CITY OF COOS BAY
Agenda Staff Report

MEETING DATE March 17, 2015	**AGENDA ITEM NUMBER**

TO: Mayor Shoji and City Councilors

FROM: Jim Hossley, Public Works Director

THROUGH: Rodger Craddock, City Manager

ISSUE: Presentation - North Spit Waste Water Treatment Plant Proposal by Dennis Beetham, CEO D.B. Western Texas, Inc. (DBWT)

BACKGROUND:

Mr. Dennis Beetham, CEO D.B. Western Texas, Incorporated, will present his proposal for a wastewater treatment plant on the North Spit. Mr. Beetham has requested that the City consider abandoning rebuilding WWTP#2 at Empire Blvd and Fulton Avenue and send the waste destined for that plant to the treatment plant he would design, build and, potentially, operate on the North Spit. Mr. Beetham believes he can build a treatment plant for less than the cost at the Empire and Fulton location. Mr. Beetham states that Coos Bay Estuary is profoundly impaired and that an ocean outfall would be better for the health of the estuary.

On February 27, 2015, Rodger Craddock received a revised proposal regarding the construction of a wastewater treatment plant on the North Spit from DBWT. The proposal is split into four sections: 1) Legal Issues, 2) Economic Issues, 3) Environmental and Technical Issues, and 4) Permit Issues. The proposal includes a two phased approach for Coos Bay's wastewater treatment plants. The first phase involves constructing an ocean outfall and treatment plant on the North Spit, and piping and a pump station in Coos Bay to transmit the flows tributary to Plant 2. The second phase includes piping and pumping to transmit wastewater from Plant 1 and the North Bend treatment plant to the North Spit.

BUDGET IMPLICATIONS:

The DBWT proposal states that building the treatment plant on the North Spit will provide the City with $5 to $10M in savings. The proposal states that the cost of the North Spit plant will be $24.9M. However the report is not clear about what this number encompasses. It is not clear if this number includes the demolition of the existing plant, the cost of the new proposed ocean outfall, or converting the biosolids to Class A. Additionally, it does not include the cost of support buildings for the laboratory and offices. Mr. Beetham has stated that the lab and offices would be provided in existing DBWT buildings. No life cycle costs are presented nor documentation supporting the cost estimate. The proposal does not include sublease costs for the land DBWT leases from the International Port of Coos Bay (Port). It is also not clear if the $24.9M cost is dependent upon DBWT providing operational services.

The City's design team (SHN Consulting Engineers) and contractor (Mortenson Construction) recently completed cost estimate for the proposed plant at Empire Boulevard and Fulton Ave. The cost estimate is $25.7. This cost includes the demolition of the plant and the construction of the force main to transmit the sludge from Plant 2 to Plant 1. This cost also includes the cost of two support buildings housing the laboratory, office space, and maintenance space.

As far as the City acquiring a State Revolving Fund loan from DEQ, City ownership of the land the treatment plant is being built on is not essential. What DEQ would need is assurance the City has control of the property for the duration of the construction and operating period; a long-term lease could do that, and maybe other legal tools exist. So, if the planning horizon is 20 years, at which time the plant will be replaced, DEQ will need to see that the City is either in process of buying the site or a lease to cover at least that period of time; 20 years, plus the project construction period. If the funds to repay our loan are generated from the operation of the treatment plant and collection system (which they currently are), DEQ wants to see that the City has control of its property for the duration of the payback period; a long-term lease could do that. That being said, it would be very unusual for a community to not own the land its treatment plant is built on; DEQ staff is not familiar with a case where that's been done in Oregon.

ADVANTAGES:

A single centralized wastewater treatment plant on the North Spit that discharges to the ocean could offer some operational advantages if waste from both City plants were to be treated at one plant. However, at this time it is unclear if this centralized plant would provide an immediate and long term cost saving advantage to our rate payers.

DISADVANTAGES

Besides the unknown cost issues previously mentioned, the City's procurement process cannot guarantee that the DBWT team (engineer, contractor, and/or operator) would be successful in competing for contracts. Additionally, the time necessary to go through the plan review and permit review processes to relocate the facility to the North Spit will take at least a year, probably longer. Going through the procurement process will take a minimum of 3 months. As material/labor prices continue to escalate, delays mean increased construction costs.

With regard to the North Spit land leased from the Port by DBWT, the Port does not envision that a wastewater treatment plant is the best use of that particular piece of property as it is not a water dependent use. Further, per State Wide Planning Goal #11 (OAR660-015-000(11)), the City cannot own a wastewater treatment plant outside the limits of the City of Coos Bays Urban Growth Boundary (UGB). A governmental entity other than the City of Coos Bay must own and operate a wastewater treatment plant on the North Spit. The only exception to the City's ownership of a plant outside its UGB is where the new or extended system is the only practicable alternative to mitigate a public health hazard. DBWT is claiming there is a public health hazard in the Coos Bay Estuary and that the DBWT proposal is the only practicable alternative. However the state agency regulating the City's discharge into the bay (DEQ), is not telling us there is a public health hazard that cannot be mitigated by the City's present course of action for replacing WWTP#2. Thus the current course of action is an acceptable and practicable alternative.

RELATED CITY GOAL:

Maintain and improve the City's physical infrastructure and provide quality services for current and future citizens.

ACTION REQUESTED:

This item is a presentation by Mr. Dennis Beetham; staff is not requesting any action.

Presentation of the North Spit Wastewater Treatment Plant Proposal for the City of Coos Bay
03/17/2015

Presented by

DBWT

Dennis Beetham, President

The most important things we would like the City Council to take away from this presentation is:

1. **Health and Environmental issues with the Coos Bay Estuary**
2. **Human Health Issues associated with the current condition of the Bay**
3. **Cost savings of relocation for now and into the future**

DBWT has spent over 2,000 hours of Research and Engineering for this presentation. We cannot possibly cover all of our material in the 15 minutes allotted. We are happy to give our full presentation to the City Council during a work session and invite the general public to our full presentation that will be held at the Coos Bay Library on Thursday March 19th at 6pm. We will be able to take questions and have a full discussion at that time.

DBWT LOCATION AND PROFILE

PROFILE

We are a recognized global business leader and chemical engineering corporation providing advanced technology and support to customers through business development, engineering design, planning, contract administration, and construction.

DBWT has designed and fabricated 41 chemical plants globally with over 8.8 billion lbs/yr capacity (4,000,000 MT/yr.) – and Resin production plants for clients around the world. DBWT's plant in LaPorte Texas has the largest capacity in the world of Formaldehyde, Triazines, and UF Concentrate with 100% supply in Texas to Dupont, Koch Industries, GPRI and Momentive. DBWT has the production capability of 1.4 billion lbs/yr (635,000 MT) of Formaldehyde per year.

For more than 40 years DBWT has been committed to meeting the needs of tomorrow by offering the best available technology today. Our performance in the chemical industry has been exceptional. DBWT's proprietary technology exceeds the industry's environmental, efficiency and safety requirements with an ISO 9001 Certification at our Texas plant. This environmental ethic is incorporated into every aspect of new business development. We are recognized to have the best available technology for the manufacturing of Formaldehyde and UFC as well. This recognition is based on our total containment of all tanks vents, removal of formaldehyde emissions and removal of other VOC emissions. We are meeting the challenges of building plants around the world, and are committed to the current and future needs of the global chemical industry.

GOALS AND PLANS

GOAL A Remove the effluent from CB2 out of the Coos Bay Estuary and into an Ocean Outfall.

PLAN A Start with CB2 relocation to the North Spit along with the necessary Ocean outfall to allow future effluents from CB1 and NB

GOAL B Remove all current Anaerobic Sludge processing in CB1, CB2, NB, and process into "EPA certified Class A Exceptional Quality "Fertilizer 5 % solids

PLAN B Start with CB2 sludge and convert to Class A, in a dual temperature (55/35 deg C) phase Anaerobic process owned and operated by DBWT sized to process all Coos County Sludge.

GOAL C Remove the effluents from CB1 and NB out of the Coos Bay Estuary and into an Ocean Outfall.

PLAN C Start piping effluents from CB1 and NB to new ocean outfall completed with CB2.

VISION: Present our citizens, and their children a legacy gift of a cleaner Coos Bay Estuary

We acknowledge scientists with EPA, WHO (World Health Organization), NSF, DEQ, FFDA, South Slough Sanctuary, NEMF, OFW, ODA, many Universities, and concerned local fishermen that have helped with our research.

ENVIRONMENTAL, COST, AND CHALLENGES TO GOALS

COST BENEFITS TO GOALS:

- Lower initial cost
- Lower long term cost
- Less risk to NPDES challenge and future re-building cost
- A DBO will be a guaranteed FIXED COST vs current COST PLUS
- A DBO will use LOCAL Labor and Engineers
- Will improve the Oyster growing and Recreational Industries

Note: NPDES = National Pollution Discharge Elimination System – DBO = Design, Build, Operate

ENVIRONMENTAL BENEFITS TO GOALS:

- The removal of effluent from the Estuary will begin immediately
- The removal of harmful Pathogenic Organisms from the Bay including: Parasites, Viruses, Bacteria, etc….
- The conversion of Class B Sludge (Live Pathogens) to Class A Fertilizer (Dead Pathogens) will begin immediately
- This will begin the healing of our "Impaired" Estuary towards the goal of achieving the requirements of the EPA's Clean Water Act
- Avoid a "Public Health Hazard" as stated in Goal 11
- Neighborhood health issues due to aerosols drifting from the aeration basin

CHALLENGES TO GOALS:

- Both the EPA and DEQ stated that the Coos Bay City Council holds the "Decision Power" to relocate CB2 to the North Spit
- A TEAM EFFORT of City, Port, DEQ, BLM, and DBWT will make it happen

NPDES FLOW TABLES

Table ES.7 –NPDES Discharge Limits Summary

(1) May 1 – October 31:					
Parameter	Average Effluent Concentrations (Monthly)	Average Effluent Concentrations (Weekly)	Monthly Average (lb/day)	Weekly Average (lb/day)	Daily Maximum (lbs)
BOD_5	20 mg/L	30 mg/L	340	510	670
TSS	20 mg/L	30 mg/L	340	510	670

(2) November 1 – April 30:					
Parameter	Average Effluent Concentrations (Monthly)	Average Effluent Concentrations (Weekly)	Monthly Average (lb/day)	Weekly Average (lb/day)	Daily Maximum (lbs)
BOD_5	30 mg/L	45 mg/L	510	760	1000
TSS	30 mg/L	45 mg/L	510	760	1000

Table ES.5 – Projected Wastewater Flows

Summary of Projected Wastewater Flows	
Parameter	**2037 Flow (MGD)**
Dry Weather Flows	
Average Dry Weather Flow (ADWF)	0.99
Average Daily Flow (ADF)	1.24
Maximum Month Dry Weather Flow (MMDWF)	1.51
Wet Weather Flows	
Average Wet Weather Flow (AWWF)	1.50
Maximum Month Wet Weather Flow (MMWWF)	2.09
Peak Week Flow	3.57
Peak Daily Average Flow (PDAF)	6.31
Peak Instantaneous Flow (PIF)	8.20

Table ES.6 – Projected Wastewater Loads

Projected Loading			
Parameter	**2037 Loading** (lbs)		
	BOD	TSS	NH-3
Annual Average	2334	2926	243
Winter Average	2334	2929	244
Summer Average	2334	2923	242
Maximum Month	3314	4638	316
Maximum Day	4567	6792	375

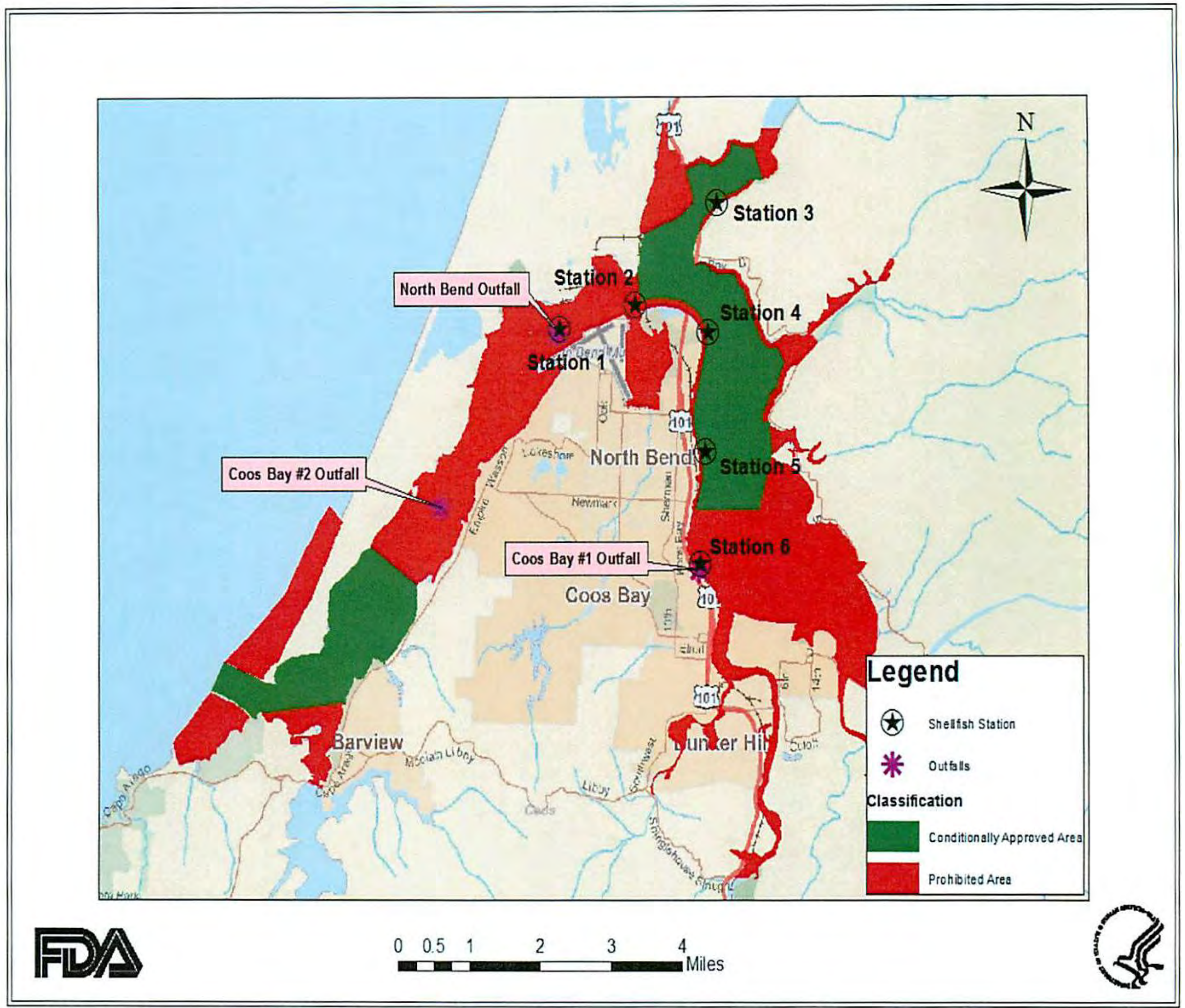
PATHOGEN LEVELS AND INFECTIOUS DOSE

Table 1. Indicative levels of pathogens commonly found in secondary treated wastewater. Actual numbers will vary depending on the treatment process. (Sources: US EPA 1992; Rose 1995; Toze 1997)

Pathogen		Disease or Type of infection	Indicative levels of pathogens	Infectious dose
Bacteria	*Shigella* spp.	Dysentery	10^4 - 10^6 organsms/looml	180
	Salmonella sp.	Typhoid and gastroenteritis		$10^4 \cdot 10^6$
	Escherichia coli (enteropathogenic)	Gastroenteritis		$10^6 - 10^{10}$
	Campylobacter spp.	Gastroenteritis		
	Vibrio spp.	Cholera		$10^3 - 10^7$
	Mycobacterium spp.	Johne's disease (cattle, sheep, goats)		
Viruses	Enteroviruses:		10^1 - 10^4 viruses/L	1·10
	• Poliovirus	Paralysis		
	• Echovirus	Gastroenteritis		
	• Coxsackievirus	Meningitis		
	Hepatitis A	Hepatitis		
	Adenovirus	Respiratory disease		
	Calicivirus:	Gastroenteritis		
	• Norwalk virus			
	Rotavirus	Gastroenteritis		
Protozoa	*Giardia* spp.	Giardiasis	10'·10 ^{4} oocysts/ L	< 10
	Cryptosporidium spp.	Crypto-sporidiosis		
	Entamoeba spp.	Amoebic dysentery		
Helminths	*Ascaris* spp.	Roundworm	10'- 10^3 eggs/L	1·10
	Ancylostoma spp.	Hookworm		
	Trichuris spp.	Whipworm		
	Strongiloides spp.	Threadworm		
	Taenia spp.	Tapeworm in humans (causes "Cysticercosis" infections in cattle (that is, "beef measles") & pigs)		

PROHIBITED AREAS

Figure 1: Station Locations, WWTP Outfalls, and Classified Growing Areas in Coos Bay



FDA NORTH BEND INFLUENT & EFFLUENT DATA

Table 1 - North Bend WWTP Influent Data

Date	Time	GI RT-PCR units/100 ml	GII RT-PCR units/100 ml	Adenovirus units/100 ml	MSC/100 ml	EC/100 ml	FC/100 ml
2/6/2011	1:00 to 6:00	<17	14,400	1,270	76,800	1,500,000	2,000,000
2/6/2011	13:00 to 18:00	<17	71,860	7,380	1,176,000	1,500,000	1,500,000
2/7/2011	1:00 to 6:00	24	47,330	1,120	212,000	600,000	600,000
2/7/2011	13:00 to 18:00	80	6,910	1,540	306,000	660,000	695,000
2/8/2011	1:00 to 6:00	<17	6,570	4,680	346,000	785,000	845,000
2/8/2011	13:00 to 18:00	<17	13,000	15,590	280,000	745,000	750,000

ND- Not Determined

Table 2 - North Bend WWTP Effluent Data

Date	Time	GI RT-PCR units/100 ml	GII RT-PCR units/100 ml	Adenovirus units/100 ml	MSC/100 ml	EC/100 ml	FC/100 ml
2/6/2011	1:00 to 6:00	<17	1,970	1,560	3,840	7.0	8.5
2/6/2011	13:00 to 18:00	ND	ND	ND	ND	<0.5	<0.5
2/7/2011	1:00 to 6:00	<17	3,260	530	ND	<0.5	<0.5
2/7/2011	13:00 to 18:00	<17	1,890	63	12,200	12.0	17.0
2/8/2011	1:00 to 6:00	<17	2,500	470	4,000	2.5	3.0
2/8/2011	13:00 to 18:00	<17	<10	1,680	2,000	<0.5	<0.5

ND- Not Determined

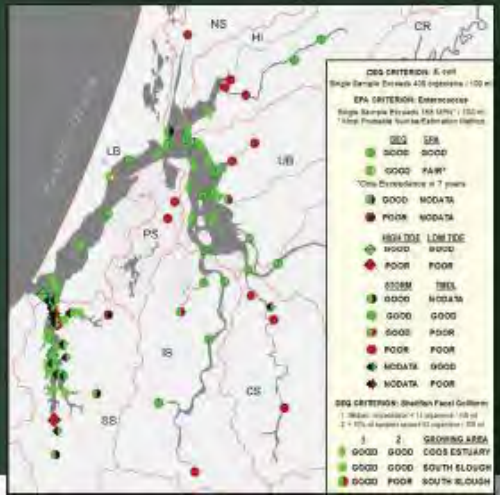
Bacteria in the Coos Estuary

Bacteria in the Coos Estuary

Partnership for COASTAL Watersheds

Summary:

- *Bacteria concentrations are highly variable depending on water quality sampling location in the Coos estuary and surrounding stream systems.*
- *Approximately 20% of the sampling sites (17 of 84) did not meet state standards established for commercial fishing (including shellfish cultivation).*
- *Higher bacteria concentrations are typically correlated to areas of lower salinity and where land uses are likely sources of fecal coliform bacteria (e.g., sewage treatment, stormwater outfalls, grazing lands, areas where wildlife congregate).*



Evaluation

Several sites in the Coos estuary and associated streams do not meet state water quality standards while some do and others are stable or are improving. Bacteria sampling should continue to be monitored.

What's Happening?

Several types of fecal bacteria are monitored as indicators of water quality status (Table 1). These bacteria are not generally harmful but they can indicate the presence of disease-causing bacteria, viruses, and protozoans that also inhabit animal and human feces. Methods for determining the presence of disease-causing pathogens in water is difficult, costly and time consuming. Therefore, relatively easy and cost-effective tests using the presence and abundance of fecal coliforms

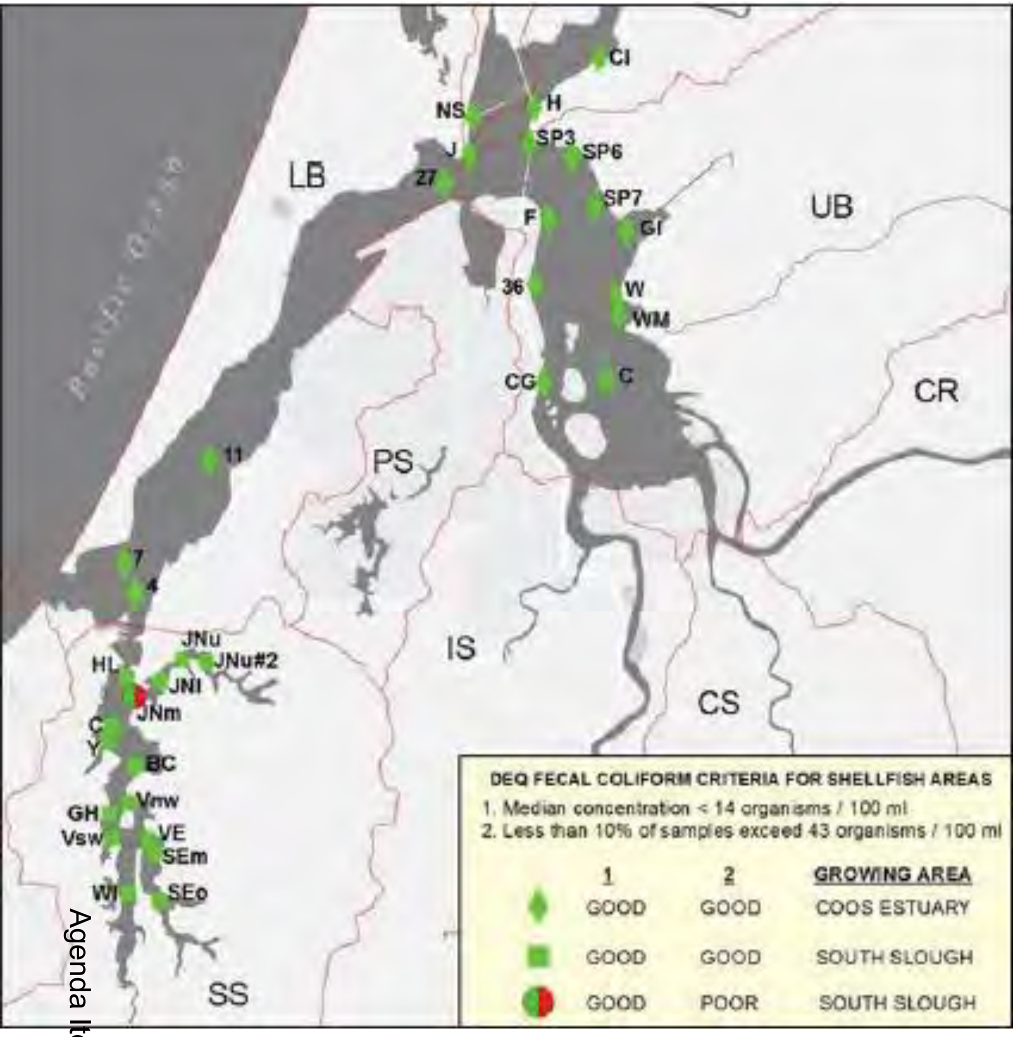


Figure 8. ODA Fecal Colifrm sampling sites in Coos Bay and South Slough. Green symbols indicate sites that met ODEQ standards shell-fish growing waters; Red symbols indicate sites that did not meet the standards.

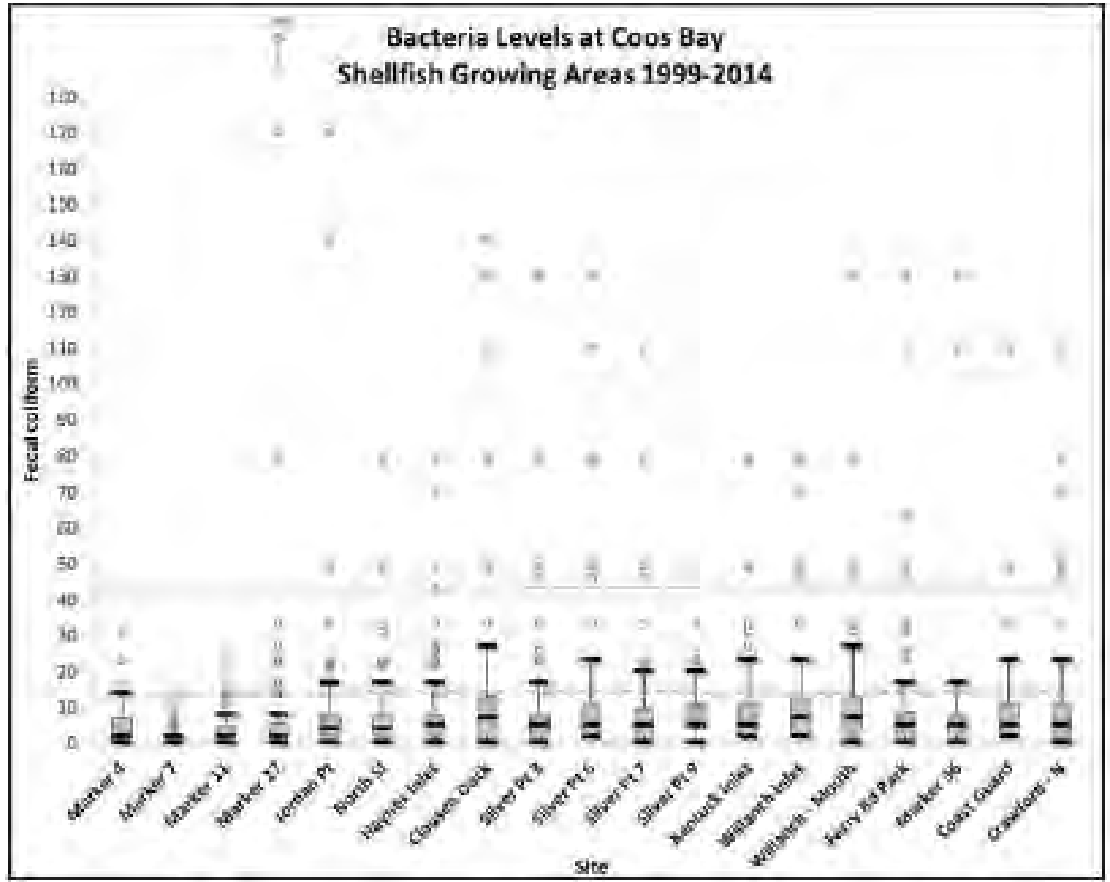


Figure 9. Tukey-style box plots of fecal coliform concentrations from ODA Coos Bay shellfish growing sampling sites from 1999-2014. Shaded gray box represents middle 50% of the data. Central black line (within gray box) indicates median value. Upper and lower black bars bound 99.3% of normal distribution data. Outliers outside this coverage are shown as open red circles. One outlier was outside the scale of this figure; value is indicated above arrow at the top. Short blue dashed line indicate ODEQ standard: 10% of samples may not exceed 43 organisms/10mL. Long blue dash line indicate ODEQ standard of median 14 organisms/100mL. Data: ODA 2014

COOS SUB-BASIN RECREATIONAL CONTACT BACTERIAL SUMMARY

Table 21 – Coos Sub-basin Recreational Contact Bacterial Summary

Site Type	Sample Description	log mean *E. coli* /N	Maximum *E. coli*	%Reduction log mean/max
	Larson Creek at mouth	323/16	4611	61/91
	Larson Creek at first bridge U/S of mouth	622/19	9800	80/96
	Larson Ck at second bridge U/S of dairy	19/19	189	0/0
	Sullivan Creek at mouth	87/19	2419	0/83
	Palouse Creek at mouth	75/20	1515	0/73
	Palouse Creek at first bridge U/S of mouth	410/4	1092	69/63
	Palouse Creek at Mile Post 4	175/4	341	28/0
	Palouse Creek at Elliott Keyhole	58/2	108	0/0
	Pony Creek So of North Bend High School	200/21	743	37/45
	Pony Slough at Coca Cola bottling plant	111/21	1670	0/76
	Isthmus Slough at Eastside Bridge	27/15	259	0/0
	Shingle House Slough at mouth	28/19	471	0/14
	Davis Slough at Highway 101	32/19	294	0/0
	Noble Creek at tidegate	98/20	1259	0/68
	Coos Bay at entrance to Haynes Inlet at Marker #1	26/8	328	0/0
	Haynes Inlet at Clausen Dock	10/4	148	
	Hollow Stump Creek upstream of tidegate	5/3	41	
	North Slough at mouth (Causeway Bridge)	34/11	850	0/52
	North Slough U/S of tidegate	146/20	2143	14/81
Coos Bay Estuary	Cooston Channel at south end	19/9	41	0/0
	Coos Bay at mouth of Marshfield Channel	36/10	292	
	Coos Bay at City Dock	26/5	63	
	Coos Bay at Pierce Point Channel	34/10	98	
	Coos Bay at Silver Point 3	29/10	75	
	Coos Bay at Silver Point 4,5,6	21/10	98	
	Coos Bay at Silver Point 7	20/10	85	
	Coos Bay at Silver Point 8,9	34/10	199	
	Coos Bay at Jordan Point	14/14	148	
	Coos Bay at Mkr #23 (Henderson Marsh)	15/15	86	
Slough	So Sl @ entrance to Charleston Bt Basin	10/3	10	
	Charleston Boat Basin At East End	10/5	29	
	Joe Ney Slough at Crown Point Bridge	22/8	52	
	South Slough 50 yds w of Joe Ney Slough	197/3	146	
	So Sl at Buoy #10 – Charleston Triangle	15/3	41	
	South Slough at Hallmark Fisheries	15/3	41	

Source: South Coast Basin Water Quality Status and Action Plan

FDA COOS BAY INFLUENT & EFFLUENT DATA

Table 3 - Coos Bay #1 WWTP Influent Data

Date	Time	GI RT-PCR units/100 ml	GII RT-PCR units/100 ml	Adenovirus units/100 ml	MSC/100 ml	EC/100 ml	FC/100 ml
2/10/2011	1:00 to 6:00	<17	5,580	4,580	92,000	925,000	955,000
2/11/2011	1:00 to 6:00	<17	3,310	2,731	154,000	850,000	865,000
2/11/2011	13:00 to 18:00	<17	780	6,260	128,000	1,185,000	1,190,000
2/12/2011	1:00 to 6:00	<17	13,610	5,600	108,000	105,000	115,000
2/12/2011	13:00 to 18:00	<17	77,000	25,900	128,000	ND	ND
2/13/2011	1:00 to 6:00	<17	840	990	136,000	1,600,000	1,700,000
2/13/2011	13:00 to 18:00	<17	2,007	890	76,000	2,400,000	2,800,000
2/15/2011	7:28 (grab)	ND	ND	ND	25,400	300,000	360,000
2/15/2011	12:08 (grab)	ND	ND	ND	62,000	1,500,000	1,650,000

ND- Not Determined

Table 4 - Coos Bay #1 WWTP Effluent Data

Date	Time	GI RT-PCR units/100 ml	GII RT-PCR units/100 ml	Adenovirus units/100 ml	MSC/100 ml	EC/100 ml	FC/100 ml
2/10/2011	1:00 to 6:00	<17	2,810	720	8,600	<0.5	<0.5
2/11/2011	1:00 to 6:00	<17	1,140	2,360	12,400	1.50	1.50
2/11/2011	13:00 to 18:00	<17	130	560	8,000	0.50	0.50
2/12/2011	1:00 to 6:00	<17	82	430	9,200	<0.5	<0.5
2/12/2011	13:00 to 18:00	<17	600	460	10,400	ND	ND
2/13/2011	1:00 to 6:00	<17	<17	<10	12,800	1.50	2.50
2/13/2011	13:00 to 18:00	<17	<17	146	17,200	1.50	1.50
2/15/2011	7:28 (grab)	ND	ND	ND	4,400	<0.5	<0.5
2/15/2011	12:08 (grab)	ND	ND	ND	2,200	3.50	3.50

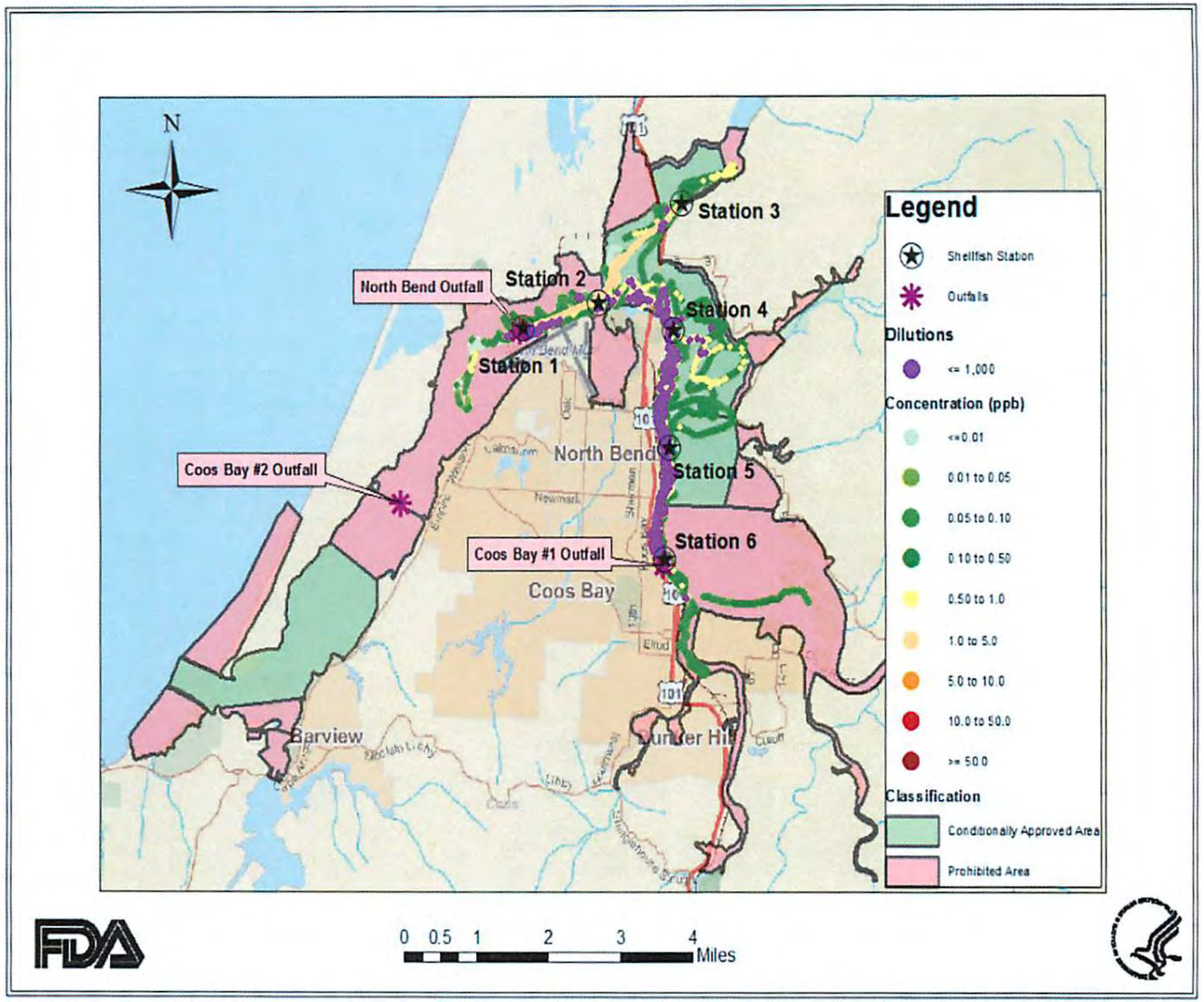
ND- Not Determined

FC and EC levels in the final effluent were low, in accordance with the WWTPs' discharge permits, but average MSC levels in the final effluent ranged from 2,000 to 12,200 MSC/100 ml for the North Bend WWTP and from 2,200 to 17,200 MSC/100 ml for the Coos Bay #1 WWTP. NoV GI was not detected in the final effluent of either plant during the studies.

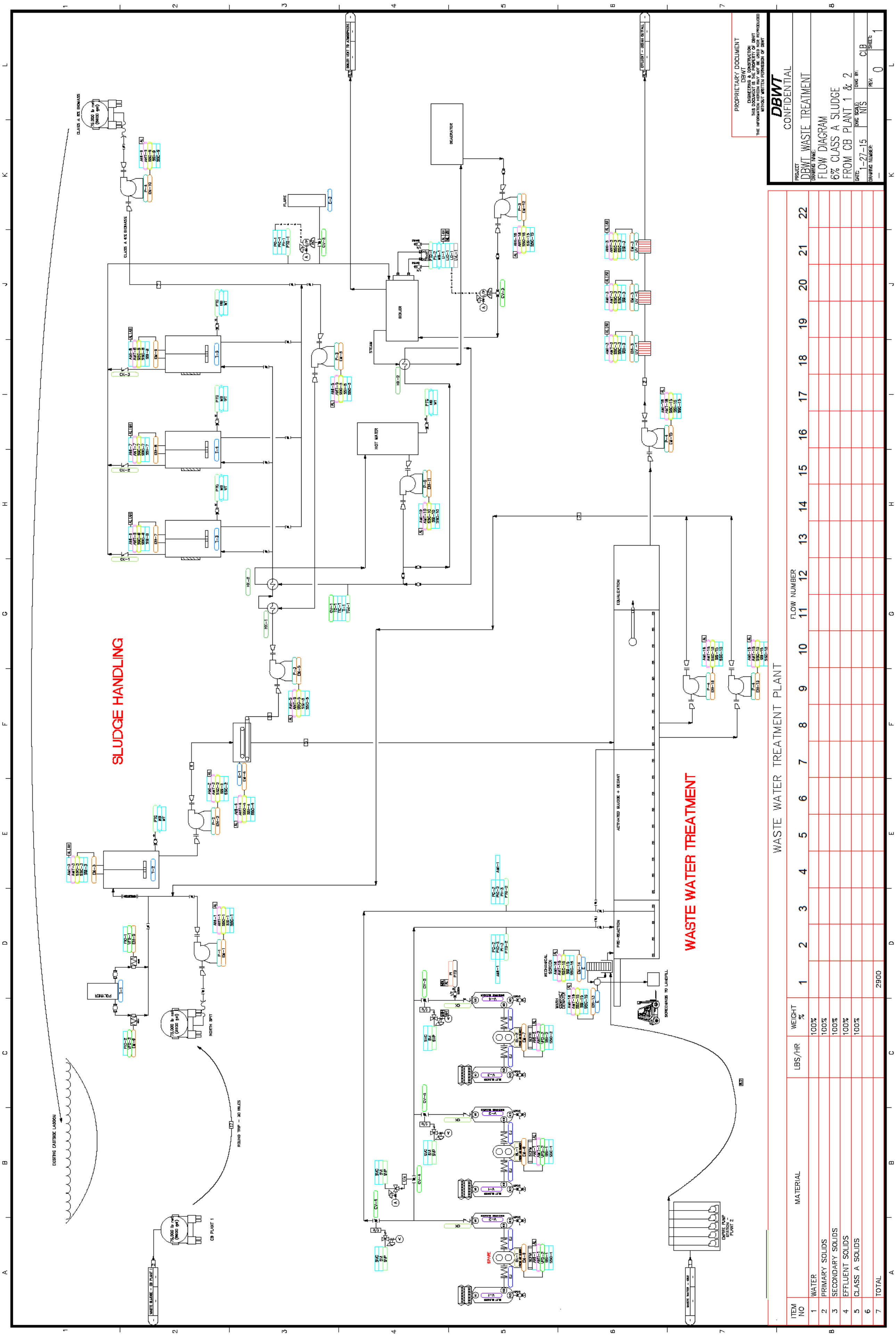
NoV GII levels detected in the North Bend WWTP influent ranged from 6,570 to 71,860 RT-PCR units/100 ml. In one case, NoV GII levels were reduced to <10 RT-PCR units/100 ml in the final effluent after treatment by the WWTP. However, in most cases virus levels detected in the WWTP final effluent remained high – ranging from 1,890 to 3260 NoV GII RT-PCR units/100 ml.

FDA DILUTION ASSESSMENT

Figure 23: Dilution Assessment for Both Studies in Relation to Shellfish Growing Area Classifications



DBWT



Agenda Item #9

DBWT

JEFFERSON CITY HEADWORKS (WESTECH) WWTP

DBWT

JEFFERSON CITY HEADWORKS (WESTECH) WWTP

DBWT

PROPOSED PLANT LOCATION 1A

DBWT

PROPOSED PLANT AND FUTURE EFFLUENTS FROM CB1 AND NB

CB2 SITE PHOTO 1

CB2 SITE PHOTO 2

DBWT

CH2M RENDERING

DBWT

AERIAL OF NEW CB2 SITE

DBWT
D.B. Western Texas, Inc.
New Business Development, Design, Engineering, EPC Contractor
ASME Fabrication, Finite Analysis, ASPEN Heat Exchanger, API Tanks
Technology, Chemical Process Development, Chemical Production

"The Relocation of the new Coos Bay Wastewater Plant 2 (CB2) to the North Spit"

GOALS AND PLANS

GOAL A Remove the effluent from CB2 out of the Coos Bay Estuary and into an Ocean Outfall.

PLAN A Start with CB2 relocation to the North Spit along with the necessary Ocean outfall to allow future effluents from CB1 and NB

GOAL B Remove all current Anaerobic Sludge processing in CB1, CB2, NB, and process into "EPA certified Class A Exceptional Quality" Fertilizer 5 % solids

PLAN B Start with CB2 sludge and convert to Class A, in a dual temperature (55/35 deg C) phase Anaerobic process owned and operated by DBWT sized to process all Coos County Sludge.

GOAL C Remove the effluents from CB1 and NB out of the Coos Bay Estuary and into an Ocean Outfall.

