15-Apr-09	12		9.2	6.7			0.01	
16-Apr-09	12		9.4	6.6			0.01	
17-Apr-09	14		9.3	6.7			0.01	
18-Apr-09	13		9.5	6.7			0.02	
19-Apr-09	13		8.7	6.7			0.01	
20-Apr-09	14		8.2	6.6			0.01	
21-Apr-09	15		7.6	6.6			0.01	
22-Apr-09	15		8.1	6.7			0.01	
23-Apr-09	14		8.8	6.8			0.01	
24-Apr-09	14		8.9	6.8			0.02	
25-Apr-09	15		9.3	6.8			0.02	
26-Apr-09	13		9	6.8			0.01	
27-Apr-09	14		8.4	6.7			0.01	
28-Apr-09	14		8.4	6.6			0.02	
29-Apr-09	14		8.9	6.6			0.02	
30-Apr-09	14		9.1	6.7			0.02	
1-May-09	14		9.3	6.8			0.01	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
2-May-09	14		9.4	6.7			0.02	
3-May-09	14		9.1	6.7			0.01	
4-May-09	14		8.9	6.7	73.1		0.02	0.03
5-May-09	15		9.3	6.8		89	0.01	
6-May-09	14		9.6	6.7			0.02	
7-May-09	15		10	6.7			0.02	
8-May-09	14		10	6.6			0.02	
9-May-09	15		10.3	6.7			0.03	
10-May-09	14		9.6	6.7			0.02	
11-May-09	15		9.7	6.9			0.02	
12-May-09	14		9.6	6.6			0.02	
13-May-09	14		9.9	6.7			0.02	
14-May-09	14		9.8	6.7			0.02	
15-May-09	14		9.9	6.6			0.03	
16-May-09	15		9.8	6.6			0.02	
17-May-09	15		9.2	6.5			0.02	
18-May-09	15		9.2	6.6			0.02	
19-May-09	15		9.3	6.7			0.02	
20-May-09	16		9.9	6.6			0.02	
21-May-09	15		10.3	6.8			0.02	
22-May-09	16		10.9	6.8			0.02	
23-May-09	15		9.8	7.1			0.01	
24-May-09	15		9.2	7.1			0.02	
25-May-09	17		9.3	7.1			0.03	
26-May-09	17		8.9	7.2			0.03	
27-May-09	16		9.1	7.2			0.03	
28-May-09	17		9.2	7.2			0.03	
29-May-09	18		9.1	7.2			0.01	
30-May-09	17		9	7.2			0.02	
31-May-09	17		8.6	7.2			0.02	
1-Jun-09	19		8.6	7.2			0.02	
2-Jun-09	19		8.4	7.3			0.01	
3-Jun-09	20		8.6	7.3			0.02	
4-Jun-09	20		8.7	7.3			0.01	0.01
5-Jun-09	20		8.3	7.3			0.01	
6-Jun-09	20		8.3	7.4			0.02	
7-Jun-09	19		8.6	7.3			0.01	
8-Jun-09	19		8.8	7.3			0.02	
9-Jun-09	19		8.7	7.3			0.04	
10-Jun-09	20		8.5	7.3	73	100	0.02	
11-Jun-09	20		8.7	7.4			0.02	
12-Jun-09	20		8.8	7.3			0.01	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
13-Jun-09	20		8.8	7.4			0.01	
14-Jun-09	19		8.2	7.3			0.01	
15-Jun-09	19		8.8	7.3			0.01	
16-Jun-09	20		8.4	7.3			0.01	
17-Jun-09	20		8.5	7.3			0.01	
18-Jun-09	20		8.5	7.3			0.01	
19-Jun-09	20		8.5	7.4			0.01	
20-Jun-09	19		8.7	7.4			0.01	
21-Jun-09	19		8	7.3			0.01	
22-Jun-09	19		8.8	7.3			0.01	
23-Jun-09	19		8.9	7.3			0.01	
24-Jun-09	20		8.8	7.4			0.01	
25-Jun-09	19		8.4	7.4			0.03	
26-Jun-09	19		8.6	7.4			0.01	
27-Jun-09	19		8	7.4			0.01	
28-Jun-09	20		8.4	7.3			0.01	
29-Jun-09	19		8.2	7.3			0.02	
30-Jun-09	19		7.7	7.4			0.02	
1-Jul-09	19		8.1	7.4			0.01	
2-Jul-09	20		7.7	7.4			0.01	0.01
3-Jul-09	20		7.3	7.3			0.02	
4-Jul-09	21		7.4	7.4			0.01	
5-Jul-09	21		6.8	7.3			0.02	
6-Jul-09	20		8.1	7.3	72.5	105	0.01	
7-Jul-09	20		8.3	7.3			0.02	
8-Jul-09	20		8.3	7.3			0.01	
9-Jul-09	19		8.2	7.4			0.01	
10-Jul-09	20		8.2	7.3			0.01	
11-Jul-09	21		8.2	7.3			0.01	
12-Jul-09	20		7.7	7.3			0.02	
13-Jul-09	21		7.9	7.4			0.01	
14-Jul-09	20		8.4	7.3			0.01	
15-Jul-09	20		8.1	7.3			0.01	
16-Jul-09	21		8.1	7.4			0.01	
17-Jul-09	21		7.8	7.3			0.02	
18-Jul-09	21		7.7	7.3			0.01	
19-Jul-09	21		7.9	7.3			0.01	
20-Jul-09	21		7.9	7.3			0.02	
21-Jul-09	21		7.8	7.3			0.01	
22-Jul-09	21		7.4	7.3			0.01	
23-Jul-09	21		7.8	7.1			0.01	
24-Jul-09	20		7.9	6.8			0.01	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
25-Jul-09	22		7.6	7.2			0.02	
26-Jul-09	22		7.5	7.3			0.02	
27-Jul-09	23		7.5	7.3			0.01	
28-Jul-09	24		7.3	7.3			0.01	
29-Jul-09	24		7.2	7.3			0.01	
30-Jul-09	24		7.2	7.3			0.02	
31-Jul-09	23		7.1	7.3			0.01	
1-Aug-09	23	23	7.6	7.3			0.01	
2-Aug-09	23	23	7.8	7.3	75	96	0.01	
3-Aug-09	23	23	7.2	7.3			0.01	
4-Aug-09	22	22	7.2	7.3			0.02	
5-Aug-09	22	22	7.3	7.3			0.02	
6-Aug-09	22	22	7.5	7.3			0.02	0.02
7-Aug-09	21	21	7.6	7.3			0.01	
8-Aug-09	21	21	7.6	7.3			0.01	
9-Aug-09	21	21	7.7	7.3			0.02	
10-Aug-09	21	21	7.7	7.3			0.01	
11-Aug-09	21	21	8.7	7.3			0.01	
12-Aug-09	21	21	7.4	7.2			0.02	
13-Aug-09	21	21	7.6	7.1			0.01	
14-Aug-09	20	20	7.7	7.2			0.01	
15-Aug-09	20	20	7.9	7.2			0.01	
16-Aug-09	19	19	7.7	7.2			0.01	
17-Aug-09		0						
18-Aug-09		0						
19-Aug-09		0						
20-Aug-09		0						
21-Aug-09		0						
22-Aug-09		0						
23-Aug-09		0						
24-Aug-09		0						
25-Aug-09		0						
26-Aug-09		0						
27-Aug-09		0						
28-Aug-09		0						
29-Aug-09		0						
30-Aug-09		0						
31-Aug-09		0						
1-Sep-09	20	20	7.9	7.1			0.02	
2-Sep-09	20	20	7.3	7.1			0.02	0.01
3-Sep-09	20	20	8.1	7			0.02	
4-Sep-09	20	20	8	7.1			0.02	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
5-Sep-09	20	20	7.9	7.1			0.02	
6-Sep-09	20	20	8	7.1			0.01	
7-Sep-09	19	19	7.8	7.2			0.01	
8-Sep-09	19	19	8	7.2		82	0.01	
9-Sep-09	19	19	7.8	7.2	77.5		0.02	
10-Sep-09	20	20	7.6	7.2			0.01	
11-Sep-09	19	19	7.9	7.3			0.02	
12-Sep-09	20	20	7.5	7.2			0.02	
13-Sep-09	20	20	7.6	7.3			0.01	
14-Sep-09	21	21	7.4	7.2			0.02	
15-Sep-09	20	20	7.8	7.2			0.01	
16-Sep-09	21	21	7.7	7.2			0.02	
17-Sep-09	20	20	7.9	7.2			0.01	
18-Sep-09	19	19	8	7.2			0.01	
19-Sep-09	20	20	7.8	7.2			0.02	
20-Sep-09	19	19	8	7.1			0.02	
21-Sep-09	18	18	8.1	7			0.02	
22-Sep-09	19	19	7.8	6.7			0.02	
23-Sep-09	19	19	8	7.2			0.01	
24-Sep-09	19	19	8.1	7.2			0.02	
25-Sep-09	18	18	8.4	7.2			0.03	
26-Sep-09	18	18	8.4	7.2			0.02	
27-Sep-09	18	18	8.3	7.1			0.01	
28-Sep-09	17	17	8.3	7.1			0.01	
29-Sep-09	17	17	8.6	7.1			0.01	
30-Sep-09	17	17	8.8	7.2			0.02	
1-Oct-09								
2-Oct-09								
3-Oct-09								
4-Oct-09								
5-Oct-09					84.1	97		
6-Oct-09								
7-Oct-09								
8-Oct-09								
9-Oct-09								
10-Oct-09								
11-Oct-09								
12-Oct-09								
13-Oct-09								
14-Oct-09								
15-Oct-09								
16-Oct-09								

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
17-Oct-09								
18-Oct-09								
19-Oct-09								
20-Oct-09								
21-Oct-09								
22-Oct-09	16	16	9.5	7.3			0.02	0.02
23-Oct-09	16	16	8.6	7.2			0.01	
24-Oct-09	15	15	9.4	7.2			0.01	
25-Oct-09	14	14	8.9	7.2			0.02	
26-Oct-09	15	15	9.1	7.2			0.01	
27-Oct-09	14	14	9.1	7.2			0.01	
28-Oct-09	13	13	9.4	7.1			0.01	
29-Oct-09	14	14	9.5	7.2			0.01	
30-Oct-09	15	15	8.9	7.2			0.01	
31-Oct-09	15	15	9.3	7.4			0.01	
1-Nov-09	13		8.9	7.3			0.01	0.02
2-Nov-09	14		8.8	7.3			0.01	
3-Nov-09	14		9.1	7.3			0.01	
4-Nov-09	13		9.3	7.2		99	0.01	
5-Nov-09	14		9	7.2	71.6		0.01	
6-Nov-09	14		9.2	7.3			0.01	
7-Nov-09	13		9.2	7.3			0.01	
8-Nov-09	12		8.8	7.2			0.01	
9-Nov-09	14		8.4	7.2			0.02	
10-Nov-09	13		9.3	7.1			0.01	
11-Nov-09	12		9.4	7.1			0.02	
12-Nov-09	13		9.2	7.2			0.01	
13-Nov-09	12		9.3	7.2			0.01	
14-Nov-09	11		9.6	7.2			0.01	
15-Nov-09	12		9.2	7.2			0.01	
16-Nov-09	13		8.3	7.1			0.01	
17-Nov-09	12		8	7			0.01	
18-Nov-09	11		9	7.1			0.01	
19-Nov-09	13		9.8	7.1			0.01	
20-Nov-09	13		9.9	7.2			0.01	
21-Nov-09	12		10	7.2			0.02	
22-Nov-09	11		9.8	7.2			0.01	
23-Nov-09	12		9	7.1			0.01	
24-Nov-09	12		9.7	7.1			0.03	
25-Nov-09	12		9.3	7.2			0.01	
26-Nov-09	13		9.4	7.1			0.02	
27-Nov-09	12		8.7	7.1			0.01	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
28-Nov-09	12		9	7.1			0.01	
29-Nov-09	12		8.4	7			0.01	
30-Nov-09	12		8.4	7			0.03	
1-Dec-09	12		8.1	6.9			0.02	
2-Dec-09	10		9	7			0.01	
3-Dec-09	10		9.1	7			0.01	0.02
4-Dec-09	9		9.1	7.1			0.01	
5-Dec-09	9		9.5	6.9			0.03	
6-Dec-09	8		8.8	7			0.01	
7-Dec-09	8		9.8	7	68.6	86	0.02	
8-Dec-09	6		10.3	7.1			0.01	
9-Dec-09	5		9.3	7.1			0.01	
10-Dec-09	6		9.5	7			0.01	
11-Dec-09	7		10	7			0.03	
12-Dec-09	7		10.5	7.1			0.03	
13-Dec-09	7		10.3	7			0.01	
14-Dec-09	9		9.5	7			0.01	
15-Dec-09	10		10	7			0.02	
16-Dec-09	11		10.6	7			0.02	
17-Dec-09	10		10.6	7			0.03	
18-Dec-09	10		11.6	7.1			0.02	
19-Dec-09	11		10.8	7.1			0.02	
20-Dec-09	11		9.8	7			0.01	
21-Dec-09	11		9.6	7.1			0.01	
22-Dec-09	10		10.7	7.1			0.02	
23-Dec-09	9		10.5	7.1			0.02	
24-Dec-09	9		10.5	7.1			0.02	
25-Dec-09	8		10.5	7			0.01	
26-Dec-09	7		10.9	7.1			0.03	
27-Dec-09	7		9.5	7			0.01	
28-Dec-09	8		8.6	6.9			0.01	
29-Dec-09	8		10.1	7			0.01	
30-Dec-09	9		9.2	6.7			0.01	
31-Dec-09	9		9.4	7			0.02	
1-Jan-10	10		8.5	6.9			0.01	
2-Jan-10	10		8.1	6.9			0.01	
3-Jan-10	10		8.6	6.9		82	0.02	
4-Jan-10	11		8.8	6.9	69.4		0.04	0.06
5-Jan-10	12		9	7			0.01	
6-Jan-10	11		9.4	7			0.01	
7-Jan-10	10		9.6	7.1			0.02	
8-Jan-10	10		9.9	7.1			0.03	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
9-Jan-10	10		10	7			0.02	
10-Jan-10	11		9.2	6.8			0.02	
11-Jan-10	12		9.3	6.9			0.01	
12-Jan-10	11		10.2	7			0.02	
13-Jan-10	11		10.2	7.1			0.01	
14-Jan-10	11		9.9	7.1			0.02	
15-Jan-10	11		11	7.1			0.02	
16-Jan-10	11		10.8	7.2			0.02	
17-Jan-10	11		10.1	7.1			0.02	
18-Jan-10	11		10.2	7.2			0.01	
19-Jan-10	11		9.7	7.1			0.01	
20-Jan-10	11		10.2	7			0.02	
21-Jan-10	11		9.8	7.1			0.01	
22-Jan-10	10		10.6	7.1			0.01	
23-Jan-10	11		10.9	7.1			0.02	
24-Jan-10	10		10.8	7.1			0.04	
25-Jan-10	11		10.2	7.1			0.01	
26-Jan-10	10		10.4	7			0.01	
27-Jan-10	11		10.6	7.1			0.01	
28-Jan-10	11		10.4	7.2			0.02	
29-Jan-10	11		10.5	7.1			0.01	
30-Jan-10	11		10.7	7.1			0.03	
31-Jan-10	11		10.3	7.1			0.02	
1-Feb-10	11		10	7			0.04	
2-Feb-10	12		9.7	7.2			0.02	
3-Feb-10	11		10.4	7.1			0.04	
4-Feb-10	11		10.7	7.1	68.2	91	0.01	0.03
5-Feb-10	11		10.3	7.1			0.01	
6-Feb-10	11		10.6	7			0.02	
7-Feb-10	12		10	7			0.01	
8-Feb-10	11		10.4	7			0.01	
9-Feb-10	11		10.5	7.1			0.01	
10-Feb-10	10		10.7	7.1			0.02	
11-Feb-10	11		11	7.1			0.01	
12-Feb-10	11		10.6	7			0.01	
13-Feb-10	11		10.5	7.1			0.02	
14-Feb-10	12		10.4	7.1			0.01	
15-Feb-10	11		10.3	7.1			0.01	
16-Feb-10	12		9.9	7.2			0.01	
17-Feb-10	12		10.5	7.1			0.02	
18-Feb-10	10		10.5	7.1			0.02	
19-Feb-10	10		10.6	7			0.01	

City of Yelm Effluent Data
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20-Feb-10	10		10.8	7.1			0.02	
21-Feb-10	9		10.5	7			0.01	
22-Feb-10	10		10.1	7.1			0.02	
23-Feb-10	10		10.2	7.2			0.02	
24-Feb-10	12		10.1	7			0.02	
25-Feb-10	12		9.7	7.1			0.03	
26-Feb-10	12		9.6	7			0.01	
27-Feb-10	12		9.7	7			0.02	
28-Feb-10	12		9.2	7			0.01	
1-Mar-10	12		9.3	7			0.02	
2-Mar-10	12		9.8	7			0.01	
3-Mar-10	12		9.2	6.9			0.02	
4-Mar-10	12		9.1	7			0.01	
5-Mar-10	11		9.3	7			0.02	
6-Mar-10	11		9.3	7			0.01	
7-Mar-10	11		8.4	6.9			0.01	
8-Mar-10	11		8.4	6.9		78	0.01	
9-Mar-10	10		8.7	6.9			0.01	
10-Mar-10	10		8.5	6.9	71		0.01	0.02
11-Mar-10	12		7.7	7			0.01	
12-Mar-10	11		9.1	6.8			0.02	
13-Mar-10	11		9	6.8			0.02	
14-Mar-10	10		8.3	6.8			0.02	
15-Mar-10	13		7.7	6.9			0.02	
16-Mar-10	12		7.8	7			0.01	
17-Mar-10	11		7.5	6.9			0.02	
18-Mar-10	11		7.7	7			0.01	
19-Mar-10	11		7.4	7			0.01	
20-Mar-10	11		7.4	7			0.01	
21-Mar-10	13		7	6.8			0.02	
22-Mar-10	12		6.8	6.9			0.02	
23-Mar-10	12		6.6	6.9			0.01	
24-Mar-10	13		6.2	6.9			0.01	
25-Mar-10	13		6	6.9			0.01	
26-Mar-10	12		6.3	6.8			0.02	
27-Mar-10	12		6.1	6.9			0.02	
28-Mar-10	13		6.1	6.9			0.03	
29-Mar-10	12		6.4	6.9			0.02	
30-Mar-10	12		6.3	6.9			0.01	
31-Mar-10	11		6.1	6.9			0.02	
1-Apr-10	12		6.2	6.9			0.07	
2-Apr-10	12		6.3	6.9			0.02	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
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3-Apr-10	12		6.4	6.9			0.04	
4-Apr-10	12		6.1	6.9			0.03	
5-Apr-10	13		6.1	7			0.02	
6-Apr-10	12		6.1	6.9			0.02	
7-Apr-10	12		6.1	6.9			0.01	
8-Apr-10	12		5.8	6.8			0.02	
9-Apr-10	12		6	7			0.02	
10-Apr-10	12		8.2	7			0.02	
11-Apr-10	13		7.8	7			0.02	
12-Apr-10	13		7.9	7			0.02	
13-Apr-10	13		7.8	7.1			0.01	
14-Apr-10	13		7.6	7			0.01	3.04
15-Apr-10	14		8.1	7.1	65	91	0.01	2.41
16-Apr-10	13		8.3	7.1			0.02	
17-Apr-10	15		8.1	7.1			0.02	
18-Apr-10	14		8.3	7.1			0.03	
19-Apr-10	15		8.2	7			0.02	0.02
20-Apr-10	15		8	7			0.02	0.01
21-Apr-10	14		8.6	7			0.03	0.04
22-Apr-10	14		9.1	7.1			0.01	0.01
23-Apr-10	14		9.1	7.1			0.03	
24-Apr-10	14		9.5	7.2			0.04	
25-Apr-10	14		9.3	7			0.04	
26-Apr-10	14		8.8	7			0.01	0.01
27-Apr-10	15		8.6	7			0.01	
28-Apr-10	14		9.6	7			0.03	
29-Apr-10	14		9.5	7			0.04	
30-Apr-10	15		9.6	7.1			0.04	0.04
1-May-10	14		9.6	7			0.01	
2-May-10	14		9.5	7			0.01	
3-May-10	14		9.4	7			0.01	<0.01
4-May-10	14		9.3	7.1			0.04	
5-May-10	14		9.1	7			0.04	
6-May-10	14		9.5	7	64.7	68	0.04	
7-May-10	14		9.8	7.1			0.01	
8-May-10	15		9.2	7.1			0.01	
9-May-10	15		9.2	6.9			0.01	
10-May-10	15		8.7	7			0.05	
11-May-10	15		9.2	7.1			0.01	
12-May-10	15		9.3	7			0.04	
13-May-10	15		9.2	7			0.03	
14-May-10	16		8.9	7			0.05	