PLAN C Start piping effluents from CB1 and NB to new ocean outfall completed with CB2.

VISION ***Present our citizens, and their children a legacy gift of a clean Coos Bay Estuary***

- We acknowledge scientists with EPA, WHO (World Health Organization), NSF, DEQ, FFDA, South Slough Sanctuary, NEMF, OFW, ODA, many Universities, and concerned local fishermen that have helped with our research.

1.1 Goal A is to present data for the City to understand the benefits of removing effluent from CB2 from our Estuary.

1.2 CB1, CB2, and NB have eliminated a major portion of the Estuary which is now "Prohibited for Recreation and Shellfish Harvesting" which if corrected, will allow the opportunity to expand the valuable shellfish and recreational industries. This "Prohibited Classification - Wastewater Discharges is set by FDAs "National Shellfish Sanitation Program Model Ordinance" and is controlled by Oregon Dept. of Agriculture (ODA).

1.3 The "US FDA Hydrographic Studies of Wastewater Treatment Plant Discharges in Coos Bay, Oregon – Feb. 2011" (FDA) has been completed, which separates Human Pathogens "Point

◆ Phone (541) 756-0533 ◆ Fax (541) 751-9837 Mail to: 95084 Larson Ln. ◆90418 Trans Pacific Lane ◆North Bend ◆ OR ◆ 97459 ◆
www.DBWT.us ◆ mail@DBWT.us

Source" from "non-point source". The results showed the marker Pathogens from CB1 and NB outfalls were traced throughout the Estuary which added significant insult to the already "Impaired" Estuary. CB2 was not tested, however FDA recommendations were that they will test CB2 in the future. The lead scientist with FDA, Greg Goblick, is working with EPA, with possible impact to the NPDES process.

1.4 The City and DEQ have suggested that they do not agree with the FDA scientists. The FDA have done these studies all over the US for 30 years; they are respected worldwide; they are very good scientists; they have the best technical equipment; and I believe they control the rule book. Their study revealed that the NPDES Permit dispersion model is not adequate on the Outfalls on any of the CB, CB2 and NB plants. Please notice what the US - FDA Coos Bay Wastewater Treatment Plant Discharge study says in 1.3 on Pages 5-6, about 14MPN/100 and 1000/1 dilution and the "NOTE". Also on page 20 our notes No. 1, 2, 3. "Insufficient to mitigate the impact of viruses in Coos Bay". If we do not challenge the NPDES for CB2, I believe someone will.

1.5 We hope DEQ will address these findings by FDA, reconsider CB2's NPDES and MAO, and possibly help the City and DBWT expedite an NPDES for an Ocean Outfall. I truly believe that DBWT, DEQ, City, Port, and a PE Engineering firm working as a TEAM, can accomplish "Facilities Planning" faster than the 9 years required for CB2. A team working together can parallel the Ocean Outfall, the facilities plan and the engineering for a North Spit plant in 12-18 months and with a construction time of 12 months we may be able to meet the 12/17 startup. We believe a DBO is the best method to meet this goal and reduce the citizens cost.

1.6 Our Estuary is polluted far beyond our communities' awareness and is potentially harmful to our citizens; the Marine ecosystem; and to shellfish. Harmful Pathogens (Viruses, Parasites, Bacteria,) of human wastes from these plants can cause diseases of Cholera, Hepatitis, Meningitis, and many Intestinal infections. These Pathogens have not been taken into account in the NPDES permit for CB2; or even being tested by DEQ in the Estuary.

1.7 DEQ has developed the data set using FC which shows this "Impairment", thus, justifying the 303d listing of the Coos Bay Estuary.

1.8 DEQ is obligated to complete a TMDL accounting of Fecal Coliforms (FC) to justify the very high 45 BOD/45TSS 6 months of the year in the NPDES Permit for CB2. This is significantly higher than other Estuaries. The TMDL has not been completed. FC is not a good indicator of the hundreds of harmful pathogens. FC does not differentiate CB1, CB2, NB from Non-Point Sources. However, FC is DEQs only measure of Bacteria, and is the data set used for Bacteria Mass in the TMDL.

1.9 Harmful Pathogens are more resistant to chlorine or UV disinfection than FC or E. Coli (EC). However the current NPDES only requires 14 FC, the same level EPA requires in the receiving Estuary. However, the Coos Bay Estuary is already 20-30 FC and is almost double the allowed 14 FC EPA Mandate. FC samples are only taken once per week at Plants.

1.10 Due to the wide range of waste effluent flows (7 to 1), only 85- -95 % Kill is achieved with UV at normal operations. Please see Tables 1, 2, 3 and 4 on page 25-26 of the FDA study. These tables speak volumes to what happens during an upset and what happens 24/7/365 .If you read all the red highlighted areas in this study, maybe you can understand my sadness , passion, and determination to remove these effluents from our Estuary. Parasites are the most resistant and WHO says they are the most harmful, however, in North America Intestinal diseases are more common. Some research has shown that the Kill is not permanent, rather the more resistive Pathogens regenerate.

1.11 FC is used in Marine waters and is not seriously harmful; EC is used in fresh waters and is deactivated in salt water. Both of these are used by EPA and DEQ as indicators of the Harmful Pathogens; however, FC and EC do not represent the true level of the more deadly Pathogens.

1.12 EPA and DEQ with the CWA have provided the mandatory requirements of a Marine Estuary for Safety in Recreation and Shellfish (oysters, clams crabs) and humans being exposed to the water, is a maximum FC of 14 FC/100ml. This is also a world standard. Our Estuary is averaging about FC 24.

1.13 Local long term fisherman in our Estuary say "The fish all have lots of Parasites; "we have not been able to catch a green sturgeon in 10 years, but we use to catch them every day 25 years ago;" "sand shrimp are disappearing"; "all white sturgeon fishing is stopped and smelt are gone"; "Chinook Smoltz from Estuary Hatcheries have difficulty making it to the Sea". These items are not totally the result of CB1, CB 2 .NB; however; the Coos Bay Estuary is the only one on the Oregon Coast with 3 WWTPs with a maximum wet weather load of 36,000,000 G/D or 6,000 semi-truck loads (250truck /hr)of waste effluent going into our bay with a relative low freshwater flow. FDA determined that it takes 2-3 days to flush out a WWTP upset or high rain event. Shell fish can take 2-3 weeks to flush out the Harmful Pathogens. Viruses can bio accumulate up to 100 fold in shellfish.

1.14 The Coos Bay Estuary is a "Critical Habitat "for Endangered Species of Southern Green Sturgeon, Coho Salmon. EPA and DEQ are responsible to manage this recovery and good science should direct changes to the NPDES which requires engineering and construction; which will cost the citizens. Planning ahead will cost less; provide for a cleaner Estuary; improve the health of marine life and people; help our businesses which helps
Employment.

1.15 The current design of CB2 is mostly closed in; except the aeration basin. An EPA study on the air bubbles releasing from the basin indicate an aerosol of less 10 microns is formed. These aerosols may contain 100 fold increase of pathogen load of untreated inflow waste. "These microorganisms loaded aerosols travel passively with the wind. The potential for plant workers and nearby residents to inhale viable organisms certainly exists"

Summary: We can understand prior to 2011 and the incredible science of the FDA, some confusion may exist in NPDES permitting for the Coos Bay Estuary. However, to proceed with the current NPDES on CB2 would be sad. Now is the time to do what is right. Regressing to the past would be wrong and maybe challenged legally and very costly to the citizens of Coos Bay.

2.1 DBWT, at our own cost, has completed a significant and meaningful due diligence of the technical and environmental issues. We will now present the legal, economic, and permitting challenges.

2.2 We reviewed Oregon Statewide Planning Goal 11 restricting Cities expansion outside their UGB. Our legal team found an exception "Except where the new or extended system is the only practical alternative to mitigate a public health hazard ". We believe 1.0 above justifies the exception.

2.3 The current NPDES, if challenged may require the City to redesign the current plans for CB2 at a terrible cost to the Citizens, especially if CB2 was built.

2.4 Is there enough property for a significant upgrading to meet new EPA mandates, or will Coos Bay have to demolish the second CB2.

2.5 The Citizens of Coos Bay will be paying for the treatment whether the new CB2 is located in a residential area of Empire, or in an Industrial Zone on the North Spit. We believe the $5-10 million dollar savings to the citizens and removing the pollution from the Bay will be worthy legacy project of great interest to the community helping our environment.

2.6 The City, by its own records, has spent millions of dollars since 2006 on Facilities Planning (FP), in addition to $4.2 million (CH2M final bill is not in) in engineering costs for CB2. Construction costs for the CB2 plant only are estimated at $26- 29 million; plus pumping sludge "over the hill" from CB2 to CB1is estimated currently (no bid yet) at $2.7 million; and the costs to retrofit or upgrade the CB1 anaerobic digestion facilities to receive 100% of CB2, are currently unknown. Consultants estimate these costs at $3-4 million; this assumes no change orders; changes in design for an alteration; this process is on a CH2M "Cost Plus" billing, just as the operation, maintenance, engineering, planning etc. cost with CH2M for CB 1 and CB2 for the last 20 years. We estimate that the total loaded cost of CB2 will be in excess 34 million dollars.

2.7 DBWT guarantees a Design Build Operate (DBO) proposal through an independently qualified General Contractor (GC) and the Engineering Consultant (EC) of $24.9 million dollars. This includes Engineering and Construction of the pumping station in Empire; under Bay directional drilled 18 inch UHMW pipe line to the new plant; treatment plant; maintenance and supplies storage; office, restrooms, lab; emergency generators at both the primary pumping station and CB2; disinfection system per EPA criteria of the full 8.2 MGD with 1 ppm CL (Chlorine) after 60 minutes; then CL removal to .1 PPM. We believe this disinfection will be to a higher standard than the current CB2 design. EPA studies have shown during storm flows; as the TSS goes up the efficiency of UV disinfection drops off as the viruses hide in the TSS. The EPA lists our estuary limits of pathogens based on an indicator designated as fecal coliform at 14FC/100 ml, therefore disinfection is critical to be maintained at the same efficiency whether it is 1.5 or 8.2 MGD. This is not the case with CB1, CB2, and NB.

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2.8 Our legal team believes a 2 acre portion of DBW site can be subleased to the City for CB2. We believe this sub-lease can be structured to meet the City of Coos Bay requirements for DEQ funding. If the funding for the project requires ownership we would hope the Port would sell 3 acres to the City to build CB2.

2.9 Our legal team determined DBWT can use DBW's site for manufacturing "EPA Certified Exceptional Quality Class A Fertilizer." Class B sludge currently being generated in CB1, CB2, and NB leaves a high load of Pathogens (Bacteria and Viruses) alive and is currently applied to farmlands. This practice with Class B Sludge is banned in Europe, along with some states and cities in the US, due to severe health consequences. DBWT will process the Class B sludge from all WWTP's in Coos County into Class A Fertilizer, which KILLS the Pathogens, and produces a product similar to what can be purchased in stores today.

2.10 Let us be clear, DBW is an Oregon licensed GC for over 20 years, actively doing business in Coos County and the world (www.dbwt.us) for 40 years, doing projects 5 times the size of the CB2 project. DBW will NOT submit a bid for this project to the city. We realize this must go thru a GC with experience and acceptable to the city meeting Qualification Base Selection (QBS). DBWT has reviewed the 2000 pages and 250 drawings produced by CH2M and the City of Coos Bay; determined the cost to bid; negotiated with 2 large and experienced (GC's) one of which would bid this project; DBWT agreed to post a performance Bond to the GC with DBW supplying the Mechanical, Electrical, Instrument, Geo-tech, Engineering, Excavation, and Drawings, and using local labor with STRICT adherence to Prevailing Wage Rules on the construction site.

2.11 The Engineering Company (EC) providing overall engineering for the relocation of the same Sanataire design same as the new CB2, will also be an EC with experience in several completed engineered plants using the same Sanataire Process. DBWT would like to use several of the very qualified Engineering Consultants in the Bay area; however, they are under constraint due to "Conflict of Interest." If the City would release them from this constraint, then DBWT would prefer to use almost all local talent as opposed to the City's historical and current path towards utilizing outside CH2M Engineering, Maintenance, Operations, Planning on a "Cost Plus" basis and now using an outside contractor, and outside labor. How is this helping the Coos Bay Area economy?

2.12 Let us also be clear that the GC will be bidding in an open and transparent way against all competitive bids, NO different than the same DBO bidding process in other cities. We believe the Citizens do not have enough time or money to go thru another Cost plus Project.

2.13 The City told DBWT that DEQ would not allow the City to do a DBO. The process DEQ required the City to use CH2M and other consultants on a "Cost Plus" has cost over $6 million dollars and over 9 years. A DBO can go out to bid in 3 months from public notice.

DBWT

D.B. Western Texas, Inc.

New Business Development, Design, Engineering, EPC Contractor
ASME Fabrication, Finite Analysis, ASPEN Heat Exchanger, API Tanks
Technology, Chemical Process Development, Chemical Production

The Coos Bay Estuary is profoundly "Impaired" with Pathogens and far exceeds the EPA and State of Oregon standards for EPA listed Shellfish and Recreation, including the endangered species of Coho Salmon, Green Sturgeon and Smelt. Continuing to make the decision to discharge waste effluent from the new Coos Bay Plant 2 (CB2) into our already "Impaired" Estuary makes no sense at any level when there is a less costly, environmentally superior opportunity available. A true opportunity, that will permanently protect our magnificent bay and the precious resource economy it represents, while saving taxpayers millions of dollars now…and well into the future. This option involves moving CB2 to the North Spit and creating a new Ocean Outfall for CB2's effluent, similar to many other environmentally progressive and fiscally conscious coastal communities. As a council member or city manager, it is incredibly difficult to leave the path you've walked a long way down…to make the right decision, but those decisions are the shining moments people will always remember, and the only legacy our community and magnificent bay deserve.

DBWT, at their own cost, has completed our significant and meaningful due diligence regarding the legal, permitting, economic, technical, and environmental issues for the Coos Bay Estuary for moving CB2 to the North Spit. This (Phase 1) new CB2, will connect to a new 5,000 ft outfall pipe with 2,000 ft of diffusers, 40 in UHMW line rated at 36 Million Gallons per Day (MGD) to the ocean. This MGD is the maximum demonstrated waste effluent going into our bay, and is equivalent to 6,000 semi-truck loads per day. This 7,000 ft of Ocean Outfall compares to 500 ft of outfall pipe plus diffusers for CB1, CB2 and North Bend (NB) combined. The new Ocean Outfall is designed for future (Phase 2) effluents from NB, CB1 and industrial development on the North Spit (Exhibit 1A). We have provided a map and table showing the potential future pipelines connecting CB1, CB2 and NB to this new Outfall (Exhibit 1B).

We also offer the following to support our position and the need for the City of Coos Bay to reach out and grasp this opportunity to start moving in the right direction with regard to our community's impact on the sensitive and "Impaired" environment for the Coos Bay Estuary:

LEGAL ISSUES:

1.0 In January 2015, the City told DBWT that DEQ stated (Exhibit 2) Statewide Planning Goal 11 (Goal 11) precluded relocation of CB2 to the North Spit; thus DBWT agreed not to present an alternate plan to the City Council at that time. The City Staff then interpreted our proposal incorrectly, along with incorrect information from the Port, and presented it during the City Council Meeting on February 3, 2015. The City Council "nixed any further work" with 3 council members absent from the meeting. However, based on the findings in this report, we request the city staff allows DBWT to present this alternate plan to the City Council Executive Session and Open Session. We are requesting the Council to delay the CB2 bid process until the citizens of Coos County receive a balanced and fair presentation of this alternate plan to consider.

2.0 It appears the City of Coos Bay is "rushing" to go out to bid in April of this year (originally scheduled for bid in June), when there are still parts missing from the bidding process for a completed, operational, and permitted plant. It appears the City is "rushing" the bid process now that DBWT has started an alternative consideration. We believe only legal or citizen pressure will give our alternate proposal a fair hearing.

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3.0 We believe the NPDES Permit may be legally challenged due to the following:

3.1 DEQ's NPDES writer's instructions are to evaluate the "receiving" waters prior to a NPDES permit using a TMDL assessment. DEQ's Category 5 (Exhibit 7) also confirms that a TMDL is required to issue a NPDES permit. We are not aware of any TMDL that has been completed to date.

3.2 DEQ suggests that the "Impairment" is from "Non-Point Sources" rather than "Point Sources" (CB1, CB2, and NB). DBWT and many other local scientists disagree as does the Federal Food and Drug Administration's (FDA) extensive and technical tests showing CB1, NB (no tests on CB2), tracing elevated pathogen levels leaving the outfall pipes directly into the Oyster Beds and throughout the bay.

3.3 The Dispersion Model used by DEQ and CH2M of the current Outfall Design is flawed as per the 2011 US FDA Coos Bay Hydrographic Wastewater Treatment Plant Discharge Study. A newer and more efficient outfall system design and permits are needed (Exhibit 8).

3.4 CB2 would use the same outfall pipe, but at higher flows than the original NPDES permit allows.

4.0 Our legal team has reviewed Goal 11 rules (Exhibit 2) and found there is an exception, "Except where the new or extended system is the only practical alternative to mitigate a public health hazard." This exception will allow the City to build CB2 outside its Urban Growth Boundary (UGB). We believe the health of this community is at risk if CB2's effluent is not removed from the Estuary as our Environmental and Technical presentations listed will support.

5.0 Our legal team believes a 2 acre portion of DBW site can be subleased to the City for CB2. We believe this sub-lease can be structured to meet the City of Coos Bay requirements for DEQ funding.

6.0 Our legal team determined DBWT can use DBW's site for manufacturing "EPA Certified Exceptional Quality Class A Fertilizer." Class B sludge currently being generated in CB1, CB2, and NB leaves a high load of Pathogens (Bacteria and Viruses) alive and is currently applied to farmlands. This practice with Class B Sludge is banned in Europe, along with some states and cities in the US, due to severe health consequences. DBWT will process the Class B sludge from all WWTP's in Coos County into Class A Fertilizer, which KILLS the Pathogens, and produces a product similar to what can be purchased in stores today.

ECONOMIC ISSUES:

7.0 The Citizens of Coos Bay will be paying for the treatment whether the new CB2 is located in a residential area of Empire, or in an Industrial Zone on the North Spit. We believe the $5-10 million dollar savings to the citizens and removing the pollution from the Bay will be of great interest to the community.

8.0 The City, by its own records, has spent millions of dollars since 2006 on Facilities Planning (FP), in addition to $4.2 million (CH2M final bill is not in) in engineering costs for CB2. Construction costs for the CB2 plant only are estimated at $26- 29 million; plus pumping sludge "over the hill" from CB2 to CB1is estimated currently (no bid yet) at $2.7 million; and the costs to retrofit or upgrade the CB1 anaerobic digestion facilities to receive 100% of CB2, are currently unknown.

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Consultants estimate these costs at $3-4 million; this assumes no change orders; changes in design for an alteration; this process is on a CH2M "Cost Plus" billing, just as the operation, maintenance, engineering, planning etc. cost with CH2M for CB 1 and CB2 for the last 20 years. We estimate that the total loaded cost of CB2 will be in excess 34 million dollars.

9.0 DBWT guarantees a Design Build Operate (DBO) proposal through an independently qualified General Contractor (GC) and the Engineering Consultant (EC) of $24.9 million dollars. This includes Engineering and Construction of the pumping station in Empire; under Bay directional drilled 18 inch UHMW pipe line to the new plant; treatment plant; maintenance and supplies storage; office, restrooms, lab; emergency generators at both the primary pumping station and CB2; disinfection system per EPA criteria of the full 8.2 MGD with 1 ppm CL (Chlorine) after 60 minutes; then CL removal to .1 PPM. We believe this disinfection will be to a higher standard than the current CB2 design. EPA studies have shown during storm flows; as the TSS goes up the efficiency of UV disinfection drops off as the viruses hide in the TSS. The EPA lists our estuary limits of pathogens based on an indicator designated as fecal coliform at 14FC/100 ml, therefore disinfection is critical to be maintained at the same efficiency whether it is 1.5 or 8.2 MGD. This is not the case with CB1, CB2, and NB.

10.0 Let us be clear, DBW is an Oregon licensed GC for over 20 years, actively doing business in Coos County and the world (www.dbwt.us) for 40 years, doing projects 5 times the size of the CB2 project. DBW will NOT submit a bid for this project to the city. We realize this must go thru a GC with experience and acceptable to the city meeting Qualification Base Selection (QBS). DBWT has reviewed the 2000 pages and 250 drawings produced by CH2M and the City of Coos Bay; determined the cost to bid; negotiated with 2 large and experienced (GC's) one of which would bid this project; DBWT agreed to post a performance Bond to the GC with DBW supplying the Mechanical, Electrical, Instrument, Geo-tech, Engineering, Excavation, and Drawings, and using local labor with STRICT adherence to Prevailing Wage Rules on the construction site.

11.0 The Engineering Company (EC) providing overall engineering for the relocation of the same Sanataire design same as the new CB2, will also be an EC with experience in several completed engineered plants using the same Sanataire Process. DBWT would like to use several of the very qualified Engineering Consultants in the Bay area; however, they are under constraint due to "Conflict of Interest." If the City would release them from this constraint, then DBWT would prefer to use almost all local talent as opposed to the City's historical and current path towards utilizing outside CH2M Engineering, Maintenance, Operations, Planning on a "Cost Plus" basis and now using an outside contractor, and outside labor. How is this helping the Coos Bay Area economy?

12.0 Let us also be clear that the GC will be bidding in an open and transparent way against all competitive bids, NO different than the same DBO bidding process in other cities. We believe the Citizens do not have enough time or money to go thru another Cost plus Project.

13.0 The City told DBWT that DEQ would not allow the City to do a DBO. The process DEQ required the City to use CH2M and other consultants on a "Cost Plus" has cost over $6 million dollars and over 9 years. A DBO can go out to bid in 3 months from public notice.

The City also told DBWT that the City could not build outside the Cities UGB; the City has gone through a complete Facilities Planning Process which has cost the City millions of dollars and taken over 9 years; they say no alternatives can be used at this late date as they will miss the December 2017 start up as per the Mutual Agreement Order (MAO) issued by DEQ; the City told DBWT they could lose their financing which is over 50% financed by DEQ, if they change course.

14.0 DBWT's RESPONSE TO 13.0 is that several other cities have implemented a DBO bid; we believe the City can build outside their UGB per the Statewide Planning Goal 11 exception; several consultants have suggested we are using the same design and only changing the address; DEQ indicates that this should not have to go thru the same Facilities Planning Process for the same plant, but rather only modifications may be required; DEQ suggested the new DBO plant may even incorporate newer and better technologies in the alternate plan; other consultants building many plants around Oregon assures us that MAO's on Cities have been extended many years (DEQ has confirmed that extending the CB2 MAO is possible but must be requested by City); DBWT talked with both the DEQ and NMFS staff negotiating the financing of CB2 and the Storm Water requirements for the City and clearly, "whether CB2 is located in Empire or the North Spit made no difference on financing either the CB2 plant or the storm water improvements."

ENVIRONMENTAL AND TECHNICAL ISSUES:

15.0 The Upper and Lower Coos Bay Estuary is significantly " Impaired" (Exhibit 4 and 7) per EPA criteria for Oregon and Washington of 14 FC /100 ml (Exhibit 5) and Oregon's DEQ Division 41 Water Quality Standards and Criteria 340-041-0009 (Exhibit 6). Basic physics, logic and the study in 2011 by the scientists from the Federal Food and Drug Administration (FDA) (Exhibit 8) of tagging and tracer introduction directly to the outfall of NB and CB1 with Pathogens or Bacteria and Viruses (FC, EC, MSC, NoV G1 & G2 and AdV). These marker Pathogens clearly demonstrate the impact of point sources (CB1, CB2 and NB). This study also showed the path to the Oyster growing areas within 1 hour of an upset or high rain event. Their studies included processing the oysters and confirming the inclusion of markers into the meat of the oyster. The only data found to date, other than the FDA data, is based upon E Coli and Fecal Coliforms which does not clearly define the impact of Point versus Non-Point Source.

16.0 The effluents from CB1, CB2 and NB are a serious threat to the health of Coos Bay Estuary; Coos County citizens; Bay Area businesses; and these impacts are clearly seen by the "Impairment" of our ocean shores both North and South of the entrance to the Bay (Exhibit 4). Our Bay is like a giant bath tub. When the "Impaired Water" flushes out, much of the same water flushes back in, with a relative small amount of fresh water from the steams being added. Thus as the FDA study indicates one of the problems is the dispersion of the CD1, CB2 NB effluents in the Bay and the impact of a slack tide collecting these effluents, and then an incoming flood tide pushing the inadequately dispersed effluents all the way up the Estuary as the FDA markers demonstrated. We feel that too much emphasis is placed on E Coli and Fecal Coliform when these are only markers or indicators of much more harmful Bacteria and Viruses originating from the CB1, CB 2 and NB effluents as defined in (Exhibit 7). A 5,000 ft ocean outfall with 2,000 ft of lateral dispersion; with tidal mixing; and constant currents is a far greater dispersion model than (3)100 to 200 ft outfall pipes into the Estuary; with a bathtub physics model; as is currently the case in our Bay.

17.0 NB and the new CB2 are hydraulically designed for high rain events except for a major failure; however CB1 is not designed for full hydraulic flow, and "bypassing or blending" happens above 7 MGD. The design peak hydraulic flow for CB1 is 20 MGD. The new NPDES permits authorized by DEQ for the new CB2 are a weekly average 30 BOD/30 TSS at ADF (Average Dry Flow) 6 mo/yr of 1.24 MGD; and 45 BOD/45 TSS at AWWF (Average Wet Weather Flow) of 1.5 MGD. However, if one takes the daily permitted maximum of a 1000 lb solids per day and normalize to the 45 BOD/ 45 TSS weekly average; then one gets 1000/760 x 45 = 59 BOD/ 59 TSS allowed on a maximum daily average on a 8.2 MGD (Exhibit 9). CB2 will be allowed to discharge on a PPIF (high rain event) 8.2/1.5 x 59/30 = 10.8 times the BOD and TSS over the average design 6 months out of the year. Combine CB1, CB2, and NB together and we have a major environmental problem in Coos Bay. Many EPA reports are sounding an alarm for "High flows during rain events" and the lowering of efficiency of pathogen kills, especially viruses, which are many times harder to kill and more dangerous to humans.

PERMIT ISSUES:

18.0 DBWT had a meeting with BLM regarding directional drilling under BLM property for a new 40 inch Ocean Outfall crossing BLM land. BLM indicated the Joint Application NEPA process should take approximately 12 months and BLM would participate with all required agencies in the permitting process; BLM was also clear that they could not advocate for any processes, as has been the same comments from all state and federal agencies.
However, all Federal and State Agencies, Cities, Counties, and 501(C) 3 groups have been very cooperative with our team in providing data sets to DBWT including providing direct personal access to those experts by phone and email.

19.0 We believe if the City will show a willingness to take the lead in the CB2 relocation, the DEQ, and EPA will support this effort. The City and the Citizens of Coos Bay will be leaders to a healthier future for our marine life; our children and grandchildren; and help the many businesses that depend on a healthy bay. We also feel this is the right path to encourage potential new businesses and job opportunities on the North spit and the Bay Area.

These are our legal, economic, technical, environmental, and permitting reasons to move the new CB2 to the North Spit, along with providing a new 40 inch ocean outfall. In the future, we have offered a long range plan to route both NB and CB1 into the same ocean outfall with any current and new industries on the North Spit.

We understand there are still details to work out for this bold plan, however, history shows that the citizens of Coos County have pooled their resources and come together for very worthy projects, and causes.

EXHIBIT 1A

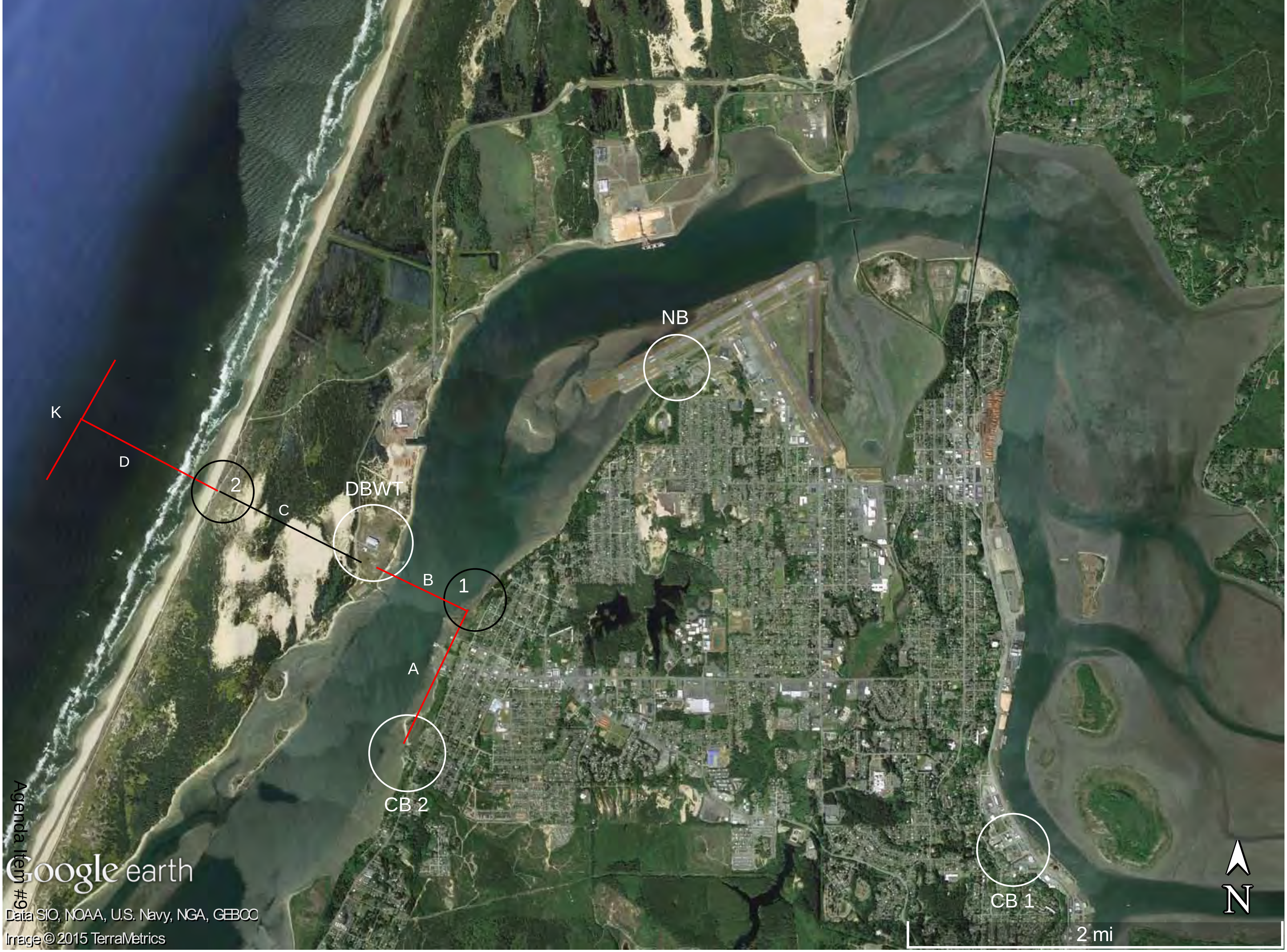

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Image © 2015 TerraMetrics

EXHIBIT 1B

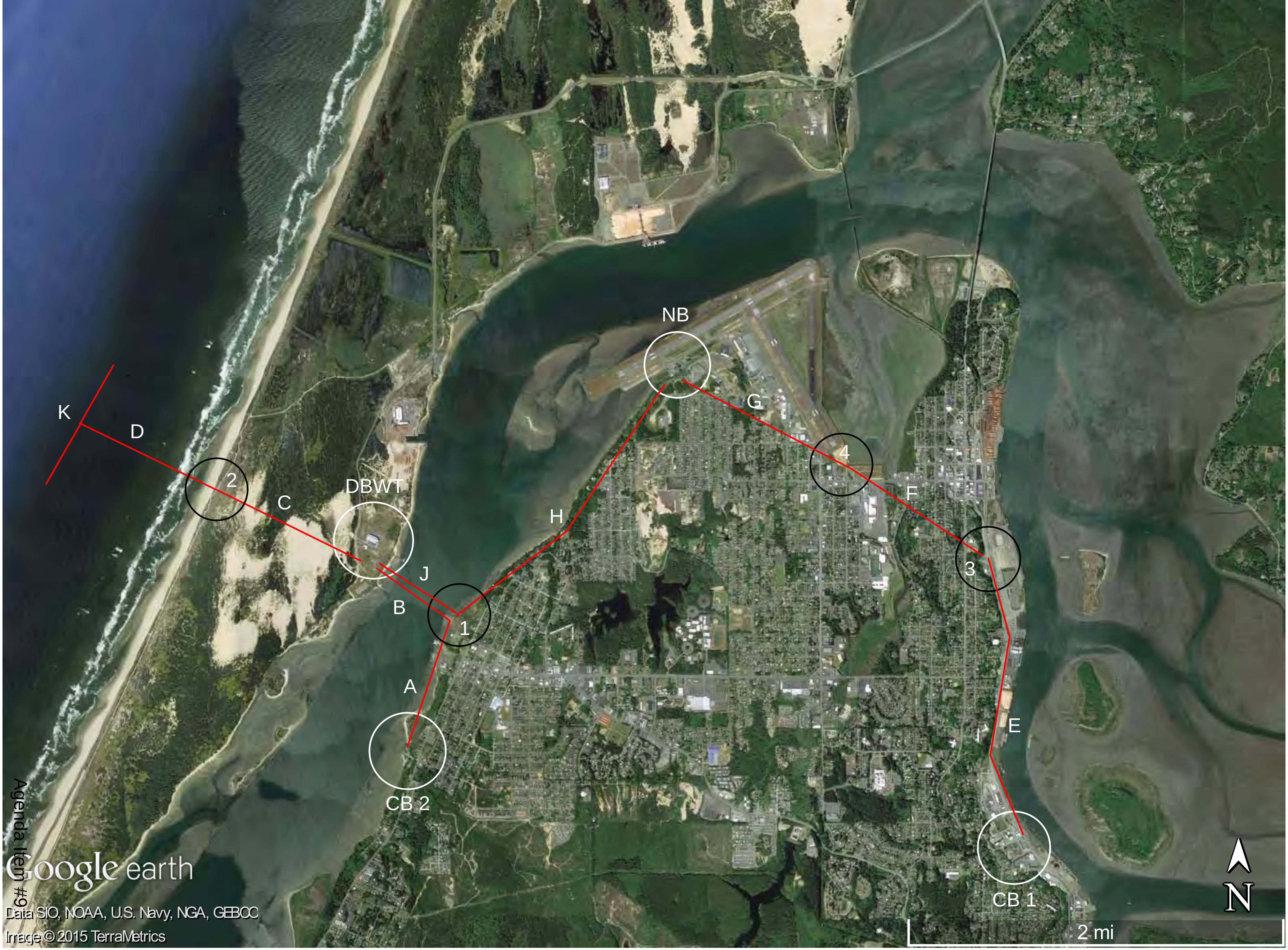

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Image © 2015 TerraMetrics

EXHIBIT 1A & 1B

PATH	FROM	TO	DISTANCE		PIPE SIZE	TYPE*	WASTE FLOW**	NOTES
			ft	mi				
A	CB 2	Point 1	4,000	0.76	18	T	PW	
B	Point 1	DBWT	2,700	0.52	18	D	PW	
C	DBWT	Point 2	4,400	0.85	40	D	E	
D	Point 2	Outfall	5,280	1.00	40	D	E	
E	CB 1	Point 3	8,000	1.53	36	T	E	
F	Point 3	Point 4	5,000	0.93	36	D	E	
G	Point 4	NB	4,800	0.92	36	D	E	
H	NB	Point 1	8,800	1.67	36	T	E	
J	Point 1	DBWT	2,700	0.52	36	D	E	
K	Diffuse		2,000	0.38	40		E	

CB 1 = Coos Bay Plant 1 * D = Directional Drilling * T = Trenching

CB 2 = Coos Bay Plant 2 ** PW = Primary Waste ** E = Outflow Effluent

NB = North Bend Plant

EXHIBIT 2

Oregon's Statewide Planning Goals & Guidelines

GOAL 11: PUBLIC FACILITIES AND SERVICES

OAR 660-015-0000(11)

To plan and develop a timely, orderly and efficient arrangement of public facilities and services to serve as a framework for urban and rural development.

Urban and rural development shall be guided and supported by types and levels of urban and rural public facilities and services appropriate for, but limited to, the needs and requirements of the urban, urbanizable, and rural areas to be served. A provision for key facilities shall be included in each plan. Cities or counties shall develop and adopt a public facility plan for areas within an urban growth boundary containing a population greater than 2,500 persons. To meet current and long-range needs, a provision for solid waste disposal sites, including sites for inert waste, shall be included in each plan.

Counties shall develop and adopt community public facility plans regulating facilities and services for certain unincorporated communities outside urban growth boundaries as specified by Commission rules.

Local Governments shall not allow the establishment or extension of sewer systems outside urban growth boundaries or unincorporated community boundaries, or allow extensions of sewer lines from within urban growth boundaries or unincorporated community boundaries to serve land outside those boundaries, except where the new or extended system is the only practicable alternative to mitigate a public health hazard and will not adversely affect farm or forest land.

Local governments may allow residential uses located on certain rural residential lots or parcels inside existing sewer district or sanitary authority boundaries to connect to an existing sewer line under the terms and conditions specified by Commission rules.

Local governments shall not rely upon the presence, establishment, or extension of a water or sewer system to allow residential development of land outside urban growth boundaries or unincorporated community boundaries at a density higher than authorized without service from such a system.

In accordance with ORS 197.180 and Goal 2, state agencies that provide funding for transportation, water supply, sewage and solid waste facilities shall identify in their coordination programs how they will coordinate that funding with other state agencies and with the public facility plans of cities and counties.

A Timely, Orderly, and Efficient Arrangement – refers to a system or plan that coordinates the type, locations and delivery of public facilities and services in a manner that best supports the existing and proposed land uses.

Rural Facilities and Services – refers to facilities and services suitable and appropriate solely for the needs of rural lands.

Urban Facilities and Services – Refers to key facilities and to appropriate types and levels of at least the following: police protection; sanitary facilities; storm drainage facilities; planning, zoning and subdivision control; health services; recreation facilities and services; energy and communication services; and community governmental services.

Public Facilities Plan – A public facility plan is a support document or documents to a comprehensive plan. The facility plan describes the water, sewer and transportation facilities which are to support the land uses designated in the appropriate acknowledged comprehensive plan or plans within an urban growth boundary containing a population greater than 2,500.

Community Public Facilities Plan – A support document or documents to a comprehensive plan applicable to specific unincorporated communities outside UGBs. The community public facility plan describes the water and sewer services and facilities which are to support the land uses designated in the plan for the unincorporated community.

Water system – means a system for the provision of piped water for human consumption subject to regulation under ORS 448.119 to 448.285.

Extension of a sewer or water system – means the extension of a pipe, conduit, pipeline, main, or other physical component from or to an existing sewer or water system, as defined by Commission rules.

GUIDELINES

A. PLANNING

1. Plans providing for public facilities and services should be coordinated with plans for designation of urban boundaries, urbanizable land, rural uses and for the transition of rural land to urban uses.

2. Public facilities and services for rural areas should be provided at levels appropriate for rural use only and should not support urban uses.

3. Public facilities and services in urban areas should be provided at levels necessary and suitable for urban uses.

4. Public facilities and services in urbanizable areas should be provided at levels necessary and suitable for existing uses. The provision for future public facilities and services in these areas should be based upon: (1) the time required to provide the service; (2) reliability of service; (3) financial cost; and (4) levels of service needed and desired.

5. A public facility or service should not be provided in an urbanizable area unless there is provision for the coordinated development of all the other urban facilities and services appropriate to that area.

6. All utility lines and facilities should be located on or adjacent to existing public or private rights-of-way to avoid dividing existing farm units.

7. Plans providing for public facilities and services should consider as a major determinant the carrying capacity of the air, land and water resources of the planning area. The land

conservation and development action provided for by such plans should not exceed the carrying capacity of such resources.

B. IMPLEMENTATION

1. Capital improvement programming and budgeting should be utilized to achieve desired types and levels of public facilities and services in urban, urbanizable and rural areas.

2. Public facilities and services should be appropriate to support sufficient amounts of land to maintain an adequate housing market in areas undergoing development or redevelopment.

3. The level of key facilities that can be provided should be considered as a principal factor in planning for various densities and types of urban and rural land uses.

4. Plans should designate sites of power generation facilities and the location of electric transmission lines in areas intended to support desired levels of urban and rural development.

5. Additional methods and devices for achieving desired types and levels of public facilities and services should include but not be limited to the following: (1) tax incentives and disincentives; (2) land use controls and ordinances; (3) multiple use and joint development practices; (4) fee and less-than-fee acquisition techniques; and (5) enforcement of local health and safety codes.