City of Yelm Effluent Data
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15-May-10	17		8.4	7			0.05	
16-May-10	17		8	7			0.01	
17-May-10	17		8	7			0.04	
18-May-10	17		7.9	7			0.05	
19-May-10	17		8.4	7.1			0.06	
20-May-10	16		9.2	7			0.05	
21-May-10	16		9	7.1			0.06	
22-May-10	16		9.3	7.1			0.01	
23-May-10	15		8.9	7			0.01	
24-May-10	17		8.8	7.1			0.05	
25-May-10	16		8.5	7.1			0.04	
26-May-10	16		8.6	7			0.05	
27-May-10	16		8.7	7			0.01	
28-May-10	16		9.5	7.1			0.01	
29-May-10	15		9.1	7.1			0.01	
30-May-10	15		8.7	7			0.01	
31-May-10	17		8.6	7			0.01	
1-Jun-10	17		8.3	7			0.01	
2-Jun-10	17		8.2	7.1			0.01	
3-Jun-10	17		8.3	7.1	62.9	84	0.05	0.02
4-Jun-10	17		8.4	7.1			0.06	
5-Jun-10	17		8.8	7.1			0.06	
6-Jun-10	17		8.2	7.1			0.05	
7-Jun-10	18		8.3	7			0.05	
8-Jun-10	18		8.4	7.1			0.01	
9-Jun-10	17		8.4	7.1			0.01	
10-Jun-10	17		8.4	7.1			0.01	
11-Jun-10	17		8.4	7.1			0.05	
12-Jun-10	18		8.5	7.2			0.06	
13-Jun-10	18		8.2	7			0.01	
14-Jun-10	18		8.1	7			0.01	
15-Jun-10	17		8.3	7.1			0.06	
16-Jun-10	17		8.1	7.1			0.01	
17-Jun-10	17		8.8	7.1			0.01	
18-Jun-10	18		8.6	7.2			0.05	
19-Jun-10	17		8.6	7.1			0.01	
20-Jun-10	17		8.6	7.1			0.01	
21-Jun-10	17		8.5	7.1			0.06	
22-Jun-10	17		8.5	7.1			0.01	
23-Jun-10	19		8.2	7			0.01	
24-Jun-10	19		7.9	7.1			0.03	
25-Jun-10	19		8.3	7.1			0.01	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
26-Jun-10	19		8.2	7.1			0.01	
27-Jun-10	19		8	7			0.01	
28-Jun-10	19		8	7			0.01	
29-Jun-10	19		7.8	7.1			0.01	
30-Jun-10	18		8.1	7.1			0.01	
1-Jul-10	18		8	7.1			0.05	
2-Jul-10	18		7.7	7.1			0.05	
3-Jul-10	18		8	7.2			0.01	
4-Jul-10	19		8	7.1			0.05	
5-Jul-10	19		7.7	7.2			0.01	
6-Jul-10	18		8.2	7.1	64.3	95	0.01	<0.01
7-Jul-10	20		8	7.1			0.04	
8-Jul-10	21		7.8	7.1			0.05	
9-Jul-10	21		7.6	7			0.02	
10-Jul-10	21		7.5	7			0.01	
11-Jul-10	21		7.2	7			0.01	
12-Jul-10	20		7.5	7			0.01	
13-Jul-10	20		7.6	7.1			0.01	
14-Jul-10	20		7.5	7			0.05	
15-Jul-10	20		7.6	7			0.04	
16-Jul-10	20		7.5	7.1			0.05	
17-Jul-10	20		7.5	7.1			0.04	
18-Jul-10	19		7.2	7			0.04	
19-Jul-10	20		7.3	7	76.6		0.05	
20-Jul-10	19		7.4	6.7			0.04	0.18
21-Jul-10	20		7.8	7.1			0.06	
22-Jul-10	20		7.4	7.2			0.04	
23-Jul-10	20		7.3	7.1			0.01	
24-Jul-10	21		7.3	7			0.01	
25-Jul-10	21		7.2	7			0.01	
26-Jul-10	21		7.2	7.1			0.04	
27-Jul-10	21		7.3	7.1			0.01	
28-Jul-10	21		7.8	7.1			0.01	
29-Jul-10	20		7.9	7.1			0.01	
30-Jul-10	20		7.8	7.1			0.01	
31-Jul-10	21		7.9	7.1			0.05	
1-Aug-10	21	21	7.6	7			0.01	
2-Aug-10	21	21	7.4	7	76.5	90	0.06	<0.01
3-Aug-10	21	21	7.5	7.1				
4-Aug-10	21	21	7.6	7.1				
5-Aug-10	22	22	7.4	7.2			0.01	
6-Aug-10	22	22	7.4	7.1			0.01	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
7-Aug-10	22	22	7.5	7.1			0.02	
8-Aug-10	21	21	7.6	7.1				
9-Aug-10	21	21	7.5	7				
10-Aug-10	20	20	8.7	7.1			0.03	
11-Aug-10	20	20	7.4	7.1				
12-Aug-10	21	21	7.4	7.1				
13-Aug-10	21	21	7.5	7			0.02	
14-Aug-10	22	22	7.6	7				
15-Aug-10	22	22	7.4	6.9				
16-Aug-10	22	22	7.2	6.8				
17-Aug-10	22	22	7.2	6.7				
18-Aug-10	22	22	7.3	6.9				
19-Aug-10	22	22	7.3	7.1				
20-Aug-10	20	20	7.1	7.1			0.01	
21-Aug-10	21	21	7.7	7.1			0.05	
22-Aug-10	21	21	7.4	7			0.04	
23-Aug-10	20	20	7.6	7			0.04	
24-Aug-10	20	20	7.5	7.1			0.01	
25-Aug-10	21	21	7.5	7.1			0.04	
26-Aug-10	21	21	7.4	7			0.04	
27-Aug-10	21	21	7.6	7.2			0.01	
28-Aug-10	20	20	7.7	7.1			0.04	
29-Aug-10	20	20	6.9	7			0.03	
30-Aug-10	20	20	7.6	7			0.04	
31-Aug-10	20	20	7.7	7.1			0.04	
1-Sep-10	20	20	7.6	7			0.01	
2-Sep-10	20	20	7.8	7.1	70.9	93	0.04	0.15
3-Sep-10	20	20	8	7.1			0.04	
4-Sep-10	20	20	7.4	7.2			0.01	
5-Sep-10	19	19	7.2	7			0.01	
6-Sep-10	19	19	7.2	7.1			0.03	
7-Sep-10	19	19	7	7			0.04	
8-Sep-10	19	19	7.8	7.1			0.04	
9-Sep-10	20	20	7.7	7.1			0.04	
10-Sep-10	19	19	7.2	7.1			0.01	
11-Sep-10	19	19	8.4	7.1			0.04	
12-Sep-10	19	19	8.4	7			0.04	
13-Sep-10	19	19	8.1	7			0.01	
14-Sep-10	19	19	8	7			0.01	
15-Sep-10	19	19	7.6	7			0.01	
16-Sep-10	19	19	8.8	7			0.01	
17-Sep-10	19	19	8.2	7			0.04	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
18-Sep-10	20	20	8	7.1			0.04	
19-Sep-10	20	20	8.2	7.1			0.05	
20-Sep-10	19	19	7.3	7.1			0.03	
21-Sep-10	18	18	8	7			0.01	
22-Sep-10	18	18	7.8	7			0.01	
23-Sep-10	18	18	8.2	7			0.01	
24-Sep-10	18	18	8.1	7			0.03	
25-Sep-10	18	18	8.1	7			0.03	
26-Sep-10	19	19	8.2	7			0.01	<0.01
27-Sep-10	20	20	7.7	7			0.01	
28-Sep-10	21	21	7.5	7			0.01	
29-Sep-10	19	19	7.6	7.1			0.01	
30-Sep-10	19	19	7.6	7			0.01	
1-Oct-10	18	18	7.6	7.1			0.01	
2-Oct-10	19	19	7.6	7			0.05	
3-Oct-10	19	19	8.4	7			0.04	
4-Oct-10	18	18	7.1	6.9	73.2	94	0.01	<0.01
5-Oct-10	18	18	7.3	7			0.01	
6-Oct-10	17	17	8.3	6.9			0.01	
7-Oct-10	17	17	8.2	7.1			0.05	
8-Oct-10	17	17	8.5	7.1			0.04	
9-Oct-10	18	18	8.1	7.1			0.01	
10-Oct-10	18	18	7	7			0.01	
11-Oct-10	16	16	7.6	7			0.01	
12-Oct-10	16	16	7.7	7			0.01	
13-Oct-10	16	16	8.4	7			0.05	
14-Oct-10	16	16	8.3	7			0.01	
15-Oct-10	16	16	8.3	7			0.05	
16-Oct-10	16	16	8.7	7.1			0.01	
17-Oct-10	14	14	9.1	7.2			0.01	
18-Oct-10	14	14	8.5	7			0.01	
19-Oct-10	15	15	8	7			0.01	
20-Oct-10	14	14	8.7	7			0.01	
21-Oct-10	15	15	8.6	7			0.01	
22-Oct-10	16	16	8	7			0.05	
23-Oct-10	16	16	8.3	7.1			0.01	
24-Oct-10	15	15	8.1	7			0.01	
25-Oct-10	15	15	7.9	6.9			0.05	
26-Oct-10	15	15	8.7	7.1			0.01	
27-Oct-10	14	14	8.1	6.9			0.01	
28-Oct-10	15	15	7.8	6.9			0.01	
29-Oct-10	15	15	8.6	7			0.01	

City of Yelm Effluent Data
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From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
30-Oct-10	14	14	9.1	7			0.06	
31-Oct-10	14	14	8.1	6.9			0.06	
1-Nov-10	16		7.4	6.9			0.07	
2-Nov-10	15		7.7	7			0.07	
3-Nov-10	15		8.2	6.9	70.9	92	0.01	
4-Nov-10	14		8.1	7			0.01	
5-Nov-10	15		8.3	7			0.01	
6-Nov-10	15		8.8	7			0.05	
7-Nov-10	15		8.4	7			0.07	
8-Nov-10	14		8.3	7			0.06	<0.01
9-Nov-10	14		8.9	7			0.06	
10-Nov-10	14		9.8	7			0.07	
11-Nov-10	12		9.8	7.2			0.01	
12-Nov-10	13		9.2	7.1			0.01	
13-Nov-10	13		9	7.1			0.06	
14-Nov-10	14		8.9	7.1			0.05	
15-Nov-10	15		8.5	7.1			0.01	
16-Nov-10	14		8.3	7.1			0.06	
17-Nov-10	13		8.9	7.1			0.06	
18-Nov-10	13		9.7	7			0.06	
19-Nov-10	11		9.1	7.1			0.06	
20-Nov-10	12		9.3	7			0.07	
21-Nov-10	12		8.8	7			0.01	
22-Nov-10	12		9.8	6.9			0.04	
23-Nov-10	9		10.6	7			0.07	
24-Nov-10	9		10.1	7			0.01	
25-Nov-10	9		10.7	6.9			0.01	
26-Nov-10	10		9.8	6.8			0.07	
27-Nov-10	10		9.1	6.8			0.04	
28-Nov-10	11		8.8	6.7			0.01	
29-Nov-10	11		8.7	6.8			0.01	
30-Nov-10	11		8.6	6.8			0.01	
1-Dec-10	11		7.9	6.8			0.01	
2-Dec-10	16		8	6.7			0.01	
3-Dec-10	11		8.4	6.8			0.09	
4-Dec-10	10		8.2	6.9			0.08	
5-Dec-10	10		8.4	6.8			0.09	
6-Dec-10	10		8.7	6.8			0.01	
7-Dec-10	11		8.1	6.9			0.09	
8-Dec-10	11		7.8	6.7			0.01	
9-Dec-10	12		8.1	6.8			0.01	
10-Dec-10	12		7.7	6.9			0.01	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
11-Dec-10	13		7.6	6.8			0.01	
12-Dec-10	12		8.2	6.8		66	0.02	0.7
13-Dec-10	12		7.8	6.7	73.4		0.01	
14-Dec-10	12		7.9	6.9			0.01	
15-Dec-10	13		8	6.8			0.01	
16-Dec-10	11		8.6	6.7			0.01	
17-Dec-10	10		8.5	6.9			0.01	
18-Dec-10	10		8.8	6.9			0.01	
19-Dec-10	9		9	6.9			0.01	
20-Dec-10	9		8.9	7			0.01	
21-Dec-10	10		8.8	7.1			0.1	
22-Dec-10	11		8.5	6.9			0.09	
23-Dec-10	11		8.8	7.1			0.1	
24-Dec-10	12		8.6	7			0.1	
25-Dec-10	12		8.5	7			0.11	
26-Dec-10	12		7.8	7			0.02	
27-Dec-10	11		8.8	6.8			0.01	
28-Dec-10	11		8.4	6.9			0.09	
29-Dec-10	10		8.5	7			0.01	
30-Dec-10	9		8.6	7.1			0.01	
31-Dec-10	8		8.1	7			0.01	
1-Jan-11	8		8.7	7			0.01	
2-Jan-11	8		8.9	7.1		85	0.01	4.52
3-Jan-11	7		9.3	7	75.1		0.01	
4-Jan-11	8		8.6	7			0.01	
5-Jan-11	9		9	6.8			0.01	4.9
6-Jan-11	10		8.2	6.9			0.01	
7-Jan-11	10		7.5	6.9			0.01	
8-Jan-11	11		7.6	7			0.01	
9-Jan-11	10		7	6.8			0.01	4.96
10-Jan-11	9		7.3	6.8			0.01	
11-Jan-11	9		6.8	6.8			0.01	
12-Jan-11	9		8	6.7			0.01	5.2
13-Jan-11	11		8.6	6.8			0.01	
14-Jan-11	11		8.6	6.9			0.1	
15-Jan-11	12		8.3	6.8			0.09	
16-Jan-11	12		8	6.8			0.1	
17-Jan-11	13		7.6	6.9			0.01	7.68
18-Jan-11	11		8.3	6.9			0.1	
19-Jan-11	10		8.9	6.9			0.1	7.88
20-Jan-11	9		8.4	6.9			0.01	
21-Jan-11	11		8.7	6.9			0.1	

City of Yelm Effluent Data
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22-Jan-11	11		8.6	7			0.09	
23-Jan-11	10		8.8	6.9			0.01	8.6
24-Jan-11	11		8.3	6.9			0.01	
25-Jan-11	11		9.9	7			0.1	
26-Jan-11	11		9.4	6.9			0.09	9.4
27-Jan-11	10		8.5	6.9			0.01	
28-Jan-11	11		8.6	7			0.01	
29-Jan-11	11		7	7			0.1	
30-Jan-11	11		8.9	6.6			0.01	7.75
31-Jan-11	11		8.8	6.9			0.01	
1-Feb-11	10		8.4	6.8			0.08	
2-Feb-11	9		8.2	6.8			0.09	
3-Feb-11	10		8.5	6.6	79.6	48	0.01	8.38
4-Feb-11	11		8.7	6.8			0.08	
5-Feb-11	11		8	7			0.09	
6-Feb-11	12		8.3	6.8			0.09	11.9
7-Feb-11	11		6.9	6.9			0.1	
8-Feb-11	11		7.6	6.9			0.01	
9-Feb-11	10		8.6	7.1			0.01	15
10-Feb-11	9		8.3	6.8			0.01	
11-Feb-11	10		7.8	7			0.01	
12-Feb-11	10		8.9	7.1			0.01	
13-Feb-11	11		9.2	7.1			0.01	19.4
14-Feb-11	11		8.3	7			0.01	
15-Feb-11	11		8.2	7.2			0.01	
16-Feb-11	10		8.4	7.1			0.01	19.3
17-Feb-11	10		8.7	7.2			0.01	
18-Feb-11	10		8.3	7.2			0.09	
19-Feb-11	10		9	7.3			0.01	
20-Feb-11	9		9.4	7.3			0.09	
21-Feb-11	9		9.1	7.2			0.07	26.8
22-Feb-11	10		8.5	7.5			0.01	
23-Feb-11	9		8.6	7.2			0.09	28
24-Feb-11	8		9.4	7.2			0.07	
25-Feb-11	8		8.7	7.4			0.08	
26-Feb-11	10		8.7	7.3			0.01	
27-Feb-11	8		9.4	7.1			0.01	31
28-Feb-11	9		9.2	7.3			0.01	
1-Mar-11	9		8.7	7.4			0.1	
2-Mar-11	11		8.5	7.3			0.1	
3-Mar-11	9		9.9	7.4			0.1	35.6
4-Mar-11	9		10	7.5			0.09	

City of Yelm Effluent Data
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5-Mar-11	10		10.1	7.4			0.11	
6-Mar-11	10		10.5	7.5			0.09	
7-Mar-11	10		10.2	7.4			0.01	49.8
8-Mar-11	10		9.8	7.5			0.09	
9-Mar-11	11		10.2	7.5			0.01	
10-Mar-11	11		10	7.5			0.08	38.2
11-Mar-11	11		9.8	7.5			0.09	
12-Mar-11	11		9.8	7.6			0.01	
13-Mar-11	11		9.5	7.4			0.01	
14-Mar-11	11		10	7.5			0.01	41.2
15-Mar-11	11		9.8	7.6			0.01	
16-Mar-11	11		9.8	7.4			0.08	
17-Mar-11	10		9.6	7.5	81.9		0.01	42
18-Mar-11	10		10.2	7.5			0.1	
19-Mar-11	12		10.3	7.6			0.19	
20-Mar-11	10		9.9	7.5			0.08	
21-Mar-11	11		9.7	7.5			0.1	40.2
22-Mar-11	11		9.6	7.7			0.01	
23-Mar-11	10		10.3	7.5			0.01	
24-Mar-11	11		8.6	7.6			0.14	37.4
25-Mar-11	11		9.3	7.5			0.09	
26-Mar-11	12		9.3	7.5			0.09	
27-Mar-11	11		9.4	7.5			0.01	
28-Mar-11	11		9.5	7.5			0.01	34.4
29-Mar-11	12		9.3	7.5			0.01	
30-Mar-11	12		9.9	7.5			0.07	
31-Mar-11	12		9.5	7.4			0.01	29.6
1-Apr-11	13		9.6	7.4			0.09	
2-Apr-11	12		9.3	7.4			0.01	
3-Apr-11	12		9.8	7.4			0.01	
4-Apr-11	12		9	7.4			0.01	27
5-Apr-11	11		9.2	7.4			0.09	
6-Apr-11	11		8.5	7.3			0.08	
7-Apr-11	11		8.8	7.4			0.03	21.6
8-Apr-11	11		9	7.4			0.03	
9-Apr-11	13		5.8	7.5			0.02	
10-Apr-11	12		5.4	7.3			0.02	
11-Apr-11	13		8.7	7.4	93.8		0.02	24.7
12-Apr-11	12		9	7.5			0.02	
13-Apr-11	12		7.8	7.5			0.01	
14-Apr-11	12		9.2	7.5			0.01	27.4
15-Apr-11	12		7.6	7.6			0.04	

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
16-Apr-11	13		9.2	7.5			0.02	
17-Apr-11	12		7.8	7.5			0.03	
18-Apr-11	13		9.5	7.6			0.03	32.2
19-Apr-11	13		9.1	7.6			0.01	
20-Apr-11	12		9.1	7.5			0.02	
21-Apr-11	12		9.5	7.5			0.01	35.4
22-Apr-11	12		9.1	7.5			0.03	
23-Apr-11	13		9	7.4			0.03	
24-Apr-11	14		8.5	7.3			0.02	
25-Apr-11	14		8.5	7.3			0.02	24.8
26-Apr-11	13		8.1	7.3			0.06	
27-Apr-11	13		8.3	7.1			0.03	
28-Apr-11	12		8.4	7.3			0.03	16.7
29-Apr-11	13		8.3	7.2			0.02	
30-Apr-11	14		8.2	7.2			0.04	
1-May-11	14		7.8	7.3			0.03	
2-May-11	14		7.2	7.1			0.02	12.4
3-May-11	14		7.3	7.1			0.03	
4-May-11	13		7.6	7.1			0.01	
5-May-11	14		7.1	7.1			0.03	9.28
6-May-11	15		7	7.1			0.03	
7-May-11	14		7.1	7			0.02	
8-May-11	14		7.1	7			0.02	
9-May-11	15		6.7	7			0.01	7.16
10-May-11	15		7.2	7			0.02	
11-May-11	15		6.5	7			0.02	
12-May-11	15		7.3	7.1	113		0.01	5
13-May-11	14		7.3	7.1			0.01	4.52
14-May-11	17		7.2	7.3			0.02	5.16
15-May-11	16		7.2	7.1			0.01	6.28
16-May-11	15		7.2	7.4			0.02	9.1
17-May-11	14		7.5	7.4			0.02	11.5
18-May-11	16		7	7.5			0.02	10.5
19-May-11	16		7.4	7.4			0.02	10.5
20-May-11	16		6.7	7.4			0.02	9.3
21-May-11	16		7	7.4			0.02	7.6
22-May-11	16		7.3	7.3			0.02	6.52
23-May-11	15		7	7.3			0.02	6.2
24-May-11	17		6.5	7.2			0.03	6
25-May-11	16		8.2	7.4			0.03	6.8
26-May-11	15		7.1	7.3			0.02	5.28
27-May-11	16		8	7.3			0.02	4.8

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
28-May-11	16		7.8	7.3			0.02	4.9
29-May-11	16		8.1	7.3			0.02	4.9
30-May-11	16		8.2	7.3			0.02	5
31-May-11	16		8	7.3			0.02	5.8
1-Jun-11	16		8.1	7.4			0.01	7.4
2-Jun-11	17		8	7.4			0.03	7.84
3-Jun-11	16		8.2	7.4			0.02	8.88
4-Jun-11	18		7.9	7.4			0.02	8.64
5-Jun-11	18		7.8	7.3			0.02	8
6-Jun-11	18		7.5	7.2			0.04	7.28
7-Jun-11	17		7.5	7.3			0.02	6.68
8-Jun-11	17		7.2	7.1			0.03	5.2
9-Jun-11	17		7.9	7.1			0.01	3.6
10-Jun-11	17		7	7.1			0.02	2.62
11-Jun-11	18		7.1	7			0.02	1.5
12-Jun-11	18		7.3	6.8			0.02	0.74
13-Jun-11	18		6.5	6.8			0.02	0.76
14-Jun-11	18		6.3	6.7			0.01	0.53
15-Jun-11	17		6.5	6.9			0.02	0.02
16-Jun-11	17		7.7	6.9			0.01	0.02
17-Jun-11	17		7.8	6.9			0.01	0.01
18-Jun-11	18		6.9	6.9			0.02	0.02
19-Jun-11	18		7.8	6.9			0.03	0.01
20-Jun-11	18		5.9	6.9	119.5		0.02	0.01
21-Jun-11	18		7.4	7.1			0.03	0.16
22-Jun-11	20		6.7	7.2			0.02	0.4
23-Jun-11	19		6.4	6.3			0.02	0.4
24-Jun-11	18		6	7.3			0.02	0.49
25-Jun-11	19		8.9	7.2			0.01	0.27
26-Jun-11	18		7.4	7.2			0.01	0.49
27-Jun-11	19		6.8	7.2			0.01	0.92
28-Jun-11	18		6.8	7.1			0.01	0.95
29-Jun-11	19		6.4	7.1			0.01	0.63
30-Jun-11	18		6.6	7			0.01	0.35
1-Jul-11	18		6.5	7			0.02	0.02
2-Jul-11	19		6.5	6.9			0.02	0.01
3-Jul-11	19		7.2	6.8			0.01	0.01
4-Jul-11	20		5.7	6.9			0.01	0.03
5-Jul-11	20		5.6	6.8			0.02	0.17
6-Jul-11	20		5.6	6.8			0.02	0.07
7-Jul-11	20		5.3	6.8			0.01	0.05
8-Jul-11	19		5.2	6.8			0.02	0.02