6. Plans should provide for a detailed management program to assign respective implementation roles and responsibilities to those governmental bodies operating in the planning area and having interests in carrying out the goal

EXHIBIT 4

Figure 1: Station Locations, WWTP Outfalls, and Classified Growing Areas in Coos Bay

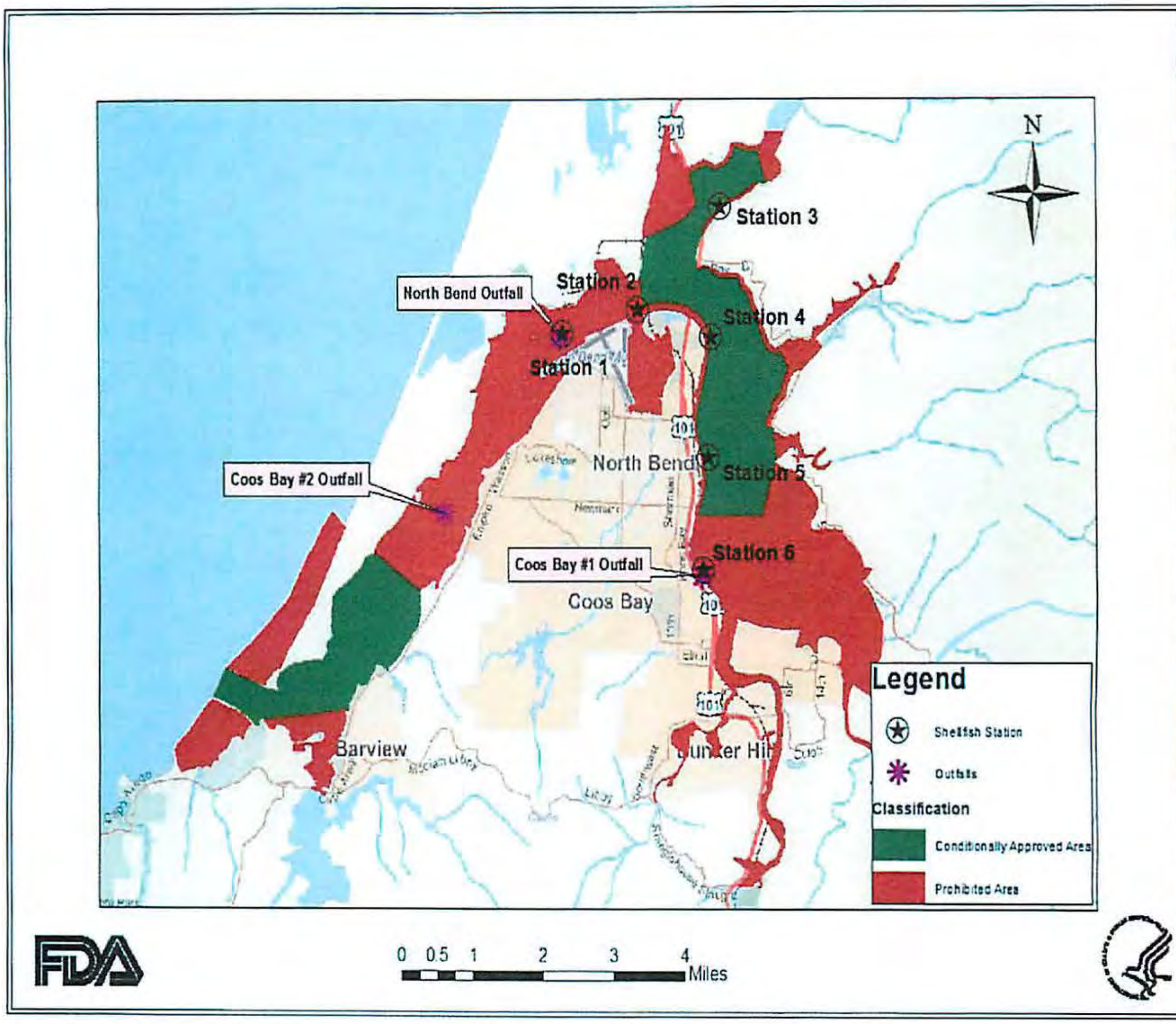


EXHIBIT 4

Chapter 3: Water Quality in the Coos Estuary and Lower Coos Watershed

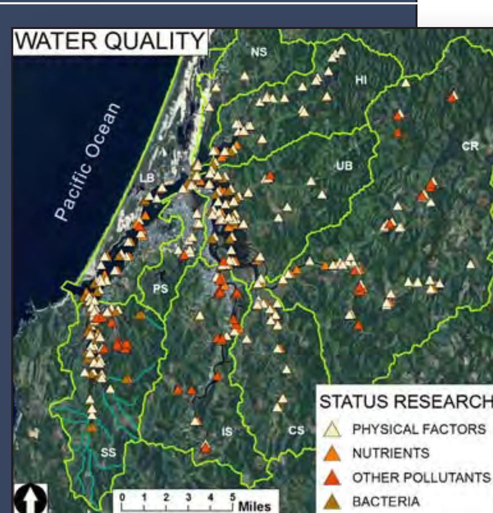
Partnership for COASTAL Watersheds

Physical Factors: *Multiple waterways in the project area are considered water quality-limited under the Clean Water Act for high temperatures and low dissolved oxygen.*

Nutrients: *Phosphorous levels are higher near the mouth and nitrogen higher after precipitation events; however, nutrient levels appear to be generally healthy.*

Bacteria: *Approximately 20% of monitored sites have maximum bacteria evels exceeding state bacteria criteria for fish and shellfish.*

Other Pollutants: *Previously operational point sources of pollution (e.g., former marina on Isthmus Slough) may still pose a threat to water quality. Remaining estuarine waters remain essentially unstudied.*



Subsystems: CR- Coos River CS- Catching Slough HI- Haynes Inlet IS- Isthmus Slough LB- Lower Bay NS- North Slough PS- Pony Slough SS- South Slough UB- Upper Bay

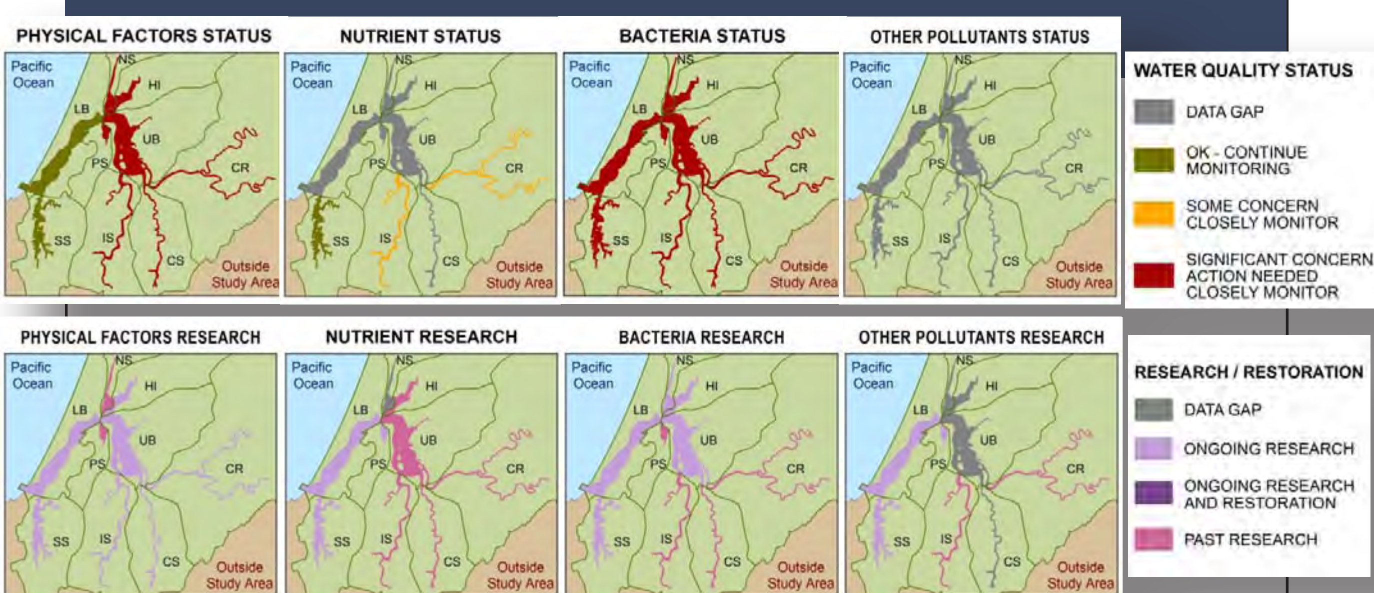


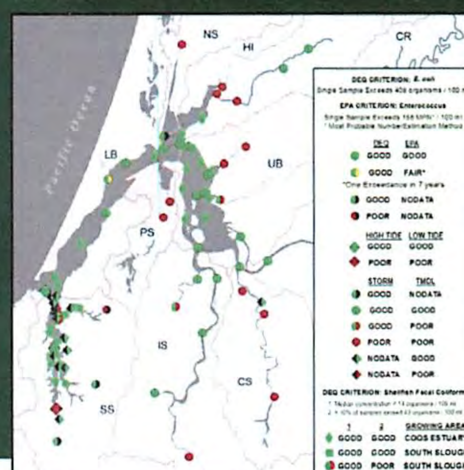
EXHIBIT 4

Bacteria in the Coos Estuary

Partnership for COASTAL Watersheds

Summary:

- *Bacteria concentrations are highly variable depending on water quality sampling location in the Coos estuary and surrounding stream systems.*
- *Approximately 20% of the sampling sites (17 of 84) did not meet state standards established for commercial fishing (including shellfish cultivation).*
- *Higher bacteria concentrations are typically correlated to areas of lower salinity and where land uses are likely sources of fecal coliform bacteria (e.g., sewage treatment, stormwater outfalls, grazing lands, areas where wildlife congregate).*



Evaluation

Several sites in the Coos estuary and associated streams do not meet state water quality standards while some do and others are stable or are improving. Bacteria sampling should continue to be monitored.

What's Happening?

Several types of fecal bacteria are monitored as indicators of water quality status (Table 1). These bacteria are not generally harmful but they can indicate the presence of disease-causing bacteria, viruses, and protozoans that also inhabit animal and human feces. Methods for determining the presence of disease-causing pathogens in water is difficult, costly and time consuming. Therefore, relatively easy and cost-effective tests using the presence and abundance of fecal coliforms

EXHIBIT 4

Form	What is it?	Water Quality Standards	Water Quality Standard Source
Escherichia coli (E. coli)	A species of fecal coliform specific to humans and warm blooded animals	In non-shellfish* growing waters: 30-day log mean no > 126 organisms/ 100 mL; No single sample > 406 organisms/ 100 mL; Oregon state standard.	Bohaboy 2011
Enterococci spp.	Several species of this bacteria can be found in intestines of humans and other warm blooded animals. Largely used to monitor ocean waters.	Geometric mean of 35 organisms/ 100 mL; No single sample > 104 organisms/100 mL at designated bathing beaches; Federal (EPA) standard	Bohaboy 2011
Fecal Coliform	Any coliform bacteria that live in animal intestines	For shellfish* growing waters: median no > 14 organisms per 100 ml; No more than 10% > 43 organisms/100 mL; Oregon state standard	Bohaboy 2011
Total coliform	All coliform bacteria, including those that live in soils. High counts are typical relative to any other form as this group is not specific to animals.	N/A	

** The term "shellfish" refers to molluscs only (e.g., clams, oysters, mussels).*

Table 1. Accepted standards and explanation of common bacterial forms that are monitored for water quality purposes.

and *Enterococci* spp. (all found in human and animal feces) are used as indicators of pathogens to evaluate water quality.

This data summary describes the results of current and historic bacteria monitoring in the Coos estuary. We report on streams listed by the EPA for high bacteria concentrations, analyze and report on data indicating the presence of storm runoff-enhanced bacteria levels, summarize research investigating the local sources of bacteria (some sources human-generated/some natural), and analyze and report on data collected by the Oregon Department of Agriculture (ODA)(related to shellfish growing waters), the Confederated tribes of Coos, Lower Umpqua, Siuslaw Indians (CTCLUSI)(focused on sites in the lower bay and South Slough), and by the South Slough NERR (SSNERR)(focused on South Slough). Limited stream data is reported for three streams in the South Slough watershed.

Listed Streams

All project area subsystems include water bodies that are 303(d) listed under EPA's Clean Water Act for high bacteria concentrations (Figure 1). High fecal coliform levels are a concern for waters where commercial shellfish are grown, while *E. coli* listings indicate human contact concerns in recreational waters. In all subsystems, eight water bodies totaling approximately 30 miles are considered impaired for *E. coli*. For fecal coliform, 28 water bodies and nearly 158 miles of water are impaired. Five water bodies are listed as having insufficient data to determine if they are meeting bacteria standards (i.e., they may or may not be impaired)(three for *E. coli* and two for fecal coliform).

Total Maximum Daily Load (TMDL)

According to USEPA's website TMDL is "a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards."

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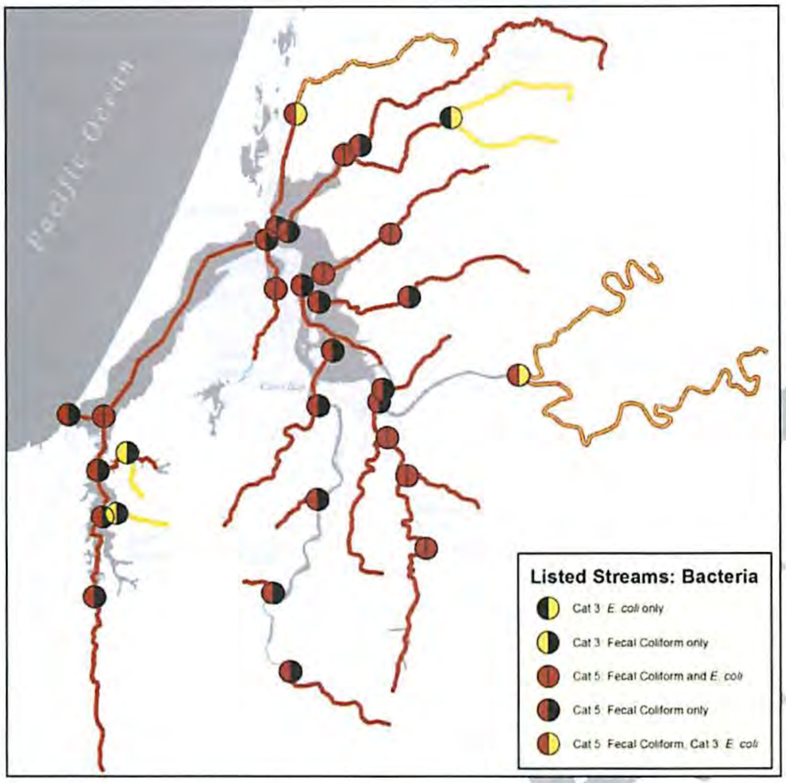

Figure 1. Streams listed as impaired for bacteria (303 (d) listed) under the Clean Water Act. Dot signifies the start of the stream segment that is listed while line shows extent of impaired stream. Category 3 indicates streams where insufficient data exists to make a determination if the water body is meeting water quality standards; category 5 indicates streams that are water quality impaired for bacteria. Report subsystems delineated and labeled in blue. Data: ODEQ 2014

Storm-Related Bacteria and Total Maximum Daily Load Bacteria Data

We summarized Coos Bay Storm-Related Bacteria and Total Maximum Daily Load (TMDL- see sidebar previous page) datasets from the Oregon Department of Environmental Quality (ODEQ)(ODEQ 2006, ODEQ 2007) (Figures 2-5). The storm-related bacteria data were collected in January and October 2007 and the TMDL data were collected in February, March, April, November, and December 2001-2005 (months vary depending on the year) and June, August, and September 2006. South Slough results only included TMDL data.

Bacteria concentrations associated with storm events were not higher than the TMDL samples. Indeed, results here show that storm-related bacteria concentrations were lower than TMDL for many sites e.g. Larson Creek (LCB), Willanch Creek (WCM), and Ross Slough (RS) in Figures 2, 3, and 4. Although not specifically associated with storms, most of the TMDL samples (2001-2005) were taken during the rainy season (Nov –Apr) with the exception of 2006 samples (Jun-Sept), so sample timing may be one reason the difference between the two is not especially great. Generally, sites with high levels of bacteria during storm-associated sampling also had high levels in the TMDL samples (Fig. 2-4). There was more variability in bacteria levels in the TMDL datasets for all three bacteria types compared to the storm-related datasets - likely due to seasonal variation.

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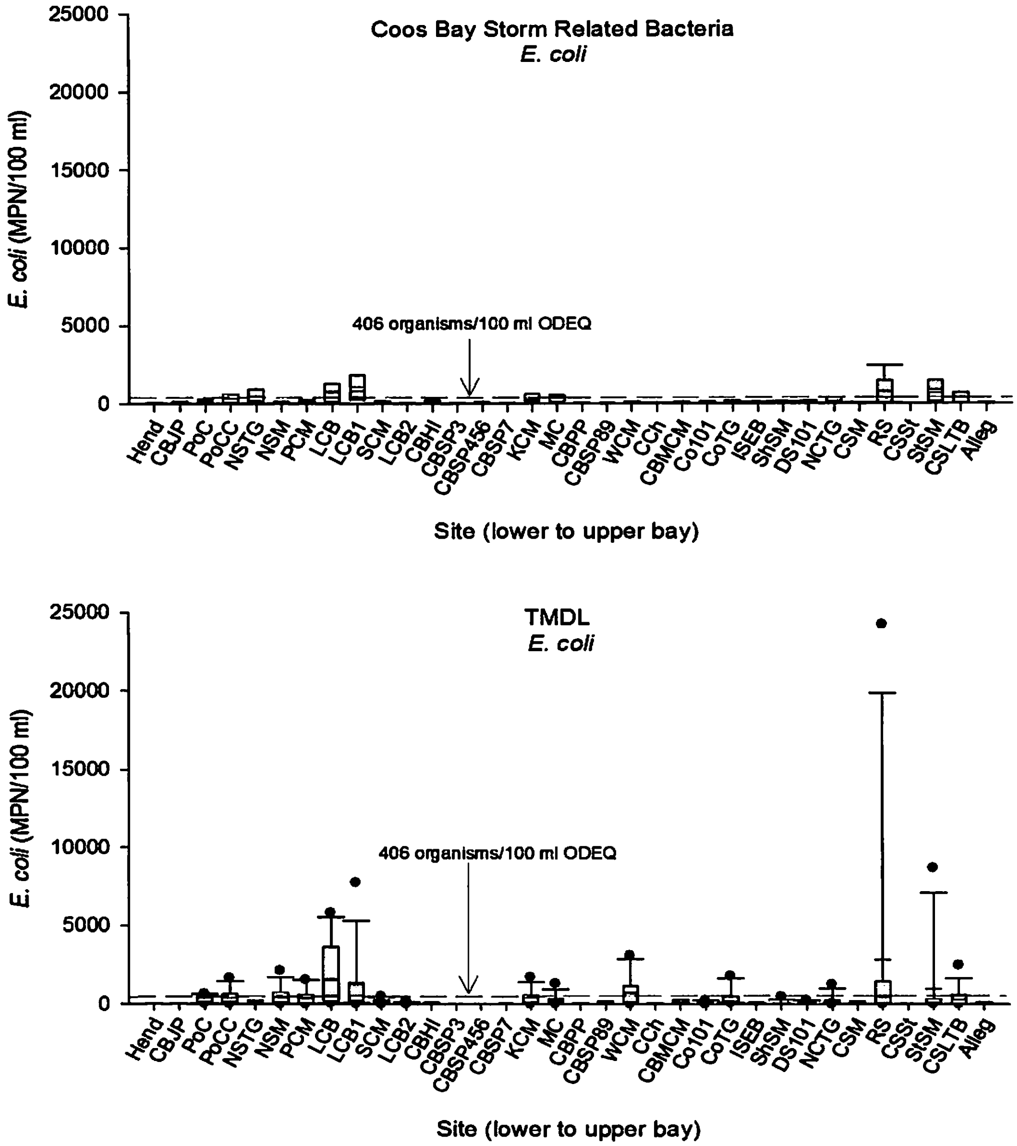

Figure 2. Box plots of *E. coli* concentrations for ODEQ Storm Related Bacteria in 2007 compared to ODEQ TMDL datasets 2001-2006 for Coos estuary sites, ordered from lower to upper Coos Bay. Gray boxes represent middle half of the dataset (top boundary is 25th percentile; bottom is 75th). Red lines within boxes indicate mean bacteria concentrations and black lines are median concentrations. Error bars represent 90th (top) and 10th (bottom) percentiles for sites with 9 samples or more. Black circles are outliers. Dark red dash line indicates ODEQ criteria for *E. coli*: No single sample may exceed 406 organisms/100 ml. See Figure 6/ Table 2 for map and site codes. Data: ODEQ 2006, 2007.

Storm-related *E. coli* bacteria results fell short of meeting state bacteria standards (see Table 1) at 12 sites including Pony Creek south of North Bend High School (PoC), Pony Slough at Coca Cola Bottling Plant (PoCC), North Slough upstream of tide gate (NSTG), Palouse Creek at Mouth (PCM), Larson creek at mouth (LCB), Larson Creek at first bridge upstream of mouth (LCB1), Kentuck Creek at mouth (KCM), Mettman Creek at mouth (MC), Noble

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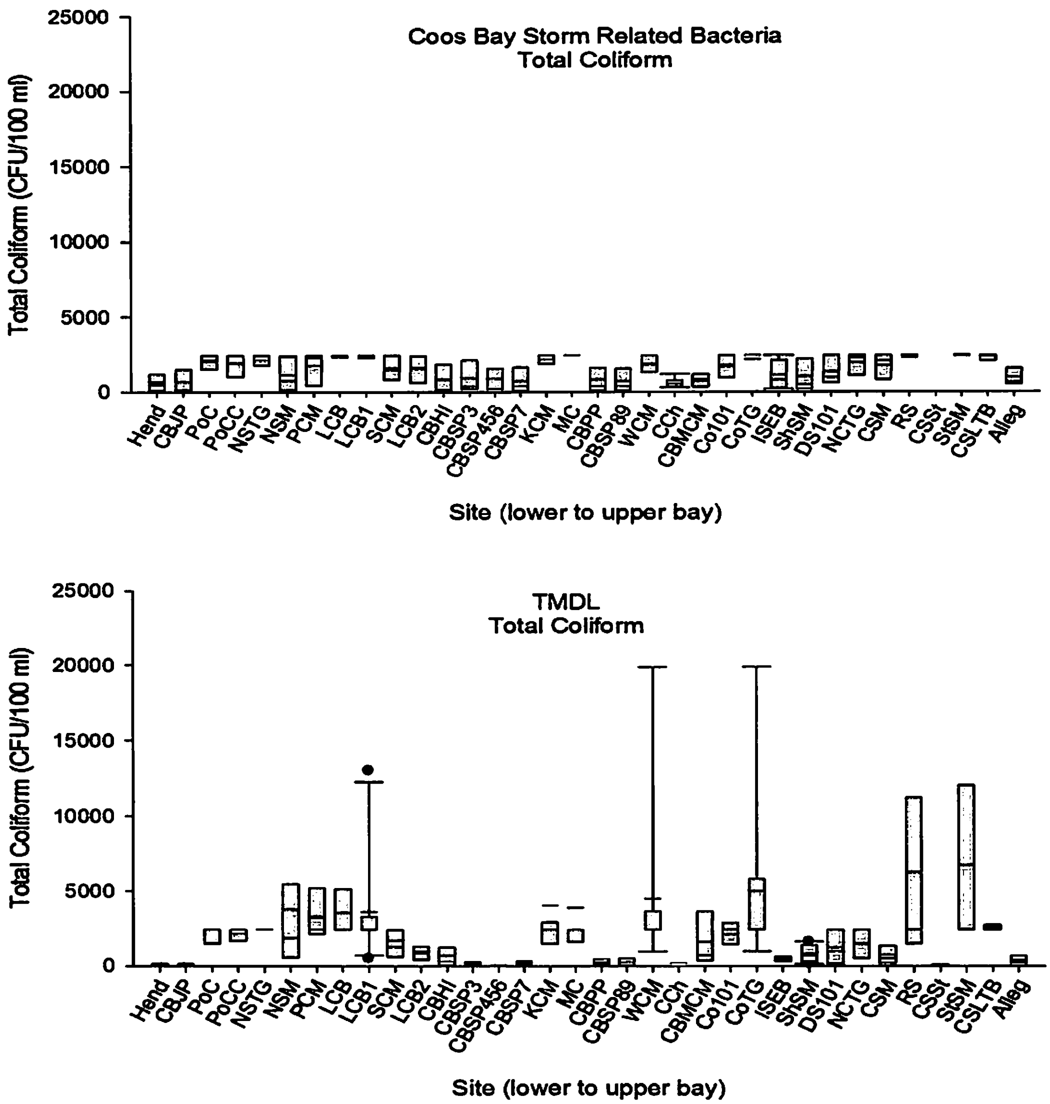

Figure 3. Box plots of Total Coliform concentrations for ODEQ Storm Related Bacteria in 2007 compared to ODEQ TMDL datasets 2001-2006 for Coos estuary sites, ordered from lower to upper Coos Bay. Gray boxes represent middle half of the dataset (top boundary is 25% percentile; bottom is 75th). Red lines within boxes indicate mean bacteria concentrations and black lines are median concentrations. Error bars represent 90th (top) and 10th (bottom) percentiles for sites with 9 samples or more. Black circles are outliers. See Figure 6/Table 2 for map and site codes. Data: ODEQ 2006, 2007.

Creek at tide gate (NCTG), Ross Slough at Ross Slough Road (RS), Stock Slough at mouth (StSM), and Catching Slough at Lone Tree Bridge (CSLTB)(Figures 2 and 6). These sites are located higher in the watershed and thus bacteria levels are likely driven by land use and facilitated by lower salinities than sites located in the estuary or lower watershed.

TMDL *E. coli* bacteria results fell short of meeting state bacteria standards at 18 sites: Pony Creek South of North Bend High School

EXHIBIT 4

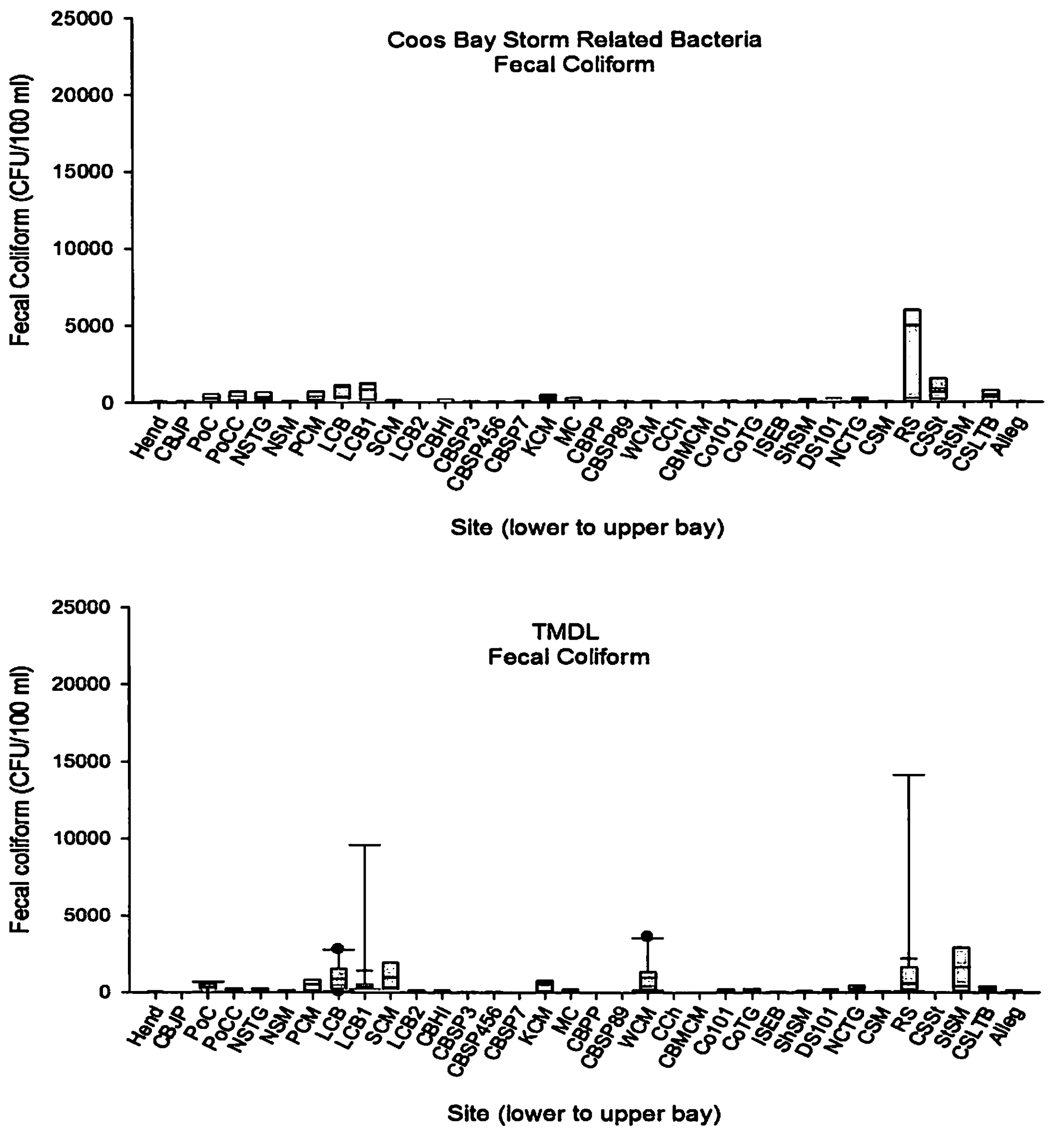

Figure 4. Box plots of Fecal Coliform concentrations for ODEQ Storm Related Bacteria in 2007 compared to ODEQ TMDL datasets 2001-2006 for Coos estuary sites, ordered from lower to upper Coos Bay. Gray boxes represent middle half of the dataset (top boundary is 25% percentile; bottom is 75th). Red linse within boxes indicate mean bacteria concentrations and black lines are median concentrations. Error bars represent 90th (top) and 10th (bottom) percentiles for sites with 9 samples or more. Black circles are outliers . See Figure 6/Table 2 for map and site codes. Data: ODEQ 2006, 2007.

(PoC), Pony Slough at Coca-Cola Bottling Plant (PoCC), North Slough at mouth(NSM), Palouse Creek at Mouth (PCM), Larson creek at mouth (LCB), Larson Creek at first bridge upstream of mouth (LCB1), Sullivan Creek at Mouth (SCM), Kentuck Creek at mouth (KCM), Mettman Creek at Mouth (MC), Willanch creek at mouth (WCM), Coalbank Slough at Tide gate (CoTG), Shinglehouse Slough at Mouth (ShSM), Noble Creek at tide gate (NCTG), Ross Slough at Ross Slough Road (RS), Stock Slough at Mouth (StSM), Catching Slough at Lone Tree Bridge (CSLTB), and two South Slough sites, Hallmark Seafood on

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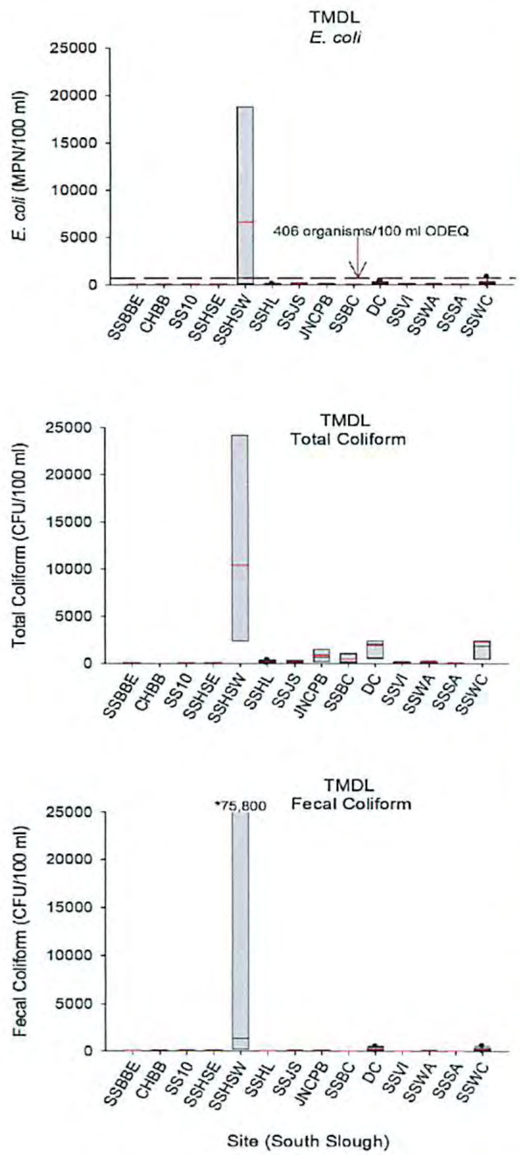

Figure 5. Box plots of E. coli, Total Coliform, and Fecal Coliform concentrations for ODEQ TMDL datasets 2001-2006 for South Slough; sites are ordered from north to south. Gray boxes represent middle half of the dataset (top boundary is 25th percentile; bottom is 75th). Red lines within boxes indicate mean bacteria concentrations and black bars are median concentrations. Error bars represent 90th (top) and 10th (bottom) percentiles for sites with 9 samples or more. Black circles are outliers. Dark red dash line indicates ODEQ criteria for E. coli: No single sample may exceed 406 organisms/100 ml. See Figure 6/Table 2 for map and site codes. Data: ODEQ 2006, 2007.

South Slough West Side (SSHSW) and Winchester Creek at Hinch Rd Bridge(SSWC)(Fig. 2, 5, 6). With the exception of 4 sites (SCM, WCM, CoTG, ShSM), those sites with high levels of *E. coli* bacteria in storm-related sampling also had high levels in TMDL sampling. Many of these sampling sites are higher in the watershed and more heavily influenced by land use and characterized by fresher water than lower estuary sites. In general, South Slough, Coos estuary, and sites in the lower watershed show much lower bacteria concentrations compared to smaller sloughs and upper watershed creek sites (Figures 2-6).

Box Plots (or Whisker and Box Plots)

Useful for graphing data that are highly variable, box plots help compare a range of data values (i.e., distribution) and identify outliers. Box plots also show median values in the data, which can be useful for interpreting highly variable results.

The "box" indicates the middle 50% of the data values; the full range of values from the rest of the data are indicated as "whiskers" the in normal box and whisker plots, or in Tukey-style box plots, an additional 1.5 x the width of the box (i.e., 1.5 x the "interquartile" range).

In Tukey-style box plots outliers outside the range of the whiskers are also shown (represented by points outside the box and whisker plot).

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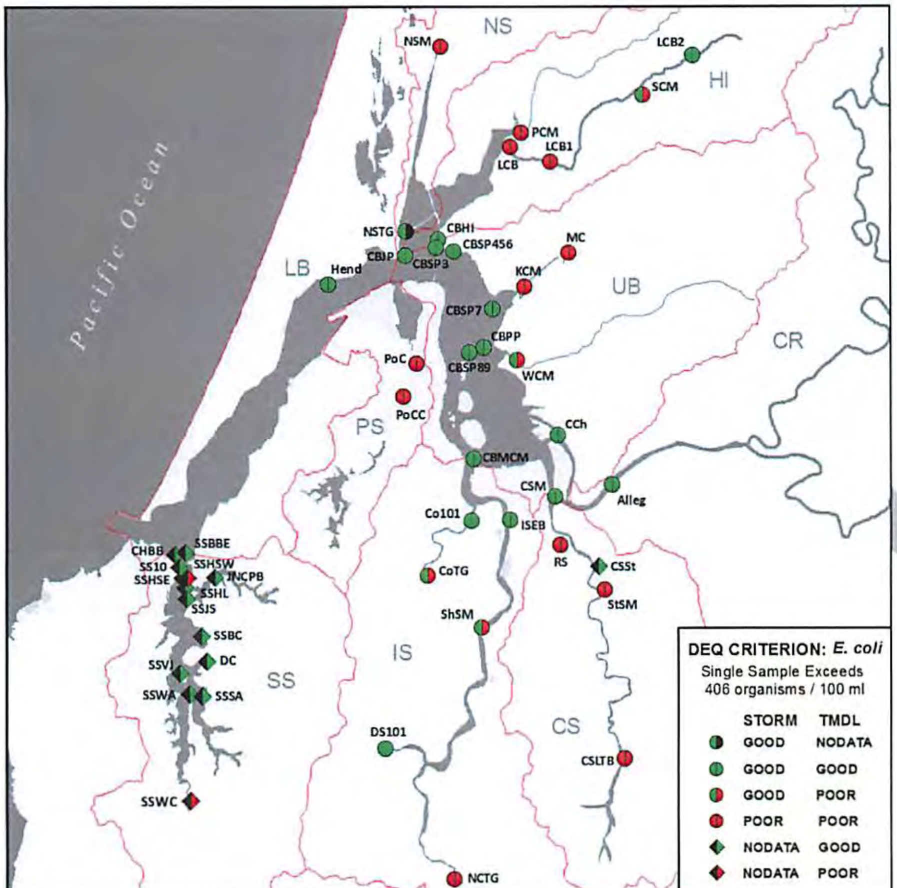

Figure 6. (left) Location and condition of Storm-Related and TMDL E. coli bacteria sampling sites.

Table 2. (below). Site codes and names for Storm-Related and TMDL bacteria sampling sites.

Site Codes	Site Name	Site Codes	Site Name
Alleg	Coos River at Allegany Road Bridge (Eastside)	**LCB2**	Larson Creek at second bridge upstream of dairy
CBHI	Coos Bay at entrance to Haynes Inlet at Marker #1	**MC**	Mettman Creek at mouth
CBJP	Coos Bay at Jordan Point	**NCTG**	Noble Creek at tide gate
CBMCM	Coos Bay Marshfield Channel Mouth	**NSM**	North Slough at mouth (Causeway Bridge)
CBPP	Coos Bay at Pierce Point Channel	**NSTG**	North Slough upstream of tide gate
CBSP3	Coos Bay at Silver Point 3	**PCM**	Palouse Creek at mouth
CBSP456	Coos Bay at Silver Point 4,5,6	**PoC**	Pony Creek south of North Bend High School
CBSP7	Coos Bay at Silver Point 7	**PoCC**	Pony Slough at Coca Cola bottling plant
CBSP89	Coos Bay at Silver Point 8,9	**RS**	Ross Slough at Ross Slough Road
CCh	Cooston Channel at south end	**SCM**	Sullivan Creek at Mouth
CHBB	Charleston Boat Basin at east end	**ShSM**	Shingle House Slough at mouth
Co101	Coalbank Slough at Hwy 101 (Coos Bay)	**SS10**	South Slough at Buoy #10 - Charleston Triangle
CoTG	Coalbank Slough at Tide gate	**SSBBE**	South Slough at entrance to Charleston Boat Basin
CSLTB	Catching Slough at Lone Tree Bridge	**SSBC**	South Slough In Brown's Cove
CSM	Catching Slough at Mouth	**SSHL**	South Slough at Hanson's Landing
CSSt	Catching Slough at dock downstream of Stock Slough	**SSHSE**	Hallmark Seafood on South Slough East Side
DC	Day Creek upstream of foot bridge	**SSHSW**	Hallmark Seafood on South Slough West Side
DS101	Davis Slough at Highway 101	**SSJS**	South Slough 50 yards west of Joe Ney Slough
Hend	Coos Bay at Marker #23 (Henderson Marsh)	**SSSA**	South Slough at head of Sengstacken Arm
ISEB	Isthmus Slough at Eastside Bridge	**SSVI**	South Slough at west side of Valino Island
JNCPB	Joe Ney Slough at Crown Point Bridge	**SSWA**	South Slough at head of Winchester Arm
KCM	Kentuck Creek at mouth (upstream of tide gate)	**SSWC**	Winchester Creek at Hinch Rd Bridge
LCB	Larson Creek at mouth	**StSM**	Stock Slough at mouth
LCB1	Larson Creek at first bridge upstream of mouth	**WCM**	Willanch Creek at mouth (tide gate)

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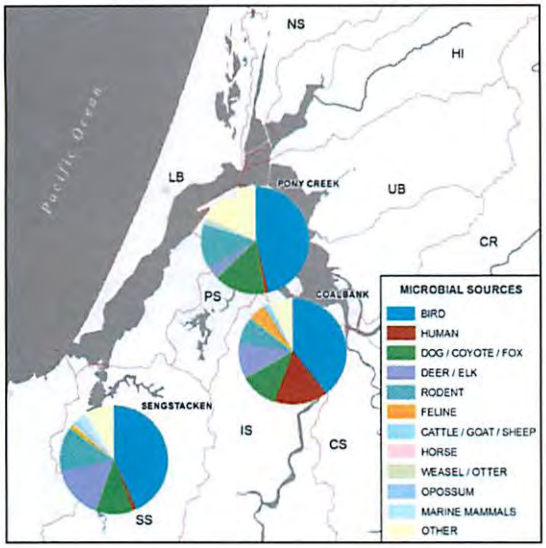

Figure 7. E. coli microbial source tracking results shown as a percentage of bacterial samples collected in Pony Creek, Coalbank Slough and Sengstacken arm of South Slough. Data: Souder 2003.

What does CFU/100 mL and MPN/100 mL mean?

CFU stands for 'Colony Forming Units' and refers to the number of viable bacterial cells in a sample per unit of volume (i.e., only live cells). For example: 50 CFU/100 mL means 50 Colony Forming Units per 100 mL of sample.

MPN stands for 'Most Probable Number' and refers to a method that uses dilution cultures and a probability calculation to determine the approximate number of viable cells in a given volume of sample, useful when samples contain too few organisms for agar plates to be used or when organisms will not grow on agar.

Bacteria units – including CFU, counts, organisms, and MPN – are considered equivalent measures of bacteria concentration.

Sources: APHA 1998; USEPA 2001

Mean and median *E. coli* levels fell below 215 MPN/100 ml for Coos Bay lower watershed and main estuary sites and South Slough with the exception of one site, Hallmark Seafood on South Slough West Side (SSHSW) (Fig. 2, 5).

Overall, highest total coliform and fecal coliform mean values occurred at Ross Slough (RS) and Stock Slough (StSM)(Fig. 3 TMDL); and Hallmark Seafood on South Slough West Side (SSHSW)(Fig. 5). In addition, Coalbank Slough at tide gate (CoTG), North Slough at mouth (NSM), Kentuck Creek at mouth (KCM), Larson Creek at first bridge upstream of mouth (LCB1), Mettman Creek at mouth (MC) and Willanch Creek at mouth (WCM) all had high levels of total coliforms for TMDL data. Some of the lowest fecal coliform levels were at South Slough sites (<60 CFU/100 mL), with the exception of Day Creek (DC) (mean = 208 CFU/100 mL), Winchester Creek Bridge (SSWC)(mean = 236 CFU/100 mL), and Hallmark Seafood (SSHSW) (mean = 48,517 CFU/100 mL).

Bacteria Sources

A joint study conducted by the Coos Watershed Association (CoosWA), SSNERR, and Marshfield High school investigated bacteria concentrations and sources in three locations

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Statistic	Pony Creek			Coalbank Slough			Sengstaken Arm		
	TC	FC	EC	TC	FC	EC	TC	FC	EC
Arithmetic Mean	5,089	246	182	3,130	349	237	342	36	26
Standard Deviation	6,709	129	103	3,498	292	204	318	31	21
Geometric Mean*	2,297	206	139	2,105	215	138	149	14	19
Est. 90th Percentile*	4,910	230	182	2,790	379	280	972	49	25
* Calculated according to procedures in *Guidance Document A.7 – Estimating the Ninetieth Percentile*									

Table 3. Summary statistics from the traditional public health bacteria indicators at the three E. coli DNA sample locations. TC = Total coliform; FC = Fecal coliform; EC = E. coli. TC and EC units are MPN/100 mLs; FC units are CFU/100 mLs. Arithmetic Mean is the average. From: Souder 2003.

in the Coos estuary: Pony Creek, Coalbank Slough, and the Sengstacken arm of South Slough (Figure 7)(Souder 2003). Investigators used DNA-based microbial source tracking methods to compare total coliforms, fecal coliforms, and *E. coli* concentrations in estuary water samples from July 2000 to June 2002.

Overall, Pony Creek had the highest average total coliform (5,089 MPN/100 mL), while Coalbank Slough had the highest average concentrations of fecal coliform and *E. coli* (349 CFU/100 mL and 237 MPN/100 mL respectively)(Table 3). Sengstacken arm consistently had lowest bacteria levels of all three sites.

Microbial source tracking results found that the most common source of bacteria at all three sites was from birds (avian sources) – responsible for 46% of all bacteria at Pony Creek, 39% at Coalbank Slough and 43% at Sengstacken arm (Figure 7).

Pony Creek also had high concentrations of bacteria from canines (15%; dogs, coyotes, foxes) and rodents (13%) while Coalbank Slough had high concentrations from humans (16%), canines (11%), and deer/elk (11%), and Sengstacken from deer/elk (16%), rodents (16%), and canines (11%)(Figure 7).

Bacteria in Shellfish Growing Areas

Oregon Department of Agriculture (ODA) samples for fecal coliforms at several sites near commercial shellfish cultivation areas in the Coos estuary (including the Upper Bay, Lower Bay, North Slough, Haynes Inlet, and South Slough subsystems (Figure 8) once per month on average. During shellfish harvest, the fecal coliform samples must meet ODEQ bacteria criteria for marine and estuarine shellfish growing waters which is a median concentration of 14 organisms per 100 mL and not more than 10% of samples may exceed 43 organisms per 100 mL. Data summarized below are from 1999-2014.

Overall, median bacteria concentrations were relatively low and met regulatory standards. In Coos Bay (all non-South Slough sampling sites), the average concentration of fecal coliform bacteria at all sites was between 3 and 14 organisms/100 mL. The median concentrations were between 2 and 7 organisms/100 mL (Figure 9). The percent of samples that were greater than 43 organisms/mL (all years

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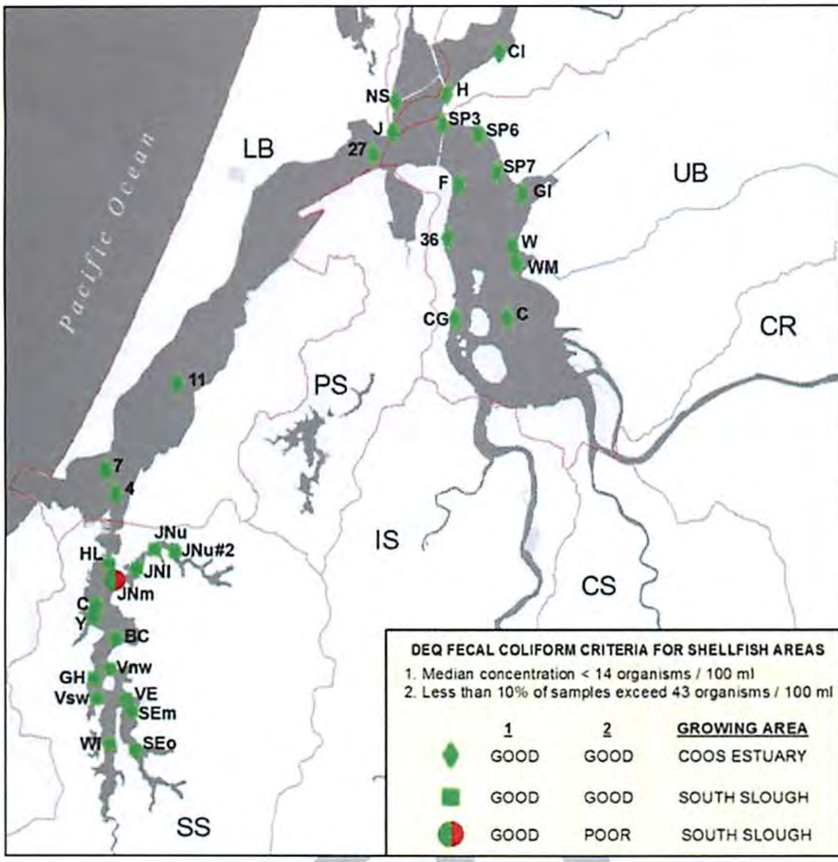

Figure 8. ODA Fecal Colifrm sampling sites in Coos Bay and South Slough. Green symbols indicate sites that met ODEQ standards shellfish growing waters; Red symbols indicate sites that did not meet the standards.

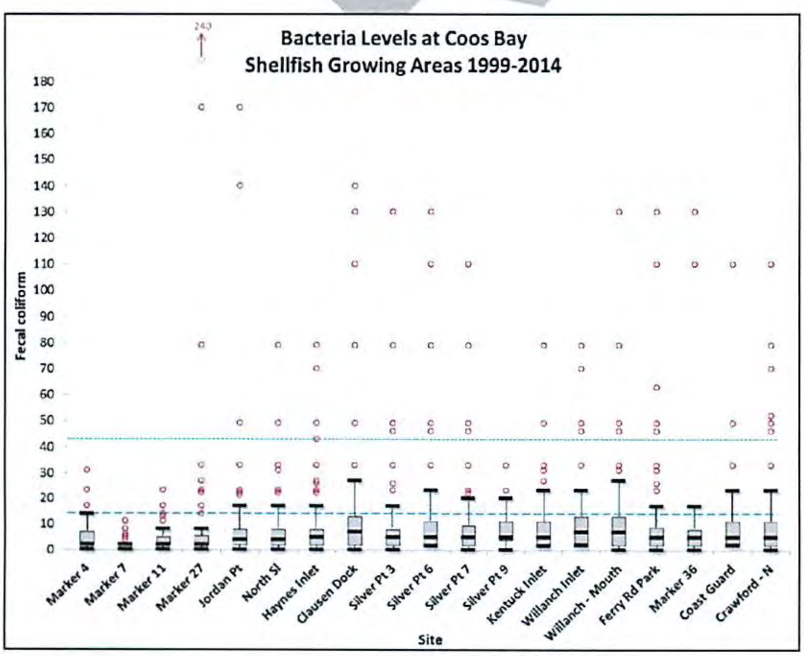

Figure 9. Tukey-style box plots of fecal coliform concentrations from ODA Coos Bay shellfish growing sampling sites from 1999-2014. Shaded gray box represents middle 50% of the data. Central black line (within gray box) indicates median value. Upper and lower black bars bound 99.3% of normal distribution data. Outliers outside this coverage are shown as open red circles. One outlier was outside the scale of this figure; value is indicated above arrow at the top. Short blue dashed line indicate ODEQ standard: 10% of samples may not exceed 43 organisms/10mL. Long blue dash line indicate ODEQ standard of median 14 organisms/100mL. Data: ODA 2014

EXHIBIT 4

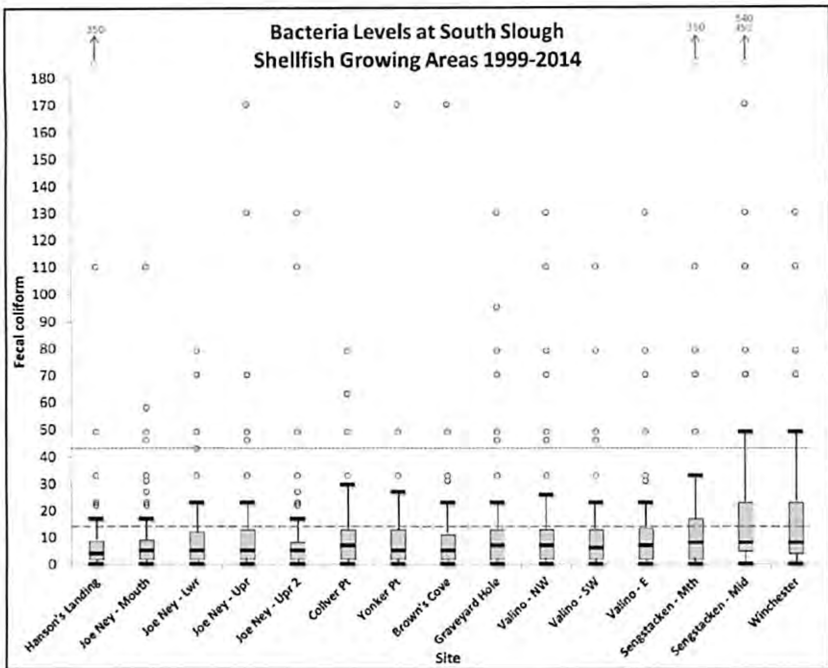

Figure 10. Tukey-style box plots of fecal coliform concentrations from ODA South Slough shellfish growing sampling sites from 1999-2014. Shaded gray box represents middle 50% of the data. Black line within gray box indicates median value. Upper and lower bars bound 99.3% of normal distribution data. Outliers outside this coverage are shown as open red circles. Several outliers were outside the scale of this figure and values are indicated above arrows at the top. Short blue dashed line indicate ODEQ standard: 10% of samples may not exceed 43 organisms/10mL. Long blue dash line indicate ODEQ standard of median 14 organisms/100mL. Data: ODA 2014

combined) were low and ranged from 0-7%, at no time exceeding the criterion of greater than 10% of samples over 43 organisms/100 mL. Similarly, for South Slough, the average concentration of fecal coliform bacteria at all sites ranged from 5 to 21 organisms/100 mL (Figure 10). The median concentrations fell between 4 and 8 organisms/100 mL. The percent samples greater than 43 organism/ mL were low and ranged from 2-11%. The only site not meeting the percent samples standard when all years were combined was

A.

Median Monthly Fecal Coliform Values at ODA's Coos Bay Sampling Sites 1999-2014

	Marker 4	Marker 7	Marker 11	Marker 27	Jordan Pt	North Sl	Haynes Inlet	Clausen Dock	Silver Pt 3	Silver Pt 6	Silver Pt 7	Silver Pt 9	Kentuck Inlet	Willanch - Inlet	Willanch - mouth	Ferry Rd Park	Marker 36	Coast Guard	Crawford Pt
Jan	2	5	5	5	8	6	6	8	7	8	8	6.15	5	13	11	7.5	17	5.8	13
Feb	2	2	2	5	2	3.5	5	7	7	11	5	5	8	6.5	7.8	8	2	5	10.5
Mar	2	2	2	6.5	5	5	8	7	5	11	5	5	5	12	7	7.5	7	8	5
Apr	4.5	2	2	2	2	2	5	6.5	2	2	2	11	4.5	6.4	6.4	6	5	4.5	5.5
May	2	2	2	2	4.5	2	2	4.5	2	2	3.5	7.8	7	7.9	4	4	5	5	3
Jun	2	2	2	2	2	2	4	5	2	2	5	4.5	5	2	5	5	4	6	4.5
Jul	3.5	2	2	2	3.25	4	5	5	3	2	5	13.9	4.25	5	5	2	5	7	5
Aug	8	2	3	2	4.25	2	2	5	2	2	4.5	2	2	4.25	4	4.75	5	5	2
Sep	3	2	2	2	2	2	2	6	2	5	4.5	3.25	4.5	8	7	2	7	6.5	5
Oct	2	2	2	2	2	2	2	4.5	2	3.5	2	6	6	4.75	2	3.25	4.25	5	2
Nov	3.5	2	2	4.25	8	7	5	5	5	13	8	5	6.5	10	13	12	7	8	11
Dec	6	3.5	3.5	10.5	6	5	5	8	5	5	8	7	11	8	11	13	7.4	11	5

B.

Median Monthly Fecal Coliform Values at ODA's South Slough Sampling Sites 1999-2014

	Hanson's Landing	Joe Ney Mouth	Joe Ney - Lwr	Joe Ney - Upr 1	Joe Ney - Upr 2	Collver Pt	Yonker Pt	Brown's Cove	Graveyard Hole	Valino - NW	Valino - SW	Valino - E	Sengstacken Mouth	Sengstacken - Mid	Winchester
Jan	5	8	5	6	2	8	3.5	7	5	13	7.9	5	5	9.5	5
Feb	2	2	5	5	2	5	5	2	5	5	6.5	3.5	5	2	3.5
Mar	2	5	4	2	2	5	2	2	2	5	4.5	5	6	8	8
Apr	5	5	4.5	2	4	7	7	2	7	5	4.5	7.5	8	5	5
May	6	5	6	4	5	8	6	5	2	8	2	5	5	17	8
Jun	4.5	7.15	5	5	5	11	5	8	7.9	19.5	3	6.5	8	8	11
Jul	2	8	7.5	10.5	8	10.5	6	8	8	6.5	13	11	17	17	22
Aug	2	5	4.75	4.5	5.9	5	13	8	7	13	13	10.5	6	9.5	6.5
Sep	4.5	5	4	5	7	8	5	5	5	5	5	5.5	8	10.5	8
Oct	2	6	7	10.5	8	8	8	11	13.5	9.5	7	5	13	8	5
Nov	5	5	11	6.8	5	4	3	2	8	8	5	8	5	12	8
Dec	7.8	8	8	11	12	9.5	7.5	8	13	6	7	8	10.5	13	6.5

Table 4. Median monthly fecal coliform at each ODA shellfish sampling site in A. Coos Bay and B. South Slough from 1999-2014. Beige bars indicate relative fecal coliform concentration. Red values indicate exceedance of ODEQ standard of median 14 organisms/100mL. Data: ODA 2014

EXHIBIT 5

Bacterial Water Quality Standards by EPA Region

Region	State	Class	Freshwater Primary	Freshwater Secondary	Marine Primary	Marine Secondary
Region 10 (cont'd.)	**Oregon**		126 EC		14 FC	
			No freshwater single sample may exceed 406 EC. No more than 10% of FC marine samples may exceed 43. For estuarine waters other than shellfish growing, same criterion as freshwater criterion. For estuarine waters with shellfish, same criterion as marine.			
	Washington	Class AA (extraordinary)	50 FC		14 FC	
			No more than 10% of FC samples may exceed 100 and 43, respectively.			
		Class A (excellent)	100 FC		14 FC	
			No more than 10% of FC samples may exceed 200 and 43, respectively.			
		Class B (good)		200 FC		100 FC
			No more than 10% of FC samples may exceed 400 and 200, respectively. Only designated for secondary contact.			
		Class C (fair)				200 FC
			No more than 10% of FC samples may exceed 400. Only designated for secondary contact.			
		Lake Class	50 FC			
			No more than 10% of samples may exceed 100 FC.			
	Confederated Tribes of the Chehalis Reservation	Class AA (extraordinary)	50 FC		14 FC	
			No more than 10% of FC samples may exceed 100 and 43, respectively.			
		Class A (excellent)	100 FC		14 FC	
			No more than 10% of FC samples may exceed 200 and 43, respectively.			
		Class B (good)		200 FC		100 FC
			No more than 10% of FC samples may exceed 400 and 200, respectively. Only designated for secondary contact.			
		Class C (fair)				200 FC
			No more than 10% of FC samples may exceed 400. Only designated for secondary contact.			
		Lake Class	50 FC			
			No more than 10% of samples may exceed 100 FC.			

EXHIBIT 5

(b) **Water contact recreation bacteria criteria.** Table 210 (3)(b) lists the bacteria criteria to protect water contact recreation in marine water.

Table 210 (3)(b)
Water Contact Recreation Bacteria Criteria in Marine Water

Category	Bacteria Indicator
Primary Contact Recreation	Fecal coliform organism levels must not exceed a geometric mean value of 14 colonies/100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 43 colonies/100 mL.
Secondary Contact Recreation	Enterococci organism levels must not exceed a geometric mean value of 70 colonies/100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 208 colonies/100 mL.

(i) When averaging bacteria sample data for comparison to the geometric mean criteria, it is preferable to average by season and include five or more data collection events within each period. Averaging of data collected beyond a thirty-day period, or beyond a specific discharge event under investigation, is not permitted when such averaging would skew the data set so as to mask noncompliance periods. The period of averaging should not exceed twelve months, and should have sample collection dates well distributed throughout the reporting period.

(ii) When determining compliance with the bacteria criteria in or around small sensitive areas, such as swimming beaches, it is recommended that multiple samples are taken throughout the area during each visit. Such multiple samples should be arithmetically averaged together (to reduce concerns with low bias when the data is later used in calculating a geometric mean) to reduce sample variability and to create a single representative data point.

(iii) As determined necessary by the department, more stringent bacteria criteria may be established for waters that cause, or significantly contribute to, the decertification or conditional certification of commercial or recreational shellfish harvest areas, even when the preassigned bacteria criteria for the water is being met.

(iv) Where information suggests that sample results are due primarily to sources other than warm-blooded animals (e.g., wood waste), alternative indicator criteria may be established on a site-specific basis by the department.

(4) **Miscellaneous uses.** The miscellaneous marine water uses are wildlife habitat, harvesting, commerce and navigation, boating, and aesthetics.

General criteria. General criteria that apply in miscellaneous marine water uses are described in WAC 173-201A-260 (2)(a) and (b), and are for:

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(B) The action is necessary and benefits of the lowered water quality outweigh the environmental costs of the reduced water quality. This evaluation will be conducted in accordance with DEQ's "Antidegradation Policy Implementation Internal Management Directive for NPDES Permits and section 401 water quality certifications," pages 27, and 33-39 (March 2001) incorporated herein by reference; and

(C) The new or increased discharged load will not unacceptably threaten or impair any recognized beneficial uses or adversely affect threatened or endangered species. In making this determination, the Commission or Department may rely upon the presumption that if the numeric criteria established to protect specific uses are met the beneficial uses they were designed to protect are protected. In making this determination the Commission or Department may also evaluate other State and federal agency data that would provide information on potential impacts to beneficial uses for which the numeric criteria have not been set;

(D) The new or increased discharged load may not be granted if the receiving stream is classified as being water quality limited under sub-section (a) of the definition of “Water Quality Limited” in OAR 340-041-0002, unless:

(i) The pollutant parameters associated with the proposed discharge are unrelated either directly or indirectly to the parameter(s) causing the receiving stream to violate water quality standards and being designated water quality limited; or

(ii) Total maximum daily loads (TMDLs), waste load allocations (WLAs) load allocations (LAs), and the reserve capacity have been established for the water quality limited receiving stream; and compliance plans under which enforcement action can be taken have been established; and there will be sufficient reserve capacity to assimilate the increased load under the established TMDL at the time of discharge; or

(iii) Effective July 1, 1996, in water bodies designated water-quality limited for dissolved oxygen, when establishing WLAs under a TMDL for water bodies meeting the conditions defined in this rule, the Department may at its discretion provide an allowance for WLAs calculated to result in no measurable reduction of dissolved oxygen (DO). For this purpose, "no measurable reduction" is defined as no more than 0.10 mg/L for a single source and no more than 0.20 mg/L for all anthropogenic activities that influence the water quality limited segment. The allowance applies for surface water DO criteria and for Intergravel dissolved oxygen (IGDO) if a determination is made that the conditions are natural. The allowance for WLAs applies only to surface water 30-day and seven-day means; or

(iv) Under extraordinary circumstances to solve an existing, immediate and critical environmental problem, the Commission or Department may, after the completion of a TMDL but before the water body has achieved compliance with standards, consider a waste load increase for an existing source on a receiving stream designated water quality limited under sub-section (a) of the definition of “Water Quality Limited” in OAR 340-041-0002. This action must be based on the following conditions:

(I) That TMDLs, WLAs and LAs have been set; and

(II) That a compliance plan under which enforcement actions can be taken has been established and is being implemented on schedule; and

(III) That an evaluation of the requested increased load shows that this increment of load will not have an unacceptable temporary or permanent adverse effect on beneficial uses or adversely affect threatened or endangered species; and

(IV) That any waste load increase granted under subparagraph (iv) of this paragraph is temporary and does not extend beyond the TMDL compliance deadline established for the water body. If this action will result in a permanent load increase, the action has to comply with sub-paragraphs (i) or (ii) of this paragraph.

(b) The activity, expansion, or growth necessitating a new or increased discharge load is consistent with the acknowledged local land use plans as evidenced by a statement of land use compatibility from the appropriate local planning agency.

(c) Oregon's water quality management policies and programs recognize that Oregon's water bodies have a finite capacity to assimilate waste. Unused assimilative capacity is an exceedingly valuable resource that enhances in-stream values and environmental quality in general. Allocation of any unused assimilative capacity should be based on explicit criteria. In addition to the conditions in subsection (a) of this section, the Commission or Department may consider the following:

(A) Environmental Effects Criteria:

(i) Adverse Out-of-Stream Effects. There may be instances where the non-discharge or limited discharge alternatives may cause greater adverse environmental effects than the increased discharge alternative. An example may be the potential degradation of groundwater from land application of wastes;

(ii) Instream Effects. Total stream loading may be reduced through elimination or reduction of other source discharges or through a reduction in seasonal discharge. A source that replaces other sources, accepts additional waste from less efficient treatment units or systems, or reduces discharge loadings during periods of low stream flow may be permitted an increased discharge load year-round or during seasons of high flow, so long as the loading has no adverse affect on threatened and endangered species;

(iii) Beneficial Effects. Land application, upland wetlands application, or other non-discharge alternatives for appropriately treated wastewater may replenish groundwater levels and increase streamflow and assimilative capacity during otherwise low streamflow periods.

(B) Economic Effects Criteria. When assimilative capacity exists in a stream, and when it is judged that increased loadings will not have significantly greater adverse environmental effects than other alternatives to increased discharge, the economic effect of increased loading will be considered. Economic effects will be of two general types:

(i) Value of Assimilative Capacity. The assimilative capacity of Oregon's streams is finite, but the potential uses of this capacity are virtually unlimited. Thus it is important that priority be given to those beneficial uses that promise the greatest return (beneficial use) relative to the unused assimilative capacity that might be utilized. In-stream uses that will benefit from reserve assimilative capacity, as well as potential future beneficial use, will be weighed against the economic benefit associated with increased loading;

(ii) Cost of Treatment Technology. The cost of improved treatment technology, non-discharge and limited discharge alternatives may be evaluated.

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03; DEQ 2-2007, f. & cert. ef. 3-15-07

340-041-0007

Statewide Narrative Criteria

EXHIBIT 6

(1) Notwithstanding the water quality standards contained in this Division, the highest and best practicable treatment and/or control of wastes, activities, and flows must in every case be provided so as to maintain dissolved oxygen and overall water quality at the highest possible levels and water temperatures, coliform bacteria concentrations, dissolved chemical substances, toxic materials, radioactivity, turbidities, color, odor, and other deleterious factors at the lowest possible levels.

(2) Where a less stringent natural condition of a water of the State exceeds the numeric criteria set out in this Division, the natural condition supersedes the numeric criteria and becomes the standard for that water body. However, there are special restrictions, described in OAR 340-041-0004(9)(a)(D)(iii), that may apply to discharges that affect dissolved oxygen.

NOTE: On August 8, 2013, the Environmental Protection Agency disapproved rule section OAR 340-041-0007(2). Consequently, section (2) is no longer effective as a water quality criterion for purposes of CWA Section 303(c) and it cannot be used for issuing certifications under CWA Section 401, permits under CWA Section 402, or total maximum daily loads under CWA section 303(d).

(3) For any new waste sources, alternatives that utilize reuse or disposal with no discharge to public waters must be given highest priority for use wherever practicable. New source discharges may be approved subject to the criteria in OAR 340-041-0004(9).

(4) No discharges of wastes to lakes or reservoirs may be allowed except as provided in section OAR 340-041-0004(9).

(5) Log handling in public waters must conform to current Commission policies and guidelines.

(6) Sand and gravel removal operations must be conducted pursuant to a permit from the Division of State Lands and separated from the active flowing stream by a watertight berm wherever physically practicable. Recirculation and reuse of process water must be required wherever practicable. Discharges or seepage or leakage losses to public waters may not cause a violation of water quality standards or adversely affect legitimate beneficial uses.

(7) Road building and maintenance activities must be conducted in a manner so as to keep waste materials out of public waters and minimize erosion of cut banks, fills, and road surfaces.

(8) In order to improve controls over nonpoint sources of pollution, federal, State, and local resource management agencies will be encouraged and assisted to coordinate planning and implementation of programs to regulate or control runoff, erosion, turbidity, stream temperature, stream flow, and the withdrawal and use of irrigation water on a basin-wide approach so as to protect the quality and beneficial uses of water and related resources. Such programs may include, but not be limited to, the following:

(a) Development of projects for storage and release of suitable quality waters to augment low stream flow;

(b) Urban runoff control to reduce erosion;

(c) Possible modification of irrigation practices to reduce or minimize adverse impacts from irrigation return flows;

(d) Stream bank erosion reduction projects; and

(e) Federal water quality restoration plans.

(9) The development of fungi or other growths having a deleterious effect on stream bottoms, fish or other aquatic life, or that are injurious to health, recreation, or industry may not be allowed;

(10) The creation of tastes or odors or toxic or other conditions that are deleterious to fish or other aquatic life or affect the potability of drinking water or the palatability of fish or shellfish may not be allowed;

(11) The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry may not be allowed;

(12) Objectionable discoloration, scum, oily sheens, or floating solids, or coating of aquatic life with oil films may not be allowed;

(13) Aesthetic conditions offensive to the human senses of sight, taste, smell, or touch may not be allowed;

(14) Radioisotope concentrations may not exceed maximum permissible concentrations (MPC's) in drinking water, edible fishes or shellfishes, wildlife, irrigated crops, livestock and dairy products, or pose an external radiation hazard;

(15) Minimum Design Criteria for Treatment and Control of Wastes. Except as provided in OAR 340-041-0101 through 340-041-0350, and subject to the implementation requirements set forth in 340-041-0061, prior to discharge of any wastes from any new or modified facility to any waters of the State, such wastes must be treated and controlled in facilities designed in accordance with the following minimum criteria.

(a) In designing treatment facilities, average conditions and a normal range of variability are generally used in establishing design criteria. A facility once completed and placed in operation should operate at or near the design limit most of the time but may operate below the design criteria limit at times due to variables which are unpredictable or uncontrollable. This is particularly true for biological treatment facilities. The actual operating limits are intended to be established by permit pursuant to ORS 468.740 and recognize that the actual performance level may at times be less than the design criteria.

(A) Sewage wastes:

(i) Effluent BOD concentrations in mg/l, divided by the dilution factor (ratio of receiving stream flow to effluent flow) may not exceed one unless otherwise approved by the Commission;

(ii) Sewage wastes must be disinfected, after treatment, equivalent to thorough mixing with sufficient chlorine to provide a residual of at least 1 part per million after 60 minutes of contact time unless otherwise specifically authorized by permit;

(iii) Positive protection must be provided to prevent bypassing raw or inadequately treated sewage to public waters unless otherwise approved by the Department where elimination of inflow and infiltration would be necessary but not presently practicable; and

(iv) More stringent waste treatment and control requirements may be imposed where special conditions make such action appropriate.

(B) Industrial wastes:

(i) After maximum practicable in-plant control, a minimum of secondary treatment or equivalent control (reduction of suspended solids and organic material where present in significant quantities, effective disinfection where bacterial organisms of public health significance are present, and control of toxic or other deleterious substances);

(ii) Specific industrial waste treatment requirements may be determined on an individual basis in accordance with the provisions of this plan, applicable federal requirements, and the following:

(I) The uses that are or may likely be made of the receiving stream;

(II) The size and nature of flow of the receiving stream;

(III) The quantity and quality of wastes to be treated; and

(IV) The presence or absence of other sources of pollution on the same watershed.

(iii) Where industrial, commercial, or agricultural effluents contain significant quantities of potentially toxic elements, treatment requirements may be determined utilizing appropriate bioassays;

(iv) Industrial cooling waters containing significant heat loads must be subjected to off-stream cooling or heat recovery prior to discharge to public waters;

(v) Positive protection must be provided to prevent bypassing of raw or inadequately treated industrial wastes to any public waters;

(vi) Facilities must be provided to prevent and contain spills of potentially toxic or hazardous materials.

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03; DEQ 2-2007, f. & cert. ef. 3-15-07; DEQ 10-2011, f. & cert. ef. 7-13-11; DEQ 5-2013, f. & cert. ef. 6-21-13; DEQ 1-2015, f. & cert. ef. 1-7-15

340-041-0009

Bacteria

(1) Numeric Criteria: Organisms of the coliform group commonly associated with fecal sources (MPN or equivalent membrane filtration using a representative number of samples) may not exceed the criteria described in paragraphs (a) and (b) of this paragraph:

(a) Freshwaters and Estuarine Waters Other than Shellfish Growing Waters:

(A) A 30-day log mean of 126 E. coli organisms per 100 milliliters, based on a minimum of five (5) samples;

(B) No single sample may exceed 406 E. coli organisms per 100 milliliters.

(b) Marine Waters and Estuarine Shellfish Growing Waters: A fecal coliform median concentration of 14 organisms per 100 milliliters, with not more than ten percent of the samples exceeding 43 organisms per 100 ml.

(2) Raw Sewage Prohibition: No sewage may be discharged into or in any other manner be allowed to enter the waters of the State, unless such sewage has been treated in a manner approved by the Department or otherwise allowed by these rules;

(3) Animal Waste: Runoff contaminated with domesticated animal wastes must be minimized and treated to the maximum extent practicable before it is allowed to enter waters of the State;

(4) Bacterial pollution or other conditions deleterious to waters used for domestic purposes, livestock watering, irrigation, bathing, or shellfish propagation, or otherwise injurious to public health may not be allowed;

(5) Effluent Limitations for Bacteria: Except as allowed in subsection (c) of this section, upon NPDES permit renewal or issuance, or upon request for a permit modification by the permittee at an earlier date, effluent discharges to freshwaters, and estuarine waters other than shellfish growing waters may not exceed a monthly log mean of 126 E. coli organisms per 100 ml. No single sample may exceed 406 E. coli organisms per 100 ml. However, no violation will be found, for an exceedance if the permittee takes at least five consecutive re-samples at four-hour intervals beginning as soon as practicable (preferably within 28 hours) after the original sample was taken and the log mean of the five re-samples is less than or equal to 126 E. coli. The following conditions apply:

(a) If the Department finds that re-sampling within the timeframe outlined in this section would pose an undue hardship on a treatment facility, a more convenient schedule may be negotiated in the permit, provided that the permittee demonstrates that the sampling delay will result in no increase in the risk to water contact recreation in waters affected by the discharge;

(b) The aquatic life criteria for chlorine established in the water quality toxic substances rule under OAR 340-041-0033 must be met at all times outside the assigned mixing zone;

(c) For sewage treatment plants that are authorized to use recycled water pursuant to OAR 340, division 55, and that also use a storage pond as a means to dechlorinate their effluent prior to discharge to public waters, effluent limitations for bacteria may, upon request by the permittee, be based upon appropriate total coliform limits as required by OAR 340, division 55:

(i) Class C limitations: No two consecutive samples may exceed 240 total coliform per 100 milliliters.

(ii) Class A and Class B limitations: No single sample may exceed 23 total coliform per 100 milliliters.

(iii) No violation will be found for an exceedance under this paragraph if the permittee takes at least five consecutive re-samples at four hour intervals beginning as soon as practicable (preferably within 28 hours) after the original sample(s) were taken; and in the case of Class C recycled water, the log mean of the five re-samples is less than or equal to 23 total coliform per 100 milliliters or, in the case of Class A and Class B recycled water, if the log mean of the five re-samples is less than or equal to 2.2 total coliform per 100 milliliters.

(6) Sewer Overflows in winter: Domestic waste collection and treatment facilities are prohibited from discharging raw sewage to waters of the State during the period of November 1 through May 21, except during a storm event greater than the one-in-five-year, 24-hour duration storm. However, the following exceptions apply:

EXHIBIT 6

(a) The Commission may on a case-by-case basis approve a bacteria control management plan to be prepared by the permittee, for a basin or specified geographic area which describes hydrologic conditions under which the numeric bacteria criteria would be waived. These plans will identify the specific hydrologic conditions, identify the public notification and education processes that will be followed to inform the public about an event and the plan, describe the water quality assessment conducted to determine bacteria sources and loads associated with the specified hydrologic conditions, and describe the bacteria control program that is being implemented in the basin or specified geographic area for the identified sources;

(b) Facilities with separate sanitary and storm sewers existing on January 10, 1996, and which currently experience sanitary sewer overflows due to inflow and infiltration problems, must submit an acceptable plan to the Department at the first permit renewal, which describes actions that will be taken to assure compliance with the discharge prohibition by January 1, 2010. Where discharges occur to a receiving stream with sensitive beneficial uses, the Department may negotiate a more aggressive schedule for discharge elimination;

(c) On a case-by-case basis, the beginning of winter may be defined as October 15, if the permittee so requests and demonstrates to the Department's satisfaction that the risk to beneficial uses, including water contact recreation, will not be increased due to the date change.

(7) Sewer Overflows in summer: Domestic waste collection and treatment facilities are prohibited from discharging raw sewage to waters of the State during the period of May 22 through October 31, except during a storm event greater than the one-in-ten-year, 24-hour duration storm. The following exceptions apply:

(a) For facilities with combined sanitary and storm sewers, the Commission may on a case-by-case basis approve a bacteria control management plan such as that described in subsection (6)(a) of this rule;

(b) On a case-by-case basis, the beginning of summer may be defined as June 1 if the permittee so requests and demonstrates to the Department's satisfaction that the risk to beneficial uses, including water contact recreation, will not be increased due to the date change;

(c) For discharge sources whose permit identifies the beginning of summer as any date from May 22 through May 31: If the permittee demonstrates to the Department's satisfaction that an exceedance occurred between May 21 and June 1 because of a sewer overflow, and that no increase in risk to beneficial uses, including water contact recreation, occurred because of the exceedance, no violation may be triggered, if the storm associated with the overflow was greater than the one-in-five-year, 24-hour duration storm.

(8) Storm Sewers Systems Subject to Municipal NPDES Stormwater Permits: Best management practices must be implemented for permitted storm sewers to control bacteria to the maximum extent practicable. In addition, a collection-system evaluation must be performed prior to permit issuance or renewal so that illicit and cross connections are identified. Such connections must be removed upon identification. A collection system evaluation is not required where the Department determines that illicit and cross connections are unlikely to exist.

(9) Storm Sewers Systems Not Subject to Municipal NPDES Stormwater Permits: A collection system evaluation must be performed of non-permitted storm sewers by January 1, 2005, unless the Department determines that an evaluation is not necessary because illicit and cross connections are unlikely to exist. Illicit and cross-connections must be removed upon identification.

(10) Water Quality Limited for Bacteria: In those water bodies, or segments of water bodies identified by the Department as exceeding the relevant numeric criteria for bacteria in the basin standards and designated as water-quality limited under section 303(d) of the Clean Water Act, the requirements specified in section 11 of this rule and in OAR 340-041-0061(11) must apply.

(11) In water bodies designated by the Department as water-quality limited for bacteria, and in accordance with priorities established by the Department, development and implementation of a bacteria management plan may be required of those sources that the Department determines to be contributing to the problem. The Department may determine that a plan is not necessary for a particular stream segment or segments within a water-quality limited basin based on the contribution of the segment(s) to the problem. The bacteria management plans will identify the technologies, best management practices and/or measures and approaches to be implemented by point and nonpoint sources to limit bacterial contamination. For point sources, their National Pollutant Discharge Elimination System permit is their bacteria management plan. For nonpoint sources, the bacteria management plan will be developed by designated management agencies (DMAs) which will identify the appropriate best management practices or measures and approaches.

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03; DEQ 6-2008, f. & cert. ef. 5-5-08; DEQ 10-2011, f. & cert. ef. 7-13-11; DEQ 16-2013, f. & cert. ef. 12-23-13

340-041-0011

Biocriteria

Waters of the State must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities.

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 14-1991, f. & cert. ef. 8-13-91; Renumbered from 340-041-0027 by DEQ 17-2003, f. & cert. ef. 12-9-03

340-041-0016

Dissolved Oxygen

Dissolved oxygen (DO): No wastes may be discharged and no activities may be conducted that either alone or in combination with other wastes or activities will cause violation of the following standards: The changes adopted by the Commission on January 11, 1996, become effective July 1, 1996. Until that time, the requirements of this rule that were in effect on January 10, 1996, apply:

(1) For water bodies identified as active spawning areas in the places and times indicated on the following Tables and Figures set out in OAR 340-041-0101 to 340-041-0340: Tables 101B, 121B, and 190B, and Figures 130B, 151B, 160B, 170B, 180A, 201A, 220B, 230B, 260A, 271B, 286B, 300B, 310B, 320B, and 340B, (as well as any active spawning area used by resident trout species), the following criteria apply during the applicable spawning through fry emergence periods set forth in the tables and figures and, where resident trout spawning occurs, during the time trout spawning through fry emergence occurs:

(a) The dissolved oxygen may not be less than 11.0 mg/l. However, if the minimum intergravel dissolved oxygen, measured as a spatial median, is 8.0 mg/l or greater, then the DO criterion is 9.0 mg/l;

(b) Where conditions of barometric pressure, altitude, and temperature preclude attainment of the 11.0 mg/l or 9.0 mg/l criteria, dissolved oxygen levels must not be less than 95 percent of saturation;

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(c) The spatial median intergravel dissolved oxygen concentration must not fall below 8.0 mg/l.

(2) For water bodies identified by the Department as providing cold-water aquatic life, the dissolved oxygen may not be less than 8.0 mg/l as an absolute minimum. Where conditions of barometric pressure, altitude, and temperature preclude attainment of the 8.0 mg/l, dissolved oxygen may not be less than 90 percent of saturation. At the discretion of the Department, when the Department determines that adequate information exists, the dissolved oxygen may not fall below 8.0 mg/l as a 30-day mean minimum, 6.5 mg/l as a seven-day minimum mean, and may not fall below 6.0 mg/l as an absolute minimum (Table 21);

(3) For water bodies identified by the Department as providing cool-water aquatic life, the dissolved oxygen may not be less than 6.5 mg/l as an absolute minimum. At the discretion of the Department, when the Department determines that adequate information exists, the dissolved oxygen may not fall below 6.5 mg/l as a 30-day mean minimum, 5.0 mg/l as a seven-day minimum mean, and may not fall below 4.0 mg/l as an absolute minimum (Table 21);

(4) For water bodies identified by the Department as providing warm-water aquatic life, the dissolved oxygen may not be less than 5.5 mg/l as an absolute minimum. At the discretion of the Department, when the Department determines that adequate information exists, the dissolved oxygen may not fall below 5.5 mg/l as a 30-day mean minimum, and may not fall below 4.0 mg/l as an absolute minimum (Table 21);

(5) For estuarine water, the dissolved oxygen concentrations may not be less than 6.5 mg/l (for coastal water bodies);

(6) For ocean waters, no measurable reduction in dissolved oxygen concentration may be allowed.

[ED. NOTE: Tables referenced are available from the agency.]

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03; DEQ 2-2007, f. & cert. ef. 3-15-07

340-041-0019

Nuisance Phytoplankton Growth

(1)(a) The following values and implementation program must be applied to lakes, reservoirs, estuaries and streams, except for ponds and reservoirs less than ten acres in surface area, marshes and saline lakes:

(b) The following average Chlorophyll a values must be used to identify water bodies where phytoplankton may impair the recognized beneficial uses:

(A) Natural lakes that thermally stratify: 0.01 mg/1;

(B) Natural lakes that do not thermally stratify, reservoirs, rivers and estuaries: 0.015 mg/1;

(C) Average Chlorophyll a values may be based on the following methodology (or other methods approved by the Department): A minimum of three samples collected over any three consecutive months at a minimum of one representative location (e.g., above the deepest point of a lake or reservoir or at a point mid-flow of a river) from samples integrated from the surface to a depth equal to twice the secchi depth or the bottom (the lesser of the two depths); analytical and quality assurance methods must be in accordance with the most recent edition of Standard Methods for the Examination of Water and Wastewater.

(2) Upon determination by the Department that the values in section (1) of this rule are exceeded, the Department may:

(a) In accordance with a schedule approved by the Commission, conduct such studies as are necessary to describe present water quality; determine the impacts on beneficial uses; determine the probable causes of the exceedance and beneficial use impact; and develop a proposed control strategy for attaining compliance where technically and economically practicable. Proposed strategies could include standards for additional pollutant parameters, pollutant discharge load limitations, and other such provisions as may be appropriate. Where natural conditions are responsible for exceedance of the values in section (1) of this rule or beneficial uses are not impaired, the values in section (1) of this rule may be modified to an appropriate value for that water body;

(b) Conduct necessary public hearings preliminary to adoption of a control strategy, standards or modified values after obtaining Commission authorization;

(c) Implement the strategy upon adoption by the Commission.

(3) In cases where waters exceed the values in section (1) of this rule and the necessary studies are not completed, the Department may approve new activities (which require Department approval), new or additional (above currently approved permit limits) discharge loadings from point sources provided that it is determined that beneficial uses would not be significantly impaired by the new activity or discharge.

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 7-1986, f. & ef. 3-26-86; Renumbered from 340-041-0150 by DEQ 17-2003, f. & cert. ef. 12-9-03

340-041-0021

pH

(1) Unless otherwise specified in OAR 340-041-0101 through 340-041-0350, pH values (Hydrogen ion concentrations) may not fall outside the following ranges:

(a) Marine waters: 7.0-8.5;

(b) Estuarine and fresh waters: See basin specific criteria (OAR 340-041-0101 through 340-041-0350).

(2) Waters impounded by dams existing on January 1, 1996, which have pHs that exceed the criteria are not in violation of the standard, if the Department determines that the exceedance would not occur without the impoundment and that all practicable measures have been taken to bring the pH in the impounded waters into compliance with the criteria.

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048

(g) Release of Stored Water. Stored cold water may be released from reservoirs to cool downstream waters in order to achieve compliance with the applicable numeric criteria. However, there can be no significant adverse impact to downstream designated beneficial uses as a result of the releases of this cold water, and the release may not contribute to violations of other water quality criteria. Where the Department determines that the release of cold water is resulting in a significant adverse impact, the Department may require the elimination or mitigation of the adverse impact.

(13) Site-Specific Criteria. The Department may establish, by separate rulemaking, alternative site-specific criteria for all or a portion of a water body that fully protects the designated use.

(a) These site-specific criteria may be set on a seasonal basis as appropriate.

(b) The Department may use, but is not limited by the following considerations when calculating site-specific criteria:

(A) Stream flow;

(B) Riparian vegetation potential;

(C) Channel morphology modifications;

(D) Cold water tributaries and groundwater;

(E) Natural physical features and geology influencing stream temperatures; and

(F) Other relevant technical data.