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
9-Jul-11	20		5.7	6.8			0.02	0.02
10-Jul-11	20		5.2	6.9			0.01	0.09
11-Jul-11	20		4.9	6.9			0.02	0.16
12-Jul-11	20		5.2	7			0.01	0.57
13-Jul-11	20		5.2	7	104.5		0.02	0.57
14-Jul-11	20		5.6	7.2			0.02	1.34
15-Jul-11	20		6.1	7.3			0.02	2.46
16-Jul-11	20		6.4	7.3			0.03	4.28
17-Jul-11	20		6.8	7.4			0.02	5.96
18-Jul-11	19		5.8	7.4			0.02	8.2
19-Jul-11	20		5.8	7.3			0.02	10.08
20-Jul-11	20		5.2	7.2			0.01	9.65
21-Jul-11	20		5	7.3			0.02	7.76
22-Jul-11	20		5	7.2			0.02	5.16
23-Jul-11	20		5	7.2			0.02	3.52
24-Jul-11	20		5.3	7.1			0.02	1.66
25-Jul-11	21		5.2	7			0.03	0.71
26-Jul-11	20		5.1	7			0.02	0.29
27-Jul-11	20		5.1	6.7			0.03	0.15
28-Jul-11	20		5	7			0.03	0.1
29-Jul-11	20		5	7.1			0.02	0.29
30-Jul-11	20		4.9	7			0.03	0.81
31-Jul-11	21		4.6	7.1			0.03	1.05
1-Aug-11	20	20	4.7	7.1			0.1	1.52
2-Aug-11	21	21	4.9	7.1			0.02	
3-Aug-11	21	21	4.6	7.1			0.04	1.18
4-Aug-11	21	21	4.3	7			0.03	0.22
5-Aug-11	21	21	4.9	7			0.01	0.03
6-Aug-11	21	21	5.8	7			0.02	0.01
7-Aug-11	21	21	5.4	7			0.02	0.03
8-Aug-11	21	21	5.1	6.9			0.03	0.02
9-Aug-11	21	21	5	7			0.01	0.05
10-Aug-11	20	20	6.5	6.8			0.03	0.01
11-Aug-11	21	21	6.6	7.1			0.01	0.01
12-Aug-11	21	21	6.5	7.1			0.03	0.03
13-Aug-11	21	21	6.7	7			0.02	0.01
14-Aug-11	21	21	6.2	6.7			0.01	0.03
15-Aug-11	20	20	5.2	6.8			0.02	0.01
16-Aug-11	20	20	6.1	6.9			0.01	0.04
17-Aug-11	20	20	6.2	7			0.03	0.01
18-Aug-11	20	20	6.3	7			0.03	0.03
19-Aug-11	20	20	5	6.9			0.01	0.04

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
20-Aug-11	20	20	5.4	6.8			0.03	0.04
21-Aug-11	22	22	6.6	7			0.02	0.01
22-Aug-11	21	21	5.8	7				
23-Aug-11	21	21	6.5	6.9				
24-Aug-11	21	21	7.2	7.2				
25-Aug-11	22	22	7.2	7.1				
26-Aug-11	21	21	7.2	7.1				
27-Aug-11	21	21	7.1	7.1				
28-Aug-11	21	21	7.4	7.1				
29-Aug-11	21	21	7.3	7				
30-Aug-11	21	21	7.6	7.1				
31-Aug-11	20	20	7.5	7				
1-Sep-11	20	20	7.8	7.1			0.02	0.02
2-Sep-11	20	20	7.2	7.1			0.02	0.01
3-Sep-11	20	20	8.2	7.1			0.01	0.01
4-Sep-11	20	20	8.4	7			0.02	0.01
5-Sep-11	20	20	8.4	7			0.03	0.01
6-Sep-11	20	20	7	7			0.04	0.01
7-Sep-11	20	20	8.2	7.1			0.03	0.01
8-Sep-11	21	21	7	7	91.8		0.04	0.01
9-Sep-11	21	21	8.2	7.1			0.01	0.02
10-Sep-11	21	21	7.7	7.1			0.02	0.01
11-Sep-11	21	21	8.3	7.1			0.02	0.03
12-Sep-11	21	21	7.9	7.1			0.04	0.04
13-Sep-11	21	21	8.4	7.1			0.01	0.02
14-Sep-11	21	21	8.5	7.1			0.01	0.01
15-Sep-11	20	20	8.4	7.2			0.01	0.02
16-Sep-11	19	19	8.5	7.1			0.01	0.03
17-Sep-11	19	19	8.1	7.1			0.01	0.01
18-Sep-11	20	20	8.6	7.1			0.02	0.01
19-Sep-11	19	19	8.1	6.9			0.01	0.01
20-Sep-11	19	19	8.7	7			0.02	0.03
21-Sep-11	20	20	8.6	7			0.01	0.02
22-Sep-11	20	20	8.6	7			0.01	0.01
23-Sep-11	21	21	8.2	7.1			0.02	0.02
24-Sep-11	21	21	8.4	7.1			0.02	0.01
25-Sep-11	20	20	8.5	7.1			0.02	0.01
26-Sep-11	19	19	8.5	7.1			0.02	0.01
27-Sep-11	19	19	7.8	7.1			0.01	0.04
28-Sep-11	18	18	7.3	7			0.01	0.01
29-Sep-11	17	17	6.8	6.8			0.02	0.01
30-Sep-11	18	18	7	6.9			0.02	0.01

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
1-Oct-11	18	18	6.7	6.9			0.03	0.03
2-Oct-11	19	19	7.8	6.9			0.02	0.02
3-Oct-11	19	19	6.3	6.9			0.02	0.05
4-Oct-11	18	18	6.4	7.1			0.03	0.92
5-Oct-11	17	17	6.4	7			0.01	1.2
6-Oct-11	17	17	6	7	92.8		0.02	0.82
7-Oct-11	17	17	6.1	7.1			0.02	2.04
8-Oct-11	17	17	5.5	7			0.03	2.94
9-Oct-11	18	18	6.3	7			0.04	1.89
10-Oct-11	17	17	5.3	6.9			0.01	1.16
11-Oct-11	17	17	5	7			0.03	1.86
12-Oct-11	17	17	4.9	6.9			0.03	2.84
13-Oct-11	16	16	4.9	6.9			0.03	3.45
14-Oct-11	17	17	4.8	7			0.04	3.18
15-Oct-11	16	16	5	7			0.01	2.8
16-Oct-11	16	16	4.9	7			0.01	2.66
17-Oct-11	15	15	5.2	7			0.02	2.94
18-Oct-11	15	15	6.2	7.1			0.01	3.52
19-Oct-11	16	16	6.3	6.9			0.01	1.74
20-Oct-11	16	16	8.2	7.1			0.03	0.01
21-Oct-11	17	17	8.3	7.1			0.01	0.04
22-Oct-11	17	17	9	7			0.03	0.01
23-Oct-11	16	16	8.7	7			0.04	0.05
24-Oct-11	15	15	8	6.9			0.04	0.04
25-Oct-11	15	15	8.6	6.9			0.03	0.02
26-Oct-11	14	14	7.9	6.8			0.04	0.04
27-Oct-11	14	14	7.6	6.7			0.04	0.02
28-Oct-11	14	14	6.4	6.8			0.06	0.04
29-Oct-11	14	14	6.4	6.9			0.03	1.33
30-Oct-11	14	14	6.8	6.9			0.05	3.08
31-Oct-11	15	15	6.3	7			0.04	5.04
1-Nov-11	13		6.6	7			0.07	7.48
2-Nov-11	13		6.5	7	98.6		0.03	7.8
3-Nov-11	14		6.5	6.9			0.04	7.08
4-Nov-11	13		7	6.9			0.03	6.2
5-Nov-11	12		7	6.8			0.03	4.4
6-Nov-11	13		6.8	6.8			0.04	2.7
7-Nov-11	12		7.3	6.5			0.02	0.46
8-Nov-11	13		7.4	6.4			0.03	0.06
9-Nov-11	13		7.5	6.5			0.05	0.01
10-Nov-11	12		7.9	6.5			0.01	0.01
11-Nov-11	12		8	6.7			0.04	0.02

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
12-Nov-11	12		8.1	6.7			0.01	0.07
13-Nov-11	12		7.2	6.7			0.01	0.04
14-Nov-11	13		6.7	6.5			0.03	0.03
15-Nov-11	12		7.7	6.6			0.04	0.02
16-Nov-11	12		8.6	6.7			0.07	0.04
17-Nov-11	12		8.8	6.8			0.03	0.05
18-Nov-11	11		9	6.9			0.01	0.05
19-Nov-11	11		9.3	6.9			0.04	0.05
20-Nov-11	11		8.1	6.8			0.01	0.04
21-Nov-11								3.2
22-Nov-11	14		8.1	6.8			0.13	
23-Nov-11	12		8.6	7			0.03	3.2
24-Nov-11	11		8.6	6.8			0.01	2.69
25-Nov-11	11		8.8	6.8			0.01	1.14
26-Nov-11	11		11.3	6.9			0.02	0.36
27-Nov-11	11		9.5	7			0.04	0.01
28-Nov-11	10		10.5	6.7			0.01	0.02
29-Nov-11	10		11.3	6.8			0.01	0.01
30-Nov-11	10		11.3	6.8			0.01	0.01
1-Dec-11	10		11.5	6.9			0.03	0.04
2-Dec-11	10		11.3	6.9			0.01	0.01
3-Dec-11	8		12.2	6.8			0.03	0.01
4-Dec-11	10		11.7	6.9			0.02	0.04
5-Dec-11	8		11.9	6.7			0.01	0.01
6-Dec-11	8		11.6	6.7	98.7		0.01	0.02
7-Dec-11	8		11.7	6.8			0.01	0.01
8-Dec-11	8		12	6.8			0.05	0.01
9-Dec-11	8		12	6.9			0.01	0.05
10-Dec-11	7		12.2	6.8			0.01	0.01
11-Dec-11	7		12.5	6.8			0.01	0.06
12-Dec-11	7		11	6.6			0.01	0.01
13-Dec-11	8		12	6.6			0.05	0.09
14-Dec-11	7		12	6.8			0.04	0.01
15-Dec-11	9		12.7	6.9			0.01	0.03
16-Dec-11	10		12.2	6.9			0.01	0.06
17-Dec-11	8		12.7	7			0.04	0.02
18-Dec-11	9		12.5	6.8			0.02	0.04
19-Dec-11	9		11	6.9			0.02	0.02
20-Dec-11	10		11.5	7			0.01	0.05
21-Dec-11	9		12.2	7			0.01	0.04
22-Dec-11	7		12.6	6.9			0.01	0.04
23-Dec-11	8		13.1	7.1			0.01	0.05

City of Yelm Effluent Data
Conventional Pollutants, Residual Chlorine, and Ammonia
From DMR data (Jan 2006 - December 2011)

Date	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	DO mg/L	pH SU	Hardness mg/L	Alkalinity mg/L	Residual Chlorine mg/L	Total Ammonia as NH3-N mg/L
24-Dec-11	9		12	7			0.01	0.01
25-Dec-11	11		12.8	6.8			0.01	0.02
26-Dec-11	9		12.3	7			0.01	0.02
27-Dec-11	10		11.5	7			0.01	0.01
28-Dec-11	10		10	6.9			0.03	0.02
29-Dec-11	11		10.9	7.1			0.02	0.01
30-Dec-11	11		11.1	7.1			0.01	0.05
31-Dec-11	8		12.3	7			0.03	0.01
Count	2138	520	2106	2137	72	60	2095	351
Minimum	5.0		4.3	6.1	55.1	21.0	0.01	0.01
5th %	9.0	14.0	6.3	6.6	61.2	67.9	0.01	0.01
10th%	9.0	15.0	7.0	6.7	62.1	77.9	0.01	0.01
Average	14.6	17.9	8.6	7.0	73.1	94.9	0.02	3.90
90th %	20.0	21.0	10.4	7.3	91.0	113.2	0.03	10.08
95th %	21.0	21.0	11.0	7.4	98.6	117.2	0.05	23.15
Maximum	24.0	23.0	13.1	7.9	119.5	139.0	0.19	49.80
Std Dev	4.2	3.8	1.4	0.2	12.0	18.2	0.02	7.99
CV	0.29	0.21	0.16	0.03	0.16	0.19	0.87	2.05

Ambient Nisqually River Data
Conventional Pollutants
From USGS Monitoring Station No. 12089500

Sample Date/Time	Annual Temperature	Dry Season Temperature (Aug-Oct)	Turbidity	DO	pH	Hardness (as CaCO3)
	deg C	deg C	NTU	mg/L	SU	mg/L
1960-01-26 00:00	6.0			12.1	7.1	17
1960-02-22 00:00	4.8			12.4	6.9	19
1960-03-22 00:00	7.5			12.2	7.2	18
1960-04-15 00:00	7.2			12.0	7.0	18
1960-05-13 00:00	9.0			10.1	7.4	20
1960-06-07 00:00	12.3			9.9	7.4	18
1960-07-11 00:00	16.3			10.4	7.5	24
1960-10-14 00:00	11.1	11.1		10.3	7.3	22
1961-01-05 00:00	5.5			12.0	7.0	18
1961-04-07 00:00	5.5			12.3	7.2	18
1961-07-14 00:00	12.0			10.0	7.2	19
1961-11-08 00:00	10.0			11.7	6.9	22
1962-02-19 00:00	5.1			11.3	7.3	17
1962-05-10 00:00	7.9			11.5	7.0	18
1962-08-17 00:00	15.9	15.9		8.6	7.1	28
1962-10-16 00:00	10.5	10.5		10.9	7.4	20
1963-01-09 00:00	5.0			12.0	7.3	18
1963-04-03 00:00	6.2			11.7	7.1	20
1963-07-10 00:00	13.3			10.3	7.1	22
1963-10-31 00:00	11.0	11.0		11.3	7.0	22
1964-01-29 00:00	5.2			11.7	7.0	18
1964-04-17 00:00	7.8				6.8	20
1964-07-15 00:00	11.8			11.2	7.3	17
1964-10-27 00:00	9.2	9.2		11.5	7.2	20
1965-01-14 00:00	5.0			12.7	6.9	18
1965-06-22 00:00					7.3	24
1965-07-07 00:00	20.0			9.8	7.2	26
1965-12-16 00:00	6.2			12.0	7.3	20
1966-03-17 00:00	6.2			12.3	6.9	20
1966-06-30 00:00	11.3			10.9	7.3	20
1966-09-26 00:00	15.4	15.4		11.3	7.4	22
1966-10-03 00:00				10.9		
1966-11-03 00:00					7.3	20
1967-01-04 00:00					7.1	19
1967-01-30 00:00	5.6				7.2	18
1967-02-21 00:00	5.8			12.6	7.4	18

Ambient Nisqually River Data
Conventional Pollutants
From USGS Monitoring Station No. 12089500

Sample Date/Time	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	Turbidity NTU	DO mg/L	pH SU	Hardness (as CaCO3) mg/L
1967-03-27 00:00	6.8			12.2	7.3	18
1967-04-26 00:00	7.8			13.7	7.4	20
1967-05-17 00:00	9.2			12.7	7.4	19
1967-06-12 00:00	10.6			11.1	7.5	22
1967-07-24 00:00	15.6			10.3	7.5	21
1967-08-14 00:00	15.8	15.8		10.8	7.3	19
1967-09-18 00:00	13.1	13.1		10.7	7.3	19
1967-10-16 00:00	12.5	12.5		10.7	7.3	19
1967-11-13 00:00	10.0			11.2	7.6	17
1968-01-05 00:00	5.0			12.8	7.2	17
1968-01-25 00:00	4.5				7.2	19
1968-02-09 00:00	5.3			12.3	7.1	18
1968-03-18 00:00	5.4			12.7	7.2	17
1968-04-22 00:00	8.0			13.6	7.2	19
1968-05-06 00:00	8.0			12.0	7.3	20
1968-06-03 00:00	10.5			10.7	6.9	17
1968-07-15 00:00	12.2			9.9	7.1	22
1968-08-05 00:00	13.0	13.0		9.9	7.2	22
1968-09-09 00:00	11.4	11.4		11.1	7.3	22
1968-10-07 00:00	12.0	12.0		10.4	7.4	22
1968-11-18 00:00	8.0			11.2	7.1	19
1968-12-02 00:00	6.1			11.2	7.1	20
1969-01-13 00:00	3.2			10.3	7.3	20
1969-02-10 00:00	3.0			13.0	7.1	20
1969-03-17 00:00	8.0			11.9	7.3	18
1969-04-08 00:00	8.0			12.1	7.0	19
1969-05-12 00:00	12.0			11.4	7.4	19
1969-06-16 00:00	13.0			11.0	7.6	20
1969-07-14 00:00	11.2			10.4	7.1	19
1969-09-15 00:00	11.0	11.0		10.6	7.2	19
1969-10-13 00:00	10.2	10.2		10.7	7.5	20
1969-11-11 00:00	9.2			10.8	7.1	21
1969-12-08 00:00	6.9			11.4	7.7	22
1970-01-12 00:00	4.4			12.1	7.5	20
1970-02-09 00:00	5.2			11.9	7.0	18
1970-03-09 00:00	5.0			11.9	7.3	18
1970-04-06 00:00	6.8			11.8	7.1	20
1970-05-11 00:00	6.7			11.6	7.4	21
1970-06-08 00:00	10.5			10.2	7.1	24

Ambient Nisqually River Data
Conventional Pollutants
From USGS Monitoring Station No. 12089500

Sample Date/Time	Annual Temperature	Dry Season Temperature (Aug-Oct)	Turbidity	DO	pH	Hardness (as CaCO3)
	deg C	deg C	NTU	mg/L	SU	mg/L
1970-07-02 00:00	14.9			10.7	7.3	23
1970-08-10 00:00	12.4	12.4		10.7	7.1	22
1970-09-08 00:00	11.6	11.6		10.2	7.4	20
1973-09-19 16:30	13.9	13.9		9.8	7.3	
1973-12-19 13:00	5.8			12.0	6.9	
1974-01-16 13:40	4.4			12.6		
1974-02-21 12:20	5.0			12.4	7.1	
1974-06-19 12:05	10.7			11.0	7.4	
1974-09-18 14:40	15.8	15.8		10.7	8.0	
1974-12-11 10:25	7.6			11.4	7.1	
1975-01-20 09:35	5.7			12.4		
1975-03-06 10:30	3.8			12.6	6.8	
1975-05-08 12:10	9.6			11.9	6.6	
1975-08-08 11:00	13.1	13.1		10.8	7.2	
1975-11-20 12:45	7.0			12.0	7.1	
1975-12-03 12:10	7.6			11.7		
1976-02-19 11:05	4.4			12.6	7.4	
1976-05-19 11:05	8.4			11.9	7.4	
1976-09-22 11:50	13.0	13.0		10.6	7.3	
1976-12-15 11:50	8.3			13.1	7.8	
1977-04-13 11:25	8.0			13.2	7.6	
1977-06-15 12:00	10.0			12.0	7.2	
1977-09-14 12:05	13.7	13.7		9.9	7.0	
1977-11-10 11:10	8.6			11.5	7.1	
1977-12-07 12:30	5.8			12.0	7.2	
1978-01-11 12:15	5.8			11.9	7.4	
1978-02-09 13:50	5.8			12.3	7.4	
1978-03-08 12:00	6.9			12.5	7.4	
1978-04-05 11:30	8.5			12.4	7.9	
1978-05-03 11:55	9.3			11.8	7.6	
1978-06-14 11:30	10.7			11.7	7.4	
1978-07-19 11:15	11.5			10.9	7.4	
1978-08-16 12:45	13.9	13.9		10.5	7.6	
1978-09-14 11:45	13.6	13.6		10.7	7.6	
1978-10-18 12:35	12.3	12.3	10.0	10.5	7.4	
1978-11-08 11:30	10.4		20.0	9.9	7.2	
1978-12-06 11:50	4.5		8.0	12.3	7.1	
1979-01-12 13:00	3.7		9.0	12.9	7.6	
1979-02-07 12:15	2.6		35.0	13.1	7.0	

Ambient Nisqually River Data
Conventional Pollutants
From USGS Monitoring Station No. 12089500

Sample Date/Time	Annual Temperature deg C	Dry Season Temperature (Aug-Oct) deg C	Turbidity NTU	DO mg/L	pH SU	Hardness (as CaCO3) mg/L
1979-03-07 11:45	6.2		20.0	12.6	7.3	
1979-04-12 12:40	6.6		4.0	13.0	7.8	
1979-05-09 11:20	7.8		3.0	12.1	7.3	
1979-06-06 12:00	10.4		1.0	11.4	7.4	
1979-07-11 11:30	12.2		7.0	11.1	7.0	
1979-08-08 11:20	13.4	13.4	4.0	10.5	7.2	
1979-09-12 11:35	14.4	14.4	15.0	10.1	7.6	
1979-10-11 11:35	12.9	12.9	30.0	10.3	6.9	
1979-11-15 12:30	7.8		15.0	12.0	7.0	
1979-12-12 11:15	5.9		40.0	11.7	7.6	
1980-01-16 11:40	5.2		10.0	11.7	7.4	
1980-02-06 12:25	4.2		7.0	11.9	7.2	
1980-03-18 11:35	6.0		4.0	12.0	7.2	
1980-04-09 11:10	7.6		7.0	11.8	7.2	
1980-05-14 10:10	8.6		2.0	11.9	7.7	
1980-06-12 11:35	10.0		2.0	11.3	7.4	
1980-07-09 11:50	12.0		1.0	11.7	7.8	
1980-08-13 11:45	12.6	12.6	15.0	10.7	7.5	
1980-09-17 12:45	15.0	15.0	20.0	11.0	7.9	
Minimum	2.6	9.2	1.0	8.6	6.6	17.0
5th Percentile	4.4	10.3	1.2	9.9	6.9	17.0
10th Percentile	5.0	10.9	2.0	10.3	7.0	18.0
Average	9.0	12.9	12.0	11.5	7.3	19.9
90th Percentile	13.6	15.5	27.0	12.6	7.6	22.0
95th Percentile	15.2	15.8	34.3	13.0	7.7	24.0
Maximum	20.0	15.9	40.0	13.7	8.0	28.0

Streeter-Phelps analysis of critical dissolved oxygen sag.

Based on Lotus File DOSAG2.WK1 Revised 19-Oct-93

INPUT

1. EFFLUENT CHARACTERISTICS	
Discharge (cfs):	1.89
CBOD5 (mg/L):	45
NBOD (mg/L):	301.62
Dissolved Oxygen (mg/L):	1.1
Temperature (deg C):	23
2. RECEIVING WATER CHARACTERISTICS	
Upstream Discharge (cfs):	370
Upstream CBOD5 (mg/L):	4.3
Upstream NBOD (mg/L):	0
Upstream Dissolved Oxygen (mg/L):	10.5
Upstream Temperature (deg C):	14
Elevation (ft NGVD):	250
Downstream Average Channel Slope (ft/ft):	0.00041
Downstream Average Channel Depth (ft):	1.83
Downstream Average Channel Velocity (fps):	1.77
3. REAERATION RATE (Base e) AT 20 deg C (day^-1):	10.35

Reference	Applic. Vel (fps)	Applic. Dep (ft)	Suggested Values
Churchill	1.5 - 6	2 - 50	7.34
O'Connor and Dobbins	.1 - 1.5	2 - 50	6.96
Owens	.1 - 6	1 - 2	10.35
Tsivoglou-Wallace	.1 - 6	.1 - 2	3.01

4. BOD DECAY RATE (Base e) AT 20 deg C (day^-1): 0.57

Reference	Suggested Value
Wright and McDonnell, 1979	0.57

Streeter-Phelps analysis of critical dissolved oxygen sag.