(c) DEQ may consider the thermal benefit of increased flow when calculating the site-specific criteria.

(d) Once established and approved by EPA, the site-specific criteria will be the applicable criteria for the water bodies affected.

[ED. NOTE: Tables referenced are available from the agency.]

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03; DEQ 1-2007, f. & cert. ef. 3-14-07; DEQ 2-2007, f. & cert. ef. 3-15-07; DEQ 10-2011, f. & cert. ef. 7-13-11; DEQ 5-2013, f. & cert. ef. 6-21-13; DEQ 1-2015, f. & cert. ef. 1-7-15

340-041-0031

Total Dissolved Gas

(1) Waters will be free from dissolved gases, such as carbon dioxide hydrogen sulfide, or other gases, in sufficient quantities to cause objectionable odors or to be deleterious to fish or other aquatic life, navigation, recreation, or other reasonable uses made of such water.

(2) Except when stream flow exceeds the ten-year, seven-day average flood, the concentration of total dissolved gas relative to atmospheric pressure at the point of sample collection may not exceed 110 percent of saturation. However, in hatchery-receiving waters and other waters of less than two feet in depth, the concentration of total dissolved gas relative to atmospheric pressure at the point of sample collection may not exceed 105 percent of saturation.

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03

340-041-0032

Total Dissolved Solids (TDS)

Total Dissolved Solids: Total Dissolved Solids: The concentrations listed in the basin specific criteria found in OAR 340-041-0101 through 340-041-0350, may not be exceeded unless otherwise specifically authorized by DEQ upon such conditions as it may deem necessary.

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03; DEQ 2-2007, f. & cert. ef. 3-15-07

340-041-0033

Toxic Substances

Effectiveness. Amendments to this rule and associated revisions to Table 30 under OAR 340-041-8033 do not become applicable for purposes of ORS chapter 468B or the federal Clean Water Act until EPA approves the revisions it identifies as water quality standards according to 40 CFR 131.21 (4/27/2000).

(1) Toxic Substances Narrative. Toxic substances may not be introduced above natural background levels in waters of the state in amounts, concentrations, or combinations that may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediments or bioaccumulate in aquatic life or wildlife to levels that adversely affect public health, safety, or welfare or aquatic life, wildlife or other designated beneficial uses.

(2) Aquatic Life Numeric Criteria. Levels of toxic substances in waters of the state may not exceed the applicable aquatic life criteria listed in Table 30 under OAR 340-041-8033.

(3) Human Health Numeric Criteria. The criteria for waters of the state listed in Table 40 under OAR 340-041-8033 are established to protect Oregonians from potential adverse health effects associated with long-term exposure to toxic substances associated with consumption of fish, shellfish and water.

(4) To establish permit or other regulatory limits for toxic substances without criteria in Table 30 under OAR 340-041-8033 or Table 40 under 340-041-8033, DEQ may use the guidance values in Table 31 under 340-041-8033, public health advisories, and published scientific literature. DEQ may also require or conduct bio-assessment studies to monitor the toxicity to aquatic life of complex effluents, other suspected discharges or chemical

(e) Procedure to derive a site-specific human health water quality criterion to address a background pollutant:

(A) DEQ will develop a flow-weighted characterization of the relevant flows and pollutant concentrations of the receiving waterbody, effluent and all facility intake pollutant sources to determine the fate and transport of the pollutant mass.

(i) The pollutant mass in the effluent discharged to a receiving waterbody may not exceed the mass of the intake pollutant from the same body of water.

(ii) Where a facility discharges intake pollutants from multiple sources that originate from the receiving waterbody and from other waterbodies, DEQ will calculate the flow-weighted amount of each source of the pollutant in the characterization.

(iii) Where a municipal water supply system provides intake water for a facility and the supplier provides treatment of the raw water that removes an intake water pollutant, the concentration and mass of the intake water pollutant must be determined at the point where the water enters the water supplier's distribution system.

(B) Using the flow weighted characterization developed in section (5)(e)(A), DEQ will calculate the in-stream pollutant concentration following mixing of the discharge into the receiving water. DEQ will use the resultant concentration to determine the conditions in section (5)(d)(A) and (B).

(C) Using the flow-weighted characterization, DEQ will calculate the in-stream pollutant concentration based on an increase of 3 percent above background pollutant concentration. DEQ will use the resultant concentration to determine the condition in Section (5)(d)(C).

(i) For the main stem Willamette and Columbia Rivers, DEQ will use 25 percent of the harmonic mean flow of the waterbody.

(ii) For all other waters, DEQ will use 100 percent of the harmonic mean flow or similar critical flow value of the waterbody.

(D) DEQ will select the most conservative of the following values as the site-specific water quality criterion.

(i) The projected in-stream pollutant concentration described in section (5)(e)(B);

(ii) The in-stream pollutant concentration based on an increase of 3 percent above background described in section (5)(e)(C); or

(iii) A water quality criterion based on a risk level of 1 x 10-4.

(f) Calculation of water quality based effluent limits based on a site-specific background pollutant criterion:

(A) For discharges to receiving waters with a site-specific background pollutant criterion, DEQ will use the site-specific criterion in the calculation of a numeric water quality based effluent limit.

(B) DEQ will compare the calculated water quality based effluent limits to any applicable aquatic toxicity or technology based effluent limits and select the most conservative for inclusion in the permit conditions.

(g) In addition to the water quality based effluent limits described in section (5)(f), DEQ will calculate a mass-based limit where necessary to ensure that the condition described in section (5)(c)(B) is met. Where mass-based limits are included, the permit will specify how DEQ will assess compliance with mass-based effluent limitations.

(h) The permit shall include a provision requiring DEQ to consider the re-opening of the permit and re-evaluation of the site-specific background pollutant criterion if new information shows the discharger no longer meets the conditions described in subsections (5)(c) and (e).

(i) Public Notification Requirements.

(A) If DEQ proposes to grant a site-specific background pollutant criterion, it must provide public notice of the proposal and hold a public hearing. The public notice may be included in the public notification of a draft NPDES permit or other draft regulatory decision that would rely on the criterion and will also be published on DEQ's water quality standards website;

(B) DEQ will publish a list of all site-specific background pollutant criteria approved according to this rule. DEQ will add the criterion to this list within 30 days of its effective date. The list will identify the:

(i) Permittee;

(ii) Site-specific background pollutant criterion and the associated risk level;

(iii) Waterbody to which the criterion applies;

(iv) Allowable pollutant effluent limit; and

(v) How to obtain additional information about the criterion.

(6) Arsenic Reduction Policy: The inorganic arsenic criterion for the protection of human health from the combined consumption of organisms and drinking water is 2.1 micrograms per liter. While this criterion is protective of human health and more stringent than the federal maximum contaminant level (MCL) for arsenic in drinking water, which is 10 micrograms per liter, it is based on a higher risk level than EQC used to establish other human health criteria. This higher risk level recognizes that much of the risk is due to naturally high levels of inorganic arsenic in Oregon's waterbodies. In order to maintain the lowest human health risk from inorganic arsenic in drinking water, EQC determined that it is appropriate to adopt the following policy to limit the human contribution to that risk.

(a) It is EQC policy to reduce the addition of inorganic arsenic from new or existing anthropogenic sources to waters of the state within a surface water drinking water protection area to the maximum amount feasible. The requirements of this rule section (OAR 340-041-0033(6)) apply to sources that discharge to surface waters of the state with an ambient inorganic arsenic concentration equal to or lower than the applicable numeric inorganic arsenic criteria for the protection of human health.

(b) Definitions. As used in this section:

(A) "Add inorganic arsenic" means to discharge a net mass of inorganic arsenic from a point source (the mass of inorganic arsenic discharged minus the mass of inorganic arsenic taken into the facility from a surface water source).

(B) A "surface water drinking water protection area," means an area delineated as such by DEQ under the source water assessment program of the quality limited, the time of year the water quality standards violations occur, the segment of stream or area of water body limited, the parameter(s) of concern, and whether it is water quality limited under the definition of "Water Quality Limited" in OAR 340-041-0002. Appendix B and C of the Status Assessment report will identify the specific evaluation process for designating water bodies limited;

(2) The water quality limited list contained in Appendix A of the Status Assessment report will be placed on public notice and reviewed through the public hearing process. At the conclusion of the hearing process and the evaluation of the testimony, Appendix A will become the official water quality limited list. The Department may add a water body to the water quality limited list between status assessment reports after placing that action out on public notice and conducting a public hearing;

(3) For interstate water bodies, the State is responsible for completing the requirements of OAR 340-041-0004(9) of this rule for that portion of the interstate water body within the boundary of the State;

(4) For water bodies designated as water quality limited under sub-section (c) of the definition of "Water Quality Limited" in OAR 340-041-0002, the Department will establish a priority list and schedule for future water quality monitoring activities to determine: if the water body should be designated as water quality limited under sub-sections (a) or (b) of the definition of "Water Quality Limited" in OAR 340-041-0002, if estimated TMDLs need to be prepared, and if an implementation plan needs to be developed and implemented;

(5) For water bodies designated as water quality limited under sub-section (b) of the definition of "Water Quality Limited" in OAR 340-041-0002, requests for load increases may be considered using the process set out in OAR 340-041-0004(9)(b) of this rule.

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03; DEQ 2-2007, f. & cert. ef. 3-15-07

340-041-0053

Mixing Zones

(1) The Department may allow a designated portion of a receiving water to serve as a zone of dilution for wastewaters and receiving waters to mix thoroughly and this zone will be defined as a mixing zone;

(2) The Department may suspend all or part of the water quality standards, or set less restrictive standards in the defined mixing zone, provided that the following conditions are met:

(a) A point source for which the mixing zone is established may not cause or significantly contribute to any of the following:

(A) Materials in concentrations that will cause acute toxicity to aquatic life as measured by a Department approved bioassay method. Acute toxicity is lethal to aquatic life as measured by a significant difference in lethal concentration between the control and 100 percent effluent in an acute bioassay test. Lethality in 100 percent effluent may be allowed due to ammonia and chlorine only when it is demonstrated on a case-by-case basis that immediate dilution of the effluent within the mixing zone reduces toxicity below lethal concentrations. The Department may on a case-by-case basis establish a zone of immediate dilution if appropriate for other parameters;

(B) Materials that will settle to form objectionable deposits;

(C) Floating debris, oil, scum, or other materials that cause nuisance conditions; and

(D) Substances in concentrations that produce deleterious amounts of fungal or bacterial growths.

(b) A point source for which the mixing zone is established may not cause or significantly contribute to any of the following conditions outside the boundary of the mixing zone:

(A) Materials in concentrations that will cause chronic (sublethal) toxicity. Chronic toxicity is measured as the concentration that causes long-term sublethal effects, such as significantly impaired growth or reproduction in aquatic organisms, during a testing period based on test species life cycle. Procedures and end points will be specified by the Department in wastewater discharge permits;

(B) Exceedances of any other water quality standards under normal annual low flow conditions.

(c) The limits of the mixing zone must be described in the wastewater discharge permit. In determining the location, surface area, and volume of a mixing zone area, the Department may use appropriate mixing zone guidelines to assess the biological, physical, and chemical character of receiving waters, effluent, and the most appropriate placement of the outfall, to protect instream water quality, public health, and other beneficial uses. Based on receiving water and effluent characteristics, the Department will define a mixing zone in the immediate area of a wastewater discharge to:

(A) Be as small as feasible;

(B) Avoid overlap with any other mixing zones to the extent possible and be less than the total stream width as necessary to allow passage of fish and other aquatic organisms;

(C) Minimize adverse effects on the indigenous biological community, especially when species are present that warrant special protection for their economic importance, tribal significance, ecological uniqueness, or other similar reasons determined by the Department and does not block the free passage of aquatic life;

(D) Not threaten public health;

(E) Minimize adverse effects on other designated beneficial uses outside the mixing zone.

(d) Temperature Thermal Plume Limitations. Temperature mixing zones and effluent limits authorized under 340-041-0028(12)(b) will be established to prevent or minimize the following adverse effects to salmonids inside the mixing zone:

(A) Impairment of an active salmonid spawning area where spawning redds are located or likely to be located. This adverse effect is prevented or minimized by limiting potential fish exposure to temperatures of 13 degrees Celsius (55.4 Fahrenheit) or more for salmon and steelhead, and 9 degrees Celsius (48 degrees Fahrenheit) or more for bull trout;

(B) Acute impairment or instantaneous lethality is prevented or minimized by limiting potential fish exposure to temperatures of 32.0 degrees Celsius (89.6 degrees Fahrenheit) or more to less than 2 seconds);

(C) Thermal shock caused by a sudden increase in water temperature is prevented or minimized by limiting potential fish exposure to temperatures of 25.0 degrees Celsius (77.0 degrees Fahrenheit) or more to less than 5 percent of the cross section of 100 percent of the 7Q10 low flow of the water body; the Department may develop additional exposure timing restrictions to prevent thermal shock; and

(D) Unless the ambient temperature is 21.0 degrees of greater, migration blockage is prevented or minimized by limiting potential fish exposure to temperatures of 21.0 degrees Celsius (69.8 degrees Fahrenheit) or more to less than 25 percent of the cross section of 100 percent of the 7Q10 low flow of the water body.

(e) The Department may request the applicant of a permitted discharge for which a mixing zone is required, to submit all information necessary to define a mixing zone, such as:

(A) Type of operation to be conducted;

(B) Characteristics of effluent flow rates and composition;

(C) Characteristics of low flows of receiving waters;

(D) Description of potential environmental effects;

(E) Proposed design for outfall structures.

(f) The Department may, as necessary, require mixing zone monitoring studies and/or bioassays to be conducted to evaluate water quality or biological status within and outside the mixing zone boundary;

(g) The Department may change mixing zone limits or require the relocation of an outfall, if it determines that the water quality within the mixing zone adversely affects any existing beneficial uses in the receiving waters.

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03; DEQ 1-2007, f. & cert. ef. 3-14-07; DEQ 2-2007, f. & cert. ef. 3-15-07

340-041-0057

Implementation at Domestic Wastewater Treatment Works

(1) Oregon's publicly owned sewerage utilities have since 1956 developed an increasing reliance on federal sewerage works construction grant funds to meet a major portion of the cost of their sewerage works construction needs. This reliance did not appear unreasonable based on federal legislation passed up through 1978. Indeed, the Environmental Quality Commission (Commission) has routinely approved compliance schedules with deadlines contingent on federal funding. This reliance no longer appears reasonable based on recent and proposed legislative actions and appropriations and the general state of the nation's economy.

(2) The federal funds expected for future years will address a small percentage of Oregon's sewerage works construction needs. Thus, continued reliance by DEQ and public agencies on federal funding for sewerage works construction will not assure that sewage from a growing Oregon population will be adequately treated and disposed of so that health hazards and nuisance conditions are prevented, and beneficial uses of public waters are not threatened or impaired by quality degradation.

(3) Therefore, the following statements of policy are established to guide future sewerage works planning and construction:

(a) The Commission remains strongly committed to its historic program of preventing water quality problems by requiring control facilities to be provided prior to the connection of new or increased waste loads;

(b) The Commission urges each sewerage utility in Oregon to develop, as soon as practicable, a financing plan that will ensure that future sewerage works construction, operation, maintenance and replacement needs can be met in a timely manner. Such financing plans will be a prerequisite to Department issuance of permits for new or significantly modified sewerage facilities, for approval of plans for new or significantly modified sewerage facilities, or for access to funding assistance from the State pollution control bond fund. The Department may accept assurance of development of such financing plan if necessary to prevent delay in projects already planned and in the process of implementation. The Department will work with the League of Oregon Cities and others as necessary to aid in the development of financing plans;

(c) No sewerage utility should assume that it will receive grant assistance to aid in addressing its planning and construction needs;

(d) Existing sewerage facility plans that are awaiting design and construction should be updated where necessary to include:

(A) Evaluation of additional alternatives where appropriate, and re-evaluation of costs of existing alternatives;

(B) Identification and delineation of phased construction alternatives; and

(C) A financing plan which will assure ability to construct facilities over an appropriate time span with locally derived funds.

(e) New sewerage works facility planning initiated after October 1, 1981 should not be approved without adequate consideration of alternatives and phased construction options, and without a financing plan which assures adequate funding for construction, operation, maintenance and replacement of sewerage facilities:

(A) The Commission recognizes that many cities in need of immediate sewerage works construction have completed planning and are awaiting design or construction funding. These cities have developed their program relying on 75 percent federal grants. They will have difficulty developing and implementing alternatives to fund immediate construction needs. Many are, or will be, under moratoriums on new connections because existing facilities are at, or near, capacity. The Commission will consider the following interim measures as a means of assisting these cities to get on a self-supporting basis provided that an approvable long-range program is presented:

(i) Temporary increases in waste discharge loading may be approved provided a minimum of secondary treatment, or equivalent control is maintained and beneficial uses of the receiving waterway are not impaired;

(ii) Installation and operation of temporary treatment works may be approved providing:

(I) The area served is inside an approved urban growth boundary and the proposal is consistent with State Land Use Planning laws;

The following TMDLs have been approved by EPA, and appear on the Department's web site:

Clear Lake -- Phosphorus -- December 8, 1992

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03

340-041-0225

Water Quality Standards and Policies for this Basin

(1) pH (hydrogen ion concentration). pH values may not fall outside the following ranges:

(a) Marine waters: 7.0-8.5;

(b) Estuarine and fresh waters: 6.5-8.5.

(2) Total Dissolved Solids. Guide concentrations listed below may not be exceeded unless otherwise specifically authorized by DEQ upon such conditions as it may deem necessary to carry out the general intent of this plan and to protect the beneficial uses set forth in OAR 340-04l-0220: 100.0 mg/l.

(3) Nutrients in Clear Lake Watershed. In order to preserve the existing high quality water in Clear Lake north of Florence for use as a public water supply source requiring only minimal filtration, it is the policy of the Environmental Quality Commission to protect the Clear Lake watershed including both surface and groundwater, from existing and potential contamination sources with the following requirements:

(a) The total phosphorus maximum annual loading discharged into Clear Lake may not exceed 241 pounds per year from all sources.

(b) The total phosphorus maximum annual loading for the Clear Lake watershed may be deemed exceeded if the median concentration of total phosphorus from samples collected in the epilimnion between May 1 and September 30 exceed nine micrograms per liter during two consecutive years.

(c) Of the total phosphorus loading of 241 pounds per year specified in section (1) of this rule, 192 pounds per year will be considered current background and Department reserve and is not available to other sources.

(d) The total phosphorus maximum annual loading discharged into Collard Lake may not exceed 123 pounds per year.

(e) If water quality monitoring within the Clear Lake watershed indicates degradation, the Commission may require additional studies, corrective actions, or both, by rule. Such corrective actions may include but are not limited to the construction of sewage collection and off-site treatment and disposal facilities.

(4) Minimum Design Criteria for Treatment and Control of Sewage Wastes:

(a) During periods of low stream flows (approximately May 1 to October 31): Treatment resulting in monthly average effluent concentrations not to exceed 20 mg/l of BOD and 20 mg/l of SS, or equivalent control;

(b) During the period of high stream flows (approximately November 1 to April 30) and for direct ocean discharges: a minimum of secondary treatment or equivalent control, and unless otherwise specifically authorized by the Department, operation of all waste treatment and control facilities at maximum practicable efficiency and effectiveness so as to minimize waste discharges to public waters.

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03

Basin-Specific Criteria (North Coast)

340-041-0230

Beneficial Uses to Be Protected in the North Coast Basin

(1) Water quality in the North Coast Basin (see Figure 1) must be managed to protect the designated beneficial uses shown in Table 230A (November 2003).

(2) Designated fish uses to be protected in the North Coast Basin are shown in Figures 230A and 230B (November 2003).

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03

340-041-0234

Approved TMDLs in the Basin:

The following TMDLs have been approved by EPA, and appear on the Department's web site:

Nestucca Bay Drainage -- Temperature, Bacteria and Sediment -- May 13, 2002

Tillamook Bay Drainage -- Temperature and Bacteria -- July 31, 2001

North Coast -- Temperature and Bacteria -- August 20, 2003

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03

340-041-0235

EXHIBIT 6

Water Quality Standards and Policies for this Basin

(1) pH (hydrogen ion concentration). pH values may not fall outside the following ranges:

(a) Marine waters: 7.0-8.5;

(b) Estuarine and fresh waters: 6.5-8.5.

(2) Total Dissolved Solids. Guide concentrations may not be exceeded unless otherwise specifically authorized by DEQ upon such conditions as it may deem necessary to carry out the general intent of this plan and to protect the beneficial uses set forth in OAR 340-04l-0230: All Fresh Water Streams and Tributaries (other than the main stem Columbia River) -- 100.0 mg/l.

(3) Minimum Design Criteria for Treatment and control of Sewage Wastes in this Basin:

(a) During periods of low stream flows (approximately April 1 to October 31): Treatment resulting in monthly average effluent concentrations not to exceed 20 mg/l of BOD and 20 mg/l of SS or equivalent control;

(b) During the period of high stream flows (approximately November 1 to April 30): A minimum of secondary treatment or equivalent control and unless otherwise specifically authorized by the Department, operation of all waste treatment and control facilities at maximum practicable efficiency and effectiveness so as to minimize waste discharges to public waters.

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03; DEQ 2-2007, f. & cert. ef. 3-15-07

Basin-Specific Criteria (Owyhee)

340-041-0250

Beneficial Uses to Be Protected in the Owyhee Basin

(1) Water quality in the Owyhee Basin (see Figure 1) must be managed to protect the designated beneficial uses shown in Table 250A (November 2003).

(2) Designated fish uses to be protected in the Owyhee Basin are shown in Table 250B (November 2003).

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03

340-041-0254

Approved TMDLs in the Basin:

The following TMDLs have been approved by EPA, and appear on the Department's web site: None.

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03

340-041-0256

Water Quality Standards and Policies for this Basin

(1) pH (hydrogen ion concentration). pH values may not fall outside the range of 7.0 to 9.0. When greater than 25 percent of ambient measurements taken between June and September are greater than pH 8.7, and as resources are available according to priorities set by the Department, the Department will determine whether the values higher than 8.7 are anthropogenic or natural in origin.

(2) Total Dissolved Solids. Guide concentrations listed below may not be exceeded unless otherwise specifically authorized by DEQ upon such conditions as it may deem necessary to carry out the general intent of this plan and to protect the beneficial uses set forth in OAR 340-041-0250: Snake River -- 750.0 mg/l.

(3) Minimum Design Criteria for Treatment and Control of Sewage Wastes: a minimum of secondary treatment or equivalent control and unless otherwise specifically authorized by the Department, operation of all waste treatment and control facilities at maximum practicable efficiency and effectiveness so as to minimize waste discharges to public waters.

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03

Basin-Specific Criteria (Powder/Burnt)

340-041-0260

Beneficial Uses to Be Protected in the Powder/Burnt Basins

(1) Water quality in the Powder/Burnt Basins (see Figure 1) must be managed to protect the designated beneficial uses shown in Table 260A (August 2005).

(2) Designated fish uses to be protected in the Powder/Burnt Basins are shown in Figure 260A (November 2003).

[ED. NOTE: Tables referenced are available from the agency.]

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048

effectiveness so as to minimize waste discharges to public waters.

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03

Basin-Specific Criteria (Sandy Basin)

340-041-0286

Beneficial Uses to Be Protected in the Sandy Basin

(1) Water quality in the Sandy Basin (see Figure 1) must be managed to protect the designated beneficial uses shown in Table 286A (November 2003).

(2) Designated fish uses to be protected in the Sandy Basin are shown in Figures 286A and 286B (November 2003).

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03

340-041-0289

Approved TMDLs in the Basin:

The following TMDLs have been approved by EPA, and appear on the Department's web site: None.

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03

340-041-0290

Water Quality Standards and Policies for this Basin

(1) pH (hydrogen ion concentration). pH values may not fall outside the following ranges:

(a) All Basin waters (except main stem Columbia River and Cascade lakes): pH values may not fall outside the range of 6.5 to 8.5;

(b) Cascade lakes above 3,000 feet altitude: pH values may not fall outside the range of 6.0 to 8.5.

(2) Total Dissolved Solids. Guide concentrations listed below may not be exceeded unless otherwise specifically authorized by DEQ upon such conditions as it may deem necessary to carry out the general intent of this plan and to protect the beneficial uses set forth in OAR 340-041-0286: All Basin Waters (other than the main stem Columbia river) -- 100.0 mg/l.

(3)(a) Minimum Design Criteria for Treatment and Control of Sewage Wastes:

(b) All Basin waters (except main stem Columbia River):

(A) During periods of low stream flows (approximately June 1 to October 31): Treatment resulting in monthly average effluent concentrations not to exceed 10 mg/l of BOD and 10 mg/l of SS or equivalent control;

(B) During the period of high stream flows (approximately November 1 to May 31): A minimum of secondary treatment or equivalent control and unless otherwise specifically authorized by the Department, operation of all waste treatment and control facilities at maximum practicable efficiency and effectiveness so as to minimize waste discharges to public waters.

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03

Basin-Specific Criteria (South Coast)

340-041-0300

Beneficial Uses to Be Protected in the South Coast Basin

(1) Water quality in the South Coast Basin (see Figure 1) must be managed to protect the designated beneficial uses shown in Table 300A (November 2003).

(2) Designated fish uses to be protected in the South Coast Basin are shown in Figures 300A (August 2005) and 300B (November 2003).

[ED. NOTE: Tables referenced are available from the agency.]

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03; DEQ 2-2007, f. & cert. ef. 3-15-07

340-041-0304

Approved TMDLs in the Basin

The following TMDLs have been approved by EPA, and appear on the Department's web site:

Coquille -- BOD -- July 3, 1996

Upper South Fork of the Coquille -- Temperature -- March 23, 2001

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Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03

340-041-0305

Water Quality Standards and Policies for this Basin

(1) pH (Hydrogen ion concentration) pH values may not fall outside the following ranges:

(a) Estuarine and fresh waters: 6.5-8.5.

(b) Marine waters: 7.0-8.5.

(2) Total Dissolved Solids. Guide concentrations listed below may not be exceeded unless otherwise specifically authorized by DEQ upon such conditions as it may deem necessary to carry out the general intent of this plan and to protect the beneficial uses set forth in OAR 340-04l-0300: 100.0 mg/l.

(3) Minimum Design Criteria for Treatment and Control of Sewage Wastes:

(a) During periods of low stream flows (approximately May 1 to October 31): Treatment resulting in monthly average effluent concentrations not to exceed 20 mg/l of BOD and 20 mg/l of SS or equivalent control;

(b) During the period of high stream flows (approximately November 1 to April 30) and for direct ocean discharges: A minimum of secondary treatment or equivalent control and unless otherwise specifically authorized by the Department, operation of all waste treatment and control facilities at maximum practicable efficiency and effectiveness so as to minimize waste discharges to public waters.

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03

Basin-Specific Criteria (Umatilla)

340-041-0310

Beneficial Uses to Be Protected in the Umatilla Basin

(1) Water quality in the Umatilla Basin (see Figure 1) must be managed to protect the designated beneficial uses shown in Table 310A (January 2015).

(2) Designated fish uses to be protected in the Umatilla Basin are shown in Figures 310A and 310B (November 2003, except as noted in Table 310A).

[ED. NOTE: Tables referenced are not included in rule text. Click here for PDF copy of table(s).]

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03; DEQ 3-2012, f. & cert. ef. 5-21-12; DEQ 1-2015, f. & cert. ef. 1-7-15

340-041-0314

Approved TMDLs in the Basin:

The following TMDLs have been approved by EPA, and appear on the Department's web site:

Umatilla River Basin -- Temperature, pH, Sediment, Turbidity, Aquatic Weeds, and Algae -- May 9, 2001

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03

340-041-0315

Water Quality Standards and Policies for this Basin

(1) pH (hydrogen ion concentration). pH values may not fall outside the following range: all Basin streams except the main stem Columbia River and the “constructed channel” segment of the West Division Main Canal: 6.5-9.0. When more than 25 percent of ambient measurements taken between June and September are greater than pH 8.7, and as resources are available according to priorities set by DEQ, DEQ will determine whether the values higher than 8.7 are anthropogenic or natural in origin.

(2) The following criteria apply to the “constructed channel” segment of the West Division Main Canal and supersede the water quality standards in OAR 340-041-0011 through 340-041-0036 for the “constructed channel” segment of the canal. The criteria in (b) and (c) also apply to the “overflow channels” segment of the West Division Main Canal.

(a) Canal waters may not exceed the numeric criteria shown in Table 315 from the uppermost irrigation withdrawal to the end of the “constructed channel” segment of the canal.

(b) Toxic substances must not be present in canal waters in amounts likely to singularly or in combination harm the designated beneficial uses of the canal or downstream waters.

(c) Sediment load and particulate size shall not exceed levels that interfere with irrigation or the other designated beneficial uses of the canal;

(d) pH values may not fall outside the range of 4.5 to 9.0.

(3) Minimum Design Criteria for Treatment and control of Sewage Wastes in this Basin:

(a) During periods of low stream flows (approximately April 1 to October 31): Treatment resulting in monthly average effluent concentrations not to

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Table 21 – Coos Sub-basin Recreational Contact Bacterial Summary				
Site Type	**Sample Description**	**log mean *E. coli* /N**	**Maximum *E. coli***	**%Reduction log mean/max**
	Larson Creek at mouth	323/16	4611	61/91
	Larson Creek at first bridge U/S of mouth	622/19	9800	80/96
	Larson Ck at second bridge U/S of dairy	19/19	189	0/0
	Sullivan Creek at mouth	87/19	2419	0/83
	Palouse Creek at mouth	75/20	1515	0/73
	Palouse Creek at first bridge U/S of mouth	410/4	1092	69/63
	Palouse Creek at Mile Post 4	175/4	341	28/0
	Palouse Creek at Elliott Keyhole	58/2	108	0/0
	Pony Creek So of North Bend High School	200/21	743	37/45
	Pony Slough at Coca Cola bottling plant	111/21	1670	0/76
	Isthmus Slough at Eastside Bridge	27/15	259	0/0
	Shingle House Slough at mouth	28/19	471	0/14
	Davis Slough at Highway 101	32/19	294	0/0
	Noble Creek at tidegate	98/20	1259	0/68
	Coos Bay at entrance to Haynes Inlet at Marker #1	26/8	328	0/0
	Haynes Inlet at Clausen Dock	10/4	148	
	Hollow Stump Creek upstream of tidegate	5/3	41	
	North Slough at mouth (Causeway Bridge)	34/11	850	0/52
	North Slough U/S of tidegate	146/20	2143	14/81
Coos Bay Estuary	Cooston Channel at south end	19/9	41	0/0
	Coos Bay at mouth of Marshfield Channel	36/10	292	
	Coos Bay at City Dock	26/5	63	
	Coos Bay at Pierce Point Channel	34/10	98	
	Coos Bay at Silver Point 3	29/10	75	
	Coos Bay at Silver Point 4,5,6	21/10	98	
	Coos Bay at Silver Point 7	20/10	85	
	Coos Bay at Silver Point 8,9	34/10	199	
	Coos Bay at Jordan Point	14/14	148	
	Coos Bay at Mkr #23 (Henderson Marsh)	15/15	86	
South Slough	So Sl @ entrance to Charleston Bt Basin	10/3	10	
	Charleston Boat Basin At East End	10/5	29	
	Joe Ney Slough at Crown Point Bridge	22/8	52	
	South Slough 50 yds w of Joe Ney Slough	197/3	146	
	So Sl at Buoy #10 – Charleston Triangle	15/3	41	
	South Slough at Hallmark Fisheries	15/3	41	

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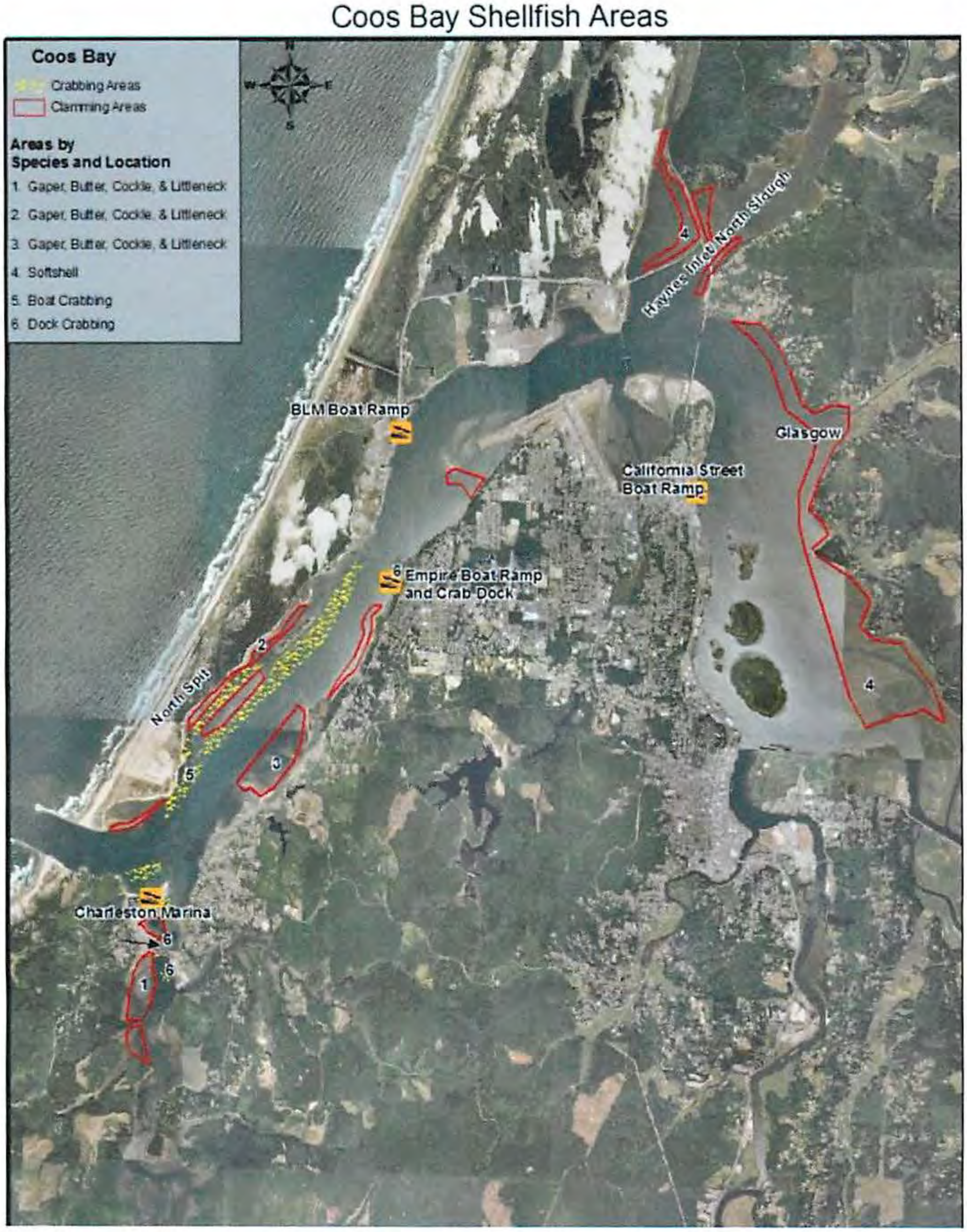
Figure 33 – Coos Bay Recreational Shellfish Harvesting Areas
http://www.dfw.state.or.us/mrp/shellfish/maps/Coos.asp



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PARAMETER: **Bacteria – Fecal coliform**
(Marine Waters and Estuarine Shellfish Growing Waters)

BENEFICIAL USES AFFECTED: Shellfish Growing (fishing/shellfish consumption)

NARRATIVE CRITERION: OAR 340-041-0007(10)
OAR 340-041-0009(4)

NUMERIC CRITERION: OAR 340-041-0009(1) (b)

340-041-0007
Statewide Narrative Criteria
(10) The creation of tastes or odors or toxic or other conditions that are deleterious to fish or other aquatic life or affect the potability of drinking water or the palatability of fish or shellfish may not be allowed;

340-041-0009
Bacteria
(1) Numeric Criteria: Organisms of the coliform group commonly associated with fecal sources (MPN or equivalent membrane filtration using a representative number of samples) may not exceed the criteria described in paragraphs (a) and (b) of this paragraph:

(b) Marine Waters and Estuarine Shellfish Growing Waters: A fecal coliform median concentration of 14 organisms per 100 milliliters, with not more than ten percent of the samples exceeding 43 organisms per 100 ml.

(4) Bacterial pollution or other conditions deleterious to waters used for domestic purposes, livestock watering, irrigation, bathing, or shellfish propagation, or otherwise injurious to public health may not be allowed;

ASSIGNMENT OF ASSESSMENT CATEGORY:

Category 5: Water Quality Limited, TMDL Needed (303(d) List)
For a datasets of less than 30 samples, a minimum of 2 exceedances of 43 organisms/100 ml. For datasets with greater than 30 samples, 10% of the samples must exceed 43 organisms/100mL.
OR, for datasets with a minimum of 5 samples, the median value is greater than 14 organisms/100 ml.

Category 4: Water Quality Limited, TMDL Not Needed
TMDLs needed to attain applicable water quality standards have been approved (Category 4A), other pollution control requirements are expected to address pollutant and will attain water quality standards (Category 4B), or impairment is not caused by a pollutant (Category 4C).

Category 3: Insufficient Data
Less than 5 samples available for analysis, or 5 to 9 samples with 1 exceedance and the median is 14 organisms/100 ml or less.

Category 3B: Insufficient Data – Potential Concern
Less than 5 samples available to evaluate, with 2 or more samples exceeding 43 organisms per 100 milliliters.

Category 2: Attaining
A *minimum* number of 5 samples per site, with 90% of the samples less than 43 organisms/100 ml and the median value of 14 organisms/100 ml or less.

In 1996, DEQ collected and analyzed fish tissue (sculpin and rainbow trout) and stream sediment samples for total (inorganic + organic) mercury. Several sizes of each fish species were collected and fish tissue results showed mercury concentrations in the upstream sculpin approaching 0.35 mg/kg. Elevated mercury concentration in the sculpins' tissue may be attributable to age since the larger sculpins and trout had the greatest mercury concentrations. The average mercury concentrations in the fish tissue samples were found to be low compared to similar fish tissue studies conducted in Oregon lakes. The DEQ laboratory recommended sampling of larger and older fish to determine if mercury body burden increases. The stream sediment sample results showed low total mercury concentrations. Concentrations of elemental mercury segregate into the substrate - bedrock interface by density and instream mercury deposits appear to be predominantly in sediments and at depth.

In August 1998, crayfish were collected and analyzed for total mercury. Mercury concentrations ranged from 0.05 mg/kg to 0.11 mg/kg, well below the OHA's trigger level of 0.20 mg/kg. In 1998, the drinking water well at the Recreation Site was tested for metals including mercury, pesticides and VOCs (volatile organic compounds). The results showed contaminant levels below method detection limits or below levels of concern (EPA Region 9 Tap Water PRGs).

Human Health – Shellfish Bacteria

CONCERN - Shellfish Consumption: Elevated Levels of Fecal Coliform

Commercial Shellfish Aquaculture

Coos Bay and South Slough support one of the states' largest commercial oyster industries. No other South Coast Basin areas are currently utilized for commercial oyster production at this time. Water quality in the Coos Bay estuary is "conditionally approved" for shellfish growing. Oysters are filter feeders and tend to concentrate contaminants present in the water column.

Rainfall events trigger runoff carrying elevated bacterial levels which adversely impact water quality and resulting harvest closures. Conditionally approved growing waters are determined to be water quality limited and 36 South Coast Basin "estuary" segments are identified on the 2010 303d list as impaired (DEQ, 2011). Some areas of Coos Bay are prohibited for use as commercial shellfish growing areas because of the close proximity to bacterial sources like waste water treatment plant outfalls as well as areas with urban storm drains. Areas where large ships moor and load are also classified as prohibited due the potential for discharges.

Elevated levels of fecal coliform bacteria result in recreation and commercial shellfish growing area advisories and closures. Fecal coliform is used as the bacterial indicator organism to manage shellfish growing waters in order to protect humans from disease when consuming shellfish.

Fecal coliform data collected from estuaries supporting shellfish growing are available but have not been presented here. Bacterial load reductions needed to attain shellfish growing criteria can be derived from this information. In addition, bacterial intensive sampling studies implemented during storm events provide additional insight into the amount of rainfall needed to trigger bacterial loading, sources of bacterial loads to estuaries, and the period of time needed for bacterial levels to decline. ***These data are not presented here but should be added to this assessment as time allows.***

Conditionally approved shellfish growing areas are managed based upon rainfall events of sufficient size to raise fecal coliform levels above a geometric mean of 14 colonies/100 ml. Less

Point Source Design Criteria

Waste water treatment plant design criteria state that domestic waste collection and treatment facilities are prohibited from discharging raw sewage to waters of the State during the period of November 1 through May 21, except during a storm event greater than the one-in-five-year, 24-hour duration storm as specified in OAR 340-041-0009(6) and (7). A one-in-five year, 24 hour duration, storm is based upon Figure 26 of the 1973 NOAA Atlas 2 entitled “Precipitation-Frequency Atlas of the Western United States, Volume X – Oregon”. This figure is entitled “Isopluvials of 5-yr 24-hr precipitation in tenths of an inch”. A one-in-five-year, 24-hour duration storm size ranges from 4.0 inches in the northern portion of the South Coast Basin to 6.0 inches in the southern portion of the basin.

The NPDES CAFO general permit prohibits the discharge of process wastes to surface waters except when rainfall events cause an overflow of process waste water from a facility designed, constructed, operated, and maintained to contain all process-generated waste water plus the runoff and direct precipitation from a 25-year, 24-hour rainfall event. (For new source swine, poultry, and veal large concentrated AFOs, facilities must be designed, constructed, operated, and maintained to contain all process-generated wastewaters plus the runoff from a 100-year, 24-hour rainfall event for the location of the facility.) This is essentially a “no discharge” technology-based effluent limit required by the federal EPA. A one-in-twenty five-year, 24-hour duration storm size ranges from 5.5 inches in the northern portion of the South Coast Basin to 8.0 inches in the southern portion of the basin.

Point source design criteria should be examined and aligned with shellfish growing criteria to assure that allowable PS design criteria alone do not result in water quality limited 303d listings. Where this is the case, DEQ should determine if either design criteria and/or shellfish growing criteria need clarification or adjustments.

Human Health - Harmful Algal Blooms

CONCERN: Biological Toxins - Recreational Contact and Drinking Water

Some species of algae, such as cyanobacteria or blue-green algae, can produce toxins that can cause serious illness or death in pets, livestock, wildlife, and humans. There are multiple beneficial uses affected by harmful algal blooms. These include: aesthetics, livestock watering, fishing, water contact recreation, and drinking water supply (DEQ, 2011b).

Nutrient pollution, warm water, high pH, stagnant water and lots of sunlight can lead to excessive blooms. Nutrient pollution can come from wastewater treatment plants, residential on-site wastewater treatment systems, agricultural, urban and forestry runoff, and natural sources. Introduced fish species also can recycle nutrients and preferentially graze zooplankton within a lake, allowing for more intense blooms. Warm water, high pH, stagnant water and sunlight are conditions that are harder to control in lakes and large rivers than nutrient pollution (DEQ, 2011b).

In 2011 DEQ finished the development of an Oregon DEQ Harmful Algal Bloom (HAB) Strategy. The purpose of this effort was to describe and recommend improvements to an overall strategy that the Department of Environmental (DEQ) can implement in order to prevent and control, where possible, Harmful Algal Blooms (HAB) in Oregon. The primary audience for this strategy is DEQ management and staff. This document may also be useful to others, particularly the wide range of partners that are involved addressing HABs in Oregon (DEQ, 2011b). The HABs strategy document provided a HABs summary for Tenmile Lakes which is presented in

EXHIBIT 7

United States Environmental Protection Agency | Office of Water Washington, D.C. | EPA 832-F-99-064 September 1999

EPA

Wastewater Technology Fact Sheet
Ultraviolet Disinfection

DESCRIPTION

Disinfection is considered to be the primary mechanism for the inactivation/destruction of pathogenic organisms to prevent the spread of waterborne diseases to downstream users and the environment. It is important that wastewater be adequately treated prior to disinfection in order for any disinfectant to be effective. Some common microorganisms found in domestic wastewater and the diseases associated with them are presented in Table 1.

An Ultraviolet (UV) disinfection system transfers electromagnetic energy from a mercury arc lamp to an organism's genetic material (DNA and RNA). When UV radiation penetrates the cell wall of an organism, it destroys the cell's ability to reproduce. UV radiation, generated by an electrical discharge through mercury vapor, penetrates the genetic material of microorganisms and retards their ability to reproduce.

The effectiveness of a UV disinfection system depends on the characteristics of the wastewater, the intensity of UV radiation, the amount of time the microorganisms are exposed to the radiation, and the reactor configuration. For any one treatment plant, disinfection success is directly related to the concentration of colloidal and particulate constituents in the wastewater.

The main components of a UV disinfection system are mercury arc lamps, a reactor, and ballasts. The source of UV radiation is either the low-pressure or medium-pressure mercury arc lamp with low or high intensities.

TABLE 1 INFECTIOUS AGENTS POTENTIALLY PRESENT IN UNTREATED DOMESTIC WASTEWATER

Organism	Disease Caused
Bacteria	
Escherichia coli (enterotoxigenic)	Gastroenteritis
Leptospira (spp.)	Leptospirosis
Salmonella typhi	Typhoid fever
Salmonella (=2,100 serotypes)	Salmonellosis
Shigella (4 spp.)	Shigellosis (bacillary dysentery)
Vibrio cholerae	Cholera
Protozoa	
Balantidium coli	Balantidiasis
Cryptosporidium parvum	Cryptosporidiosis
Entamoeba histolytica	Amebiasis (amoebic dysentery)
Giardia lamblia	Giardiasis
Helminths	
Ascaris lumbricoides	Ascariasis
T. solium	Taeniasis
Trichuris trichiura	Trichuriasis
Viruses	
Enteroviruses (72 types, e.g., polio, echo, and coxsackie viruses)	Gastroenteritis, heart anomalies, meningitis
Hepatitis A virus	Infectious hepatitis
Norwalk agent	Gastroenteritis
Rotavirus	Gastroenteritis

Source: Adapted from Crites and Tchobanoglous, 1998.

EXHIBIT 7

Assessment Summary for Reporting Year 2006
Oregon, Coos Watershed

Description of this table

Click here to list Threatened and Impaired Waters Only

NOTE: Click on the underlined "Waterbody Name" to view a Waterbody report.

Waterbody Name	Waterbody ID	Location	Map	Waterbody Type	Size	Units	Status	State TM Developn Statu
Adams Creek: Mm 0-5.4	OR_1241631435695_0_5.4	Coos: 17100304	Waterbody Map	River	5.4	Miles	Not_Assessed	
Arrow Creek: Mm 0-4.3	OR_1236812433281_0_4.3	Coos: 17100304	Waterbody Map	River	4.3	Miles	Good	
Beale Lake	OR_1242330435061_0_0	Coos: 17100304	Waterbody Map	Freshwater Lake	51.3	Acres	Impaired	
Benson Creek: Mm 0-8.2	OR_1241051435643_0_8.2	Coos: 17100304	Waterbody Map	River	8.2	Miles	Good	
Big Creek: Mm 0-8.4	OR_1241211435984_0_8.4	Coos: 17100304	Waterbody Map	River	8.4	Miles	Impaired	
Bluebill Lake	OR_1242596434474_0_0	Coos: 17100304	Waterbody Map	Freshwater Lake	14.6	Acres	Impaired	
Bottom Creek: Mm 0-9.7	OR_1237848433258_0_9.7	Coos: 17100304	Waterbody Map	River	9.7	Miles	Impaired	
Burnt Creek: Mm 0-1.7	OR_1238079432612_0_1.7	Coos: 17100304	Data Unavailable	River	1.7	Miles	Good	
Burnt Creek: Mm 0-2.6	OR_1238079432612_0_2.6	Coos: 17100304	Waterbody Map	River	2.6	Miles	Impaired	
Catching Creek: Mm 0-4.6	OR_1241452433077_0_4.6	Coos: 17100304	Waterbody Map	River	4.6	Miles	Impaired	
Catching Slough: Mm 0-5.6	OR_1241738433647_0_5.6	Coos: 17100304	Waterbody Map	River	5.6	Miles	Impaired	
Cedar Creek: Mm 0-11.6	OR_1237303433122_0_11.6	Coos: 17100304	Waterbody Map	River	11.6	Miles	Impaired	
Clear Creek: Mm 0-3.8	OR_1241749436031_0_3.8	Coos: 17100304	Waterbody Map	River	3.8	Miles	Not_Assessed	
Clear Lake / Clear Lake: Mm 0-1.8	OR_1241830436339/1241808436455_0_1.8	Coos: 17100304	Waterbody Map	Freshwater Lake	280.2	Acres	Good	
Coal Creek: Mm 0-3	OR_1238539433562_0_3	Coos: 17100304	Waterbody Map	River	3.0	Miles	Good	
Coalbank Slough: Mm 0-0.5	OR_1242064433621_0_0.5	Coos: 17100304	Waterbody Map	River	.5	Miles	Impaired	
Coalbank Slough: Mm 0.5-2.5	OR_1242064433621_0.5_2.5	Coos: 17100304	Waterbody Map	River	2.0	Miles	Not_Assessed	
Coos Bay: Mm 0-7.8	OR_1243397433543_0_7.8	Coos: 17100304	Waterbody Map	River	7.8	Miles	Impaired	
Coos Bay: Mm 7.8-12.3	OR_1243397433543_7.8_12.3	Coos: 17100304	Waterbody Map	River	4.5	Miles	Impaired	
Coos River: Mm 0-6.5	OR_1241999433842_0_6.5	Coos: 17100304	Waterbody Map	River	6.5	Miles	Impaired	
Cox Creek: Mm 0-3.1	OR_1239301433617_0_3.1	Coos: 17100304	Waterbody Map	River	3.1	Miles	Good	
Daniels Creek: Mm 0-7.7	OR_1240832433630_0_7.7	Coos: 17100304	Waterbody Map	River	7.7	Miles	Not_Assessed	
Davis Slough: Mm 0-1.3	OR_1242261432874_0_1.3	Coos: 17100304	Waterbody Map	River	1.3	Miles	Not_Assessed	
Day Creek: Mm 0-1.4	OR_1243114433162_0_1.4	Coos: 17100304	Waterbody Map	River	1.4	Miles	Not_Assessed	
East Fork								

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Millicoma River: Mm 0-23.7	OR_1240300434242_0_23.7	Coos: 17100304	Waterbody Map	River	23.7	Miles	Good	
Echo Creek: Mm 0-2.5	OR_1241722433697_0_2.5	Coos: 17100304	Waterbody Map	River	2.5	Miles	Impaired	
Eel Creek: Mm 0-2.5	OR_1241934435768_0_2.5	Coos: 17100304	Waterbody Map	River	2.5	Miles	Not_Assessed	
Eel Lake / Eel Lake: Mm 0-2.5	OR_1241758436025/1241591436089_0_2.5	Coos: 17100304	Waterbody Map	Freshwater Lake	374.1	Acres	Impaired	
Elk Creek: Mm 0-2.7	OR_1239320435826_0_2.7	Coos: 17100304	Data Unavailable	River	2.7	Miles	Good	
Elk Creek: Mm 0-8.7	OR_1239320435826_0_8.7	Coos: 17100304	Waterbody Map	River	8.7	Miles	Impaired	
Fall Creek: Mm 0-7.7	OR_1238261433538_0_7.7	Coos: 17100304	Waterbody Map	River	7.7	Miles	Not_Assessed	
Fivemile Creek: Mm 0-4.6	OR_1236663432303_0_4.6	Coos: 17100304	Waterbody Map	River	4.6	Miles	Not_Assessed	
Haynes Inlet: Mm 0-3.3	OR_1242266434305_0_3.3	Coos: 17100304	Waterbody Map	River	3.3	Miles	Impaired	
Horsfall Lake	OR_1242493434584_0_0	Coos: 17100304	Waterbody Map	Freshwater Lake	326.7	Acres	Not_Assessed	
Isthmus Slough: Mm 0-10.6	OR_1241999433841_0_10.6	Coos: 17100304	Waterbody Map	River	10.6	Miles	Impaired	
Isthmus Slough: Mm 10.6-12.9	OR_1241999433841_10.6_12.9	Coos: 17100304	Waterbody Map	River	2.3	Miles	Not_Assessed	
Joe Ney Slough: Mm 0-2.2	OR_1243226433328_0_2.2	Coos: 17100304	Waterbody Map	River	2.2	Miles	Impaired	
Johnson Creek: Mm 0-9.3	OR_1241294435535_0_9.3	Coos: 17100304	Waterbody Map	River	9.3	Miles	Impaired	
Kentuck Slough: Mm 0-2.2	OR_1242068434143_0_2.2	Coos: 17100304	Waterbody Map	River	2.2	Miles	Impaired	
Larson Creek: Mm 0-4.1	OR_1241413434785_0_4.1	Coos: 17100304	Waterbody Map	River	4.1	Miles	Not_Assessed	
Larson Slough: Mm 0-3.9	OR_1241983434618_0_3.9	Coos: 17100304	Waterbody Map	River	3.9	Miles	Impaired	
Lost Creek: Mm 0-4.9	OR_1236175431952_0_4.9	Coos: 17100304	Waterbody Map	River	4.9	Miles	Not_Assessed	
Matson Creek: Mm 0-11.2	OR_1239203434224_0_11.2	Coos: 17100304	Waterbody Map	River	11.2	Miles	Not_Assessed	
Mettman Creek: Mm 0-3.5	OR_1241714434313_0_3.5	Coos: 17100304	Waterbody Map	River	3.5	Miles	Good	
Millicoma River: Mm 0-3.7	OR_1240991433777_0_3.7	Coos: 17100304	Data Unavailable	River	3.7	Miles	Good	
Millicoma River: Mm 0-8.9	OR_1240991433777_0_8.9	Coos: 17100304	Waterbody Map	River	8.9	Miles	Impaired	
Miner Creek: Mm 0-1.8	OR_1243539433404_0_1.8	Coos: 17100304	Waterbody Map	River	1.8	Miles	Not_Assessed	
Mink Creek: Mm 0-3.3	OR_1238335433347_0_3.3	Coos: 17100304	Waterbody Map	River	3.3	Miles	Good	
Morgan Creek: Mm 0-4.6	OR_1240915433450_0_4.6	Coos: 17100304	Waterbody Map	River	4.6	Miles	Good	
Murphy								

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Creek: Mm 0-3.9	OR_1241147436092_0_3.9	Coos: 17100304	Waterbody Map	River	3.9	Miles	Good	
Noble Creek: Mm 0-3.6	OR_1242150432567_0_3.6	Coos: 17100304	Waterbody Map	River	3.6	Miles	Not_Assessed	
Noble Creek: Mm 0-4	OR_1240981435940_0_4	Coos: 17100304	Waterbody Map	River	4.0	Miles	Not_Assessed	
North Inlet: Mm 0-3.3	OR_1242326434319_0_3.3	Coos: 17100304	Waterbody Map	River	3.3	Miles	Impaired	
North Slough: Mm 0-2.4	OR_1242253434772_0_2.4	Coos: 17100304	Waterbody Map	River	2.4	Miles	Impaired	
North Tenmile Lake	OR_1241456435885_0_0	Coos: 17100304	Data Unavailable	Freshwater Lake	846.0	Acres	Good	
North Tenmile Lake / North Tenmile Lake: Mm 0-4.5	OR_1241613435770/1241456435885_0_4.5	Coos: 17100304	Waterbody Map	Freshwater Lake	.0	Acres	Impaired	
Palouse Creek: Mm 0-10.5	OR_1241899434658_0_10.5	Coos: 17100304	Waterbody Map	River	10.5	Miles	Impaired	
Panther Creek: Mm 0-5.3	OR_1236722432430_0_5.3	Coos: 17100304	Waterbody Map	River	5.3	Miles	Good	
Pony Creek: Mm 0-5.8	OR_1242319434076_0_5.8	Coos: 17100304	Waterbody Map	River	5.8	Miles	Impaired	
Pony Slough: Mm 0-0.8	OR_1242380434268_0_0.8	Coos: 17100304	Waterbody Map	River	.8	Miles	Impaired	
Pony Slough: Mm 0.8-1.4	OR_1242380434268_0.8_1.4	Coos: 17100304	Waterbody Map	River	.6	Miles	Not_Assessed	
Ross Slough: Mm 0-3.1	OR_1241687433509_0_3.1	Coos: 17100304	Waterbody Map	River	3.1	Miles	Impaired	
Sandpoint Lake	OR_1242391434756_0_0	Coos: 17100304	Waterbody Map	Freshwater Lake	89.6	Acres	Impaired	
Shinglehouse Slough: Mm 0-0.8	OR_1242047433253_0_0.8	Coos: 17100304	Waterbody Map	River	.8	Miles	Impaired	
Shotgun Creek: Mm 0-2.6	OR_1237981433021_0_2.6	Coos: 17100304	Waterbody Map	River	2.6	Miles	Good	
Shutter Creek: Mm 0-2	OR_1241569435461_0_2	Coos: 17100304	Waterbody Map	River	2.0	Miles	Not_Assessed	
Snag Lake	OR_1242438434859_0_0	Coos: 17100304	Waterbody Map	Freshwater Lake	35.1	Acres	Impaired	
South Fork Coos River: Mm 0-2.6	OR_1240991433776_0_2.6	Coos: 17100304	Data Unavailable	River	2.6	Miles	Impaired	
South Fork Coos River: Mm 0-31.1	OR_1240991433776_0_31.1	Coos: 17100304	Waterbody Map	River	31.1	Miles	Impaired	
South Slough: Mm 0-5.3	OR_1243210433542_0_5.3	Coos: 17100304	Waterbody Map	River	5.3	Miles	Impaired	
Stock Slough: Mm 0-1.1	OR_1241571433361_0_1.1	Coos: 17100304	Waterbody Map	River	1.1	Miles	Impaired	
Storey Creek: Mm 0-1.3	OR_1243072433403_0_1.3	Coos: 17100304	Waterbody Map	River	1.3	Miles	Not_Assessed	
Sullivan Creek: Mm 0-3.3	OR_1241413434784_0_3.3	Coos: 17100304	Waterbody Map	River	3.3	Miles	Not_Assessed	
Susan Creek: Mm 0-2.8	OR_1238023432807_0_2.8	Coos: 17100304	Waterbody Map	River	2.8	Miles	Good	
Sutton		Coos:	Waterbody					

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Creek: Mm 0-1	OR_1238499434232_0_1	17100304	Map	River	1.0	Miles	Not_Assessed	
Tenmile Creek: Mm 0-5	OR_1242320435616_0_5	Coos: 17100304	Waterbody Map	River	5.0	Miles	Not_Assessed	
Tenmile Lake / Tenmile Lake: Mm 0-5	OR_1241746435728/1241367435617_0_5	Coos: 17100304	Waterbody Map	Freshwater Lake	1,186.2	Acres	Impaired	
Tioga Creek: Mm 0-1.3	OR_1238359432563_0_1.3	Coos: 17100304	Data Unavailable	River	1.3	Miles	Good	
Tioga Creek: Mm 0-16.2	OR_1238097433169_0_16.2	Coos: 17100304	Data Unavailable	River	16.2	Miles	Impaired	
Tioga Creek: Mm 0-17.5	OR_1238097433169_0_17.5	Coos: 17100304	Waterbody Map	River	17.5	Miles	Impaired	
Tioga Creek: Mm 0-2	OR_1238359432563_0_2	Coos: 17100304	Data Unavailable	River	2.0	Miles	Good	
West Fork Millicoma River: Mm 0-34.7	OR_1240300434241_0_34.7	Coos: 17100304	Data Unavailable	River	34.7	Miles	Impaired	
West Fork Millicoma River: Mm 0-34.8	OR_1240300434241_0_34.8	Coos: 17100304	Data Unavailable	River	34.8	Miles	Good	
West Fork Silver Creek: Mm 0-1.7	OR_1239348434855_0_1.7	Coos: 17100304	Waterbody Map	River	1.7	Miles	Not_Assessed	
Willanch Creek: Mm 0-2.5	OR_1241601434067_0_2.5	Coos: 17100304	Waterbody Map	River	2.5	Miles	Not_Assessed	
Willanch Creek: Mm 0-3.9	OR_1241601434067_0_3.9	Coos: 17100304	Waterbody Map	River	3.9	Miles	Impaired	
Willanch Slough: Mm 0-2.8	OR_1242083434031_0_2.8	Coos: 17100304	Waterbody Map	River	2.8	Miles	Not_Assessed	
Willanch Slough: Mm 0.7-2.8	OR_1242083434031_0.7_2.8	Coos: 17100304	Waterbody Map	River	2.1	Miles	Impaired	
Williams River: Mm 0-20.9	OR_1238097433168_0_20.9	Coos: 17100304	Waterbody Map	River	20.9	Miles	Impaired	
Winchester Creek: Mm 0-5.4	OR_1243214432826_0_5.4	Coos: 17100304	Waterbody Map	River	5.4	Miles	Impaired	

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U.S. Food and Drug Administration

U.S. Department of Health and Human Services

CENTER FOR FOOD SAFETY AND APPLIED NUTRITION

Hydrographic Studies of Wastewater Treatment Plant Discharges in Coos Bay, Oregon

February 2011

FDA Technical Assistance and Research Project

Reported by:
U.S. Food and Drug Administration
Center for Food Safety and Applied Nutrition
Office of Food Safety
Shellfish and Aquaculture Policy Branch
College Park, MD 20740-3835

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September 2013

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1.0 EXECUTIVE SUMMARY

FDA and the Oregon Department of Agriculture conducted two studies in February 2011 in Coos Bay, OR – one at the North Bend wastewater treatment plant (WWTP) and one at the Coos Bay #1 WWTP. Cages filled with oyster sentinels were deployed between the two plants and fluorometers were attached to the cages. Rhodamine WT dye was injected into the effluent of the North Bend WWTP on February 7, 2011 and into the effluent of the Coos Bay WWTP on February 15, 2011. The cage-attached fluorometers measured the dye-tagged effluent received by each cage. Boat tracking fluorometers were also used to measure the level of dye-tagged effluent near each cage and in other parts of Coos Bay. A new mobile geographic information system (GIS) tool was employed to assist in collecting the boat tracking data in real-time. Microbiological analyses of fecal coliforms (FC), *E. coli* (EC), male-specific coliphage (MSC), norovirus (NoV) genogroup I (GI) and genogroup II (GII), and adenovirus (AdV) were conducted in the WWTPs' effluent and in the oyster sentinels. Extensive shoreline survey work was conducted with microbial indicator analysis performed on potential pollution sources. The results of the microbiological analyses and the dye study are presented in this report

The results indicate that sufficient levels of dilution are not achieved in the conditionally approved growing area located in the northeast of Coos Bay, in between the two WWTP outfalls, to mitigate the impact of viruses in the WWTPs' effluent. Furthermore, a sufficient level of dilution would not be achieved at either WWTP in the event of a failure to manage any portion of the growing area as approved. The notification time needed to close the growing area in the event of a WWTP failure at either plant is one hour or less. For these reasons, FDA is unable to recommend any portion of the northeast growing area in Coos Bay be managed as approved or conditionally approved based on all data currently available. FDA recommends that this area be classified as conditionally restricted, with conditions based upon the WWTPs' performance. However, alternative classification and management plans could be considered if the mitigation of viral risks is supported by the data.

The results of the dye studies indicate that there is sufficient dilution in the other conditionally approved growing area, located in the southwest at the entrance of Coos Bay, with respect to effluent discharges from the North Bend and the Coos Bay #1 WWTPs. However, the Coos Bay #2 WWTP located closest to this conditionally approved area was not assessed due to limitations in time and resources. Although the two dye study results indicate that the rate of tidal flushing and dilution significantly increases closer to the mouth of the estuary, the level of effluent dilution in this growing area from the Coos Bay #2 WWTP is unknown and should be assessed with a separate study or computer modeling analysis.

1.1 INTRODUCTION

Two hydrographic dye studies of treated wastewater effluent from the North Bend WWTP facility and the Coos Bay #1 WWTP facility, as well as a shoreline survey of the area, were conducted between the dates of February 2 - 18, 2011 in Coos Bay, OR. The hydrographic dye studies assessed the dilution, time of travel, and dispersion of effluent from the two tested WWTPs. In addition to the hydrographic dye studies, the microbiological impacts of the wastewater on molluscan shellfish were assessed by testing oyster sentinels placed in cages located along the anticipated paths of both WWTPs' effluents. Levels of FC, EC, MSC, NoV GI & GII, and AdV were determined. The Oregon Department of Agriculture (ODA) requested technical assistance and training from the FDA and the Coos Bay site was chosen because of mutual interest. These studies were led by FDA in conjunction with the ODA. FDA was interested in assessing the combined impact from multiple WWTPs, and Coos Bay has three WWTPs impacting the same growing areas; the two with the impacts of most concern were chosen for this study. As sanctioned under the Public Health Act, FDA provides technical assistance to State Shellfish Control Authorities (SSCAs). For over 30 years, FDA has assisted SSCAs by conducting hydrographic dye-dilution studies, such as the studies conducted in Coos Bay, as a means to assess the impact of WWTPs on shellfish growing areas.

1.2 Study Objectives

The general objective of this study was to provide highly technical applied field training to a cadre of federal and state shellfish specialists. Other objectives of this study were to: 1) determine the sanitary water quality conditions in the estuary that could arise under a short term lapse in treatment and disinfection; 2) determine the steady state bacterial conditions in the shellfish growing waters that could arise in the event of a long term elimination or lapse in disinfection; 3) provide guidance to the ODA regarding WWTP closure zones; and 4) establish the necessary minimum zone of dilution of wastewater needed to achieve a sufficient reduction in viruses to ensure the safety of shellfish. The findings of these objectives are intended to inform FDA's recommendations for growing area management in Coos Bay and its dilution guidance for establishing prohibited zones around WWTP outfalls. Finally, an additional goal of this research was to determine the impact of combined effluents from different WWTPs on microbial bio-accumulation in shellfish.

1.3 FDA Guidance on Establishing Closure Zones for WWTP Discharges

In consideration of Section II, Chapter IV @.03 E(5) (Prohibited Classification – Wastewater Discharges) of the National Shellfish Sanitation Program Model Ordinance, which notes that the determination of the size of a prohibited zone around a WWTP outfall shall include "the wastewater's dispersion and dilution, and the time of waste transport to the growing area where shellstock may be harvested" (iii), FDA has provided guidance to state shellfish control authorities to size prohibited zones around WWTP outfalls according to the following scenarios:

Scenario 1: In consideration of effluent discharged from a WWTP under **failure conditions** (such as a loss of disinfection), the prohibited zone should provide a sufficient amount of dilution to dilute the effluent discharged under failure conditions to the fecal coliform standard of 14 MPN/100 ml within the prohibited zone

OR

Scenario 2: In order to reduce the size of the prohibited zone, a conditionally approved zone may be operated **if** a factor of at least a 1000:1 dilution of effluent is achieved within the prohibited area to mitigate the impact of viruses, **and** there is a sufficient amount of time to close the conditional area to the harvesting of shellfish **before** the effluent discharged at the onset of a failure can travel to the boundaries of the prohibited zone

Note: the additional area beyond the prohibited zone to be closed under WWTP failure conditions should provide a sufficient amount of dilution to dilute the effluent discharged under failure conditions to the fecal coliform standard of 14 MPN/100 ml within the closed (due to failure) zone (consistent with Scenario 1).

Over the years, wastewater treatment technologies have improved. However, FDA has maintained a conservative position recognizing that a WWTP may still be subject to failure regardless of the type of treatment system used. FDA does recognize that with the advancement of technologies such as improved monitoring and alarm systems, it may be possible to operate a conditional area as outlined in Scenario 2 above. This allows additional shellfish growing areas to be harvested under certain conditions.

When a WWTP is operating normally, disinfection has been shown to be effective in reducing the coliform bacteria groups (fecal coliform and total coliform) to levels below shellfish harvesting standards as can be seen in WWTP permit records kept in accordance with the Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Program. However, human enteric viruses such as noroviruses and hepatitis A virus are more resistant to disinfection and thus are not reduced to the same degree as the coliform bacteria group. In an effort to mitigate the risk of contaminating shellfish with viruses, FDA has recommended a 1000:1 dilution as described in Scenario 2 as the minimum zone of dilution needed when the WWTP is operating under normal conditions.

1.4 Description of North Bend WWTP and Coos Bay #1 WWTP

Figure 1 shows a map of Coos Bay with the locations of the three WWTP outfalls. Growing area classifications are also shown on the map, with approved areas delineated in green and prohibited areas delineated in red.

The North Bend WWTP was constructed in 1954 and was last renovated in 2008. It serves a population of 9855 in the North Bend, OR area. It has primary and secondary treatment with activated sludge and gas fed chlorine disinfection. The design flow is 2.0 MGD and the hydraulic capacity is 8.3 MGD. The average daily dry flow is 1.0 MGD, and the average daily wet flow is 2.5 MGD. The peak hourly dry flow is 2.0 MGD and the peak hourly wet flow can be up to 8.5 MGD. The WWTP has a 27" outfall with a 128 ft. multi-port diffuser that is 10 feet deep. According to a 1991 mixing zone study, the estimated dilution at the outfall was predicted to be in the range of 53:1 – 107:1.

The Coos Bay #1 WWTP serves a population of approximately 11,000 in the Coos Bay, OR and surrounding areas. It has primary and secondary treatment with activated sludge and chlorine disinfection. Flows up to 7 MGD receive both primary and secondary treatment, but flows in excess of 7 MGD bypass primary treatment and receive secondary treatment only. The design year peak flow is 20 MGD. Data provided in a May 2008 facilities plan indicated that the average daily dry flow is 1.6 MGD, and the average daily wet flow is 3.2 MGD. The peak daily flow is 10.0 MGD and the peak wet weather flow is 15.0 MGD. The WWTP has a 42" outfall with a 715 ft., 5-port diffuser.

1.5 General Description of Study Design

Prior to the comprehensive dye study, a drogue study was conducted with oranges. The GPS coordinates of the drogues were marked in a new mobile GIS application developed for FDA's Shellfish and Aquaculture Policy Branch called the Real-Time Application for Tracking and Mapping (RAFT-MAP). The drogue study provided information about tidal cycles, tidal velocity, and wind speed and direction in Coos Bay. The drogue study was also used to assist in the placement of oyster sentinel cages in order to maximize the oysters' exposure to the effluent plumes and to viruses.

The six oyster sentinel cages were equipped with submersible WET Labs fluorometers (WET Labs, Inc., Philomath, OR) and were placed at various distances between the North Bend WWTP and the Coos Bay #1 WWTP along the path of the effluent plumes from both plants for a three week period. Figure 1 shows the locations of the six cage stations. Each cage was also equipped with a Star-Oddi miniature CTD (Star-Oddi Ltd., Iceland) to monitor conductivity/salinity, temperature, and depth/pressure during the course of the comprehensive dye study.

The dye for each of the two comprehensive studies was injected over half a tidal cycle (12.4 hours) and remained in the Coos Bay system for at least two days. Boat tracking with towed fluorometers was conducted to find the edges of the dye plume during daylight hours, in addition to the continuous dye readings recorded by the cage-attached submersible fluorometers. The submersible fluorometers were collected from the cages on February 18, after dye readings had fallen below detectable levels.

The oyster sentinels from the six cages were shipped to FDA's Gulf Coast Seafood Laboratory (GCSL) in Dauphin Island, AL to test for FC, EC, MSC, NoV (GI and GII), and AdV. Water samples taken from the influent, final effluent, and post-disinfected flows at the North Bend and Coos Bay #1WWTPs were also analyzed for FC, EC, MSC, NoV (GI and GII) and AdV to compare with the levels found in the oyster sentinels. The results of these microbiological analyses were compared with the level of dilution of the dye found at each of the cages to determine the relationship between effluent dilution and viral impacts on shellfish.

2.0 METHODS

2.1 Dye Standard Preparation and Fluorometer Calibration

The dye tracer used in this study, Rhodamine WT, was purchased from the Keystone Aniline Corporation and had a specific gravity of approximately 1.12 (20% as dry dye). Ten (10) standards were prepared from the stock solution of Rhodamine WT dye and distilled water by serial dilution, ranging from 100,000 parts per million (ppm) to 0.1 part per billion (ppb).

The Rhodamine WT dye was detected and its concentrations in Coos Bay were obtained using a combined total of nine fluorometers. Six of these were WET Labs FLRHB submersible fluorometers (WET Labs, Inc., Philomath, OR) that were attached to the shellfish cages deployed at stations along the anticipated path of the effluent throughout the course of the study. Two were WET Labs FLRHRT fluorometers that were pulled behind a boat and used for tracking the dye on the ebb tide for each day of the study. The final instrument was a WET Labs FLRHB fluorometer with a built-in pressure (depth) sensor that was used for taking depth profiles to determine the vertical distribution of the dye within Coos Bay. This instrument was on loan from Mr. Mark Toy of the Washington Department of Health, who received training during the study and was an active participant of this study.

The dye standards were used to develop calibration curves for FDA's WET Labs FLRHRT-586 and 2040 tracking fluorometers, the six moored, submersible fluorometers – WET Labs FLRHB units 585, 913, 915, 1730, 1731, and 2032, and the profiling fluorometer – WET Labs FLRHB 2153 - in distilled water. With the subtraction of background fluorescence levels in Coos Bay, these curves were used to calculate part per billion (ppb) levels of dye based on the WET Labs' measured fluorescent units (FUs).

The y-intercept of the calibration curve was adjusted so that a "0.1 ppb" result read as a perfect "0.1" on the curve. The slope and x-axis values for the curve remained the same, but this adjustment introduced only a slight addition of error to the higher concentrations on the curve, such as 1, 10 and 100 ppb standards. For example, for the 585 unit calibrated for the North Bend study, the intercept was increased from 0.025 to 0.047 to produce a 0.1 ppb reading for the 0.1 ppb standard. The increase of 0.022 in the intercept would mean that a 1 ppb reading would increase to 1.022 (2.2% difference) and a 10 ppb reading would read 10.022 (0.22% difference) and a 100 reading would read 100.022 (0.022% difference). Thus, the accuracy at the lower end of the curve, 0.1 ppb, is more vital in order to optimize accuracy in dye concentration readings at low concentrations, as important data tends to fall within the 0.1 – 1 ppb range during FDA dye studies. Using a calibration curve adjusted in this manner is necessary when converting raw FU readings to ppb values if sensitivity in the 0.1 – 1 ppb range is critical for the study.

On February 6, 2011, background fluorescence levels in Coos Bay were assessed using the WET Labs FLRHRT-586 tracking fluorometer and WET Labs FLRHB-2153 profiling fluorometer. Background levels were subtracted from the calibration equation when performing the conversion from fluorescent units to ppb.

2.2 Drogue Study

Approximately thirty drogues (oranges) were used on Feb. 4, 2011 to access the timing of tidal cycles (i.e., slack high/start of ebb tide), tidal velocity, and the influence of wind to estimate the velocity and direction of the effluent leaving the outfall of the Coos Bay #1 WWTP. The drogues were released on the surface of the water, and were influenced in part by surface winds.

A portion of the drogues were thrown in a horizontal line near the outfall just prior to the turning of the tide from flood to ebb tide. The timing of the turn to ebb tide was noted and used to help plan the timing for the dye studies. The drogues were marked with drop points in FDA's new RAFT-MAP GIS mobile application, and the time at which each drogue was released was recorded. After the tide switched to ebb, the movement of the drogues was tracked and the new locations of the drogues were marked in RAFT-MAP about 41 minutes after the initial release. This information was used to determine the velocity and direction of the tidal movement in ArcGIS 10.0. To calculate the general velocity of the drogues, the median values for the times of release and the times of re-marking were used, as well as the central locations for the first drogue cluster and the second drogue cluster.

2.3 Dye Tracer Injection

For the first study at the North Bend WWTP, a total of 4.4 Gallons of dye was injected into the WWTP effluent over a 12.4 hour period at a constant rate. The injection began around 1:16 AM on February 7, 2011. To facilitate the pumping of dye, 4.4 Gallons of deionized water was added creating a 1:2 dye dilution mixture (~9 Gallons). A Masterflex model 7553-20 variable speed peristaltic pump (Cole-Palmer Instrument Co.) was used to withdraw the tracer dye solution from a large plastic holding bin, using Masterflex Tygon L/S-16 tubing. A pump head size 7016 was used with a constant pumping rate of 46 ml/min which was maintained at about 58 revolutions/minute (rpm) head speed. The tracer dye mixture was fed continuously into the effluent following the chlorine detention tank over the half tidal day period. The initial concentration of the dye in the effluent was determined using the WWTP's flow average over the course of the dye injection period.

For the second study at the Coos Bay #1 WWTP, a total of 10 Gallons of dye was injected into the WWTP effluent over a 19.5 hour period at a constant rate. The period of the dye injection should have been 12.4 hours, but a problem with the tubing (discussed more below) resulted in a lengthening of the overall injection period. The injection started at 4:00 AM on February 15, 2011. To facilitate the pumping of dye, 10 Gallons of deionized water was added creating a 1:2 dye dilution mixture (20 Gallons). A Masterflex model 7553-20 variable speed peristaltic pump (Cole-Palmer Instrument Co.) was used to withdraw the tracer dye solution from a large plastic holding bin, using Masterflex Tygon L/S-16 tubing. A pump head size 7016 was set at a 121 revolutions/minute (rpm) head speed which maintained a constant pumping rate of 101.88 ml/min (38.6 gal/day). The tracer dye mixture was fed continuously into the effluent following the chlorine detention tank. The initial concentration of the dye in the effluent was determined using the WWTP's flow average as described below.

During the second study at the Coos Bay #1 WWTP, the dye injection pump was placed inside a cooler to protect it from heavy winds and rain from a strong storm. A piece of foam was placed under the cooler lid to elevate it so that the Masterflex Tygon L/S 16 tubing could be threaded under the lid and into the final effluent chamber of the WWTP. However, the lid of the cooler crimped down on the foam and the tubing and thereby decreased the rate of the dye flow. Because the dye was still flowing (albeit at a much lower rate than 101.88 ml/min) and was still visible in the final effluent, and it was initially picked up at low concentrations of 0.1 ppb near the outfall, this problem was not discovered until hours later at 12:50 PM. At that time, the lid of the cooler was lifted and the dye flowed through the tubing freely at the proper rate. The dye injection continued until 11:33 PM on February 15, at which time the entire dye/water mixture of 20 Gallons had been injected. Therefore, the bulk of the dye injection actually took place over 10.7 hours from 12:50 PM to 11:33 PM. The WWTP flows from this time period were averaged and used to determine the initial concentration of dye injected into Coos Bay. However, the low levels of dye injected prior to 12:50 PM were still detected and recorded by the submersible fluorometers located closest to the outfall and were factored into the calculations when determining the dye levels at those stations.

2.4 Dilution Analysis - Dye Readings from Submersible Fluorometers

The fluorescence readings recorded by the submersible fluorometers at each of the six oyster sentinel stations were downloaded, converted to ppb using each fluorometer's calibration curve chart, and plotted in SigmaPlot alongside tidal depth charts and salinity readings from the Star-Oddi CTD for the period of the study.

A five-point moving average was applied to the dye concentration data to smooth out any false high or low readings in the data. Dilution was calculated by dividing the initial concentration of dye injected at the WWTP by the final (five-point moving average) concentrations detected in the estuary.

Since only half tidal day dye injections were conducted – rather than full tidal day injections – an improved variation on the superposition method (Kilpatrick, 1993) was used to estimate the steady state condition for dye at each of the cage stations using data collected during the two study periods, from 2/7/2011 – 2/10/2011 and from 2/15/2011 – 2/17/2011, respectively. In the past, FDA would typically conduct a 2 – 3 day injection of dye to determine the build-up of WWTP effluent in a system and to determine the steady state condition, in which the rate of effluent flowing into a system is equal to that being flushed out by tides. However, Kilpatrick (1993) demonstrated using the superposition principle that a shorter dye injection period could be used and the steady state condition estimated if remaining dye in the system on the second tidal day after an injection is added to the dye detected on the first tidal day, and if the remaining dye detected on the third tidal day is added to the dye found on both the first and second tidal days, and so on. FDA has successfully employed the superposition method, even with only a half tidal day (12.4 hour) injection, and used this method in the Coos Bay study.

For example, for the day of the injection for the North Bend study, 2/7/2011, the superposition dye concentration was plotted based on the first half-tidal day. For the second day of the study, 2/8/2011, the remaining dye level in the system from the first day was added to the levels detected on day 2. Following the superposition principle, remaining dye levels found in the system on days 3 and 4 of the study were also used to determine the steady state condition at each cage station.

To determine the combined impact of the effluents from the both the North Bend WWTP and the Coos Bay #1 WWTP, FDA applied a new method to calculate the "combined dilution" at each cage station, factoring in the decrease in dilution combining the impact caused by both WWTPs based on the area under the concentration-time curve method described in Goblick, et al. (in press). Dilution of effluent from each WWTP can be determined separately considering the impact from a single WWTP described as follows:

$$D_1 = \frac{A_1}{SA_1}$$

Where:

D_1 = Dilution of effluent discharged from WWTP 1
A_1 = Area under the concentration-time curve produced by injecting dye into WWTP 1 effluent
SA_1= Area under the concentration-time curve measured at Station in growing area in response to the area under the concentration-time curve A_1

Similarly, the dilution of effluent discharged from WWTP 2 can be determined as follows:

$$D_2 = \frac{A_2}{SA_2}$$

Where:

D_2 = Dilution of effluent discharged from WWTP 2
A_2 = Area under the concentration-time curve produced by injecting dye into WWTP 1 effluent
SA_2= Area under the concentration-time curve measured at Station in growing area in response to the area under the concentration-time curve A_2

Both the steady state average dilution as well as the steady state peak 1 hour dilution may be determined based on the area analysis as described in more detail in Goblick, et al. (in press). The steady state average is based on the cumulative area under the concentration-time curve for each half tidal day whereas the steady state peak 1 hour is based on the cumulative area under the concentration-time curve for each half tidal day during the peak 1 hour timeframe which produces the highest concentrations.

However, in consideration of the impact from both WWTPs the area under the concentration-time curve method can also be utilized to determine the dilution of effluent relative to WWTP 1 and WWTP 2 and considering the combined impact from both WWTPs. It should be noted that FDA's long standing minimum dilution recommendation of 1000:1 is with respect to a "single" WWTP discharge. Thus, the "combined" dilution analysis method presented below is made relative to one WWTP discharge (and adding the impact of the second discharge) such that the dilution results can be compared against the FDA minimum dilution recommendation based on a single discharge. This will enable the determination if adequate dilution is achieved at each state with respect to the recommended 1000:1.

Thus, to find the dilution with respect to with respect to either WWTP 1 or WWTP 2 but combining the impacts from both, the dilution can be presented as follows:

Dilution relative to WWTP 1 (and adding the impact from WWTP 2):

$$D = \frac{A_1}{SA_1 + SA_2(\frac{A_1}{A_2})}$$

Where:

D = Dilution with respect to WWTP 1 but combining the impact of both WWTP 1 and WWTP 2
A_1 = Area under the concentration-time curve produced by injecting dye into WWTP 1 effluent
SA_1= Area under the concentration-time curve measured at Station in growing area in response to the area under the concentration-time curve A_1
A_2 = Area under the concentration-time curve produced by injecting dye into WWTP 2 effluent
SA_2= Area under the concentration-time curve measured at Station in growing area in response to the area under the concentration-time curve A_2

Thus, in the equation above, the additional impact of (SA_2) caused by WWTP 2 are added to the Station. However, in order to make the impact of SA_2 relative to the impact of SA_1 a scaling factor A_2/A_1 is needed such that they can be combined.

The dilution equation could also be expressed relative to WWTP 2 which would yield similar results. If expressed relative to WWTP2 the dilution equation can be expressed as:

$$D = \frac{A_2}{SA_2 + SA_1(\frac{A_2}{A_1})}$$

Where:

D = Dilution with respect to WWTP 2 but combining the impact of both WWTP 2 and WWTP 1
SA_1 = Area under the concentration-time curve produced by injecting dye into WWTP 1 effluent
SA_1= Area under the concentration-time curve measured at Station in growing area in response to the area under the concentration-time curve A_1
A_2 = Area under the concentration-time curve produced by injecting dye into WWTP 2 effluent
SA_2= Area under the concentration-time curve measured at Station in growing area in response to the area under the concentration-time curve A_2

Dilution analysis using either equation will produce results that make relative the impacts from both WWTP 1 and WWTP 2 such that the impact from both WWTPs can be combined. However, it is important to note that the dilution analysis is made relative to one discharge (although combining the impact from both) such that the dilution result can be compared against the FDA recommended minimum dilution of a 1000:1 which was in consideration of a single discharge.