Based on Lotus File DOSAG2.WK1 Revised 19-Oct-93

OUTPUT

1. INITIAL MIXED RIVER CONDITION	
CBOD5 (mg/L):	4.5
NBOD (mg/L):	1.5
Dissolved Oxygen (mg/L):	10.5
Temperature (deg C):	14.0
2. TEMPERATURE ADJUSTED RATE CONSTANTS (Base e)	
Reaeration (day^-1):	8.99
BOD Decay (day^-1):	0.43
3. CALCULATED INITIAL ULTIMATE CBODU AND TOTAL BODU	
Initial Mixed CBODU (mg/L):	6.6
Initial Mixed Total BODU (CBODU + NBOD, mg/L):	8.2
4. INITIAL DISSOLVED OXYGEN DEFICIT	
Saturation Dissolved Oxygen (mg/L):	10.204
Initial Deficit (mg/L):	-0.25
5. TRAVEL TIME TO CRITICAL DO CONCENTRATION (days):	0.41
6. DISTANCE TO CRITICAL DO CONCENTRATION (miles):	11.86
7. CRITICAL DO DEFICIT (mg/L):	0.33
8. CRITICAL DO CONCENTRATION (mg/L):	9.87

Calculation of pH of a mixture of two flows. Based on the procedure in EPA's DESCON program (EPA, 1988. Technical Guidance on Supplementary Stream Design Conditions for Steady State Modeling. USEPA Office of Water, Washington D.C.)

Based on Lotus File PHMIX2.WK1 Revised 19-Oct-93

	Low pH Range	High pH Range	
INPUT			
1. DILUTION FACTOR AT MIXING ZONE BOUNDARY	21.6	21.6	
2. UPSTREAM/BACKGROUND CHARACTERISTICS			
Temperature (deg C):	15.0	15.0	
pH:	6.0	6.0	
Alkalinity (mg CaCO3/L):	23.5	23.5	
3. EFFLUENT CHARACTERISTICS			
Temperature (deg C):	21.0	21.0	95th percentile of DMR Data
pH:	6.6	7.4	5th and 95th percentile of DMR Data
Alkalinity (mg CaCO3/L):	67.9	67.9	5th percentile of DMR Data
OUTPUT			
1. IONIZATION CONSTANTS			
Upstream/Background pKa:	6.42	6.42	
Effluent pKa:	6.38	6.38	
2. IONIZATION FRACTIONS			
Upstream/Background Ionization Fraction:	0.28	0.28	
Effluent Ionization Fraction:	0.63	0.91	
3. TOTAL INORGANIC CARBON			
Upstream/Background Total Inorganic Carbon (mg CaCO3/L):	85.31	85.31	
Effluent Total Inorganic Carbon (mg CaCO3/L):	108.36	74.31	
4. CONDITIONS AT MIXING ZONE BOUNDARY			
Temperature (deg C):	15.28	15.28	
Alkalinity (mg CaCO3/L):	25.56	25.56	
Total Inorganic Carbon (mg CaCO3/L):	86.38	84.80	
pKa:	6.42	6.42	
pH at Mixing Zone Boundary:	6.04	6.05	

Effluent Metals Data

	Units	Sep-11	Mar-11	Dec-10	Sep-10	Mar-10	Dec-09	Sep-09	Jun-09	Mar-09	Dec-08	Sep-08	Jun-08	Mar-08	Dec-07	Sep-07	Jun-07	Mar-07	Dec-06	Sep-06	Jun-06	Mar-06	Max	95th %	Avg	St. Dev	CV
Arsenic	ug/L	ND																									
Cadmium	ug/L	ND																									
Chromium	ug/L	ND																									
Copper	ug/L	39	23	31	25	18	27	25	12	5.6	8.4	20	6.1	20	13	20	10	15.7	26	28	19	8	39	34.6	20.01	10.41	0.52
Iron	ug/L	ND																									
Lead	ug/L			0.8										0.01									0.8	0.8			
Mercury	ug/L	ND																									
Nickel	ug/L	2.9	2	2.4	1.9	2.0	1.6	2.5	2.4	1.8	1.9	3	2.3	1.8	1.7	2	1.9	2.7	2	2.2	2.6	2.5	3	2.9	2.23	0.44	0.20
Silver	ug/L	ND																									
Zinc	ug/L	48	29	49	34	32	36	40	40	40	36	54	43	39	48	63	35	51	48	45	18	27	63	51.3	40.08	7.40	0.18

		Parameter		
Date	Copper	Nickel	Zinc	Lead
Mar-06	8	2.5	27	
Jun-06	19	2.6	18	
Sep-06	28	2.2	45	
Dec-06	26	2	48	
Mar-07	15.7	2.7	51	
Jun-07	10	1.9	35	
Sep-07	20	2	63	
Dec-07	13	1.7	48	
Mar-08	20	1.8	39	0.01
Jun-08	6.1	2.3	43	
Sep-08	20	3	54	
Dec-08	8.4	1.9	36	
Mar-09	5.6	1.8	40	
Jun-09	12	2.4	40	
Sep-09	25	2.5	40	
Dec-09	27	1.6	36	
Mar-10	18	2	32	
Sep-10	25	1.9	34	
Dec-10	31	2.4	49	0.8
Mar-11	23	2	29	
Sep-11	39	2.9	48	
Count	21	21	21	2
Average	19.0	2.2	40.7	0.4
Maximum	39	3	63	0.8

Ambient Nisqually River Data
Metals
From Battelle Receiving Water Study

Date	Cadmium Total (ug/L)	Cadmium Dissolved (ug/L)	Copper Total (ug/L)	Copper Dissolved (ug/L)	Lead Total (ug/L)	Lead Dissolved (ug/L)	Mercury Total (ug/L)	Mercury Dissolved (ug/L)	Zinc Total (ug/L)	Zinc Dissolved (ug/L)
9/7/00										
Blank	0.0000	0.0038	0.001	0.018	0.00	0.0066	0.00026	0.00051	0.00	0.691
Sample	0.0063	0.0016	3.170	0.660	0.3470	0.0211	0.00242	0.00107	1.670	0.736
Duplicate	0.0071	0.0021	3.060	0.553	0.3550	0.0212	0.00226	0.00088	1.590	0.580
Average	0.0067	0.0018	3.115	0.607	0.3510	0.0212	0.00234	0.00098	1.630	0.658
Avg - Blank	0.0067	0	3.114	0.589	0.3510	0.0146	0.00208	0.00047	1.630	0
8/15/01										
Blank	0.00	0.00	0.000	0.047	0.0104	0.0135	0.00029	0.00041	0.013	0.138
Sample	0.00	0.00	1.170	0.514	0.1270	0.0267	0.00100	0.00056	0.970	0.736
Duplicate	0.00	0.00	1.200	0.775	0.0999	0.0237	0.00070	0.00042	0.732	0.553
Average	0.00	0.00	1.185	0.645	0.1135	0.0252	0.00085	0.00049	0.851	0.645
Avg - Blank	0.00	0.00	1.185	0.597	0.1031	0.0117	0.00056	0.00008	0.838	0.507
5/31/02										
Blank	0.00	0.00	0.000	0.000	0.0000	0.0174	0.00025	0.00040	0.119	0.357
Sample	0.0000	0.0110	0.891	0.329	0.0848	0.0064	0.00143	0.00090	0.715	0.465
Duplicate	0.0000	0.0132	0.854	0.390	0.1040	0.0208	0.00137	0.00062	0.609	1.780
Average	0.0000	0.0121	0.873	0.360	0.0944	0.0136	0.00140	0.00076	0.662	1.123
Avg - Blank	0.0000	0.0121	0.873	0.360	0.0944	0	0.00115	0.00036	0.543	0.766
7/11/02										
Blank	0.00	0.00	0.006	0.066	0.0069	0.0136	0.00061	0.00040	0.030	0.392
Sample	0.0045	0.0027	9.030	4.330	0.0580	0.0214	0.00096	0.00063	3.980	0.680
Duplicate	0.0017	0.0017	0.701	0.495	0.0342	0.0142	0.00093	0.00058	0.236	0.311
Average	0.0031	0.0022	4.866	2.413	0.0461	0.0178	0.00094	0.00061	2.108	0.496
Avg - Blank	0.0031	0.0022	4.859	2.347	0.0392	0.0042	0.00033	0.00021	2.078	0.104
5/16/03										
Blank	0.0125	0.00	0.016	0.009	0.0126	0.0110	0.00057	0.00047	0.009	0.219
Sample	0.00	0.0150	0.934	0.752	0.0417	0.0221	0.00127	0.00103	0.451	0.250
Duplicate	0.0114	0.0000	0.923	0.751	0.0477	0.0233	0.00131	0.00124	0.498	1.890
Average	0.0057	0.0075	0.929	0.752	0.0447	0.0227	0.00129	0.00114	0.475	1.070
Avg - Blank	0	0.0075	0.913	0.743	0.0321	0.0117	0.00072	0.00067	0.466	0.851
7/16/03										
Blank	0.0162	0.0110	0.016	0.002	0.0000	0.0000	0.00045	0.00036	0.181	0.203
Sample	0.0129	0.0100	0.796	0.614	0.0245	0.0000	0.00088	0.00082	0.231	0.662
Duplicate	0.0027	0.0014	0.739	0.532	0.0236	0.0006	0.00099	0.00085	0.217	0.167
Average	0.0078	0.0057	0.768	0.573	0.0241	0.0003	0.00093	0.00083	0.224	0.415
Avg - Blank	0	0	0.752	0.571	0.0241	0.0003	0.00048	0.00047	0.043	0.212
8/28/03										
Blank	0.0004	0.0015	0.000	1.260	0.0000	0.0000	0.00074	0.00043	0.022	0.128
Sample	0.0002	0.00	0.719	0.315	0.0329	0.0000	0.00086	0.00097	0.139	0.115
Duplicate	0.00	0.0011	0.729	0.340	0.0396	0.0000	0.00098	0.00073	0.142	0.012
Average	0.0001	0.0006	0.724	0.328	0.0363	0.0000	0.00092	0.00085	0.141	0.063
Avg - Blank	0	0	0.724	0	0.0363	0.0000	0.00018	0.00042	0.118	0
4/8/04										
Blank	0.0150	0.0070	0.022	0.020	0.0573	0.0150	0.00029	0.00026	0.077	0.138
Sample	0.0220	0.0110	1.150	0.655	0.1050	0.0310	0.00144	0.00091	0.458	0.267
Duplicate	0.0030	0.0039	1.090	1.230	0.0929	0.0389	0.00150	0.00084	0.503	0.337

Freshwater Metals Criteria

		Acute	Chronic	
Hardness =		31.4	23.4	mg/L

#	Parameter	Conversion Factor Acute	Conversion Factor Chronic	Surface Water Criteria, ug/L Dissolved Criteria Acute	Dissolved Criteria Chronic	Total Recoverable Criteria Acute	Total Recoverable Criteria Chronic
1	Chromium (Hex)	0.982	0.962	15	10	15.3	10.4
2	Chromium (Tri)	0.316	0.860	213	54.2	673	63.0
3	Copper	0.960	0.960	5.7	3.3	5.95	3.42
4	Lead	0.960	1.000	17.9	0.501	18.7	0.501
5	Mercury	0.850	1.000	2.1	0.012	2.47	0.012
6	Nickel	0.998	0.997	532	46.0	533	46.2
7	Zinc	0.978	0.986	42.9	30.5	43.9	31.0

Simple Mixing Analysis

Effluent Hardness =	**73.1**
Acute Dilution Factor =	**5.0**
Ambient Hardness =	**21**
Acute Hardness =	31.4
Effluent Hardness =	**73.1**
Chronic Dilution Factor =	**21.6**
Ambient Hardness =	**21**
Chronic Hardness =	23.4

Average ambient hardness from receiving water study data.

Average effluent hardness based upon monthly DMR data from 2006-2011

Ambient Nisqually River Data
Metals

Average	0.0125	0.0075	1.120	0.943	0.0990	0.0350	0.00147	0.00087	0.481	0.302
Avg - Blank	0	0.0005	1.098	0.922	0.0417	0.0200	0.00118	0.00062	0.404	0.164
4/22/04										
Blank	0.0004	0.0005	0.003	0.018	0.0006	0.0023	0.00057	0.00054	0.145	0.249
Sample	0.0054	0.0021	1.130	0.701	0.1050	0.0191	0.00153	0.00104	0.494	0.380
Duplicate	0.0039	0.1980	1.180	0.721	0.0951	0.0231	0.00153	0.00099	0.517	0.434
Average	0.0046	0.1000	1.155	0.711	0.1001	0.0211	0.00153	0.00102	0.506	0.407
Avg - Blank	0.0042	0.0996	1.152	0.693	0.0994	0.0188	0.00096	0.00048	0.361	0.158

Set to 0 when blank concentration greater than average sample concentration.

Data used to determine statistics below. Analysis conservatively assumes concentrations without subtracting blank concentration.

Average Data and Stats	Dissolved	Dissolved	Dissolved	Dissolved
	0.607	0.0212	0.00098	0.658
	0.645	0.0252	0.00049	0.645
	0.360	0.0208	0.00076	1.123
	0.495	0.0178	0.00061	0.496
	0.752	0.0227	0.00114	1.070
	0.573	0.0350	0.00083	0.415
	0.328	0.0211	0.00085	0.063
	0.655		0.00087	0.302
	0.711		0.00102	0.407
90th %	0.719	0.02912	0.00104	1.081
95th %	0.736	0.03206	0.00110	1.104
Max	0.752	0.035	0.00114	1.123

Metals Translator Calculations

	Copper			Lead			Zinc		
	Dissolved	Total	Translator	Dissolved	Total	Translator	Dissolved	Total	Translator
9/7/2000	0.607	3.115	0.195	0.0212	0.351	0.060	0.658	1.63	0.404
8/15/2001	0.645	1.185	0.544	0.0252	0.1135	0.222	0.645	0.851	0.758
5/31/2002	0.36	0.873	0.412	0.0208	0.104	0.200	1.123		
7/11/2002	0.495	0.701	0.706	0.0178	0.0461	0.386	0.496	2.108	0.235
5/16/2003	0.752	0.929	0.809	0.0227	0.0447	0.508	1.07		
7/16/2003	0.573	0.768	0.746	0.035	0.099	0.354	0.415		
8/28/2003	0.328	0.724	0.453	0.0211	0.1001	0.211	0.063	0.141	0.447
4/8/2004	0.655	1.15	0.570				0.302	0.481	0.628
4/22/2004	0.711	1.155	0.616				0.407	0.506	0.804
		Avg	0.561		Avg	0.277		Avg	0.546

This spreadsheet calculates the reasonable potential to exceed state water quality standards for a small number of samples. The procedure and calculations are done per the procedure in Technical Support Document for Water Quality-based Toxics Control, U.S. EPA, March, 1991 (EPA/505/2-90-001) on page 56. User input columns are shown with red headings. Corrected formulas in col G and H on 5/98 (GB)

Parameter	Metal Criteria Translator as decimal Acute	Metal Criteria Translator as decimal Chronic	Ambient Conc (metals as dissolved) ug/L	State Water Quality Standards: Acute ug/L	State Water Quality Standards: Chronic ug/L	Max concentration at edge of... Acute Mixing Zone ug/L	Max concentration at edge of... Chronic Mixing Zone ug/L	LIMIT REQ'D?	Effluent percentile value	*Pn*	Max effluent conc. measured (metals as total recoverable) ug/L	Coeff Variation *CV*	*s*	# of samples *n*	Multiplier	Acute Dil'n Factor	Chronic Dil'n Factor	RPA Ratio: Acute	RPA Ratio: Chronic
Copper	0.56	0.56	0.736	5.70	3.30	5.63	1.87	NO	0.95	0.867	34.6	0.52	0.49	21	1.30	5.00	21.6	0.99	0.57
Lead	0.28	0.28	0.032	17.90	0.50	0.09	0.04	NO	0.95	0.867	0.8	0.60	0.55	21	1.34	5.00	21.6	0.00	0.09
Nickel	1.00	1.00	0.000	532.00	46.00	0.64	0.15	NO	0.95	0.867	2.9	0.20	0.20	21	1.11	5.00	21.6	0.00	0.00
Zinc	0.55	0.55	1.104	97.35	42.90	30.50	2.48	NO	0.95	0.867	51.3	0.18	0.18	21	1.10	5.00	21.6	0.31	0.06
Residual Chlorine (mg/L)	1.00	1.00	0.000	19.00	11.00	0.01	0.00	NO	0.95	0.999	0.05	0.87	0.75	2095	1.00	5.00	21.6	0.00	0.00
Ammonia (mg/L)	1.00	1.00	0.000	24.61	2.11	4.63	1.07	NO	0.95	0.992	23.2	2.05	1.28	351	1.00	5.00	21.6	0.19	0.51

Residual Clorine and Ammonia multiplier set to 1.0 to be conservative

Dilution (Dil'n) factor is the inverse of the percent effluent concentration at the edge of the acute or chronic mixing zone.

Permit Limit Calculation Summary | **Waste Load Allocation (WLA) and Long Term Average (LTA) Calculations** | Statistical variables for permit calculation

PARAMETER	Acute Dil'n Factor	Chronic Dil'n Factor	Metal Criteria Translator Acute	Metal Criteria Translator Chronic	Ambient Concentration *ug/L*	Water Quality Standard Acute *ug/L*	Water Quality Standard Chronic *ug/L*	Average Monthly Limit (AML) ug/L	Maximum Daily Limit (MDL) ug/L	WLA Acute *ug/L*	WLA Chronic *ug/L*	LTA Acute *ug/L*	LTA Chronic *ug/L*	LTA Coeff. Var. (CV) *decimal*	LTA Prob'y Basis *decimal*	Limiting LTA *ug/L*	Coeff. Var. (CV) *decimal*	AML Prob'y Basis *decimal*	MDL Prob'y Basis *decimal*	# of Samples per Month *n*
Copper	5.00	21.6	0.560	0.560	0.74	5.7	3.3	**43.6**	**45.6**	26	56.12	9.2	32.0	0.52	0.99	9.2	0.52	0.95	0.99	0.33

This spreadsheet calculates water quality based permit limits based on the two value steady state model using the State Water Quality standards contained in WAC 173-201A. The procedure and calculations are done per the procedure in Technical Support Document for Water Quality-based Toxics Control, U.S. EPA, March, 1991 (EPA/505/2-90-001) on page 99. Last revision date 9/98. Written by G. Shervey

4H: DRAFT SBR Modeling Evaluation

Draft Technical Memorandum

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Prepared for: City of Yelm

Project Title: On-Call Wastewater Consulting Services

Project No.: 140984

Technical Memorandum

Subject: DRAFT SBR Modeling Evaluation

Date: February 6, 2012

To: Stephanie Ray, City of Yelm Project Manager

From: Richard Kelly

Prepared by: Richard Kelly, Ph.D., P.E., Washington License #45235, Exp. 6/3/2013

Reviewed by: Jeff Morgan, P.E., Project Manager

Henryk Melcer, Ph.D., P.E.

Limitations:

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List of Abbreviations

BOD	biochemical oxygen demand
°C	degree(s) Celsius
COD	chemical oxygen demand
DO	dissolved oxygen
ISS	inert suspended solids
lb/d	pound(s) per day
mgd	million gallon(s) per day
mg/L	milligram(s) per liter
MLSS	mixed liquor suspended solids
MLVSS	mixed liquor volatile suspended solids
N	nitrogen
NOB	nitrite oxidizing bacteria
P	phosphorus
PAX	polyaluminum chloride
RBCOD	readily biodegradable chemical oxygen demand
SBR	sequencing batch reactor
sCOD	soluble chemical oxygen demand
SRT	sludge retention time
STEP	septic tank effluent pumping
TKN	total Kjeldahl nitrogen
TM	technical memorandum
TN	total nitrogen
TSS	total suspended solids
VFA	volatile fatty acid
VSS	volatile suspended solids
WAS	waste activated sludge
WRF	Water Reclamation Facility
WWC	wastewater characterization

Executive Summary

This technical memorandum (TM) describes process modeling of the Yelm Water Reclamation Facility (WRF) that has been undertaken by Brown and Caldwell. This TM describes how the process model was developed and calibrated to match as closely as possible the results of a wastewater characterization study that was performed in September 2011.

This TM then estimates the treatment capacity of the WRF with respect to total nitrogen (TN) and ammonia. The WRF is currently operating at a flow of approximately 0.37 million gallons per day (mgd). Table 1 presents the estimated treatment capacity for six different sets of operating conditions.

Table 1. Treatment Capacity Evaluation Summary

Capacity condition	Treatment capacity, mgd
Summer, 2 SBRs, 10 mg/L total nitrogen (WRF meets reclaimed water permit)	0.45
Summer, 3 SBRs, 10 mg/L total nitrogen (WRF meets reclaimed water permit)	0.67
Summer, 2 SBRs, 3 mg N/L ammonia (WRF meets permit limit to Centralia Power Canal, but not reclaimed water permit)	0.89
Winter, 2 SBRs, 10 mg/L total nitrogen (WRF meets reclaimed water permit)	0.37
Winter, 3 SBRs, 10 mg/L total nitrogen (WRF meets reclaimed water permit)	0.56
Winter, 3 SBRs, 3 mg N/L ammonia (WRF meets permit limit to Centralia Power Canal, but not reclaimed water permit)	0.74

Improvements to the WRF will need to be made in order to achieve the treatment capacities shown above. The implementation of those improvements is being evaluated as part of the General Sewer Planning process that is currently underway.

1. Introduction

This TM provides a summary of results of the calibration and verification of the BioWin biological process simulator used for modeling the sequencing batch reactor (SBR) activated sludge processes at the Yelm WRF. Detailed wastewater characteristics were collected for calibration of the simulator in September 2011. The intent of this process was to ensure that the model created for the Yelm WRF is sufficiently accurate to simulate future flow and loading conditions for the capacity assessment.

Additionally, this TM describes the Yelm WRF secondary treatment capacity as it relates to meeting permit requirements for reclaimed water production and discharge to the power canal in summer and winter operational conditions.

2. Activated Sludge Simulator Calibration

A model for the activated sludge secondary treatment processes at the Yelm WRF was created using the BioWin simulator, developed by EnviroSim Associates Ltd of Hamilton, Ontario, Canada. BioWin allows the prediction of complex biological interactions using various mechanistic and empirical models to represent material transformations and pollutant removals in the plant for both liquid and solids process streams. It enables the user to simulate carbonaceous oxidation and the fate of nutrients (nitrogen, phosphorus) in activated sludge treatment facilities.

Calibration of the biological process simulator is an important part of the plant capacity assessment. The simulator is used to predict plant operation under future flow and loading conditions. To ensure that simulator predictions are as accurate as possible, the simulator is calibrated against a set of data collected over a 1-week period (see Appendix A: Wastewater Characterization TM). Adjustments are made to the simulator so that there is agreement between the measured effluent characteristics and the simulated effluent quality.

2.1 Simulation of the Yelm WRF

Figure 1 is the Yelm WRF process flow schematic as created in the BioWin simulator. Shown in the figure are the two SBRs in operation at the time of the wastewater characterization (WWC) period, the waste sludge from the two SBRs, their combined effluent, the raw plant influent, and another input called “inert suspended solids (ISS) from lime and polyaluminum chloride (PAX).” The “ISS from lime and PAX” is an input set up to provide an estimate of the ISS recycled from the effluent filters due to PAX addition and lime addition to the SBRs for pH control.

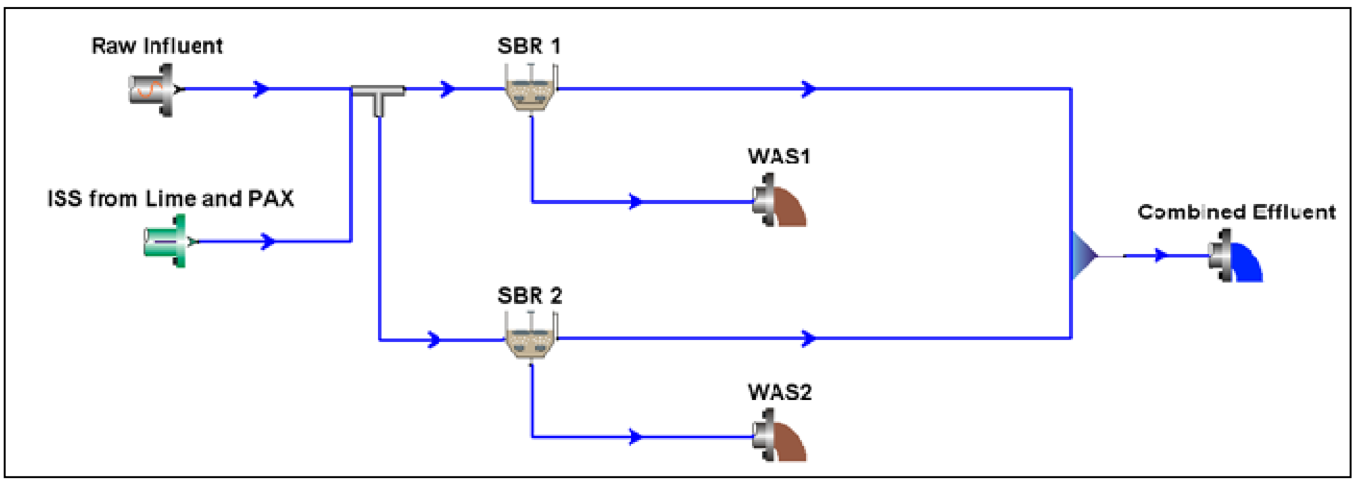

Figure 1. Process flow schematic in BioWin simulator

The WWC data were used to calibrate a dynamic simulation for the September operational parameters. The graphical representation of the plant layout and flow scheme was created as shown in Figure 1, in which physical data such as tank volumes and clarifier areas were specified. Process data such as influent flow rates and compositions, cycle times, and typical operating dissolved oxygen (DO) concentrations were also entered into the simulator. The aeration basin temperature was maintained at 21 degrees Celsius (°C) for the September simulations, same as measured during the WWC period used for calibration. Cycle times for simulation of the SBRs were matched to the actual operating cycle times for the SBRs during the September wastewater characterization. The recycle stream from the tertiary sand filters and the lime addition for pH control was simulated as a separate influent addition.

The aeration scheduling for anoxic fill periods (filling of SBR without aeration) was initially set with a DO concentration of 0 milligrams per liter (mg/L). Similarly, for aerobic fill-and-react periods (with aeration), the DO concentrations were set at 3.0 mg/L, which was the program set point for the aeration period. However, after difficulty during calibration to match effluent nutrient concentration and discussions with plant superintendent Jim Doty, it was clear that the DO concentrations did not match the set points within the control program. Over-aeration and high DO concentrations during the aerobic period were common and carry-over of excessively high DO concentrations into the subsequent anoxic fill periods were occurring. This had the impact of providing oxygen during periods that were supposed to be anoxic, which reduces the ability of the system to remove nitrogen through the denitrification process. Therefore, after receiving the monitored DO concentrations measured by the plant Historian (computer program for collecting plant data), simulator calibration was implemented by scheduling the simulator DO concentrations in the SBRs to match, as closely as possible, the actual DO concentrations in the basins.

Simulations were performed for dynamic conditions as steady state modeling is not possible with the SBR module in BioWin. Calibration was checked against operating data from the WWC periods to produce a final calibrated dynamic model that accurately depicts the nitrifying/denitrifying conditions at the plant. Dynamic inputs were developed using the diurnal data collected during the wastewater sampling periods. The results of the dynamic simulations were compared to the effluent and mixed liquor characteristics measured during the WWC period to verify that the model was properly calibrated. Calibration was considered complete when effluent characteristics produced by the simulator model matched, as closely as possible, the actual plant performance during the WWC period.

2.1.1 Simulation Results

Table 2 summarizes the inputs to the simulator for the final model calibrated against the September WWC data. Diurnal condition comparisons between the model predictions and plant performance for the simulation period are shown on Figures 2, 3, and 4 for conditions based on the September 2011 sampling period. It is important to point out that the figures show the effluent concentrations predicted during the entire cycle, including settling times and times when there is no discharge from the SBRs. This is why values on the plots often go to 0 at certain times of the day. For comparison to plant-measured values, the averages of the peaks are used as these represent periods of discharge (for effluent values) or periods of complete mixing (for mixed liquor suspended solids/mixed liquor volatile suspended solids [MLSS/MLVSS] values).

Calibration of the model to the September sampling period required that the influent ISS concentration be modified significantly to match the measured MLSS:MLVSS ratio and the effluent parameters, within a reasonable margin of error. It was determined that in addition to the measured influent ISS mass of approximately 12 pounds per day (lb/d), another 165 lb/d of ISS was required to account for differences between measured MLSS:MLVSS and that predicted by the BioWin simulator. After investigating more closely, Brown and Caldwell found that the addition of PAX at the effluent filters and in the SBRs for control of *Microthrix,* and addition of lime for pH control, accounted for the additional ISS required by the simulator to match the MLSS:MLVSS ratios. The additional ISS added is accounted for by approximately 50 lb/d of added lime and approximately 100 lb/d of added PAX. Therefore, it was assumed for subsequent simulations that the reduced waste activated sludge (WAS) rate predicted by BioWin was correct. No other parameters were significantly modified to achieve calibration of the simulator.

The dynamic simulation results for effluent chemical oxygen demand (COD) and total suspended solids (TSS) concentrations (Figure 2) show good agreement between predicted values and plant-measured values. While the model-predicted effluent TSS and COD concentrations are slightly lower than those observed in the field, these differences are explained by the performance of the tertiary sand filters, which remove additional

TSS and particulate COD that was not predicted by the model. The effluent soluble COD (sCOD) was predicted to be lower than that measured during the wastewater characterization. However, the difference between actual and modeled values is small (6 mg/L or less) and can be within the error associated with sample collection and measurement.

Table 2. BioWin Steady State Calibration Summary: High flow Wastewater Characterization Period, July 2010

Parameter	Units	Observed	Inputs to BioWin
Raw influent			
COD and TKN fractions [a]			
F_{bs}		0.32	0.35
F_{us}		0.06	0.06
F_{up}		-	0.40
F_{xsp}		-	0.27
F_{ac}		-	0.30
F_{na}		0.84	0.84
F_{nox}		-	0.25
F_{po4}		0.82	0.82
F_{Nus}		-	0.02
F_{upN}		-	0.03
F_{upP}		-	0.007
COD/BOD		2.66	
VSS/TSS		-	
COD/VSS		-	
NOB max. spec. growth rate	1/d	-	0.9

a. *F_{bs} = fraction of influent COD that is readily biodegradable COD.*
F_{us} = fraction of influent COD that is unbiodegradable soluble COD.
F_{up} = fraction of influent COD that is unbiodegradable particulate COD.
F_{xsp} = fraction of slowly biodegradable COD that is particulate.
F_{ac} = fraction of readily biodegradable COD that is VFAs.
F_{na} = fraction of TKN that is ammonia.
F_{nox} = fraction of organic nitrogen that is particulate.
F_{po4} = fraction of phosphorus as orthophosphate.
F_{Nus} = fraction of soluble TKN that is non-biodegradable.
F_{upN} = N:COD ratio for unbiodegradable particulate COD.
F_{upP} = P:COD ratio for unbiodegradable particulate COD.

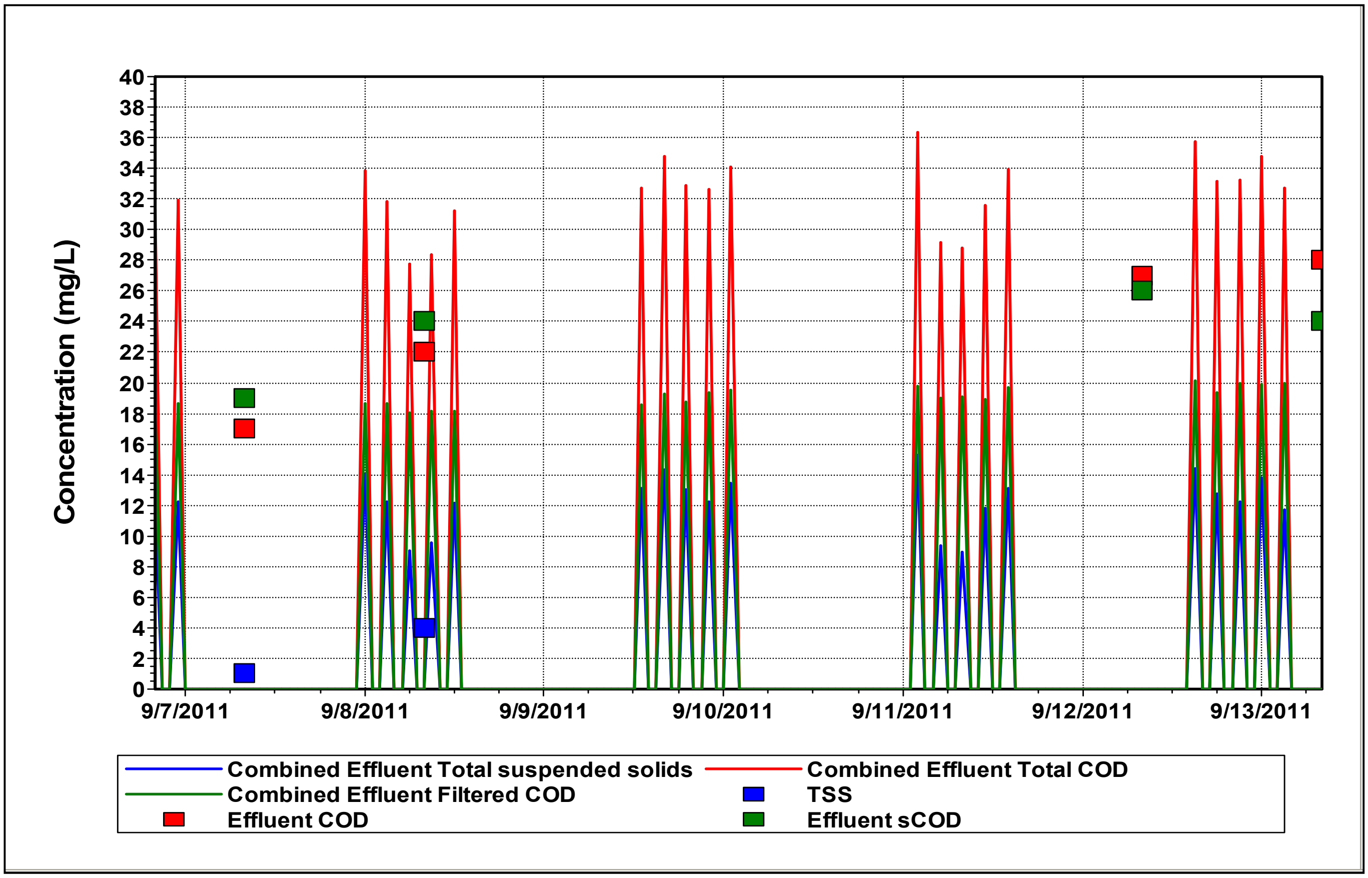

Figure 2. Dynamic simulation of effluent COD and TSS

(Model output is identified as a continuous plot, concentrations measured during the September 2011 wastewater characterization are identified by specific symbols at the time measured)

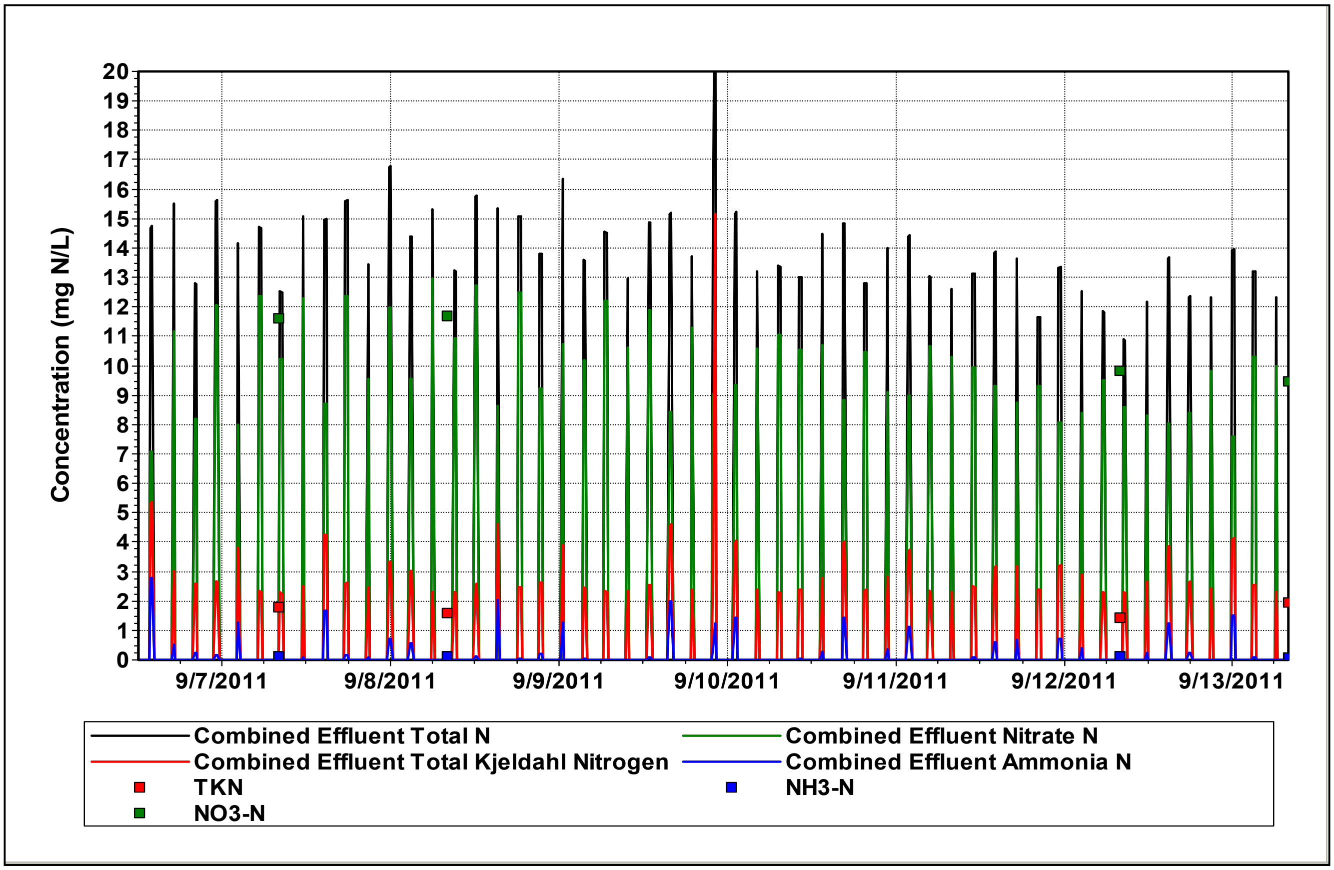

Figure 3. Dynamic simulation of effluent nitrogen species

(Model output is identified as a continuous plot, concentrations measured during the September 2011 wastewater characterization are identified by specific symbols at the time measured)

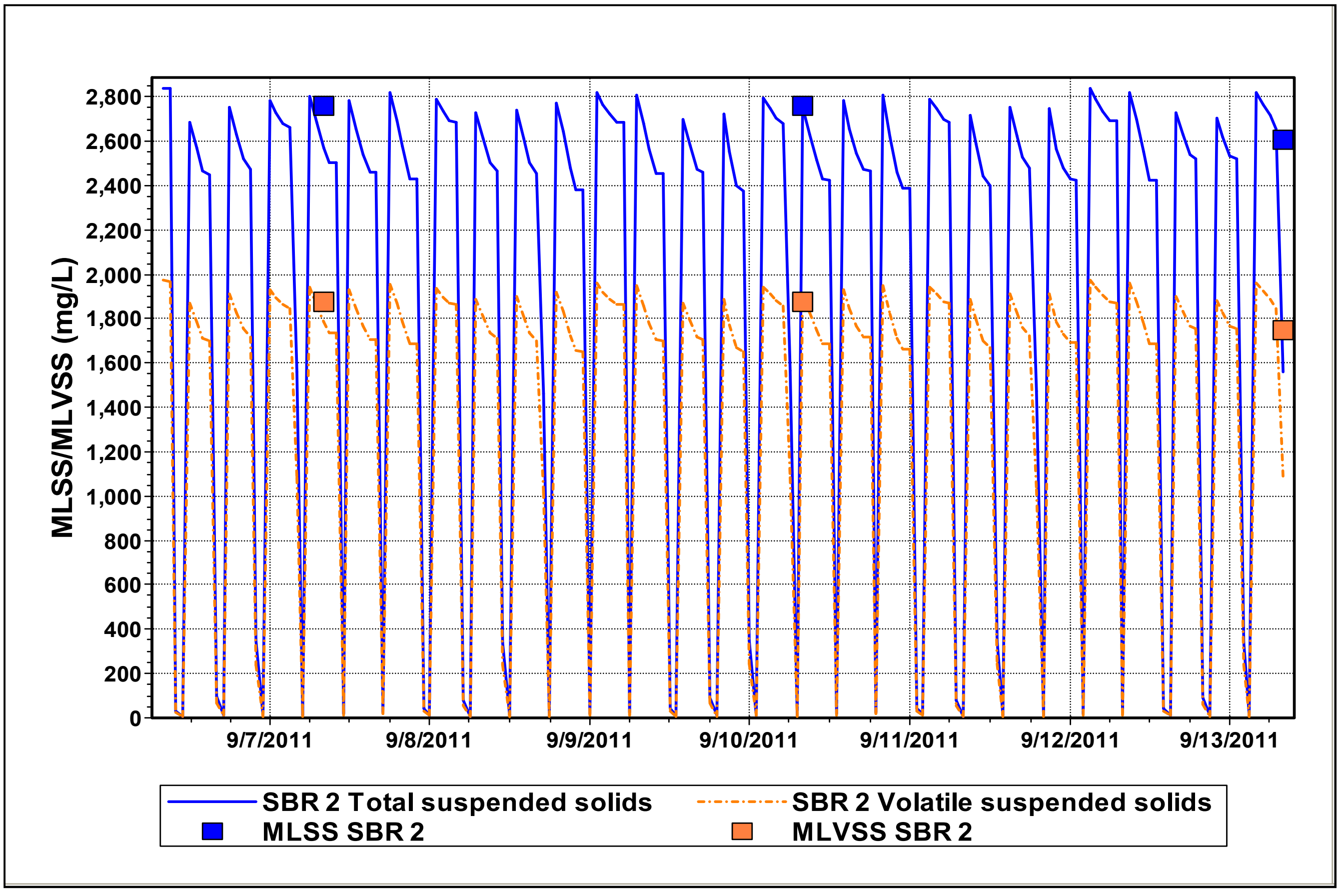

Figure 4. Dynamic simulation of MLSS/MLVSS concentration for SBR 2

(Model output is given as a continuous plot, measured values by specific symbols at the time measured)

The model also very closely predicts the effluent nitrogen species for ammonia and nitrate concentrations, as shown in Figure 3. In this figure, we observe that the plant was meeting permit requirements with respect to effluent ammonia, but that the effluent TN concentrations were higher than allowable for production of reclaimed water. The BioWin model predicts this same effect for the influent conditions modeled. The calibration of the model with respect to effluent nitrogen species was highly dependent on the aeration time applied and DO concentration in the reactors. As mentioned previously, the actual DO concentrations varied significantly from the DO concentrations specified in the plant control program. If the average DO concentrations from the plant control program are used for calibration, BioWin underestimates the effluent nitrogen concentrations. Once the actual DO concentrations were used in BioWin, effluent nitrogen species were more closely matched to those predicted in BioWin. The BioWin model still tended to over-predict effluent nitrate nitrogen by approximately 1 mg N/L, but this is likely due to the presence of algae that grow in the effluent storage lagoon in summer and fall months. These algae use nitrate as a nitrogen source for growth and can account for 1 mg/L of nitrogen uptake in the lagoons, which would lower the final effluent nitrogen concentration relative to the nitrogen discharged from the SBR.

The MLSS concentrations measured in the SBRs also closely match those predicted by the BioWin simulator. Figure 4 shows the MLSS and MLVSS concentrations for SBR 2 during the wastewater characterization period. Predicted values for MLSS and MLVSS were within 3 percent of the actual measured values for the same period when wasted sludge mass was within 5 percent of the actual wasted mass. The MLSS:MLVSS ratio was matched only after accounting for additional ISS due to PAX and lime addition at the plant.

Because only minor differences were observed between the plant-measured daily values and those predicted by the model, no further modifications to flows, influent characteristics, or biological kinetics were required.

The calibrated BioWin simulator was subsequently used in the plant treatment capacity assessment for the existing facility.

2.2 Conclusions and Recommendations from Calibration

Based on the results of the simulator calibration and investigations that occurred in support of calibration, the following conclusions can be made:

1. Significant ISS is added at the treatment plant both from lime addition for pH control and from PAX addition as a coagulant for tertiary sand filtration and for control of *Microthrix* in the winter. While this additional ISS does not detrimentally affect performance, the additional solids added to the system reduce overall system treatment capacity. However, it is important to point out that the addition of these compounds is necessary for the performance of the system and cannot be reduced or eliminated at this time.
2. The DO concentrations in the SBRs vary significantly from the control set points in the control program. Over-aeration is common and DO concentrations at saturation (8–9 mg/L) are frequently observed. This additional DO is frequently carried over through the settling and decant phases of the SBR into the anoxic phase of the next cycle and reduces the amount of time available in the anoxic phase and the amount of sCOD available during the anoxic phase for denitrification. This detrimentally affects denitrification at the Yelm WRF and inhibits the ability of operations staff to meet effluent TN requirements for reclaimed water production. The over-aeration likely occurs because the aeration blowers are too large for the current flows and loads to the WRF. Potential solutions to over-aeration include replacement of the blowers with smaller units, installation of a blow-off to minimize over-aeration with the existing blowers, and programming on-off operation to the existing blowers. Investigation into the feasibility and cost-effectiveness of these solutions will be evaluated as part of the ongoing General Sewer Plan process.
3. The model over-predicts the final measured effluent nitrogen. This is likely due to the presence of algae that grow in the effluent storage lagoons in summer and fall months. Algae growth is minimized at colder temperatures and lower light periods that occur in the winter and spring. These algae do not detrimentally affect performance of the system; rather, they help to reduce TN. Because there is sufficient capacity in the tertiary sand filters to filter the algae that do grow in the effluent lagoons, no action to limit algae growth is recommended at this time.