2.5 Dye Tracking Via Boat

The dye was tracked and the outer edges of the dye plume were located via boat using FDA's WET Labs FLRHRT-586 and FLRHRT-2040 fluorometer units linked to either a Trimble GPS unit operating with Terrasync software or an Itronix DuoTouch II operating FDA's new custom-made mobile GIS software RAFT-MAP.

RAFT-MAP allowed FDA and ODA to see the dye concentration results plotted in real-time on a GIS map with colors like red, yellow, and green representing high, medium, and low concentrations, respectively. The slope and intercept values of the calibration curves for the WET Labs FLRHRT units were programmed into RAFT-MAP so that the program could automatically convert the fluorescence units recorded by the WET Labs into part per billion (ppb) concentration values, which were the values plotted on the map in real-time. RAFT-MAP was also able to identify maximum and minimum detected concentrations and calculate estimates of dye dilution as well. RAFT-MAP was field tested for the very first time in Coos Bay, and the results of this beta test with the new tracking system are discussed more in Section 2.7 below.

The dye plume was followed during the beginning of the North Bend WWTP study on 2/7/2011 as it moved through Coos Bay on an ebb tide using FDA's WET Labs FLRHRT-586 and FLRHRT-2040 tracking fluorometers and with the FLRHB-2153 profiling fluorometer. Three boats were used, with each instrument on a different boat. Dye readings were also taken on successive days (2/8/2011 and 2/9/2011) for high and low tides. Traverses were done on all the days of study from west to east and east to west, and dye readings were also recorded at each of the station locations (via boat and with the submersible fluorometers fixed to the stationary cage stations) to show changes in dye concentration and build-up with time at the fixed locations. The same boat tracking methods were used for the Coos Bay #1 study on 2/15/2011 – 2/17/2011.

A five-point moving average was applied to the dye concentration data to normalize the range and variability of the readings. Dilution was calculated by dividing the initial concentration of dye injected at the WWTP by the final (five-point moving average) concentrations detected in the estuary. As previously noted, since the injection only lasted a half tidal day, the build-up and steady state concentration of pollutants at the station locations were estimated using the superposition principle (Kilpatrick, 1993).

For data recorded with the Trimble GeoXM data logger, the fluorometer dye readings (in fluorescent units) with the associated GPS readings were later downloaded and converted into ppb units using the calibration curve for WET Labs FLRHRT-586. These values were then imported into a geodatabase in ArcGIS v.10.0 (ESRI, Inc., Redlands, CA) to create a color-coded map representing the presence of different dye concentrations along the path of the effluent during the North Bend study. The concentrations in ppb were converted to dilution values by dividing the initial concentration of dye in the effluent with the final concentration of dye in the estuary. The dilution values were also plotted in a color-coded GIS map using ArcGIS v.10.0.

For data recorded with FDA's new RAFT-MAP program, concentrations in ppb were automatically plotted on a GIS map in real-time on the boat.

2.6 Beta Testing of FDA's Real-Time Application for Tracking and Mapping (RAFT-MAP)

During the studies in Coos Bay in February 2011, FDA beta tested for the first time a new mobile GIS application called RAFT-MAP, which was developed with ESRI, Inc. RAFT-MAP allowed FDA to plot the dye concentration results in real-time on an electronic map tagged with latitude and longitude coordinates. High levels of dye were mapped with red points, average levels were mapped with yellow points, and low levels were mapped with green points. In this way, it was easy to visualize the concentrated center of the dye plume and find the edges of the plume.

RAFT-MAP also performed calculations in real-time, including the conversion of fluorescent units (FUs) from the WET Labs fluorometer into parts per billion (ppb) dye concentrations and then the calculation of dilution levels (e.g., 1000:1 dilution). The conversion of FUs into ppb units was performed by subtracting out background FU levels and by using the slope and intercept of the calibration curve for the instrument. The dilution calculation was determined by using an estimate of the initial concentration of dye injected into the effluent based on a theoretical calcuation; the estimate used was 1000 ppb. Once the actual WWTP flows for the dye injection period were known, the accurate initial concentration was determined and the dilution values were re-calculated after the study. However, by using an estimate of 1000 ppb, FDA was able to show ODA in RAFT-MAP approximately where the 1000:1 dilution line could be found.

Errors observed in RAFT-MAP during the beta test (discussed in section 3.9) were noted and reported to ESRI, Inc. for correction.

2.7 Shoreline Survey

A shoreline survey of the growing area was conducted during wet weather at every identified potential pollution source that was accessible by land. Pollution source water samples were collected and poured into 3.0 ml Whirl-pak bags, with a new bag for each sample. The sample number, date, and time were written on the bags. This date was also recorded in a notebook along with a description of the location that the sample was collected and the GPS coordinates. The GPS coordinates were recorded with a Trimble GeoXM data logger. A photograph of each sample site was taken and the number of the photograph was recorded in the notebook as well.

Pollution source samples were analyzed for FC, EC, and MSC in the same manner that WWTP influent and effluent samples were assessed for these criteria as described in Section 2.8 below. Sample sites for which FC or EC were high or for which MSC was above the limit of detection were re-sampled to confirm results and investigate the source waters further up the catchment if possible. Since MSC is used as a microbiological tool that indicates the presence of human sewage, whereas FC and EC can be attributable to other sources as well, particular attention was paid to samples that had detectable levels of MSC.

2.8 Microbiological Analysis of Wastewater and Oysters

Shellfish Sentinels at Station Locations

Local oysters (relocated from Netarts Bay) up to 3 inches in size were used as sentinels at each of the six station locations. A total of 200 oysters were used in the study. There were approximately 30 oysters per cage for each of the six FDA station locations with the other oysters used as controls. The oysters were distributed evenly throughout the cages in a mono-layer. The cages were weighed down with cement and stationary on the bottom of the estuary.

The oysters were deployed on February 4, 2012 and retrieved on February 28, 2012. A three week deployment time was used to allow time for virus and microbiological contaminant accumulation and to cover the span of both the North Bend WWTP dye study and the Coos Bay #1 WWTP dye study. Each sample set was analyzed for FC, EC, MSC, NoV GI and GII, and AdV.

Indicator Microorganisms

FC and EC densities in the shellfish and in the WWTP influent and effluent were determined using a conventional five-tube, three-dilution MPN procedure. In the case of the shellfish, the procedure was done with minimal modifications to the FDA *Bacteriological Analytical Manual* (BAM) and American Public Health Association (APHA) (1970) recommended procedures for the examination of shellfish. Modifications to this procedure included blending of the shellfish meats and liquors without dilution buffer; this was necessary due to the multiple microbial analyses performed on each shellfish sample. Following homogenization, a 1:10 dilution of homogenate (10 g) was prepared with phosphate-buffered solution (PBS). Ten ml of this dilution, a 1-g equivalent, was transferred to five tubes of 10 ml of double-strength lauryl tryptose broth (LST; Difco Laboratories, Sparks, MD). One-milliliter aliquots (0.1-g equivalent) were also transferred to five tubes of single-strength LST, while five 1-ml aliquots of a 1:100 dilution were also transferred to single-strength LST. Presumptive positive tubes were confirmed for FC and EC using EC-MUG (Difco, Sparks, MD) medium.

MSC densities were determined by using a modified double-agar-overlay method initially described by Cabelli (1988); the *E. coli* strain HS(pFamp)R (ATCC 700891) was utilized as the bacterial host strain.

Virus concentration and RNA extraction

Viral analysis for the sewage utilizes elution with an alkaline buffer followed by ultracentrifugation (Williams-Woods, et al., 2011). Concentrates were extracted for RNA with RNeasy Mini Kit (Qiagen, Valencia, CA) utilizing 6M guanidium isothiocyanate as a lysis solution. Extracted RNA and DNA was tested by real-time reverse transcription (RT)-qPCR and qPCR respectively.

For the shellfish concentration and extraction, a modified protocol was used (Williams-Woods, et al., 2011). Four to six whole oysters were shucked and the digestive diverticula were removed to obtain a 4 gram sample. An aliquot of murine norovirus was added as an extraction control prior to homogenization of the digestive diverticula with 40 ml of sterile milli-Q water. Viruses were absorbed onto the particulates and were then centrifuged at 4°C on low speed. The pellet was eluted with 0.75M glycine and 0.5 M threonine. The eluates were ultracentrifuged at 170, 000 x g for 1 hr at 4°C. The pellet was resuspended in tissue culture grade phosphate buffered saline (tcPBS) and extracted first with chloroform, and 0.5 M-threonine. Both aqueous phases were combined and 50ml of tcPBS was added to each sample, balanced, and ultracentrifuged at 1 hr at 4°C. Concentrates were extracted for RNA with RNeasy Mini Kit (Qiagen, Valencia, CA) utilizing 6M guanidium isothiocyanate as a lysis solution. Extracted RNA and DNA was tested by real-time RT-qPCR and qPCR as described below.

RT-qPCR

Positive controls used for NoV GI and GII were *in vitro* RNA transcripts of sequences cloned from positive clinical samples previously identified as NoV (Burkhardt, et al., 2006). Primers and probes for NoV GI and GII targeted the most conserved region of the open reading frame 1 (ORF1)-ORF2 junction. Real-time RT-qPCR for detection of NoV GI and NoV GII with an RNA IAC was performed in a 25-µl reaction volume by using a one-step RT-PCR kit (Qiagen). The primer concentrations for the NoV targets were 300 nM each, and the concentrations for the IAC primers (46F and 194R) were 75 nM each. The 5' nuclease probe concentrations for NoV and the IAC target were 100 and 150 nM each, respectively. The final concentration of $MgCl_2$ in the real-time RT-qPCR was 4 mM. Thermal cycling was run using the SmartCycler II system with the following conditions: 50°C for 3,000 s and 95°C for 900 s followed by 50 cycles of 95°C for 10 s, 53°C for 25 s, and 62°C for 70 s. Fluorescence was read at the end of the 62°C elongation step. Default analysis parameters were used, except that the manual threshold fluorescence units were set to 10. Samples positive with the initial primer and probe sets for NoV GI and/or NoV GII were subjected to a secondary detection assay. Amplification of the original RNA extract was performed with primers from the B region by conventional RT-PCR (see Table 1 in DePaola, et al., 2010). Amplification of a second region of the genome is non-contiguous to the first and serves as an indication that the RNA was not degraded.

Adenovirus

The positive control used for Adenovirus (AdV) was serotype 41 isolated from a clinical stool sample, propagated in-house by utilizing the A-549 cell line. Real-time PCR for the detection of AdV was performed in a 25-mL reaction volume by using Platinum TAQ DNA Polymerase (Life Technologies, Grand Island, NY) as previously described with slight modifications (Williams-Woods, et al., 2011). A DNA IAC utilizing the 46F and 194R primers and the TxRed-labeled probe as previously described was added with final primer and probe concentrations of 0.75 mM and 1.5 mM, respectively (DePaola et al., 2010). Cycle parameters were slightly adjusted as follows: 95°C for 120 s followed by 50 cycles of 95°C for 3 s, 53°C for 10 s, and 65°C for 70 s. AdV primers and probe were previously described with slight modifications to the probe (Heim, 2003) whereby probe was FAM-ZEN labeled as a fluorescent dye on the 5' end and an Iowa Black quencher dye labeled on the 3'end. Fluorescence was read at the end of the 72°C elongation step. Default analysis parameters were used except that the manual threshold fluorescence units were set to 10.

Murine norovirus

The positive control used for murine norovirus was purchased from ATCC PTA-5935 and propagated using the RAW264.7 cell line. Real-time RT-qPCR was utilized for the detection of murine norovirus (the extraction control virus) with an RNA IAC in a 25-µl reaction volume by using a one-step RT-PCR kit (Qiagen). Primers and probes were utilized as described in Hewitt, et al., 2009. Thermal cycling was run using the SmartCycler II system. Fluorescence was read at the end of the elongation step and the default analysis parameters were used except that the manual threshold fluorescence units were set to 10.

3.0 RESULTS AND DISCUSSION

3.1 Drogue Study

The orange drogues were released on the flood tide shortly before the predicted change of the tide from flood to ebb based on NOAA's Crescent City, CA tide station. However, the movement of the drogues indicated that the tide did not actually turn from flood to ebb until over an hour later than predicted. This observation assisted with the timing for the dye injection.

The drogues were tracked using RAFT-MAP and the locations of the drogues were tagged with GPS markers. The results were uploaded into ArcGIS Desktop 10.0, and the distance and travel time between the drogue clusters was ascertained. Figure 2 shows the movement and velocity of the drogues. The drogues traveled north from the Coos Bay #1 outfall site, moving 0.42 miles in 41 minutes (0.68 hours), moving at a velocity of 0.62 mph or 1.0 km/hr.

3.2 Background Readings

Background levels of fluorescent units (FUs) for the WET Labs FLRHRT-586 tracking fluorometer were measured as 82.8 FUs on average. A background level of 82.8 FUs is typical of average background levels for other estuary systems that have been evaluated with the FLRHRT-586 fluorometer. This background level was subtracted from the fluorescence readings during the dye studies.

Background levels were also assessed with the WET Labs FLRHB-2153 profiling fluorometer and for that instrument were determined to be 50.2 FUs on average. The background levels remained the same from the surface down to 10 foot depths in the water column. Background levels recorded in air were higher than those recorded in water, but this was thought to possibly be due to radio signal interference from the nearby North Bend airport.

3.3 Dye Injections

The dye injection began at the North Bend WWTP on February 7, 2012 at 1:16 AM and ended at approximately 1:40 PM. The injection was continuous for a total of 12.4 hours. The average WWTP effluent flow rate during the injection was 1.27 MGD, with a high flow of 1.75 MGD from 8:00 AM - 9:00 AM. Based on the continuous flow rate out of the dye container, 17.65 gal/day, a 1×10^8 ppb concentration factor for the Rhodamine WT dye, and an effluent flow rate of 1.27 MGD, the average dye concentration in the effluent was calculated to be 1393 ppb using a mass balance equation. The initial dye concentration of 1393 ppb was used for calculating the dilutions for the readings taken on each day of the dye study.

The dye injection began at the Coos Bay #1 WWTP on February 15, 2012 at 4:00 AM and ended at 11:33 PM. The injection was continuous for a total of 19.5 hours, but due to a crimp in the tubing that was not discovered and repaired until 12:50 PM, the bulk of the injection took place over 10.7 hours from 12:50 PM – 11:33 PM. The average WWTP effluent flow rate during this 10.7 hour injection period was 5.82 MGD with a high flow of 7.52 MGD from 1:00 PM – 2:00 PM. Based on the continuous flow rate out of the dye container, 38.80 gal/day, a 1×10^8 ppb concentration factor for the Rhodamine WT dye, and an effluent flow rate of 5.82 MGD, the average dye concentration in the effluent was calculated to be 667 ppb using a mass balance equation. The initial dye concentration of 667 ppb was used for calculating the dilutions for the readings taken on each day of the dye study.

3.4 Travel Time

Travel time of the dye on the ebb tide of the first day of the North Bend WWTP study (2/7/2012) was determined. The dye injection began at 1:16 AM on a flood tide but did not reach Station 1 until the following flood tide. Based on data obtained from the submersible fluorometers (Figures 3 – 8), the dye first reached Station 1 around 9:17 AM and first reached Station 2 around 10:12 AM (55 minutes later). Stations 1 and 2 were approximately 1.7 km apart, so the dye travel time from Station 1 to Station 2 was about 1.9 km/hr or 1.2 mph. The distance from the North Bend WWTP outfall to the nearest border of the approved growing area is 1.9 km, so it would take approximately one hour for effluent to travel from the outfall to the growing area. This is a just slightly longer than the 55 minutes it took the dye to travel from Station 1, which was close to the WWTP outfall, to Station 2, which was just south of the area border.

Travel time of the dye on the ebb tide of the first day of the Coos Bay #1 WWTP study (2/15/2012) was also determined. Based on data obtained from the submersible fluorometers (Figures 9 – 14), the dye first reached Station 6 (nearest the WWTP) around 2:24 PM and first reached Station 5 around 3:58 PM (94 minutes later). Stations 6 and 5 were approximately 2.2 km apart, so the dye travel time from Station 6 to Station 5 was about 1.4 km/hr or 0.87 mph. This compares fairly well with the travel time determined by the drogue study (1.0 km/hr), since the drogues were released in the same vicinity as the Coos Bay #1 WWTP and traveled in the same direction as the dye-tagged effluent from the plant. However, dye typically travels faster than drogues, and the more conservative value of 1.4 km/hr based on the velocity of dye movement should be used for determining the response time needed for a WWTP failure. The Coos Bay #1 WWTP outfall is 1.3 km away from the nearest border of the approved growing area, so it would take about 56 minutes for effluent to travel from the outfall to the growing area.

3.5 Dye Readings at Cage Stations

One significant advantage of the submersible fluorometers attached to the cage stations was that they could detect dye every ten minutes over the entire multi-day period of the study and could pick up dye readings during hours when boat tracking was not possible. These continuous dye readings could then be used for a steady state analysis as discussed below.

Dye readings recorded by the submersible WET Labs units at each of the station locations for the North Bend study (2/7/2011 – 2/10/2011) are shown in Figures 3 – 8 and for the Coos Bay #1 study (2/15/2011 – 2/17/2011) in Figures 9 - 14. The tidal depth in feet is also plotted, and the peaks in the Rhodamine WT dye concentration follow closely with the tidal cycles. Any readings at or below background levels, such as readings measured by the submersible WET Labs units prior to the dye injection, were removed from the graphs. Steady state conditions were estimated using the superposition method (Kilpatrick, 1993) described in the "Methods" section. Superposition dye concentrations at each station are also plotted in Figures 3 – 14.

Figure 3 shows the dye concentration levels at Station 1 over the course of the North Bend study. As expected, the peak dye concentration occurred during the low tide following the dye injection period on 2/7/2012. The 5-point moving average concentration at the peak was 3.78 ppb, which equated to a dilution of 369:1. During the North Bend study, the maximum 5-point moving average concentration detected near Station 1 via boat tracking (not including depth profiles) was 27 ppb, with a dilution of 52:1. The majority of the dye during the study was detected right near the surface of the water, whereas the cages were placed at various depths of about 10 – 30 feet deep. Therefore, Station 1 and the other cages received much lower concentrations of dye than those levels detected by boat tracking at the surface. However, unlike the boat tracking data, the build-up of dye at the stations could be assessed using the superposition method to determine steady state dilution values. The maximum dye concentrations at Station 1 for successive study days were added to ascertain the superposition concentrations, and the (half tidal day) steady state dilution was determined to be 319:1. The peak one hour steady state dilution was 1080:1, and the average steady state dilution was 2731:1.

Figures 4 – 8 show the dye concentration levels and steady state dilution values for Stations 2 – 6 over the course of the North Bend study. For Station 2, the peak one hour steady state dilution was 17415, which represents a 16-fold increase in dilution from Station 1. The peak one hour steady state dilution for Station 3 was 13930, which was actually lower than the dilution at Station 2. The maximum and average steady state dilution values were also lower at Station 3 than at Station 2. This indicates that there was some build-up of dye at Station 3, which was stationed within Haynes Inlet. Even though Station 3 was located farther away from the North Bend outfall than Station 2, it had lower levels of dilution, because dye-tagged effluent was not well flushed from the inlet.

Station 4 had higher levels of dilution than both Station 2 and Station 3, with a peak one hour steady state dilution of 10715:1. As seen in Figure 6, significant levels of dye were detected at Station 4 over a two day period from 2/7/2011 – 2/9/2011. On the other hand, Stations 5 and 6 had very high levels of dilution save for a single high peak that occurred at each station over two days after the start of the dye injection. Even with consideration of these peaks, the steady state peak one hour dilution levels at Stations 5 and 6 were 139300:1 and 1906478:1, respectively.

Figures 9 – 14 show the dye concentration levels and steady state dilution values for Stations 1 – 6 over the course of the Coos Bay #1 WWTP study, which took place a week after the North Bend WWTP study. Station 6 was actually the station closest to the Coos Bay #1 WWTP outfall, and Station 1 was the station farthest away.

As previously noted, the dye injection at the Coos Bay #1 WWTP started at 4:00 AM on 2/15/2011, but a crimp in the dye tubing impinged the free flow of dye into the final effluent and prevented dye from reaching Station 6 at significant levels. Although Station 6 was located very close to the outfall, the first peak at Station 6 was not observed until after the crimp in the tubing was resolved at 12:50 PM. Thereafter, dye reached Station 6 at significant levels, with the maximum steady state, peak one hour steady state, and average steady state dilution levels calculated as 526:1, 834:1, and 1754:1, respectively (see Figure 14).

Although Station 6 was located close to the outfall, the dye reached Station 5 at much greater levels – the peak dye concentration at Station 5 was over 300 times higher than the peak dye concentration at Station 6. For this reason, the dilution values at Station 5 were very low, with the steady state peak one hour dilution calculated to be only 74:1 (see Figure 13).

Dilution levels varied from Station 4 to Station 1. Dilution did not increase with increasing distance from the outfall in a linear fashion. As shown in Figures 12 – 9, the steady state peak one hour dilution values at Stations 4, 3, 2, and 1 were 1332:1, 933:1, 2880:1, and 807:1, respectively. Once again, there appeared to be a build-up of dye at Station 3 in Haynes Inlet, as was observed during the North Bend study. This same trend was observed via boat tracking, and it appeared that dye gathered within the inlet and was not flushed as well from the inlet as from other parts of the estuary. However, it is not clear why the dye built up at Station 1 and why dilution was lower at this station than at Stations 2, 3, and 4, which were closer to the Coos Bay #1 WWTP outfall.

During the Coos Bay #1 study, Stations 2, 3, 4, and 6 received more dye on the third day of the study, 2/17/2011, than on any of the preceding days. These findings further indicate that significant concentrations of dye-tagged effluent can remain in the Coos Bay system and build up, even after the input has stopped. It's possible that effluent from the North Bend and Coos Bay #1 WWTPs may be insufficiently flushed from the bay on the ebb tide and may return back to the bay on flood tide.

Since dilution did not increase in a linear fashion with increasing distance from the outfall during either study, a linear regression analysis to estimate the location of the 1000:1 dilution line could not be performed. However, it was possible to combine the dye concentration levels from both the North Bend and Coos Bay #1 WWTPs to determine the combined half tidal day peak one hour dilution and average dilution at each station. The maximum dilution values could also be determined, but this value was considered to be overly conservative for a comparison with the microbial data collected at each station. Figure 15 shows levels of NoV GII, and MSC in comparison to the combined dilution values from both studies at Stations 1 through 6. The NoV GII and MSC results will be discussed in more depth later in this report, but it is important to note that the highest levels of dilution were seen at Station 2, where the NoV GII levels were the lowest, whereas the lowest levels of dilution were seen at Station 5, where the NoV GII and MSC levels were the highest. These findings demonstrate that dilution is a more significant factor in regards to the impact of viruses than the distance of shellfish from the WWTP outfalls.

Figure 15 also shows that at levels of 1000:1 dilution or less at Stations 1, 3, 5, and 6, NoV GII levels were higher than 1000 RT-PCR/100g. The reason for this finding will be discussed later in the report, but this result demonstrates that the establishment of a 1000:1 dilution line for growing area classification purposes may be insufficient to mitigate the impact of viruses in Coos Bay, unless used in conjunction with other mitigation strategies.

3.6 Dye Readings by Tracking Fluorometers during the North Bend Study

While the submersible fluorometers determined the dye levels reaching the oyster cages, boat tracking was conducted with two towed fluorometers (the WET Labs FLRHRT-586 and FLRHRT-2040) and one profiling fluorometer (WA State's WET Labs FLRHB-2153 fluorometer) to track the dye past the cages and to determine the shape and edges of the dye as it traveled through Coos Bay. Figures 16 and 17 represent the 5-point moving average concentration values and the corresponding dilution levels for the first and second day of the

North Bend study (2/7/2012 and 2/8/2012). Data collected with the Trimble and the FLRHRT-586 fluorometer on one boat was combined with data collected using RAFT-MAP and the FLRHRT-2040 fluorometer on a different boat to create these figures. The raw data used to create these figures (in Excel sheets) can be provided upon request.

The WET Labs FLRHB-2153 instrument was used to conduct profiles of the dye at different depths in order to determine the vertical distribution of dye in the water column. It was observed that the dye primarily remained near the surface of the bay as it moved farther away from the WWTP diffuser, with less dye detectable at depth. This observation makes sense in that the wastewater effluent with the dye consisted of freshwater, which floated on top of the salt water. There were no other obvious freshwater inputs that could create a salt water wedge and push the dye towards the bottom of the water column. However, very close to the diffuser, which was located near the bottom of the bay, the dye levels were far higher as detected by the profiling WET Labs at depth than by the other fluorometers near the surface.

It was observed after the study that the depth data collected with the FLRHB-2153 fluorometer did not match the observations of the profiles made during the study. For example, some profiles recorded negative or very low depth readings (based on the WET Labs conversion equation for the sensor) when the profiler instrument was suspended deep in the water column or recorded high depth readings when the profiler was at the surface. There was no correlation between increasing or decreasing values recorded by the profiler and the notes/ observations made of the depth of the instrument during particular profiles. Based on the values recorded by the profiler, FDA was unable to determine the depth of the fluorometer at any given point in time. Further, there did not appear to be any relationship between increasing or decreasing dye concentration data and the pressure values recorded by the profiler. Therefore, the profiler data described in this report are based on field notes written during the study as profiles were being taken.

The highest 5-point moving average concentration of dye detected by the WET Labs FLRHB-2153 right over the WWTP diffuser on the first day of the North Bend study was 727 ppb. Since the initial concentration of dye at the WWTP was 1393 ppb, this equates to a very low dilution factor of 1.92:1. At least 40 dye readings in the area were over 450 ppb as determined with the profile data. However, the tracking WET Labs FLRHRT-2040 fluorometer used near the surface only detected a maximum dye concentration of 27 ppb. This indicates that the diffuser might not have diluted the dye significantly but that dilution did increase significantly as the dye traveled up from the bottom to the surface of the bay.

As can be seen in Figure 17, dye concentrations in the range of 1.0 – 5.0 ppb were detected as far away from the North Bend diffuser as Station 6 on the second day of the study. Comparing Figure 16 with Figure 17, it can be seen that the dye traveled farther and at higher levels to Station 3, 4, 5, and 6 on February 8th than on February 7th.

Figure 18 shows the locations of <=1000:1 dilution based on boat tracking data for both days. Because the initial concentration of dye at the North Bend WWTP outfall was 1393 ppb, a dye concentration in the bay of 1.393 ppb would represent a 1000:1 dilution of the North Bend WWTP's effluent. Dye concentrations in the bay greater than 1.393 ppb represent levels of dilution less than 1000:1. This observation is important when viewing the boat tracking data and assessing instantaneous dilution, but it does not factor in the steady state dilution analysis or build-up of dye over time that was discussed earlier. In fact, the submersible fluorometers attached to the stations showed that some were still receiving dye on 2/10/2012 – three days after the dye injection – and that two of the stations (Stations 5 and 6) received more dye in the days after the injection than on the day of the injection.

3.7 Dye Readings by Tracking Fluorometers during the Coos Bay #1 Study

Figures 19 and 20 represent the 5-point moving average concentration values and the corresponding dilution levels for each day of boat tracking for the Coos Bay #1 study (2/15/2011 and 2/16/2011). The raw data used to create these figures (in Excel sheets) can be provided upon request. The GIS data shown in Figures 19 and 20 was taken solely from the RAFT-MAP program.

As can be seen in Figure 19, dye concentrations were in the range of 1.0 – 50.0 ppb between Stations 6 and 5, but decreased below 1.0 ppb around Stations 2 to 4. The concentrated dye plume tended to stay close to the shoreline. Dye was not tracked around Stations 1 and 3 on this day, but was detected at these stations on the second day of the study as discussed below.

Figure 20 shows the RAFT-MAP data gathered on the second day of the Coos Bay #1 study, 2/16/2011. As shown on the map, dye levels in the range of 0.50 – 1.0 ppb were detected from Station 6 up to Station 4. Lower levels of dye, in the range of 0.10 – 0.50 ppb, were detected at the stations farther from the Coos Bay #1 outfall – Stations 3, 2, and 1, but dye levels of 0.50 – 1.0 ppb were also detected north and south of Station 3 within Haynes Inlet. Since the initial concentration of dye at the outfall was 667 ppb, a dye concentration of 0.667 ppb in the estuary would equate to a 1000:1 dilution. Even on the second day of the study, 84.5% of the dye levels recorded throughout the estuary were > 0.8 ppb, including dye levels detected near Station 1. The lowest dye level recorded in RAFT-MAP on 2/16/2011 was 0.32 ppb. The dye levels detected in RAFT-MAP using the boat tracking fluorometers compared well with the dye levels detected by the submersible fluorometers attached to the cage stations, e.g. dye levels recorded by both the boat tracking fluorometers and submersible fluorometers were in the range of 0.1 – 1.0 ppb at all the stations. Overall though, dye levels tended to be higher at the surface, where all dye concentration readings were greater than 0.32 ppb, than at the bottom of Coos Bay, where many dye readings were less than 0.32 ppb.

Figure 21 shows the locations of ≤1000:1 dilution based on boat tracking data for both days. Because the initial concentration of dye at the Coos Bay #1 WWTP outfall was 667 ppb, a dye concentration in the bay of 0.667 ppb would represent a 1000:1 dilution of the Coos Bay #1 WWTP's effluent. Dye concentrations in the bay greater than 0.667 ppb represent levels of dilution less than 1000:1. As seen in Figure 21, ≤1000:1 dilution levels were seen from Station 6 all the way to Station 2 and a little past that station.

3.8 Overall Boat Tracking Results for Both WWTP Studies

Figure 22 shows the boat tracking results for both the North Bend WWTP study and the Coos Bay #1 WWTP study combined. This map demonstrates that significant levels of dye-tagged effluent from one or both WWTPs reached all six stations and other parts of the bay, such as locations east of Stations 4, 5, and 6. The dye mostly concentrated along the shoreline, but also reached Station 3 at high levels (1.0 – 5.0 ppb) and accumulated in Haynes Inlet.

This map only shows dye readings taken at a single point in time at the surface level at each GPS location (or in some cases 2 or 3 points in time if the same location was traversed by the boat more than once). It does not represent a continuous stream of data from a stationary location like the data recorded by the submersible fluorometers. It's important to note that the dye-tagged effluent from both WWTPs would have a cumulative effect on the locations in between the plants. This map does not show the effect of adding effluent levels from the North Bend WWTP to effluent levels from the Coos Bay #1 WWTP, but the map does show the *minimum* level of dye-tagged effluent that could be expected to reach each station and location in Coos Bay by simultaneously displaying the boat tracking data for both studies.

Figure 23 shows the ≤1000:1 dilution estimates based on both studies' boat tracking data in relation to the conditionally approved growing area in between the WWTPs. As can be seen in the figure, levels of ≤1000:1 occur near all the shellfish stations and throughout much of the growing area. It's also important to reiterate that the ≤1000:1 dilution estimates shown in Figure 23 (and in Figures 18 and 21) and determined using daily boat tracking data do not represent the steady state dilution condition. In other words, this data does not show the build-up of dye that occurs over time, typically two to three days, before the steady state condition is reached, whereby the rate of effluent entering Coos Bay from one of the WWTPs is being flushed out of the bay by tides at the same rate, so that no further build-up of effluent occurs. This principle was demonstrated by the analysis of the station fluorometer data using the superposition method. The maps with the boat tracking data show where locations of ≤1000:1 are known to occur, but there could be even more locations within the bay where ≤1000:1 dilution occurs if the build-up of effluent from both WWTPs and the steady state condition are factored.

3.9 RAFT-MAP Beta Test

Having the ability to both map the GPS-tagged dye results electronically and perform calculations for concentration and dilution in real-time using RAFT-MAP proved to be a valuable asset. For the North Bend WWTP study, Figures 16 to 18 show data collected using RAFT-MAP. This data can be directly compared to data collected the past way of using Trimble units and post-processing the results. During the North Bend study, the Trimble was attached to a different fluorometer operating on a different boat that did not traverse the same locations at the same times as the boat operating with RAFT-MAP, but the RAFT-MAP results compare very well to the Trimble results. Whereas it took months to create the GIS maps with the Trimble results, the RAFT-MAP results were obtained in real-time out on the boat. Then post-processing with ArcGIS Desktop could be conducted back at the office.

One immediate benefit from the use of RAFT-MAP was that FDA and ODA noticed on the map that Station 1 was originally positioned outside the most concentrated portion (centerline) of the dye plume during the North Bend WWTP study. Because of this observation using the RAFT-MAP system, Station 1 was picked up and moved to a better position directly within the dye plume's centerline. This ensured that the station would detect the highest levels of dye in the area and that oysters in the cage would have the highest exposure to the dye-tagged effluent.

Figure 22 shows the RAFT-MAP results from a geodatabase for the entire Coos Bay project, including both the North Bend and Coos Bay #1 WWTP studies, over the entire time span that boat tracking data was collected. Data for each individual day of the study is located in ArcGIS "layers" within the collective map. When viewing the ArcGIS .mxd file for this project, each layer can be turned on and off to see how the dye-tagged effluent behaved on a particular day or how it behaved for the entire length of the study.

While the RAFT-MAP program performed very well during the beta test in Coos Bay, there were a few features that were noted for improvement. The program shut down a few times in the middle of data collection. This was thought to be due to a memory cache issue, since it tended to happen towards the end of the day after a lot of data had been collected. However, data collected prior to the shut downs was not lost. A related issue was that each track file took longer and longer to save towards the end of a day of data collection. These issues were partly resolved by saving data in multiple projects within RAFT-MAP, rather than trying to save all the data from Coos Bay in a single project. There were also other issues related to exporting files, re-loading calibrations, labeling markers, and error messages. Due to the calibration issue, many data readings had to be post-processed and corrected in ArcGIS Desktop after the study. All of the observations made during the beta test were discussed with ESRI, Inc. to improve the RAFT-MAP system. Once further improvements are made, FDA plans to distribute RAFT-MAP at no cost to state shellfish control authorities who are interested in using this new technology.

3.10 Wastewater Treatment Plant Flows and Performance During the Studies

The studies were conducted in February 2011 during a time of high flows and cold temperatures, which are conditions conducive to viruses. For the North Bend WWTP, the average flow during the 12.4 hour dye injection period on 2/7/2012 was 1.27 MGD based on flow data provided by the plant. The maximum flow rate during the dye injection period was 1.75 MGD. The North Bend WWTP performed within its design capacity during the study and did not experience any bypasses, loss of disinfection, or other interruptions.

The average daily wet flow for the North Bend WWTP is 2.5 MGD, with a peak hourly flow up to 8.5 MGD – close to the hydraulic capacity of 8.3 MGD – and a design flow of 2.0 MGD. Since flows of 2.5 – 8.5 MGD can be expected at the North Bend WWTP in the winter months, such flows would be 2.0 – 6.7 times higher than the average recorded during the dye study. This would result in lower dilutions of effluent, approximately 2.0 – 6.7 times lower, than those previously discussed in this report using the study data.

For the Coos Bay #1 WWTP, the average flow during the dye injection period on 2/15/2012 (after the problem with the tubing was fixed) was 5.8 MGD based on flow data provided by the plant. The maximum flow rate during that period was 7.52 MGD. It should be noted that earlier in the day, prior to detection of the tubing problem, a WWTP flow level as high as 11.61 MGD was recorded.

The average daily wet flow for the Coos Bay #1 WWTP is 3.2 MGD, with a peak daily flow up to 10.0 MGD and a peak wet weather flow up to 15.0 MGD (values obtained from document "City of Coos Bay Facilities Plan for Wastewater Treatment Plant No. 1", May 2008). The average daily wet flow is lower than the average flow calculated for the dye injection period (5.8 MGD). In fact, a significant rainstorm event occurred during the dye injection period for the Coos Bay #1 study and this event not only resulted in higher flows at the WWTP, but it also caused a bypass of primary treatment to occur. The higher flows and the bypass of treatment resulted in the detection of high levels of enteric viruses and MSC in the effluent, as discussed more below. This is believed to be the reason that even stations that experienced greater than 1000:1 dilution during the studies, as determined based on the steady state combined dilutions, still had shellfish sentinels test high for levels of viruses and indicator microorganisms.

3.11 Shoreline Survey Assessment

The results of the shoreline survey did not indicate any major contributing source of pollution to the growing area other than the WWTPs. Most of the samples collected had low levels of FC, EC, and MSC. Two of the samples, collected in the same location, had MSC levels above the limit of detection. This area was re-sampled, but the results were not replicated. The samples were collected near large homes with run-off. Soap bubbles were seen in the run-off, which are consistent with laundry detergents or other household items often present in gray water. The homes were far from the location of the growing area and the run-off flows were very small. This source was not deemed to have any significant impact on the growing area. ODA indicated that it would follow up with the home-owners about the run-off issue. Thus, the shoreline survey results indicate that the most dominant and significant source of MSC comes from the WWTPs.

3.12 Microbiological Analysis of WWTP Influent and Effluent

Tables 1 – 4 show the FC, EC, MSC, NoV GI and GII, and AdV results for the North Bend and Coos Bay WWTPs' influent and final effluent for both study periods.

Table 1 - North Bend WWTP Influent Data

Date	Time	GI RT-PCR units/100 ml	GII RT-PCR units/100 ml	Adenovirus units/100 ml	MSC/100 ml	EC/100 ml	FC/100 ml
2/6/2011	1:00 to 6:00	<17	14,400	1,270	76,800	1,500,000	2,000,000
2/6/2011	13:00 to 18:00	<17	71,860	7,380	1,176,000	1,500,000	1,500,000
2/7/2011	1:00 to 6:00	24	47,330	1,120	212,000	600,000	600,000
2/7/2011	13:00 to 18:00	80	6,910	1,540	306,000	660,000	695,000
2/8/2011	1:00 to 6:00	<17	6,570	4,680	346,000	785,000	845,000
2/8/2011	13:00 to 18:00	<17	13,000	15,590	280,000	745,000	750,000

ND- Not Determined

Table 2 - North Bend WWTP Effluent Data

Date	Time	GI RT-PCR units/100 ml	GII RT-PCR units/100 ml	Adenovirus units/100 ml	MSC/100 ml	EC/100 ml	FC/100 ml
2/6/2011	1:00 to 6:00	<17	1,970	1,560	3,840	7.0	8.5

2/6/2011	13:00 to 18:00	ND	ND	ND	ND	<0.5	<0.5
2/7/2011	1:00 to 6:00	<17	3,260	530	ND	<0.5	<0.5
2/7/2011	13:00 to 18:00	<17	1,890	63	12,200	12.0	17.0
2/8/2011	1:00 to 6:00	<17	2,500	470	4,000	2.5	3.0
2/8/2011	13:00 to 18:00	<17	<10	1,680	2,000	<0.5	<0.5

ND- Not Determined

Table 3 - Coos Bay #1 WWTP Influent Data

Date	Time	GI RT-PCR units/100 ml	GII RT-PCR units/100 ml	Adenovirus units/100 ml	MSC/100 ml	EC/100 ml	FC/100 ml
2/10/2011	1:00 to 6:00	<17	5,580	4,580	92,000	925,000	955,000
2/11/2011	1:00 to 6:00	<17	3,310	2,731	154,000	850,000	865,000
2/11/2011	13:00 to 18:00	<17	780	6,260	128,000	1,185,000	1,190,000
2/12/2011	1:00 to 6:00	<17	13,610	5,600	108,000	105,000	115,000
2/12/2011	13:00 to 18:00	<17	77,000	25,900	128,000	ND	ND
2/13/2011	1:00 to 6:00	<17	840	990	136,000	1,600,000	1,700,000
2/13/2011	13:00 to 18:00	<17	2,007	890	76,000	2,400,000	2,800,000
2/15/2011	7:28 (grab)	ND	ND	ND	25,400	300,000	360,000
2/15/2011	12:08 (grab)	ND	ND	ND	62,000	1,500,000	1,650,000

ND- Not Determined

Table 4 - Coos Bay #1 WWTP Effluent Data

Date	Time	GI RT-PCR units/100 ml	GII RT-PCR units/100 ml	Adenovirus units/100 ml	MSC/100 ml	EC/100 ml	FC/100 ml
2/10/2011	1:00 to 6:00	<17	2,810	720	8,600	<0.5	<0.5
2/11/2011	1:00 to 6:00	<17	1,140	2,360	12,400	1.50	1.50
2/11/2011	13:00 to 18:00	<17	130	560	8,000	0.50	0.50
2/12/2011	1:00 to 6:00	<17	82	430	9,200	<0.5	<0.5
2/12/2011	13:00 to 18:00	<17	600	460	10,400	ND	ND
2/13/2011	1:00 to 6:00	<17	<17	<10	12,800	1.50	2.50
2/13/2011	13:00 to 18:00	<17	<17	146	17,200	1.50	1.50
2/15/2011	7:28 (grab)	ND	ND	ND	4,400	<0.5	<0.5
2/15/2011	12:08 (grab)	ND	ND	ND	2,200	3.50	3.50

ND- Not Determined

FC and EC levels in the final effluent were low, in accordance with the WWTPs' discharge permits, but average MSC levels in the final effluent ranged from 2,000 to 12,200 MSC/100 ml for the North Bend WWTP and from 2,200 to 17,200 MSC/100 ml for the Coos Bay #1 WWTP. NoV GI was not detected in the final effluent of either plant during the studies.

NoV GII levels detected in the North Bend WWTP influent ranged from 6,570 to 71,860 RT-PCR units/100 ml. In one case, NoV GII levels were reduced to <10 RT-PCR units/100 ml in the final effluent after treatment by the WWTP. However, in most cases virus levels detected in the WWTP final effluent remained high – ranging from 1,890 to 3260 NoV GII RT-PCR units/100 ml.

For the Coos Bay #1 WWTP influent, levels of NoV GII in the influent ranged from 780 to 77,000 RT-PCR units/100 ml. In two cases, NoV GII levels were reduced to <17 RT-PCR units/100 ml in the final effluent, but as with the North Bend WWTP, the majority of final effluent samples tested had detectable levels of viruses, ranging from 82 to 2810 NoV GII RT-PCR units/100 ml.

Adenovirus was found in all North Bend influent samples and ranged from 1,120 to 15,590 units/100ml. The effluent samples ranged from 63 to 1,680 units/100ml. As with the North Bend WWTP, the Coos Bay # 1 WWTP had AdV positive results for all influent samples, with AdV values ranging from 890 to 25,900 unit/100ml. The effluent had one sample below the detection limit of <10 units /100ml and the rest ranged from 146 to 2,360 units/100ml. The AdV removal through treatment seemed consistent with the other virus analyzed.