3. Secondary Treatment Capacity for Future Flows and Loads

The Yelm WRF was initially designed for a maximum month flow of 1.06 mgd. However, given the current limitations with meeting effluent TN limits of 10 mg/L, it is clear that system treatment capacity is likely lower than the current rated capacity. There are many potential causes for this, including very low winter temperatures, higher than typical influent TN concentrations, and insufficient readily degradable influent carbon relative to the influent nitrogen concentrations. However, these cannot be confirmed as the exact design influent loading parameters for the treatment plant are not known to Brown and Caldwell at this time.

Because of the uncertainty in current plant treatment capacity, the City has requested that the BioWin model developed and calibrated for the Yelm WRF be used to evaluate the plant capacity under various conditions for summer (22°C) and winter (8°C) temperatures. These treatment capacity evaluations looked at the following operating conditions:

- summer capacity for removing nitrogen to less than 10 mg/L TN with two SBRs in service
- summer capacity for removing nitrogen to less than 10 mg/L with three SBRs in service
- summer capacity for performing nitrification only (no nitrogen removal) with two SBRs in service
- winter capacity for removing nitrogen to less than 10 mg/L TN with two SBRs in service
- winter capacity for removing nitrogen to less than 10 mg/L TN with three SBRs in service
- winter capacity for performing nitrification only (no nitrogen removal) with three SBRs in service

In each case, lime addition to the SBRs was simulated to ensure that the effluent pH remained between 7 and 7.5. The lime addition is added only as an alkalinity source and could be added as caustic or magnesium hydroxide when implemented at the treatment plant. The addition of readily biodegradable COD (RBCOD) was also simulated at an optimum level to ensure that sufficient RBCOD was present to achieve effluent TN concentrations below 10 mg/L. System sludge retention time (SRT), cycle times, and aeration/anoxic times within cycles were optimized to meet the goals of nitrification and denitrification for each of the treatment capacity evaluations listed above as well as to maintain the MLSS concentrations at or below approximately 3,000 mg/L to ensure settleability of the mixed liquor.

For all treatment capacity simulations, it was assumed that influent biochemical oxygen demand (BOD), COD, TSS, and nutrient concentrations would remain the same as those measured during the WWC period and that only the flows would increase. This would mean that flow and load would increase in the same proportion. Because Yelm's collection system is relatively new and all waste sources are currently septic tank effluent pumping (STEP) systems, this assumption is likely accurate provided that all new city growth remains as STEP discharges. If new system connections are conventional gravity or grinder pump sewer systems, then the true system capacity could be significantly different than those reported here.

3.1 Summer Treatment Capacity

Summer capacity evaluations were conducted at 22°C for the conditions discussed above. Results of these capacity evaluations are summarized in this section.

3.1.1 Two-SBR Operation, Total Nitrogen Removal Limit of 10 mg/L

Summer treatment capacity simulations showed that the current system, with two SBRs in operation, have approximately 20 percent additional capacity for flow and load relative to the flow and load observed in September 2011. This capacity assumes that the plant must average less than 10 mg/L effluent TN. The plant capacity observed was 0.45 mgd, which is approximately 20 percent higher than the 0.37 mgd influent flow measured during September 2011. Figure 5 shows the effluent nitrate and TN concentrations anticipated for summer conditions with 20 percent additional flow and load. As can be seen from this figure, the average effluent TN was 9.4 mg/L, with some excursions as high as 11.5 mg/L and others as low as 7 mg/L. The excursions are due to fluctuations in influent nitrogen load relative to the influent COD load. To achieve this effluent TN for these summer conditions, 330 lb/d of supplemental RBCOD, added at the influent, is required to supplement the anticipated influent RBCOD. This is equivalent to an additional 23 percent influent COD over the actual influent COD. Figure 6 shows the same operating conditions without any RBCOD addition and the average effluent TN concentration is approximately 19 mg/L (note axis scale is different from Figure 5). This indicates that there is insufficient influent COD to drive denitrification and supplemental carbon addition will be required to extend plant capacity.

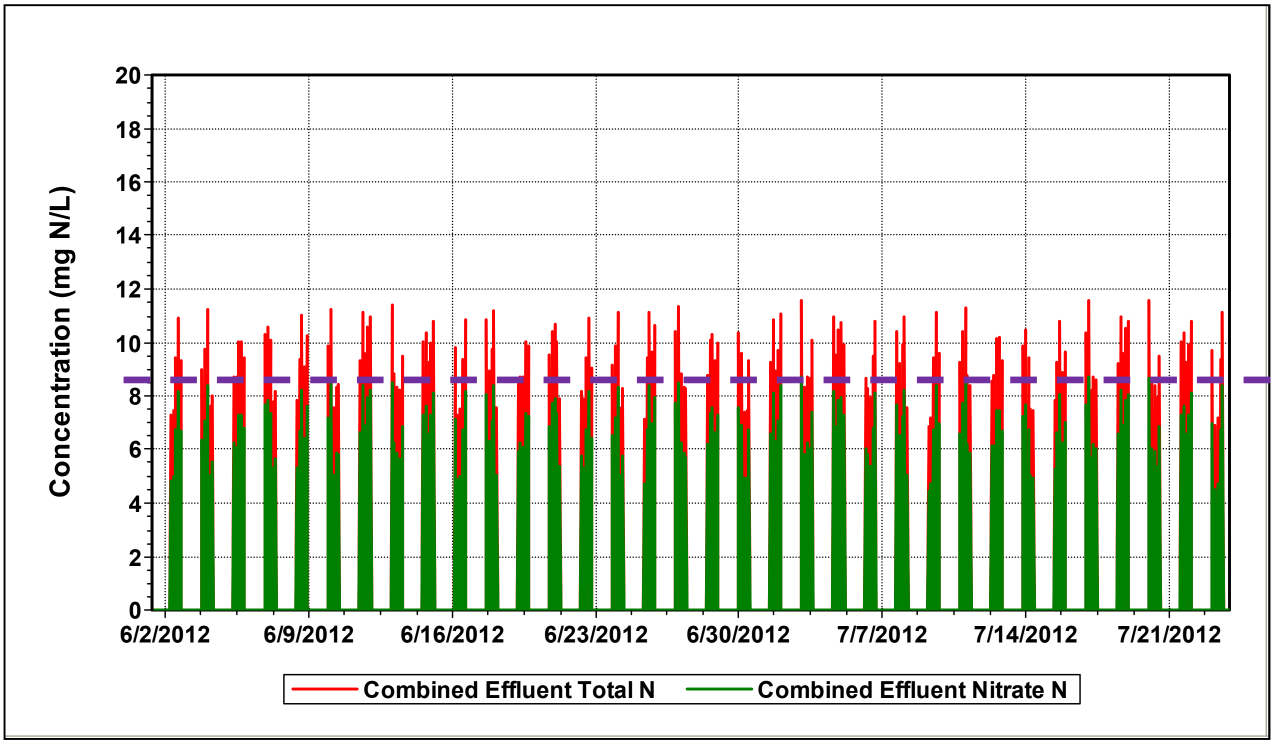

Figure 5. Summer treatment capacity results: effluent nitrate and total nitrogen for two-SBR operation with RBCOD addition to the influent

Note: Average effluent TN concentration indicated by purple dashed line. Ammonia is not shown because it never exceeds 0.5 mg/L under these simulated conditions.

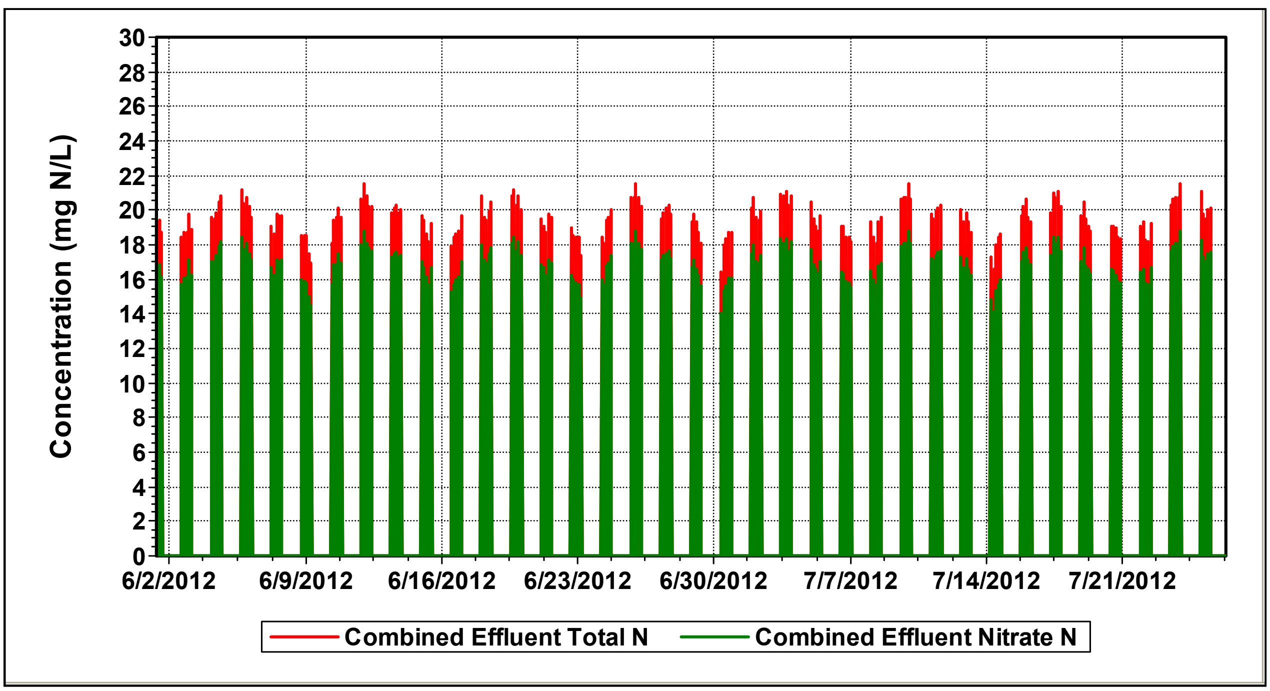

Figure 6. Summer treatment capacity results: effluent nitrate and total nitrogen for two-SBR operation without RBCOD addition

Simulation results show that the summer plant capacity is limited by the ability of the system to remove nitrogen. If nitrification and BOD removal are the only goals for the facility, there is significant additional capacity in the system, as discussed below. Table 3 shows a summary of the Yelm WRF summer capacity and operational requirements to meet an effluent TN limit of 10 mg/L. It is important to note that the operating MLSS for these conditions was determined to be only 2,300 mg/L, which is lower than the typical operating MLSS concentration. Increasing MLSS concentration by increasing SRT did not increase the nitrogen removal capacity of the SBRs during summer operation.

Table 3. Summer Treatment Capacity and Operational Requirements for Two SBRs in Operation to Meet Effluent TN Limits of 10 mg/L

Parameter	Value
Influent characteristics at SBR capacity	
Flow, mgd	**0.45**
COD, mg/L	385
TKN, mg N/L	63
Cycle times, minutes	
Overall cycle time	370
Anoxic fill	150
Aerobic fill/react	120
Settle/decant	100
Lime addition required for pH 7.0 (min), lb/d	0
Supplemental RBCOD required, lb/d	330
Average operating MLSS, mg/L	2,300
Average operating SRT, days	27

3.1.2 Three-SBR Operation, Total Nitrogen Removal Limit of 10 mg/L

The City has three SBRs at the WRF, but only two are currently used. Additional capacity can be gained if the third SBR is put into service. Evaluating the summer treatment capacity with three SBRs in service showed that the system can accommodate 80 percent more flow and load than that observed in September 2011 (0.67 mgd), but that the capacity is still significantly lower than the originally rated flow capacity of 1.06 mgd. This capacity assumes that the plant must average less than 10 mg/L effluent TN. Figure 7 shows the effluent ammonia, nitrate, and TN concentrations anticipated for summer conditions with 80 percent additional flow and load. As can be seen from this figure, the average effluent TN was projected to be 10.0 mg/L, with some excursions as high as 12 mg/L and others as low as 7 mg/L. To achieve this effluent TN for these summer conditions, 830 lb/d of RBCOD, added at the influent, is required to supplement the anticipated influent RBCOD. For summer conditions, nitrification does not control the SRT, but the detention time required to maintain both nitrification and 25 days SRT is required to maintain sufficient nitrification to maintain effluent ammonia below 3.0 mg/L and meet requirements for discharge to the Centralia Power Canal. Figure 7 shows that the average effluent ammonia concentration is approximately 0.5 mg/L and occasionally spikes to 2 mg/L. Also, at this high SRT the average MLSS concentration in the system is 2,100 mg/L. While there is some additional capacity to allow for higher MLSS concentrations, any additional flow and load elevated the average effluent TN concentration above 10 mg/L. Therefore, the practical capacity limit for the system with three SBRs in operation to meet a summer TN limit of 10 mg/L is 80 percent additional capacity compared to the September 2011 flows and loads.

Simulation results show that the winter plant capacity is limited by the ability to nitrify at cold temperatures and remove nitrogen to meet reclaimed water limits for TN. Table 4 shows a summary of the Yelm WRF winter capacity and operational requirements to meet an effluent TN limit of 10 mg/L with 3 SBRs in service.

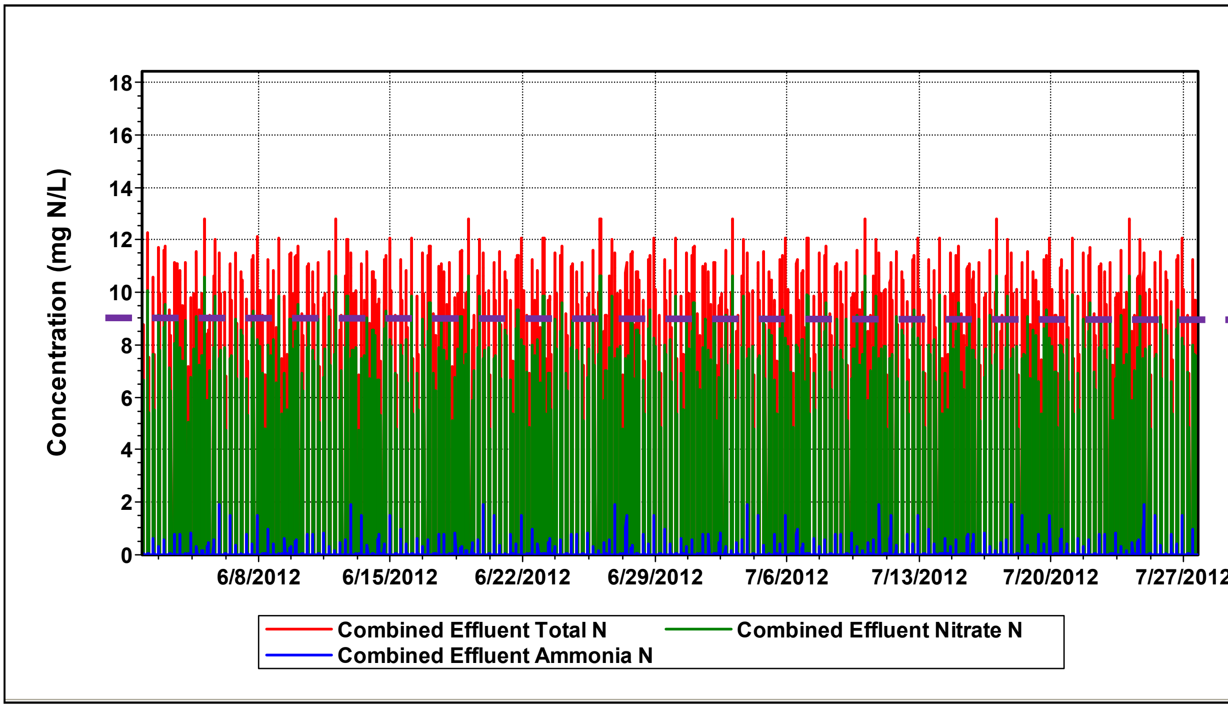

Figure 7. Winter treatment capacity results: effluent ammonia, nitrate and total nitrogen for three-SBR operation with RBCOD addition to the influent, 10 mg/L TN limit

Note: Average effluent TN concentration indicated by purple dashed line.

Table 4. Winter Treatment Capacity and Operational Requirements for Three SBRs in Operation to Meet Effluent TN Limits of 10 mg/L

Parameter	Value
Influent characteristics at SBR capacity	
Flow, mgd	**0.67**
COD, mg/L	385
TKN, mg N/L	63
Cycle times, minutes	
Overall cycle time	420
Anoxic fill	165
Aerobic fill/react	165
Settle/decant	90
Lime addition required for pH 7.0 (min), lb/d	0
Supplemental RBCOD required, lb/d	830
Average operating MLSS, mg/L	2,100
Average operating SRT, days	25

3.1.3 Two-SBR Operation, Nitrification Only

The City's current discharge permits require that a portion of its effluent go to groundwater recharge. This portion requires that the effluent TN not exceed 10 mg/L. However, the City currently treats all of its discharge to this level, even though it is not required. One option that could be considered in facility planning for an upgrade of the WRF would be to operate the SBRs to achieve effluent quality necessary for discharge to the Centralia Power Canal/Nisqually River with the addition of a tertiary treatment process to produce reclaimed water meeting the applicable nitrogen limits. This section evaluates this option by looking at the capacity of the current system to nitrify only.

To evaluate the capacity of the system to nitrify only, the entire fill-and-react period of the SBR cycle was made aerobic. No additional RBCOD is required because denitrification is not occurring. However, as denitrification is not occurring, additional lime is needed to maintain effluent pH above 7.0. Based on these limits, the existing two-SBR system has 140 percent additional capacity over the September 2011 flows and loads (0.74 mgd). Figure 8 shows the effluent ammonia concentrations predicted by the model at these increased flows. No excursions in effluent ammonia exceed the 3.0 mg N/L permit limit for discharge to the power canal, and the average remains below 0.5 mg N/L. Because no denitrification is occurring in the system, a significant amount of lime (1,190 lb/d) is required to offset the pH drop and maintain an average pH above 7.0. This is the equivalent of 860 lb/d of dry magnesium hydroxide or about 65 gallons per day of a 25 percent caustic soda solution. The SRT for this system was not limited by the SRT required to maintain nitrification, but in trying to maintain the biomass concentration above 2,000 mg/L. The SRT for these simulations was 16 days, and the average MLSS concentration at this SRT is 2,400 mg/L.

It is very important to note that the capacity limit reached for these simulations was not due to the ability of the system to nitrify or the MLSS concentration in the system. Rather, at higher flows and loads to the system, the BioWin simulator showed that the effluent TSS concentrations exceeded the 30 mg/L permit limit. While effluent filtration could be used to reduce this further, it does put an additional strain on the filtration system capacity, which was not directly evaluated using the BioWin simulator. Therefore, the summer capacity limit for nitrification only is assumed to be driven by the ability of the system to meet a 30 mg/L effluent TSS limit and a 3.0 mg/L effluent ammonia limit. Table 5 shows a summary of the Yelm WRF summer capacity and operational requirements to meet an effluent ammonia limit of 3.0 mg N/L with two SBRs in service.

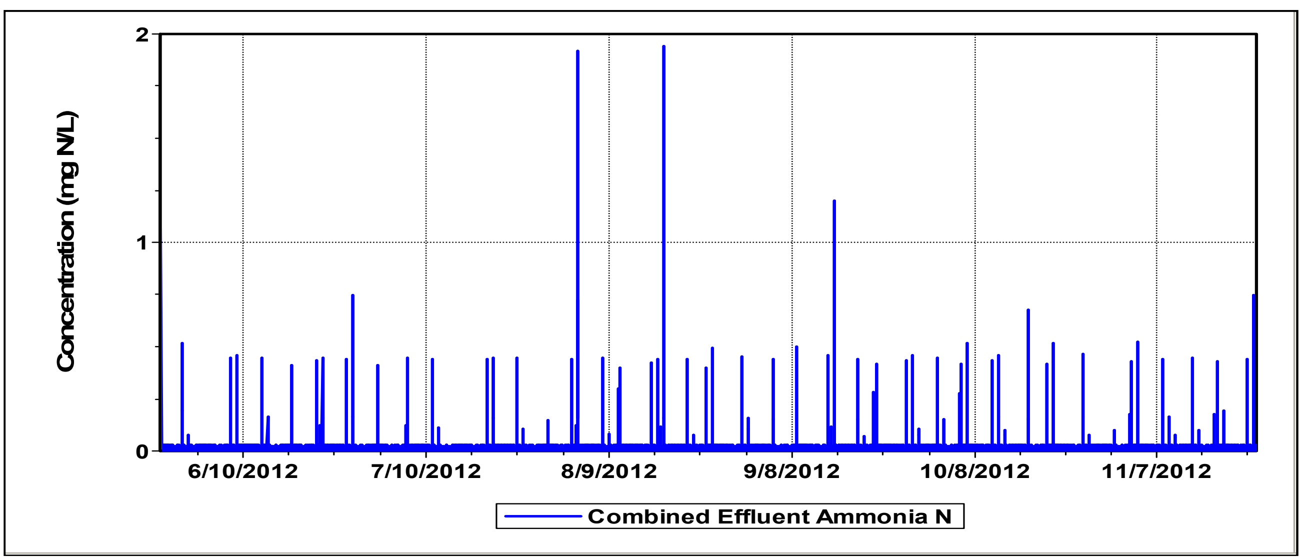

Figure 8. Winter capacity results: effluent ammonia for three-SBR operation 3 mg N/L ammonia limit

Table 5. Winter Treatment Capacity and Operational Requirements for Three SBRs in Operation to Meet Effluent Ammonia Limits of 3 mg N/L	
Parameter	Value
Influent characteristics at SBR capacity	
Flow, mgd	**0.89**
COD, mg/L	385
TKN, mg N/L	63
Cycle times, minutes	
Overall cycle time	370
Anoxic fill	0
Aerobic fill/react	270
Settle/decant	100
Lime addition required for pH 7.0 (min), lb/d	1,190
Supplemental RBCOD required, lb/d	0
Average operating MLSS, mg/L	2,400
Average operating SRT, days	16

3.2 Winter Treatment Capacity

Winter capacity evaluations were conducted at 8°C for the conditions discussed above. Results of these capacity evaluations are summarized in this section.

3.2.1 Two-SBR Operation, Total Nitrogen Removal Limit of 10 mg/L

Winter treatment capacity simulations showed that the current system, with two SBRs in operation, is at capacity with the flows and load observed in September 2011 and winter temperatures. This capacity assumes that the plant must average less than 10 mg/L effluent TN. Figure 9 shows the effluent ammonia, nitrate, and TN concentrations anticipated for these conditions. As can be seen from this figure, the average effluent TN is 9.0 mg/L, with some excursions as high as 11 mg/L and others as low as 8.5 mg/L. Again, these excursions are due to fluctuations in the influent nitrogen and COD loads to the facility. To achieve this effluent TN for these winter conditions, 250 lb/d of supplemental RBCOD, added at the influent, is required to supplement the anticipated influent RBCOD. In addition, a minimum SRT of 50 days is required to maintain sufficient nitrification to maintain effluent ammonia below 3.0 mg/L to meet requirements for discharge to the power canal. Figure 9 shows that the average effluent ammonia concentration is almost 2 mg/L and occasionally spikes to 3 mg/L. Also, at this high SRT the average MLSS concentration in the system is 3,200 mg/L, which is approximately the practical limit for this system to maintain settleability in the winter when influenced by *Microthrix* growth in the system.

Simulation results show that the winter plant capacity is limited by the ability to nitrify at cold temperatures and remove nitrogen to meet reclaimed water limits for TN. Table 6 shows a summary of the Yelm WRF winter capacity and operational requirements to meet an effluent TN limit of 10 mg/L with two SBRs in service.

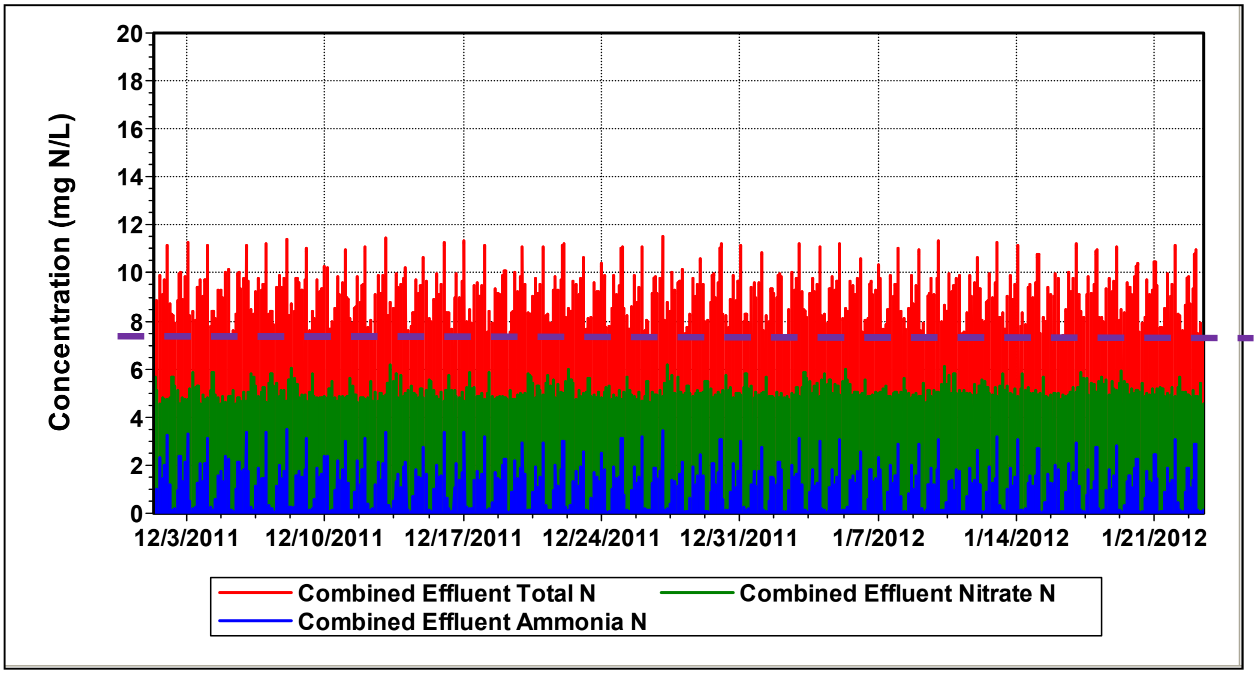

Figure 9. Winter treatment capacity results: effluent ammonia, nitrate and total nitrogen for two-SBR operation with RBCOD addition to the influent, 10 mg/L TN limit

Note: Average effluent TN concentration indicated by purple dashed line.

Table 6. Winter Treatment Capacity and Operational Requirements for Two SBRs in Operation to Meet Effluent TN Limits of 10 mg/L

Parameter	Value
Influent characteristics at SBR capacity	
Flow, mgd	**0.37**
COD, mg/L	385
TKN, mg N/L	63
Cycle times, minutes	
Overall cycle time	370
Anoxic fill	150
Aerobic fill/react	120
Settle/decant	100
Lime addition required for pH 7.0 (min), lb/d	0
Supplemental RBCOD required, lb/d	250
Average operating MLSS, mg/L	3,200
Average operating SRT, days	51

3.2.2 Three-SBR Operation, Total Nitrogen Removal Limit of 10 mg/L

The City has three SBRs at the WRF, but only two are currently used. Additional capacity can be gained if the third SBR is put into service. Evaluating the winter treatment capacity with three SBRs in service showed that the system can accommodate 50 percent more flow and load than that observed in September 2011 (0.56 mgd), but that the capacity is still significantly lower than the originally rated flow capacity of 1.06 mgd. This capacity assumes that the plant must average less than 10 mg/L effluent TN. Figure 10 shows the effluent ammonia, nitrate, and TN concentrations anticipated for winter conditions with 50 percent additional flow and load. As can be seen from this figure, the average effluent TN was projected to be 9.3 mg/L, with some excursions as high as 12 mg/L and others as low as 7 mg/L. To achieve this effluent TN for these winter conditions, 500 lb/d of RBCOD, added at the influent, is required to supplement the anticipated influent RBCOD. In addition, a minimum SRT of 34 days is required to maintain sufficient nitrification to maintain effluent ammonia below 3.0 mg/L and meet requirements for discharge to the Centralia Power Canal. Figure 10 shows that the average effluent ammonia concentration is approximately 1.5 mg/L and occasionally spikes to 4 mg/L. Also, at this high SRT the average MLSS concentration in the system is 2,600 mg/L. While there is some additional capacity to allow for higher MLSS concentrations, any additional flow and load elevated the average effluent ammonia concentration above 3.0 mg/L and the effluent TN concentration above 11 mg/L. Therefore, the practical capacity limit for the system with three SBRs in operation to meet a winter TN limit of 10 mg/L is 50 percent additional capacity compared to the September 2011 flows and loads.

Simulation results show that the winter plant capacity is limited by the ability to nitrify at cold temperatures and remove nitrogen to meet reclaimed water limits for TN. Table 7 shows a summary of the Yelm WRF winter capacity and operational requirements to meet an effluent TN limit of 10 mg/L with three SBRs in service.

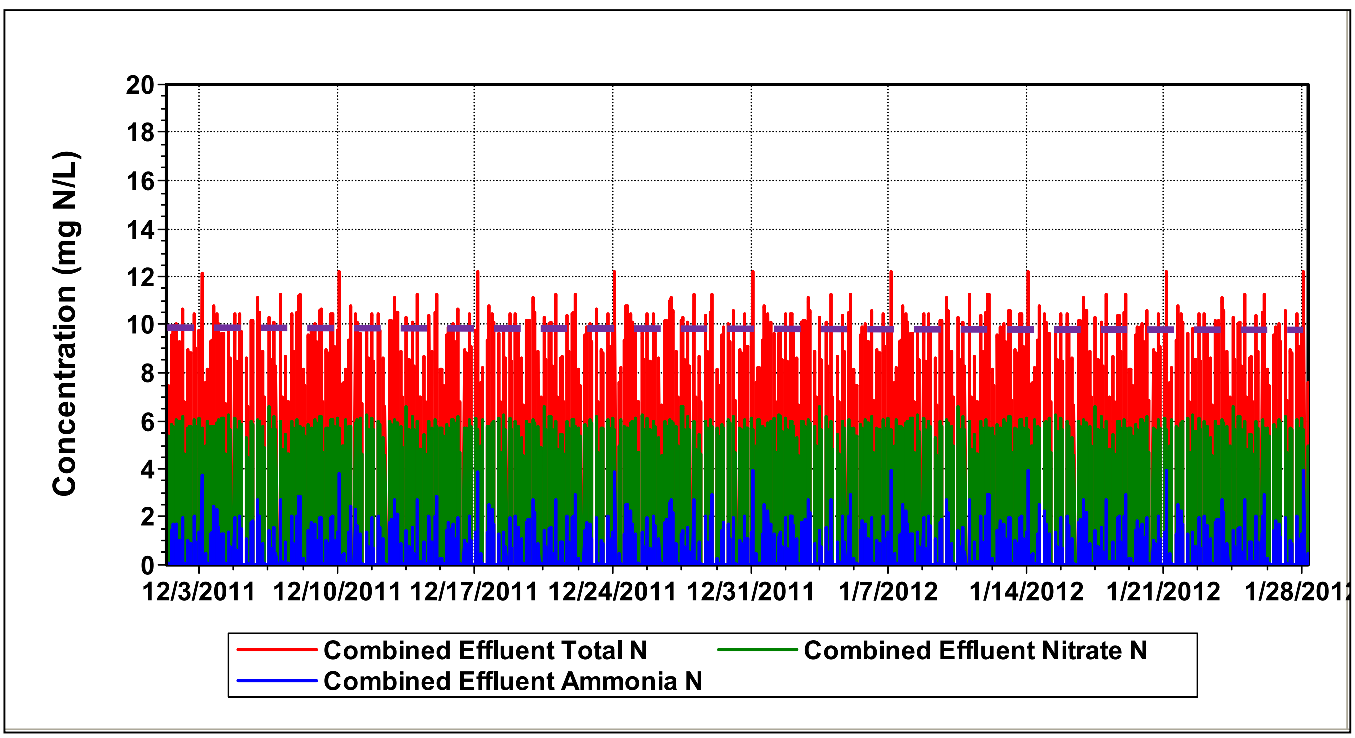

Figure 10. Winter treatment capacity results: effluent ammonia, nitrate and total nitrogen for three-SBR operation with RBCOD addition to the influent, 10 mg/L TN limit

Note: Average effluent TN concentration indicated by purple dashed line.

Table 7. Winter Treatment Capacity and Operational Requirements for Three SBRs in Operation to Meet Effluent TN Limits of 10 mg/L	
Parameter	Value
Influent characteristics at SBR capacity	
Flow, mgd	**0.56**
COD, mg/L	385
TKN, mg N/L	63
Cycle times, minutes	
Overall cycle time	420
Anoxic fill	165
Aerobic fill/react	165
Settle/decant	90
Lime addition required for pH 7.0 (min), lb/d	0
Supplemental RBCOD required, lb/d	500
Average operating MLSS, mg/L	2,600
Average operating SRT, days	34

3.2.3 Three-SBR Operation, Nitrification Only

The City's current discharge permits require that a portion of its effluent go to groundwater recharge. This portion requires that the effluent TN not exceed 10 mg/L. However, even though it is not required the City currently treats all of its discharge to this level. One option that could be considered in facility planning for an upgrade of the WRF would be to operate the SBRs to achieve effluent quality necessary for discharge to the Centralia Power Canal/Nisqually River with the addition of a tertiary treatment process to produce reclaimed water meeting the applicable nitrogen limits. This section evaluates this option by looking at the capacity of the current system to nitrify only.

To evaluate the capacity of the system to nitrify only, the entire fill-and-react period of the SBR cycle was made aerobic. No additional RBCOD is required because denitrification is not occurring. However, as denitrification is not occurring, additional lime is needed to maintain effluent pH above 7.0. Based on these limits, the existing three-SBR system has 100 percent additional capacity over the September 2011 flows and loads (0.74 mgd). Figure 11 shows the effluent ammonia concentrations predicted by the model at these increased flows. Though there are excursions in effluent ammonia as high as 6 mg/L, the average remains below 1.5 mg/L. Because no denitrification is occurring in the system, a significant amount of lime (950 lb/d) is required to offset the pH drop and maintain an average pH above 7.0. This is the equivalent of 690 lb/d of dry magnesium hydroxide or about 51 gallons per day of a 25 percent caustic soda solution. The SRT required to maintain nitrification at the minimum winter temperatures is 43 days, and the average MLSS concentration at this SRT is 2,900 mg/L. Table 8 shows a summary of the Yelm WRF winter capacity and operational requirements to meet an effluent ammonia limit of 3.0 mg N/L with three SBRs in service.

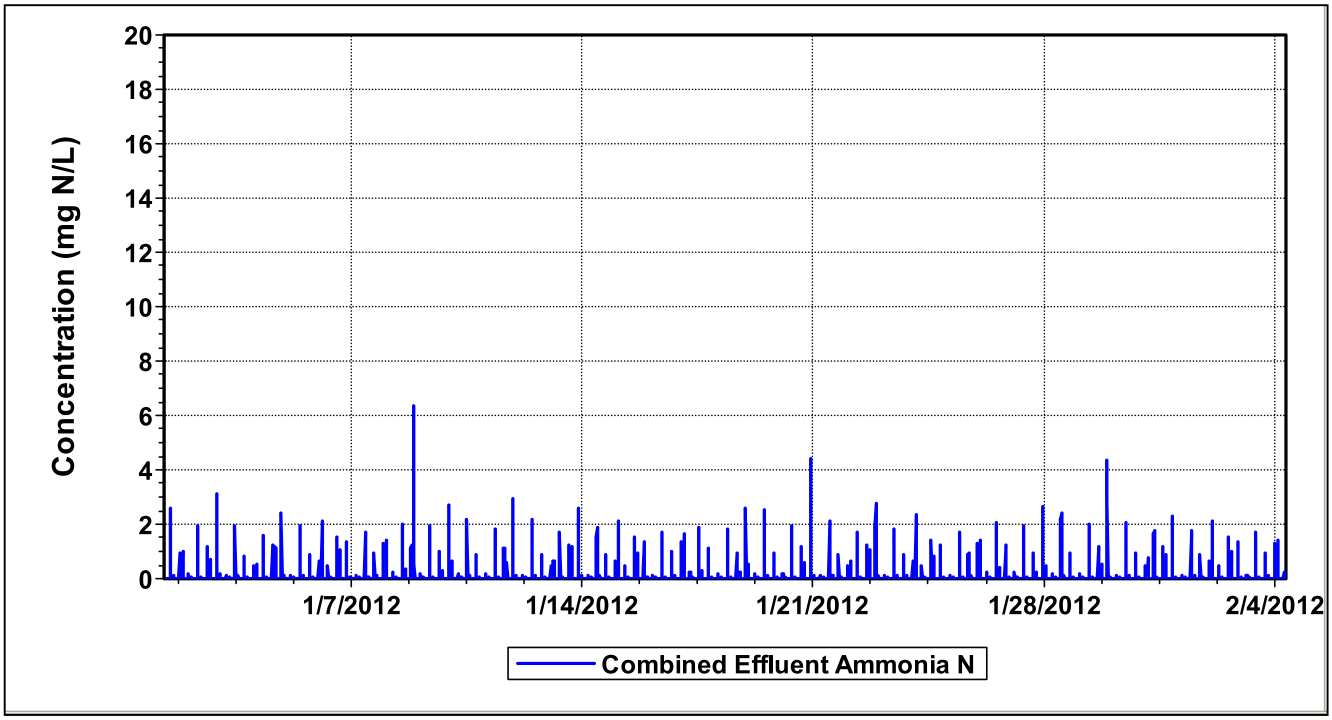

Figure 11. Winter capacity results: effluent ammonia for three-SBR operation 3 mg N/L ammonia limit

Table 8. Winter Treatment Capacity and Operational Requirements for Three SBRs in Operation to Meet Effluent Ammonia Limits of 3 mg N/L

Parameter	Value
Influent characteristics at SBR capacity	
Flow, mgd	**0.74**
COD, mg/L	385
TKN, mg N/L	63
Cycle times, minutes	
Overall cycle time	420
Anoxic fill	0
Aerobic fill/react	350
Settle/decant	70
Lime addition required for pH 7.0 (min), lb/d	950
Supplemental RBCOD required, lb/d	0
Average operating MLSS, mg/L	2,900
Average operating SRT, days	43

3.3 Conclusions

Results of the capacity evaluations, which are summarized on Table 9, show that the plant capacity is limited and that the limitations are typically caused by nitrification and nitrogen removal in the system, especially during cold winter months. Additional RBCOD is required to achieve effluent nitrogen limits in all scenarios, as the current influent RBCOD is insufficient to drive denitrification to meet effluent TN limits of 10 mg/L or less. If only nitrification is required, then significant lime or alkalinity addition is required to offset the acids produced during nitrification and maintain an average pH above 7.0 mg/L.

Table 9. Treatment Capacity Evaluation Summary

Capacity condition	Treatment capacity, mgd	RBCOD addition, lb/d	Lime addition, lb/d
Summer, 2 SBRs, 10 mg/L TN	0.45	330	0
Summer, 3 SBRs, 10 mg/L TN	0.67	830	0
Summer, 2 SBRs, 3 mg N/L ammonia	0.89	0	1,190
Winter, 2 SBRs, 10 mg/L TN	0.37	250	0
Winter, 3 SBRs, 10 mg/L TN	0.56	500	0
Winter, 3 SBRs, 3 mg N/L ammonia	0.74	0	950

Appendix A: Wastewater Characterization TM

BROWN AND CALDWELL

Technical Memorandum

Prepared for: City of Yelm, Washington

Project Title: City of Yelm On-Call

Project No: 140984

Technical Memorandum

Subject: Wastewater Characterization Summary

Date: November 01, 2011

To:

From: Rick Kelly, Ph.D., P.E., Brown and Caldwell

Reviewed by: Henryk Melcer, Ph.D., P.E., Brown and Caldwell

This memorandum provides a summary of results of the wastewater characterization carried out for the Yelm Water Reclamation Facility (WRF) in September 2011. The intent of the wastewater characterization program was to collect sufficient detailed data to help determine the cause of insufficient denitrification that is occurring at the facility and preventing production of reclaimed water and to allow calibration of the BioWin process simulator.

YELM WASTEWATER CHARACTERIZATION

The sampling program at the Yelm WRF consisted of a 4-day period of 24-hour composite samples of influent and effluent process streams from September 6 through September 12, and 1 day of 2-hourly grab sampling on September 11. Because the facility does not have any primary clarifiers and only minimal solids handling, only influent and effluent samples were collected. Influent samples were collected using a composite sampler that collects samples from the influent pipe to the facility. Effluent samples were collected from SBRs prior to the effluent storage lagoon. The samples were analyzed for a range of characteristics. Analysis of all wastewater characteristics except readily biodegradable COD (RBCOD) was according to Standard Methods (2005). The RBOD was measured by the procedure described by Mamais *et al*. (1993). All samples were measured by Edge Analytical Laboratories in Burlington, WA.

Raw Influent

The sampling data for the raw influent are summarized in Table 1. The raw influent to the Yelm WRF is from STEP (septic tank effluent pumping) systems, which consists of homes with septic tanks where the effluent is pumped to a centralized WRF instead of distributed to individual or combined leach fields. Because the effluent of septic tanks is partially treated and settled through anaerobic digestion in the septic tank, STEP influent to treatment plants is typically high in the fraction of total influent COD that is soluble and readily degradable. As the septic tank also acts to settle and capture solids, STEP influent usually has lower than normal concentrations of influent TSS. Both of these hold true for the Yelm raw influent and can be seen in the raw influent characteristics presented in Table 1. Table 1 also shows that the influent total Kjeldahl nitrogen (TKN), a measure of the total organic nitrogen plus ammonia nitrogen, is high relative to the influent COD concentration.

Table 1. Summary of Raw Influent Characteristics

Parameter	Average Concentration (mg/L)
Total BOD	146
TSS	58
VSS	53
Total COD	391
Soluble COD	215
Flocculated-filtered COD	135
TKN	63.0
Ammonia-nitrogen	52.6
Nitrate-nitrogen	0.0
Total phosphorus (TP)	7.81
Ortho-phosphate	6.43
Flow	0.37 mgd

Total BOD –Total Biochemical Oxygen Demand
TSS – Total Suspended Solids

VSS – volatile suspended solids
Total COD – Total Chemical Oxidation Demand
TKN – Total Kjeldahl Nitrogen
mg/L – milligrams per liter
mgd – million gallons per day

Secondary Effluent

The sampling data for the secondary effluent are summarized on Table 2 for all constituents, except nitrate concentration; they are significantly lower than in the raw influent. These results show excellent facility performance at the time of sampling with respect to TSS, COD (a surrogate measure of BOD), and ammonia removal. These results also show that nitrification, some denitrification, and some biological phosphorus removal are occurring in the biological treatment system. This is discussed in greater detail below.

Table 2. Summary of Secondary Effluent Characteristics

Parameter	Average Concentration (mg/L)
TSS	1.3
Total COD	24
Soluble COD	23
Flocculated-filtered COD	13
TKN	1.7
Ammonia-nitrogen	0.11
Nitrate-nitrogen	10.6
Total phosphorus	1.69
Ortho-phosphate	1.49

Raw Influent Diurnal Sampling

On September 11, 2011, a diurnal sampling was conducted for the raw influent to determine the characteristics of the influent over the course of a 24 hour day. Table 3 presents these results. These data show that the concentrations of raw wastewater characteristics do not change much throughout the day, with the largest difference between low and high COD only accounting for 85 mg/L, or about 20 percent difference. This is typical of STEP systems, where concentrations do not differ significantly due to the retention time and treatment in the septic tanks. However, the influent flows are significantly different throughout the day, differing by more than 1,000 percent (0.8 mgd versus 0.08 mgd). This is typical of small treatment systems with no industrial contributors. The highest flows are typically observed just after breakfast and again after dinner, while minimum flows are typically observed in the middle of the night.

Table 3. Raw Influent Diurnal Sampling Characteristics

Time	Flow (mgd)	TSS (mg/L)	COD (mg/L)	TKN (mg/L)	TP (mg/L)
8:35	0.50	38	353	56.2	7.26
10:35	0.67	52	438	63.7	9.16
12:35	0.53	42	361	57.7	7.61
14:35	0.48	28	397	57.2	7.64
16:35	0.40	34	393	62.6	8.98

18:35	0.52	41	407	56.4	7.94
20:35	0.80	48	428	61.5	8.24
22:35	0.34	44	403	63.8	8.66
0:35	0.13	42	392	60.0	7.72
2:35	0.08	33	394	60.9	8.09
4:35	0.12	33	348	61.6	7.61
6:35	0.49	40	372	60.9	7.91

DISCUSSION OF YELM WASTEWATER CHARACTERISTICS

This section discusses the wastewater characteristics of the Yelm WRF, especially as they relate to the nutrient removal capabilities of the facility. The Yelm influent has a high soluble and readily biodegradable fraction of the influent COD (RBCOD). The influent COD concentration averaged 391 mg/L over the four day sampling period. The soluble fraction of this influent COD was about 55 percent (215 mg/L). The readily degradable fraction of the influent COD is measured by the flocculated filtered COD (ffCOD), and is about 35 percent of the influent COD (135 mg/L). This comprises a high proportion of the influent COD.

Nutrient removal, both biological phosphorus removal and denitrification, require readily degradable COD as a carbon source to drive the biological nutrient removal processes. To evaluate the quantity of readily degradable COD available for nutrient removal, it is necessary to take the difference between the influent ffCOD and the effluent ffCOD. The amount of ffCOD that is removed across the system is the amount that is readily biodegradable and the amount available for nutrient removal. For the Yelm WRF, the amount of RBCOD available is 122 mg/L (135 mg/L – 13 mg/L).

To remove nitrogen through denitrification, the denitrifying bacteria require 2.6 mg/L of RBCOD for every 1 mg/L of nitrogen removed. Therefore, with 122 mg/L RBCOD available, the Yelm system has the theoretical capacity to remove 47 mg/L of nitrogen. When looking at the influent nitrogen balance for the Yelm facility, we find:

- 63 mg/L of TKN in the influent wastewater
- For biomass growth, 1 mg/L N is required for every 20 mg/L COD. This means that about 18 mg/L of N are required for biomass growth at Yelm based on an influent COD removal of 365 mg/L.
- This leaves 45 mg/L N available for nitrification to convert to nitrate that would be available for denitrification.

Therefore, there is theoretically sufficient RBCOD in the influent to remove all of the nitrate remaining through the denitrification process. However, based on the wastewater characterization, 10.6 mg/L of nitrate remain in the effluent. So there must be some process that is also removing some of the RBCOD and making it unavailable for denitrification.

One competing process for RBCOD is biological phosphorus removal. There are 7.8 mg/L of TP in the influent. For every 100 mg/L of COD removed, 1 mg/L of TP is required for biomass growth. This means that 3.6 mg/L of TP are used for biomass growth. If no biological phosphorus removal was occurring in the system, there should be approximately 4.2 mg/L of TP in the effluent. The measured effluent TP concentration was only 1.7 mg/L, meaning 2.5 mg/L were taken up through the biological phosphorus removal process. As a rule of thumb, for every 1 mg/L of TP taken up during biological phosphorus removal, 10 mg/L of RBCOD are consumed. This means that 25 mg/L RBCOD are consumed for biological phosphorus removal processes at Yelm. This is RBCOD that is not available for denitrification and removes almost enough RBCOD to account for the amount of nitrate in the effluent of the facility.

OBSERVATIONS/CONCLUSIONS

- The raw influent for the Yelm WRF is high in soluble and RBCOD, accounting for 55 and 35 percent of the total influent COD, respectively.
- The raw influent is low in TSS (58 mg/L).
- There is sufficient RBCOD to support denitrification of the influent to an effluent TN concentration < 10.0 mg/L.
- Some RBCOD is being consumed through biological phosphorus removal, reducing the RBCOD available for denitrification and affecting the amount of denitrification that can occur, potentially impacting the facility's ability to meet reclaimed water limits for nitrogen

4I: Drain-Pro Solids Handling Contract

CONTRACT FOR SEPTAGE WASTE AND WASTE ACTIVATED SLUDGE COLLECTION AND TRANSPORTATION BETWEEN THE CITY OF YELM AND DRAIN PRO

Date of Contract August 23, 2011

A. RECITALS

1. The City of Yelm, a Washington municipal corporation ("the City"), has negotiated with Drain Pro, a Washington corporation (Contractor) for septage waste and waste activated sludge collection and services; and

2. Septage waste collection service and waste activated sludge collection and hauling is a fundamental municipal function, with uniform, managed collection necessary for the preservation of public health. Within its municipal authority pursuant to Washington law, the City deems it necessary that participation in the City's septage waste collection program be mandatory, and that all septage waste collection services described in this contract be handled by a single contractor; and

3. Drain Pro represents that it has the experience, resources and expertise necessary to perform septage waste collection services;

4. Drain Pro was the successful low bidder for cleaning, pumping, hauling and disposing of the City's catch basin waste.

5. The Yelm City Council has accepted the bid and the parties now wish to memorialize the agreement for services.

NOW THEREFORE, based upon the above recitals and the consideration provided herein, the City and Drain Pro agree as follows:

B. AGREEMENT

1. Definitions. All terms herein shall have the meaning found in the following sources: (1) YMC Chapter 13.08; (2) Washington law; and (3) the common dictionary.

2. Collection Responsibilities and Rights. Drain Pro covenants and agrees to furnish all equipment and labor necessary for the collection and transporting of septage waste from the residential, commercial and industrial premises of the City, commencing on **September 1, 2011 and until August 31, 2013 (2 years)** and until such further date if this contract is extended in accordance with the terms provided herein. Contractor also agrees to furnish all equipment and labor necessary for the collection and transporting of the City's waste activates sludge. The City shall compensate Contractor in accordance with the terms provided herein. The City shall compensate Contractor for collection and disposal services as provided in Section 6 & 23 of this Contract.

2.1 Expenses. Contractor shall pay all expenses connected with the collection, removal, transport and disposal of septage waste in accordance with the laws of the State of Washington.

3. Term; Extension. The term of this Contract shall be for a period of two full calendar years. At the end of this term, a new term from month to month may be created between the City and Drain Pro which shall be subject to all the terms and conditions hereof but shall be terminable on thirty (30) days written notice served by either the City or Drain Pro on the other party.

3.1 Termination; Notice to Contractor. The City may terminate this Contract at any time, upon failure of Contractor to comply with any terms of this contract or any applicable federal, state or City laws, regulations or ordinances, but only upon written notice to Contractor served personally upon any employee at Contractor's local office *or* by certified or registered mail ten (10) days prior to termination and only if Contractor during said time refuses to comply without due cause with the contract terms, ordinances or laws as specified in the notice. The City may allow such longer notice of termination as the City deems appropriate, in its sole, subjective discretion. In the event notice is given by regular or certified mail, notice shall be deemed "served" upon deposit of the notice in the mail. "Due cause" shall mean a legally sufficient ground or reason, based upon the spirit and intent of this Contract and/or applicable law, as would compel a reasonable prudent person to act in a similar manner under similar circumstances. Contractor shall have the right to appeal such notice to the full City Council for reconsideration, *provided, however,* during the pendency of such appeal, septage waste collection service shall continue in full accordance with this Contract, to the satisfaction of the Public Works Director.

4. Mandatory Performance Standards. The City awards this contract to Contractor conditioned upon Contractor abiding the following performance standards:

4.1 Adequacy of Collection Vehicles and Equipment. Contractor shall furnish, at Contractor's cost and expense, adequate vehicles for the extracting and hauling of the City's septage waste and shall keep said vehicles clean, sanitary, and in good running order. Each vehicle shall meet state, county, and local motor vehicle safety and health and sanitation regulations and shall be operated at all times by qualified personnel. The vehicles shall be maintained and operated so as not to leak, spill, or scatter and waste.

4.2 Sanitary Standards. Collection shall be made as quickly as possible. Contractor shall leave all alleys, streets, paths and sidewalks in clean, sanitary condition, and shall not permit any materials to be dropped from collection vehicles in or upon any public ways of the City. Contractor's employees shall clean up any septage waste materials that fall to the ground during collection.

4.3 Special Circumstances. Under certain circumstances as deemed so by the City's authorized representative, the City shall have the authority to utilize another Contractor to perform the required service, if in the opinion of the City the service would be better performed by such said contractor.

4.4 Local Office and Telephone Contact. Contractor shall provide an office and/or local telephone service operating during normal business hours, 9:00 a.m. to 5:00 p.m., as well as emergency phone numbers for after hours calls, Monday through Friday, through which the City may contact Contractor on any matter which relates to the performance of its services under this Contract. Additionally, Contractor shall provide the City with a telephone number and pager list of local employees for the City to contact in response to septage waste collection needs during the hours of 9:00 a.m. to 5:00 p.m. on Saturdays, Sundays, and holidays, as well as emergency numbers for after hour calls. Contractor agrees to designate employees who will respond to septage waste collection needs at all such times.

5. Transport and Disposal Locations for Septage Waste. Unless and until notified in writing by the City or another disposal destination, Contractor shall dispose of all waste at Bio Recycling, Inc. 2109 Foron Road, Centralia, WA 98531; or, if waste can not be disposed at the Centralia location it shall be hauled to the Shelton facility located on Web Hill Road, Shelton, WA 98531. All waste activated sludge will be transported to City of Tacoma, Central Treatment Plant, 2210 Portland Ave, Tacoma, WA 98421.

6. Collection Rates Payable to Contractor. The City shall pay Contractor for collection and disposal rates in the amounts set forth in "EXHIBIT A" (Bid) attached hereto and by this reference incorporated into this Contract.

6.1 Adjustment of Rates. During the term of this contact, rates will be adjusted only for the following reasons:

6.1.1 (a) Any unanticipated federal, state, county, state industrial or local tax increase; or (b) Any federal or state-mandated programs which cause a demonstrable increase in Contractor's costs of collection in an amount of not less than six percent (6%) of gross total cost of operation existing at the commencement of this Contract;

6.1.2 If the price of the motor vehicle fuel used by Contractor shall increase or decrease by more than $.50 per gallon from the average price as of the date of signing this contract, which the Parties stipulate to be $3.77 per gallon for regular unleaded fuel and $4.09 per gallon for diesel fuel. The rate adjustment shall be based upon documentation deemed satisfactory to the Finance Director;

6.1.3 If the present location of the waste management facility, Bio Recycling Facility changes;

6.1.4 Such other costs as may be determined to be reasonable by the City Council.

If the parties deem any of the above unanticipated expenses to justify a rate increase, the rates will be adjusted during the year in which the increase occurs. Contractor shall have the burden of justifying any proposed rate increase by documentary and financial accounting information as shall be deemed acceptable to the City's Mayor and the City Council.

6.2 Payment schedule. Payment to Contractor for the preceding month shall generally be made following the first City Council meeting of each month, but in no event later than thirty (30) days after receipt of each statement.

7. Maintenance of Records; Accounting and Reporting Responsibilities. Contractor agrees to keep, at all times, accurate and complete written records and accounts, including route books indicating the collection from all City customers. Such records shall be maintained pursuant to good accounting practices, and to allow the City, including the City's duly authorized representative or agent, reasonable and adequate access to any and all of said records, data and accounts. Contractor shall implement any requests by the City Clerk/Treasurer to improve and/or clarify financial or billing reporting methods. Contractor shall provide the City, upon its request (within seven (7) working days from the date of the written request), accurate copies of all records, or duplicates thereof, without charge. Additionally, Contractor shall keep records and submit them to the City as specified below. Contractor shall also provide weight receipts in gallons for all materials collected and disposed of by Contractor

8. Insurance: Contractor shall procure and maintain for the duration of the Contract, insurance against claims for injuries to persons or damage to property which may arise from or in connection with the performance of the work hereunder by Contractor, its agents, representatives, employees or subcontractors. All insurance required herein shall provide occurrence-based coverage, rather than claims-made coverage.

8.1 Contractor shall provide a Certificate of Insurance evidencing:

8.1.1 Automobile liability insurance with limits no less than $1,000,000 combined single limit per accident for bodily injury and property damage; and

8.1.2 Commercial general liability insurance written on an occurrence basis with limits no less than $1,000,000 combined single limit per occurrence and $2,000,000 aggregate for personal injury, bodily injury and property damage. Coverage shall include by not be limited to: blanket contractual; products/completed operation; broad form property damage; explosion, collapse and underground (XCU) if applicable; and employer's liability.

8.2 Any payment of deductible or self-insured retention shall be the sole responsibility of Contractor.

8.3 The City shall be named as an additional insured on the insurance policy, as respects work performed by or on behalf of Contractor, and a copy of the endorsement naming the City as additional insured shall be attached to the Certificate of Insurance. The City reserves the right to receive a certified copy of all required insurance policies.

8.4 Contractor's insurance shall contain a clause stating the coverage shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability. Contractor's insurance shall be primary insurance with respect to the City, and the City shall be given thirty (30) days prior written notice of any cancellation, suspension or material change in coverage.

8.5 Should a court of competent jurisdiction determine that this contract is subject to RCW 4.24.115, then, and in the event of liability for damages arising out of bodily injury to persons or damages to property caused by or resulting from the concurrent negligence of Contractor and the City, its officers, employees and volunteers, Contractor's liability hereunder shall only be to the extent of Contractors' negligence. It is further specifically and expressly understood that the indemnification provided in the Contract constitutes Contractor's waiver of immunity under Title 51 RCW (Industrial Insurance), solely for the purposes of this indemnification. This waiver has been mutually negotiated by the parties. The provisions of this Section 8.5 shall survive the expiration or termination of this Contract.

9. Workers Compensation Responsibility; Compliance with Laws. Contractor shall pay all amounts due to the Department of Labor and Industries of the State of Washington and to the State of Washington in connection with the Workers Compensation Act or any other amounts due the State of Washington in the form of taxes or fees as required by law in connection with the performance of this Contract. Contractor shall comply with all federal, state and local laws in effect during the period of this Contract, including amendments to laws presently in effect, in connection with their performance of this contract.

10. Contractor Indemnity: Contractor shall indemnify, defend and hold harmless the City, its officers, agents and employees, from and against any and all claims, demands, damages, judgments, losses, liability and expense (including attorney's fees), including but not limited to those for personal injury, death or property damage suffered or incurred by any person, by reason of or in the course of performing this contract which is or alleged to be caused by or may directly or indirectly arise out of any act or omission of the City, its officers, employees, agents and volunteers. This Contract shall also include all costs and attorney's fees incurred by Contractor in defending the same.

11. City Indemnity. The City shall indemnify, defend and hold harmless, Contractor, its officers, agents and employees, from and against any and all claims, demands, damages, judgments, losses, liability and expenses (including attorney's fees), including but not limited to those for personal injury, death or property damage suffered or incurred by any person, by reason of or in the course of performing this contract which is or alleged to be caused by or may directly or indirectly arise out of any act or omission of

the City, its officers, employees, agents and volunteers. This Contract shall also include all costs and attorney's fees incurred by Contractor in defending the same.

12. Nondiscrimination. Contractor will comply with all state and federal laws prohibiting discriminatory practices, including but not limited to prohibition against any nondiscrimination provisions of this contract, the City shall have the right, at its option, to cancel the Contract in whole or in part.

13. Applicable Law. This Contract shall be governed by the laws of Washington State.

14. Notices. Except as otherwise may be provided in this Contract, all notices required hereunder shall be delivered personally or mailed by mail as soon as practicable, not to exceed two weeks (14 days).

CITY:
Yelm City Clerk
Yelm City Hall
105 Yelm Ave W
Yelm, WA 98597
Telephone: (360) 458-8404

CONTRACTOR:
Drain Pro
Jeff Miller
5111 85th Ave E, Bldg. C, Ste. 1
Puyallup, WA 98371
(253) 926-5586

Notices shall be deemed given upon personal delivery or, if mailed, three (3) days after the date of postmark.

14.1 Change of Address. The Parties shall be obligated to provide each other with written notice of any change in address as soon as practicable.

14.2 Emergency Notices. In the event of an emergency, telephonic notice shall be given at the telephone number listed above, followed by confirming written notice delivered or postmarked on the following business day.

15. Modification: This contract may only be modified or amended in writing, duly authorized and signed by each party and approved by written resolution of the City Council adopted at an open, public meeting.

16. Independent contractor. The parties agree and acknowledge that Contractor is an independent contractor and not an agent or employee of the City, and that no liability shall attach to the City as a result of the acts or omissions of Contractor, its employees, agents or assigns. Contractor shall have no authority to execute agreements or to make commitments on behalf of the City, and nothing contained in the Contact shall be deemed to create the relationship of employer and employee or principal and agent between the City and Contractor.

17. Assignments. Contractor may not, by operation of law or otherwise, assign or transfer all or any part of this Contact or the responsibilities, operations or interests under

this Contract, nor shall Contractor subcontract any part of this Contract. In the event of an unauthorized assignment, the City reserves the right to cancel this Contract.

18. Subcontracting. The parties intend that Contractor shall perform pursuant to the terms of this Contract with its own forces and employees. However, in the event any incidental subcontractor services are necessary, Contractor agrees to be responsible for the standards of performance of any subcontractor. Contractor agrees to assure that the work or services performed by any subcontractor shall satisfy the terms of this Contract. Contractor agrees that no subcontractor shall relieve Contractor of any obligation under this Contract. All subcontractors shall first be approved by the Public Works Director.

19. Taxes and Fees. As an independent contractor, Contractor acknowledges that it is responsible for payment of any local, state, or federal taxes or fees with respect to Contractor's agents and employees, and any taxes or licenses applicable to Contractor's business activity. Contractor shall pay all licenses or permit fees required by local ordinances or state or federal law.

20. No Partnership. It is understood and agreed that nothing contained within this Contract shall be construed as creating or constituting a partnership or joint venture between the parties.

21. Insolvency; Right to Terminate Contract. In addition to other terms of this Contract, any or all of the following shall be considered events of default of this contract, allowing the City to Terminate the in accordance with Section 3.1 herein: (a) If Contractor petitions any court to be adjudged bankrupt; or (b) If a petition in bankruptcy is filed in any court against Contractor; or (c) If Contractor is judicially determined to be insolvent' or (d) If Contractor is adjudged bankrupt; or (e) If a receiver or other officer is appointed to take charge of the whole or any part of Contractor's property or to wind up or liquidate its affairs; or (f) If Contractor seeks a reorganization under any of the terms of the Federal Bankruptcy Code, as amended, or under any insolvency laws; or (g) If Contractor admits, in writing, its inability to pay its debts as they become due; or (h) If any final judgment is rendered against Contractor and remains unsatisfied for a period of thirty (30) days from the date on which it shall become final; or (i) If Contractor abandons its responsibilities under the provisions of this Contract.

If any of these events occur and is not remedied within ten (10) days of written notice, the City shall have the right to terminate this Contract as provided in Section 3.1 herein.

22. Dispute Resolution. In order to have a mechanism for the prompt resolution of any disputes in the administration or interpretation of this Contract, it is understood that the City Council shall resolve all disputes as to the proper performance under this Contract, including all disputes as to payment. All disputes not resolved by the City Council shall be resolved in Thurston County Superior Court and the parties hereby consent to the jurisdiction of and venue in said court.

23. Prevailing Wage: The contractor will be required on this Contract to pay the Washington Sate Prevailing Wage Rates established by the Department of Labor and Industries for Thurston County. The rates to be used will be the effective rates on the date of this contract attached included as required contract provisions attached as "Exhibit B". Contractor acknowledges and agrees that it must file a Statement of Intent to Pay Prevailing Wages with the Industrial Statistician of the Department of Labor and industries Services (DLIS) and provide the City with a copy of the same.

24. Costs and Attorneys Fees: In the event any action is brought by either party to enforce the terms of this Contract or for breach of this Contract by the other party, the parties agree that the non-prevailing party shall pay to the substantially prevailing party reasonable attorney's fees (including the reasonable value of services rendered the City Attorney) and costs and disbursements incurred by such party.

25. Reservation of Municipal Authority. The City specifically reserves the right to enact general municipal ordinances affecting all business and persons in the City of Yelm, which may affect Contractor.

26. Severability. If any term or provision of this contract is held invalid, the remainder of such terms or provision of this Contract shall not be affected, if such remainder would then continue to conform to the terms and requirements of applicable law.

27. No Waiver. Failure by either Party to enforce any condition, requirement, responsibility or provision of this Contract shall not be construed as a waiver of the Party's right to subsequently enforce that condition, requirement, responsibility or provision.

28. Entire Agreement: Amendments. This contract represents the entire and integrated agreement between the City and Contractor.

29. Successors and Assigns. This contract shall be binding upon the parties, their heirs, personal representatives, successors and assigns.

30. Advise of Legal Counsel. The parties warrant and represent to each other that they have had representation by legal counsel and/or have had the opportunity to be represented by legal counsel during all stages in the negotiation of this contract. The parties further agree that they have participated in the negotiating and drafting of this contract and stipulate that this contract shall not be construed more favorably with respect to either party.

31. Corporate Authority. Each individual executing this Contract on behalf of a corporation represents and warrants he/she is duly authorized to execute and deliver this contract on behalf of the corporation in accordance with a duly adopted resolution of the board of Directors of the corporation, or in accordance with the By Laws of said

corporation, and that this Contract is binding upon the corporation in accordance with its terms.

IN WITNESS WHEREOF, the parties hereto have executed, or caused to be executed by their authorized officials, the contract in duplicate, each of which shall be deemed an original as of the last date provided below.

CITY OF YELM, a Washington municipal corporation	CONTRACTOR a Washington corporation
By: ____________________ Ron Harding, Mayor	By: ____________________ ________________, President
Date: August 23, 2011	Date: ________________, 2011

Attest:

____
Janine Schnepf, City Clerk

Approved as to Form:

____
Brent F. Dille, City Attorney

corporation, and that this Contract is binding upon the corporation in accordance with its terms.

IN WITNESS WHEREOF, the parties hereto have executed, or caused to be executed by their authorized officials, the contract in duplicate, each of which shall be deemed an original as of the last date provided below.

CITY OF YELM, a Washington municipal corporation	CONTRACTOR a Washington corporation
By: ______________ Ron Harding, Mayor	By: ______________ ______________, President
Date: August 23, 2011	Date: ______________, 2011

Attest:

____

Janine Schnepf, City Clerk

Approved as to Form:

____

Brent F. Dille, City Attorney

ORIGINAL

IN WITNESS WHEREOF, the parties hereto have executed, or caused to be executed by their authorized officials, the contract in duplicate, each of which shall be deemed an original as of the last date provided below.

CITY OF YELM, a Washington municipal corporation	CONTRACTOR a Washington corporation
By: ____________________ Ron Harding, Mayor	By: Drain-Pro Inc. [signature], President
Date: August 23, 2011	Date: Aug 26th, 2011

Attest:

____
Shelly Badger, City Administrator

Approved as to Form:

____
Brent F. Dille, City Attorney

EXHIBIT A

BID PROPOSAL ATTACHMENT

BID FORM

To: **City of Yelm**
901 Rhoton Road
Yelm, WA 98597

Project: Collection, hauling and disposal of City's Septage and Waste Activated Sludge

Date: 8/4/11

Submitted by: Joe Jean

Full name: Drain-Pro Inc.

Full address: 5111 85th Ave E, C-2
Puyallup, WA 98371

Item #	Item Description	Price per gallon
1	Septage collection, hauling and disposal	$ 0.24
2	Waste Activated Sludge collection and hauling – Tacoma	$ 0.10

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EXHIBIT B
ATTACHMENT

County	Trade	Job Classification	Wage	Holiday	Overtime	Notes
Thurston	Truck Drivers	Asphalt Mix Over 16 Yards (W. WA-Joint Council 28)	$46.47	5D	1T	8L
Thurston	Truck Drivers	Asphalt Mix To 16 Yards (W.WA-Joint Council 28)	$45.63	5D	1T	8L
Thurston	Truck Drivers	Dump Truck	$17.23		1	
Thurston	Truck Drivers	Dump Truck And Trailer	$17.23		1	
Thurston	Truck Drivers	Other Trucks (W. WA-Joint Council 28)	$46.47	5D	1T	8L
Thurston	Truck Drivers	Transit Mixer	$31.64	6I	2H	