A 1000:1 dilution of the WWTPs' outputs in the bay would reduce the highest NoV GII levels detected in the North Bend and Coos Bay #1 final effluent down to 3.3 and 2.8 NoV GII RT-PCR units/100 ml, respectively. However, the ability of shellfish to bioaccumulate viruses up to 100-fold (Seraichekas et al., 1968; Maalouf et al., 2011) should be considered in determining whether a 1000:1 dilution is sufficient, particularly since the viral impacts from both WWTPs on the approved growing area is cumulative. The elevated levels of NoV GII in the shellfish indicate that the combined impact from both WWTPs and bioaccumulation play a critical role.

3.13 Microbiological Analysis of Oysters at Cage Stations

Figure 15 shows the FC, EC, MSC, NoV GII, NoV GII, and AdV results from the oyster sentinels at the station locations.

Some overall trends seen in Figure 15 are: FC, EC, and NoV GI levels were generally low and did not appear to be directly correlated to the distance from the WWTP outfall, the level of dilution, or the NoV GII results; the stations positioned in between the two WWTP outfalls but closer to the Coos Bay #1 outfall (Stations 5, 4, and 3) had the highest NoV GII results; and MSC levels increased and decreased in a similar manner to NoV GII levels. MSC and NoV GII results were also related to dilution levels, as shown in Figure 15 and previously discussed.

For the North Bend WWTP study, Station 1 was closest to the diffuser and Station 6 was farthest away. Dye concentrations were highest near Station 1, up to 27 ppb, and were still detected at significant levels (1.0 – 5.0 ppb) near the other stations (see Figures 17 and 18). For comparison with the microbiological findings, levels of MSC and NoV GII at Station 1 were high (1630 NoV GII RT-PCR units/100g), but decreased at Station 2 (1080 NoV GII RT-PCR units/100g). The level of NoV GII (but not MSC) increased at Station 3 and Station 4, but this finding may also be due to the influence of the Coos Bay #1 WWTP on these stations. Based on the microbiological results in Figure 15, it appears that Stations 3 and 4 were more impacted by NoV GII from the Coos Bay #1 WWTP than from the North Bend WWTP. However, dye detected by the submersible fluorometers at these stations during the North Bend study (2/7/2011 – 2/10/2011) indicates that effluent from the North Bend WWTP reached Stations 3, 4, and 5 at levels up to 0.4 ppb, 0.12 ppb, and 0.4 ppb, respectively. Therefore, the NoV GII levels in the shellfish are partly representative of inputs from the North Bend WWTP, even though the Coos Bay #1 WWTP appeared to have a larger impact on the results. The viral impacts from the effluent from both WWTPs on all six stations were cumulative.

For the Coos Bay #1 WWTP study, Station 6 was closest in proximity to the WWTP outfall and Station 1 was farthest away. Interestingly, as shown in Figure 15, Station 6 had lower levels of NoV GII than Stations 5, 4, and 3 and lower levels of MSC than Stations 5 and 4, even though it was positioned closer to the WWTP outfall. Dilution was lower at Station 5 than at Station 6, so this could explain why NoV GII levels were higher at Station 5, i.e. Station 6 was closer to the outfall but was not as well positioned within the concentrated dye plume. However, it does not explain why virus levels were higher at Stations 3 and 4 than at Station 6, since those stations had higher dilution levels. One possible explanation for the observations about Station 6 is that the station was positioned so closely to the Coos Bay #1 WWTP outfall that the freshwater effluent may have adversely affected the pumping ability of the oyster sentinels at that station and hindered the uptake of NoV GII and MSC. During the North Bend WWTP study, Station 6 has normal salinity levels relative to the other stations (~18 – 24 ppt). However, after the major rainfall event that occurred during the Coos Bay #1 study, the salinity levels at Station 6 dropped below 8 ppt on 2/15 and 2/16 (see Figure 14). The salinity levels at the other stations also dropped during the second study, but Station 1 was the only other station that experienced a salinity level less than 8 ppt for a brief period on 2/16 (see Figure 9). All the other stations maintained salinities greater than 10 ppt throughout both studies. Station 6 was so close to the Coos Bay #1 WWTP outfall that the shellfish were likely impacted by the freshwater influent.

NoV GII levels in shellfish at Stations 5, 4, 3, 2 decreased in a stepwise fashion as the stations moved farther away from the Coos Bay #1 WWTP outfall. MSC levels increased from Station 3 to Station 2, which can most likely be attributed to the contribution of MSC from the North Bend WWTP. However, NoV GII levels were lower and dilution levels were higher at Station 2 than at Station 3. Therefore, we are unable to determine which WWTP had the biggest impact on Station 2.

Adenovirus was detected at Station 6 (395 adenovirus PCR units/100 g) and at Station 5 (498 adenovirus PCR units/100 g), but was not detected at the other four stations farther away from the outfall. Adenovirus was only present in oyster sentinels near the Coos Bay #1 outfall, and not in sentinels near the North Bend diffuser.

In summary, the Coos Bay #1 WWTP appeared to have a greater viral impact on Stations 6, 5, 4, and 3, whereas the North Bend WWTP appeared to have a greater viral impact on Station 1 and possibly Station 2. Nevertheless, based on dye tracking results recorded in RAFT-MAP and results from the submersible fluorometers, all six stations were impacted by effluent from both WWTPs. The cumulative estimated dilution values from both WWTPs are shown in Figure 15, along with the microbiological findings at each of the oyster sentinel stations. NoV GII levels ranged from 1080 GII RT-PCR units/100 g (at Station 2) to 4730 RT-PCR units/100 g (at Station 5). These levels are very high and should be considered in conjunction with the dye study results.

3.14 Short Term Failure Scenario – Dilution and Anticipated Fecal Coliform Concentrations in Surface Water

A short-term raw sewage failure at either the North Bend WWTP or the Coos Bay #1 WWTP could result in deteriorated water quality in a single ebb tide. Dilution is physical and is computed by dividing the dye concentration added to the WWTP effluent by the dye concentrations found at locations in the estuary. The initial concentration at the North Bend WWTP was 1393 ppb and at the Coos Bay #1 WWTP was 667 ppb. Once dilution is calculated in this manner, the FC counts detected in the influent can be divided by the dilution level achieved at a certain location within Coos Bay to estimate the FC counts that would occur at that location in the event of a raw sewage failure. For example, we can estimate the anticipated fecal coliform concentrations at the 1.5, 1.0, and 0.5 ppb contours in Coos Bay in the event of a short-term raw sewage failure. The FC counts in the pre-chlorinated effluent can also be divided by the dilution levels to determine what would happen in the event of a loss of disinfection failure.

Tables 5 and 6. The following tables provide the dilution values for 0.5, 1.0, and 1.5 ppb concentrations in the estuary and the anticipated fecal coliform (FC) concentrations if a short term failure should occur at the North Bend WWTP or the Coos Bay #1 WWTP (single ebb tide and assuming no decay). When influent data for a WWTP is unavailable, a typical literature based value of 1.4×10^6 FC MPN/100 ml can be used to represent the anticipated fecal coliform count for untreated wastewater in the event of a worst-case, total failure scenario. However, actual influent data for the North Bend and Coos Bay #1 WWTPs is presented in Figures 22 and 23 and was used in the analysis. Average FC levels in the influent at the North Bend and Coos Bay #1 WWTPs were 1.1×10^6 and 1.2×10^6 FC MPN/100 ml, respectively. FDA testing also found FC levels as high as 2.0×10^6 FC MPN/100 ml in the North Bend WWTP influent and 2.8×10^6 FC MPN/100 ml in the Coos Bay #1 WWTP (twice the literature value).

Table 5: Dilution and Theoretical Fecal Coliform Concentrations for a Raw Sewage Failure at the North Bend WWTP

Dye Contour (ppb)	Dilution with Respect to FC with no decay	Estimated Conc. in Bay (FC/100 ml)	Estimated Conc. in Bay (FC/100 ml)
		With 1.1×10^6 FC/100 ml (average level in influent)	With 2.0×10^6 FC/100 ml (max level in influent)
1.5	929:1	987	1794
1.0	1393:1	658	1196
0.5	2786:1	329	598
0.1	13930:1	66	120
0.01	139300:1	7	12

Table 6: Dilution and Theoretical Fecal Coliform Concentrations for a Raw Sewage Failure at the Coos Bay #1 WWTP

Dye Contour (ppb)	Dilution with Respect to FC with no decay	Estimated Conc. in Bay (FC/100 ml)	Estimated Conc. in Bay (FC/100 ml)
		With 1.2×10^6 FC/100 ml (average level in influent)	With 2.8×10^6 FC/100 ml (max level in influent)
1.5	445:1	2247	5243

1.0	667:1	1498	3496
0.5	1334:1	749	1748
0.1	6670:1	150	350
0.01	66700:1	15	35

Since typical literature values for FC counts in raw sewage are around 1.4 x 10^6 FC MPN/100 ml, FDA has often recommended that a 100,000:1 dilution needs to be achieved for a raw sewage failure prior to the sewage reaching the boundary of an approved growing area, since the goal is to achieve 14 FC MPN/100 ml within the approved area. Any growing areas within the 100,000:1 dilution zone should be prohibited, restricted, or conditionally managed based on the WWTP operation.

As shown in Tables 1 and 2 above, dilution levels close to 100,000:1 would be needed to reduce FC counts to acceptable levels in the event of a raw sewage failure at either WWTP. The limit of detection of the tracking fluorometers in the Coos Bay estuary was around 0.03 ppb. Since 0.01 ppb is below the limit of detection, approved areas should not be established anywhere that dye was detectable during the first ebb tide of the study. Dye was detectable in every location that boat tracking was conducted with RAFT-MAP and at every station location in both WWTP studies. The dye tracking results are shown in Figures 16 – 23 and the station fluorometer data results are shown in Figures 3 – 14. Based on these figures, there is no location in Coos Bay where an approved growing area could be established, since significant levels of dye were detected throughout the bay.

3.15 Determination of 1000:1 Dilution

Under Scenario 2 for sizing prohibited areas (see Section 1.2), the size of the prohibited zone can be reduced and a conditional area can be established if a 1000:1 dilution zone is achieved and other conditions are met.

The 1000:1 dilution line changes throughout the course of the tidal excursion, so the steady state condition of the estuary should be assessed to estimate where the 1000:1 dilution line will be when the rate of effluent entering the system from the WWTP outfall is the same as the rate of effluent being pushed out be the tides. To do this, we need to rely on the data collected from the submersible fluorometers attached to the station cages, since this data was being recorded on a continuous basis throughout the study. The superposition concentrations and steady state dilutions were calculated from the submersible data as described in Section 2.4. These results should then be compared with dilution assessments based on the boat tracking data to determine which dilution levels are the lowest at the station locations.

As seen in Figure 4, the peak 1 hour steady state dilution at Station 1 was 1080:1. If only the submersible fluorometer data is considered, the 1000:1 dilution line for the North Bend WWTP should occur right near this location, which is about 0.14 km from the outfall. Dilution at the bottom of the bay increased rapidly past Station 1, as the peak 1 hour steady state dilution at Station 2 was 17415:1. This station was 1.9 km from the outfall. However, the dilution assessment based on the boat tracking data (Figure 18) shows that dilution levels ≤1000:1 occurred as far away as Stations 5 and 6 during the North Bend study. This is because dye concentrations were higher at the surface than at the cages down below. Although the steady state dilutions at the surface are unknown, it is known that they would be less than 1000:1 at these locations. Typically steady state dilutions at the bottom of an estuary are lower than single time point dilutions determined at the surface since they accumulate the dye readings over time, but in this case the single time point dilutions calculated based on the surface readings were lower. FDA recommends considering the lowest dilution values seen at a particular location during a dye study as part of a conservative assessment, since wastewater at the surface could potentially reach the shellfish down below on low tide, in strong currents, or in other conditions.

For the Coos Bay #1 study, the peak 1 hour steady state dilution values at Stations 1 – 6 were 807:1, 2880:1, 933:1, 1332:1, 74:1, and 834:1. Although dilution increased above 1000:1 at Stations 2 and 4, dilution was less than 1000:1 at Stations 1, 3, 5, and 6, which were spread throughout Coos Bay. Station 1 was the farthest from the Coos Bay #1 WWTP but still had dilution levels less than 1000:1. Since this station is also impacted by effluent from the North Bend WWTP, the cumulative dilution would be even lower than 807:1. As seen in Figure 21, dilution levels based on boat tracking data were similarly low, with ≤1000:1 dilution levels observed from Station 6 to Station 2.

Figure 15 shows steady state dilution values based on the combined impact of effluent from both WWTPs. As shown in the figure, the peak 1 hour steady state dilution values (or "1/2 tidal day peak 1 hour dilution" values) were less than 1000:1 at every station except for Stations 2 and 4. The dilution level at Station 4 was slightly above 1000:1. Because the combined dilution levels fluctuated between the stations, it's not possible to create a regression line to estimate where the 1000:1 line may occur beyond Station 1 or Station 6. It's also not possible to factor in the impact of the Coos Bay #2 WWTP (shown in Figure 1), since a dye study was not conducted at this plant. However, the studies that were conducted at the North Bend WWTP and the Coos Bay #1 WWTP show that the dilution levels achieved in the growing area between the two plants were insufficient to mitigate the impact of viruses. In addition to the low peak 1 hour dilution values seen in Figure 15, the figure also shows that NoV GII levels in oyster sentinels from all six stations were greater than 1000 RT-PCR units/100 g.

Based on all the available data, it is not possible to establish a 1000:1 dilution line and recommend all or a portion of the growing area be managed as conditionally approved.

3.16 Bypass in Treatment at the Coos Bay #1 WWTP

Due to a large rainfall event, the Coos Bay #1 WWTP bypassed primary treatment during a portion of the study and this likely had a large impact on the NoV GII levels detected in the shellfish. However, NoV GII levels in the WWTP effluent were high prior to the bypass – 2810 RT-PCR units/100 ml on 2/10/2011 and 1140 RT-PCR units/100 ml on 2/11/2011 (see Figure 23). The large rainfall event and the bypass in primary treatment did not occur until several days later, on 2/15/2011, when the dye injection took place. Nevertheless, the oyster sentinels were still in the water during the time of the rainfall event and may have bioaccumulated virus particles that were higher in level due to the bypass in primary treatment. FDA research has found that MSC and NoV levels increase when treatment is bypassed, when flows are higher than the WWTP's design capacity, or when other interruptions in treatment occur. Therefore,we believe that malfunctions of this nature should be treated in the same manner as raw sewage or disinfection failures. FDA recommends that the growing area be closed in these circumstances.

4.0 CONCLUSIONS

Shellfish growing area considerations and recommendations are discussed in Section 5.0 below. This section discusses some general conclusions can be drawn from this study.

As previously noted, the results of the dye studies indicate that there is sufficient dilution in the southern-most conditionally approved growing area, located at the entrance of Coos Bay, with respect to effluent discharges from the North Bend and the Coos Bay #1 WWTPs. However, the Coos Bay #2 WWTP located closest to this area was not assessed due to limitations in time and resources. Although the two dye study results indicate that the rate of tidal flushing and dilution significantly increases closer to the mouth of the estuary, the level of effluent dilution in this growing area from the Coos Bay #2 WWTP is unknown. Therefore, the Coos Bay #2 WWTP may need to be assessed via a separate dye study or computer modeling assessment if ODA requires additional information for the conditional management of this growing area.

The combination of fluorometers towed by boat and moored to cages provided for a complete and extensive determination of the dispersion and dilution of effluent discharge from both the North Bend WWTP and the Coos Bay #1 WWTP into Coos Bay. In addition, new mobile GIS technology, the Real-Time Application for Tracking and Mapping (RAFT-MAP), was beta tested during this study for the first time and successfully provided dye concentration and dilution results in real-time while the data was being collected.

Significant flow data and influent and effluent microbial data was collected at the North Bend and Coos Bay #1 WWTPs during the dye studies. This data can be used to assess the WWTPs' efficiency and to contribute to FDA's research on WWTP performance. The data demonstrates the presence of NoV GII, AdV, and MSC at significant levels in the WWTPs' final effluent, both for the North Bend WWTP operating under normal conditions and for the Coos Bay #1 WWTP operating under a bypass of primary treatment. The MSC results followed the same patterns as the NoV GII results, demonstrating that MSC was a good NoV GII indicator for this study. FC, EC, NoV GI, and AdV did not follow the same patterns as NoV GII and MSC. The same observations applied to the microbiological findings in the shellfish sentinels as in the final effluent.

NoV and MSC data collected from the shellfish sentinels demonstrate that viruses in the WWTPs' effluents can be detected in shellfish located in proximity to the plants, with a trend of higher levels of viruses at sentinel stations with low dilution and lower levels of viruses at stations with high dilution. The microbiological results in the WWTP effluents and in the shellfish support the relationship between dilution and mitigation of viruses.

5.0 SHELLFISH GROWING AREA CONSIDERATIONS AND RECOMMENDATIONS

When considered collectively, the data from the hydrographic dye studies at the North Bend WWTP and the Coos Bay #1 WWTP and the microbiological assessments of WWTP effluent and shellfish supports the following conclusions and recommendations:

- Both WWTPs are very efficient at removing FC and EC bacteria but less efficient at removing MSC, AdV, and NoV GII.
- Steady state dilution values (peak 1 hour) throughout Coos Bay and the growing area were less than 1000:1 in most circumstances. It was not possible to estimate the location of a 1000:1 dilution line in relation to the conditionally approved growing area, since combined steady state dilutions at all stations except for Station 2 were close to or below 1000:1 and boat tracking results indicated that ≤1000:1 dilution occurred throughout the growing area, even without factoring in the steady state build-up for the boat tracks.
- MSC and NoV levels in the oyster sentinels were high (>1000 PFU/100g MSC at four of the stations and >1000 RT-PCR units/100g NoV GII at all of the stations).
- A bypass in primary treatment occurred at the Coos Bay #1 WWTP during the study and may have had a significant impact on the NoV GII levels detected in the oyster sentinels. FDA recommends closing the growing area when this type of bypass occurs, since it can result in an increase in viruses similar to a raw sewage of loss of disinfection failure.
- Dye-tagged effluent remained detectable in the growing areas for at least 3 days in both studies and a "build-up" of effluent was observed at some stations.
- Station 3 received higher levels of dye and had a lower combined peak 1 hour steady state dilution than Stations 2 and 4. Dye levels were observed to increase near Station 3 during boat tracking as well. Dye-tagged effluent accumulated at this location, which was within Haynes Inlet.
- Estimated travel time of the effluent from the North Bend WWTP was 1.9 km/hour and from the Coos Bay #1 WWTP was 1.4 km/hour. For both WWTPs, it would take approximately one hour for raw or untreated sewage from a failure to travel to the nearest border of the growing area. In the event of a failure, the current growing area would need to be closed within an hour.
- Over 100,000:1 dilution would be needed to dilute raw sewage from a failure at either WWTP down to acceptable levels for an approved growing area adjacent to the WWTP prohibited zone. FDA was unable to identify any locations within Coos Bay where this level of dilution would be achieved.
- Since levels of less than a 1000:1 dilution occurred throughout the growing area, recommendations for establishing or modifying the location of a conditionally approved area based on WWTP performance could not be made.

Based on these findings, FDA recommends that Coos Bay be re-classified to conditionally restricted, with conditional management based on the WWTPs' performance. Management of the growing area as conditionally restricted with long-term relay is recommended to allow continued harvest of the shellfish resources in Coos Bay while minimizing the risk of viral contamination from the North Bend and Coos Bay #1 WWTPs. It may also be possible to operate the growing area as conditionally approved, with seasonal management and harvesting limited to the summer months when the viral risk is lowest. However, studies of WWTP effluent and shellfish for MSC and/or NoV GII would need to be conducted to confirm that the viral risk is sufficiently decreased in the summer months to allow for conditionally approved management on a seasonal basis. Alternative classification and management plans could be considered if the mitigation of viral risks is supported by the data.

EXHIBIT 8

6.0 REFERENCES

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EXHIBIT 8

Figure 1: Station Locations, WWTP Outfalls, and Classified Growing Areas in Coos Bay

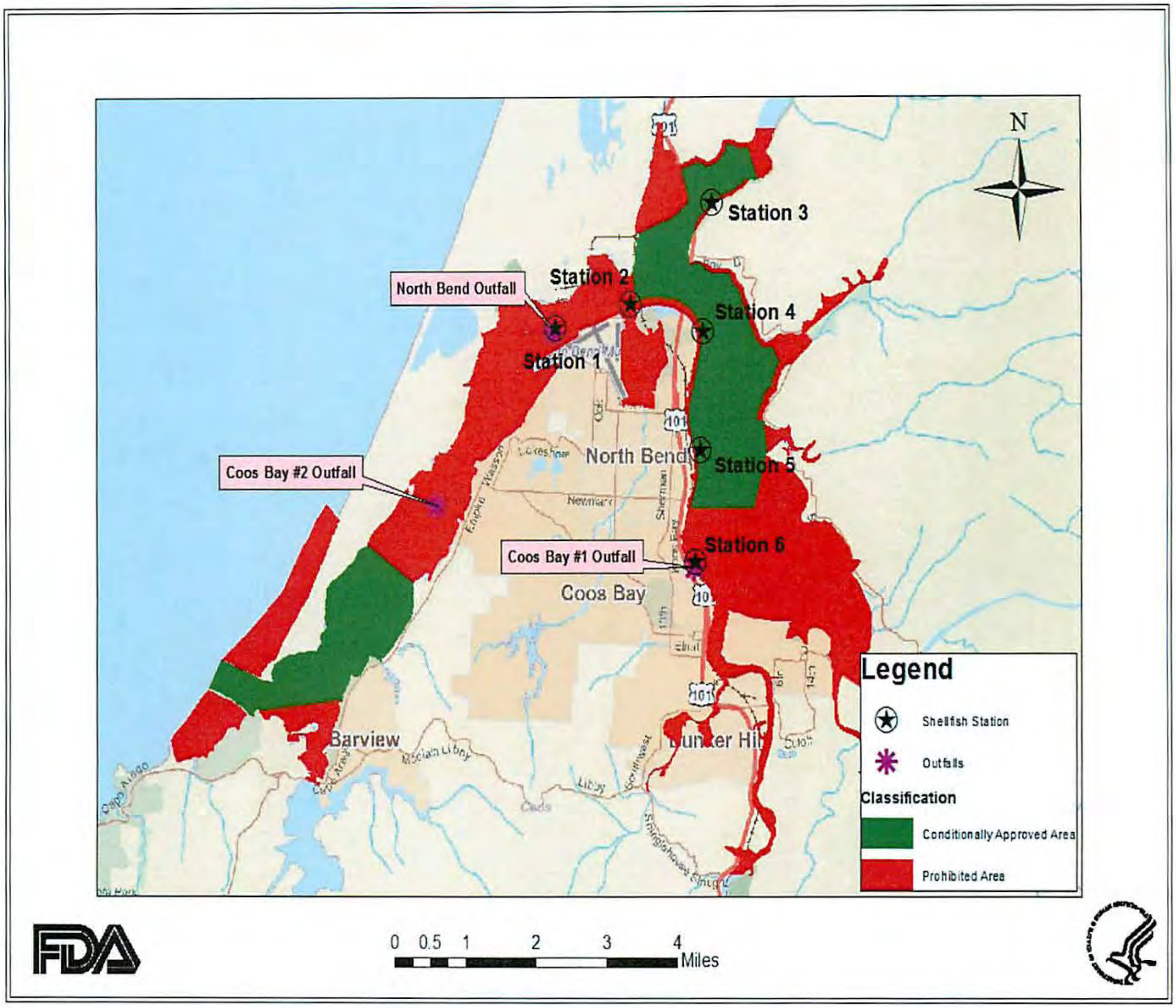

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Figure 2: Drogue Study Results

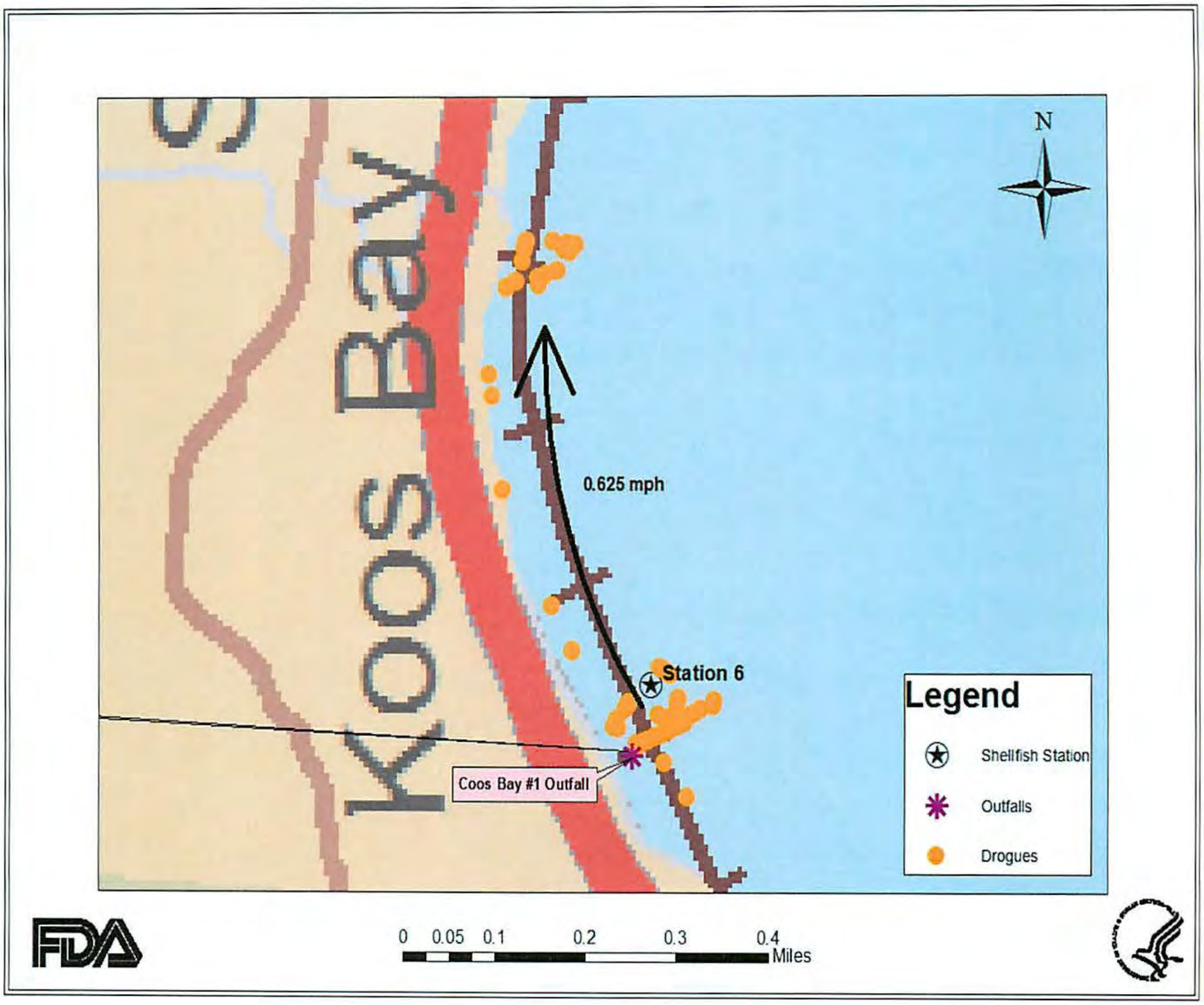

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Figure 16: Dye Tracking Results on Feb. 7, 2011 for North Bend WWTP Study

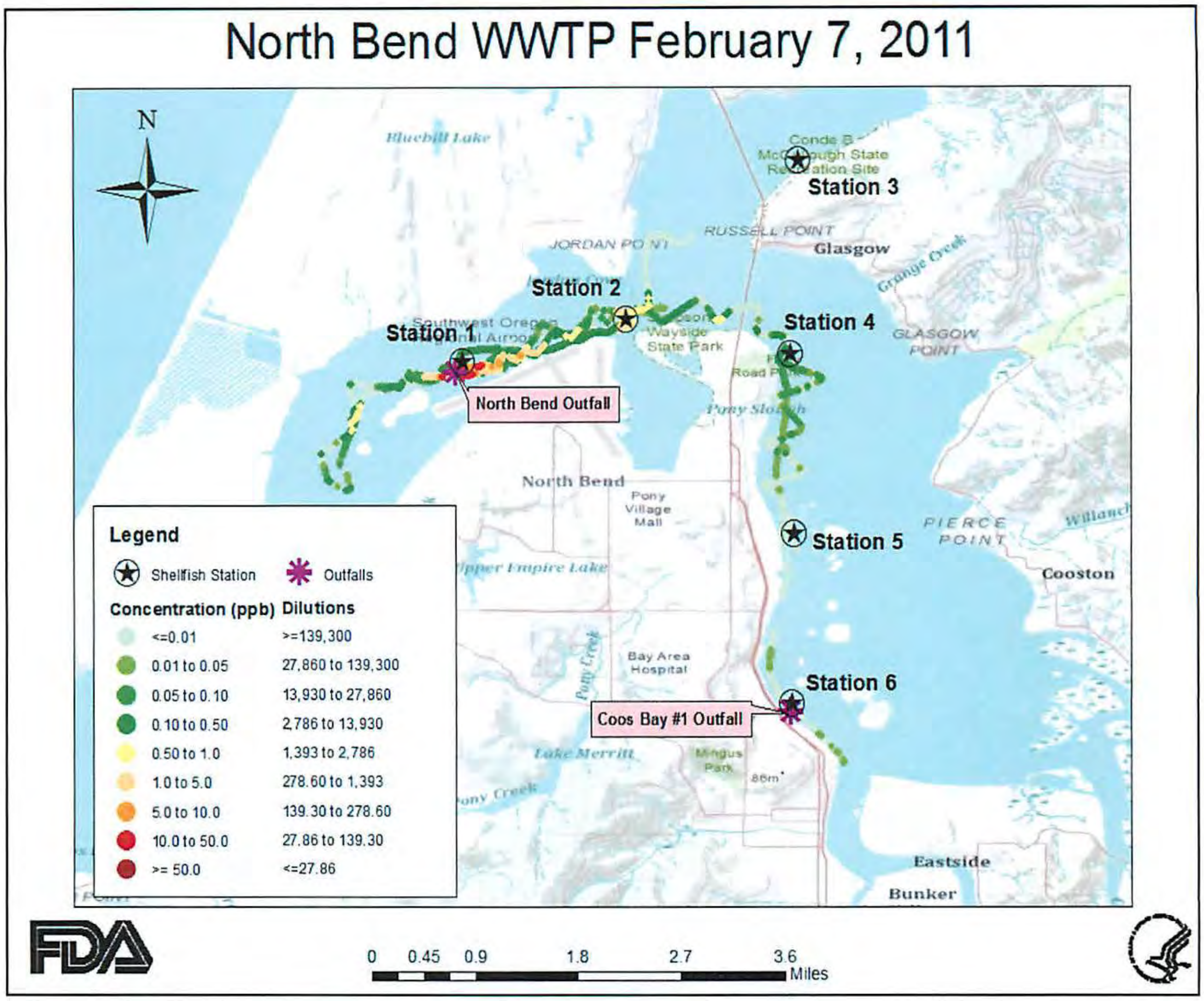

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Figure 17: Dye Tracking Results on Feb. 8, 2011 for North Bend WWTP Study

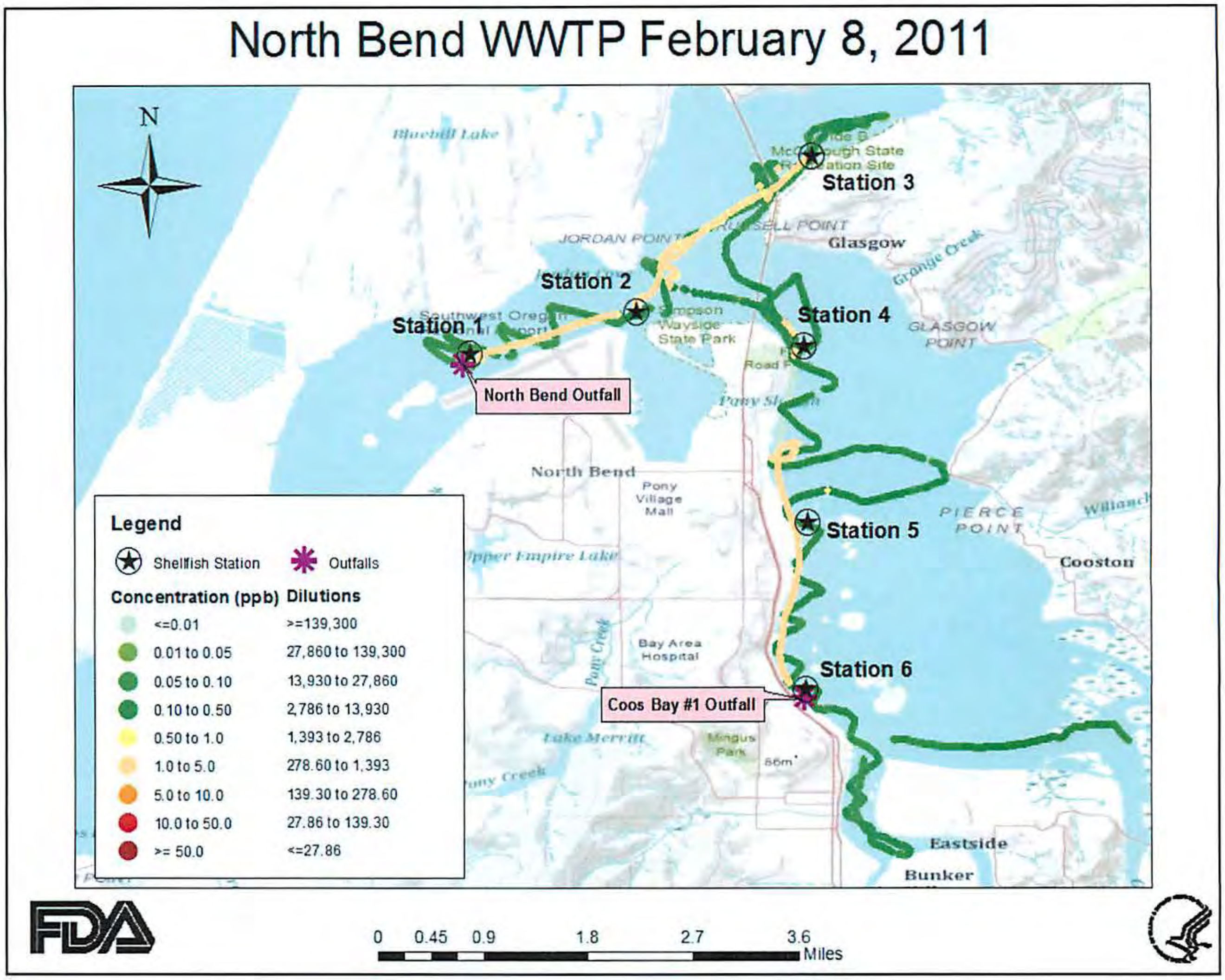

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Figure 18: Dilution Assessment for North Bend WWTP Study

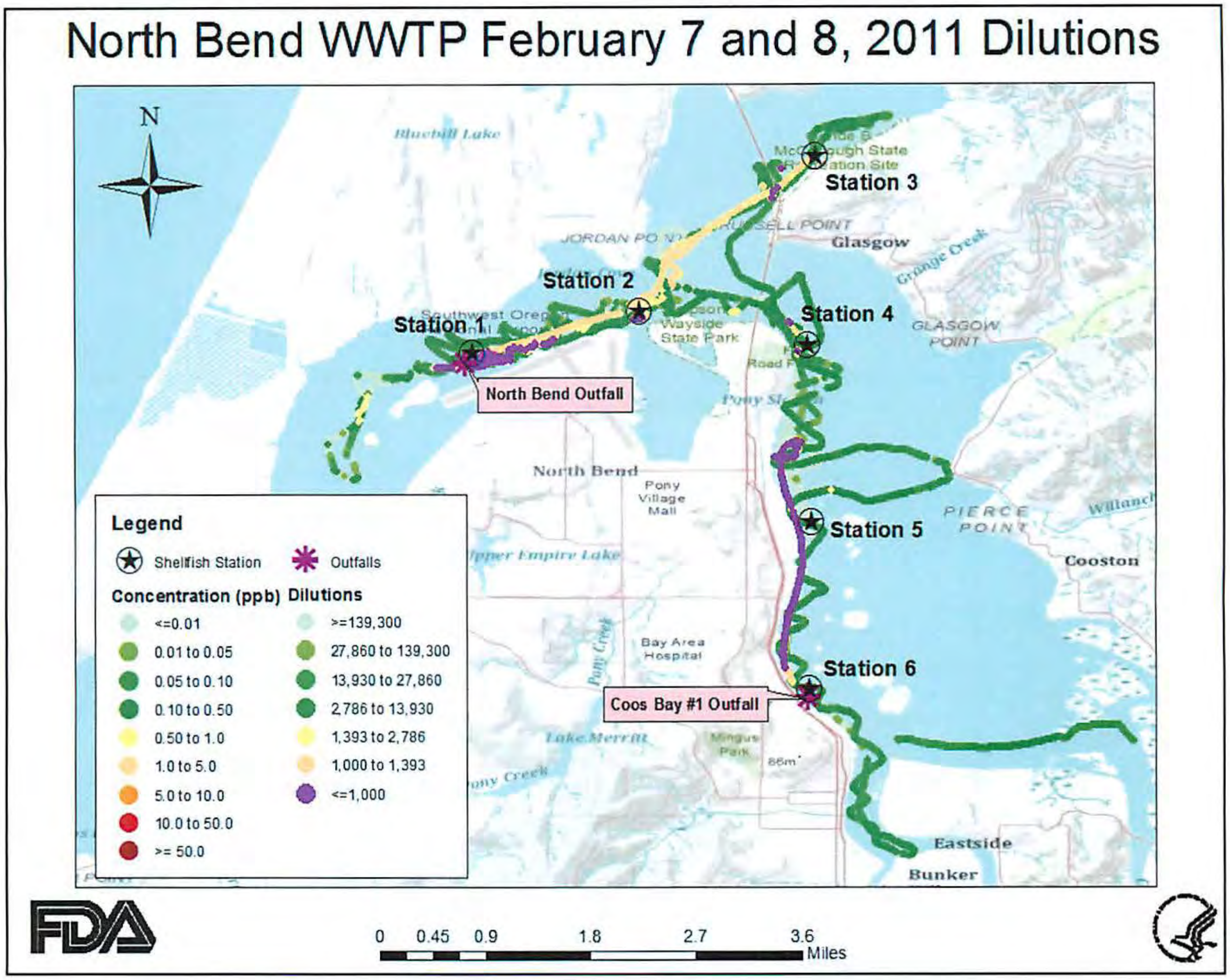

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Figure 19: Dye Tracking Results on Feb. 15, 2011 for Coos Bay #1 WWTP Study

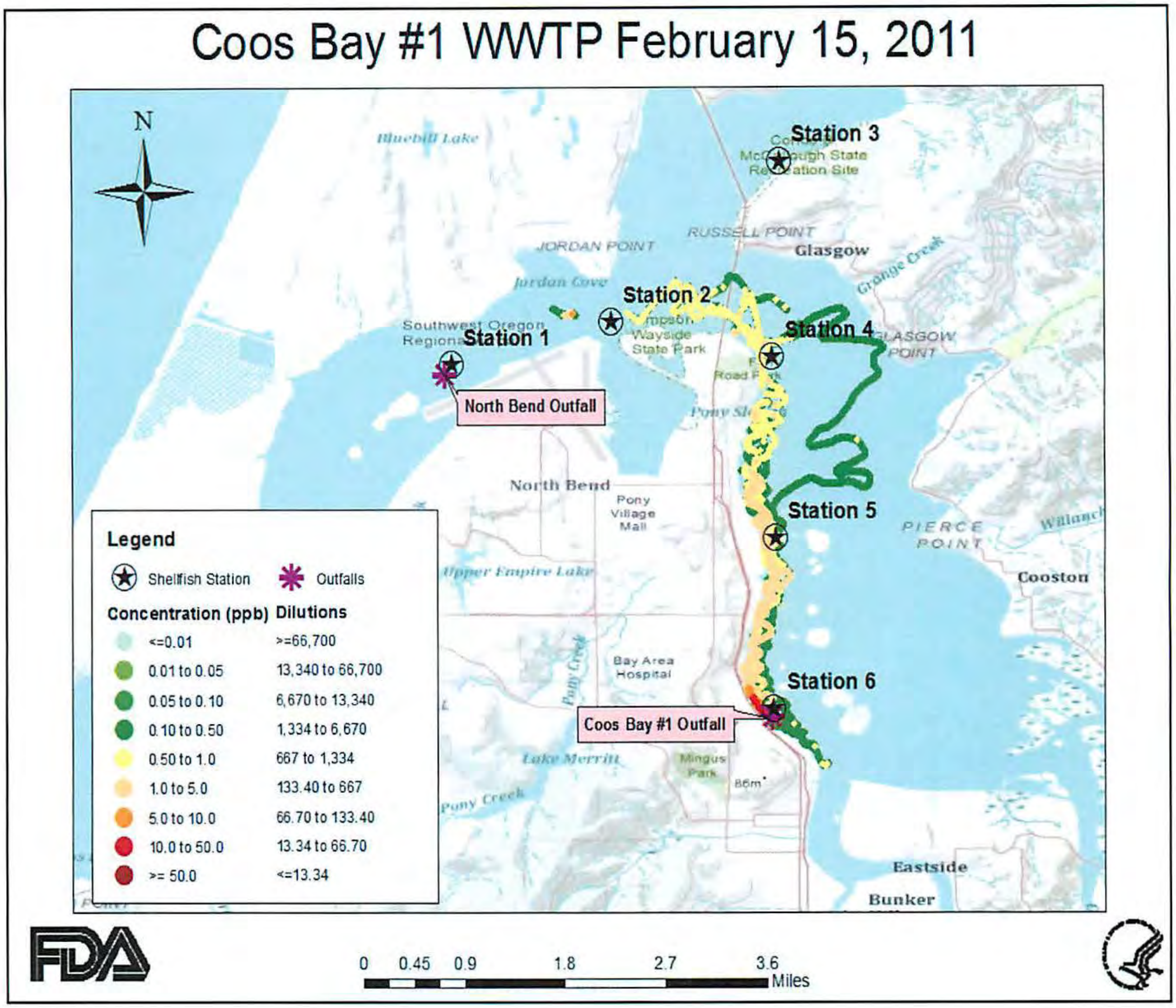

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Figure 20: Dye Tracking Results on Feb. 16, 2011 for Coos Bay #1 WWTP Study

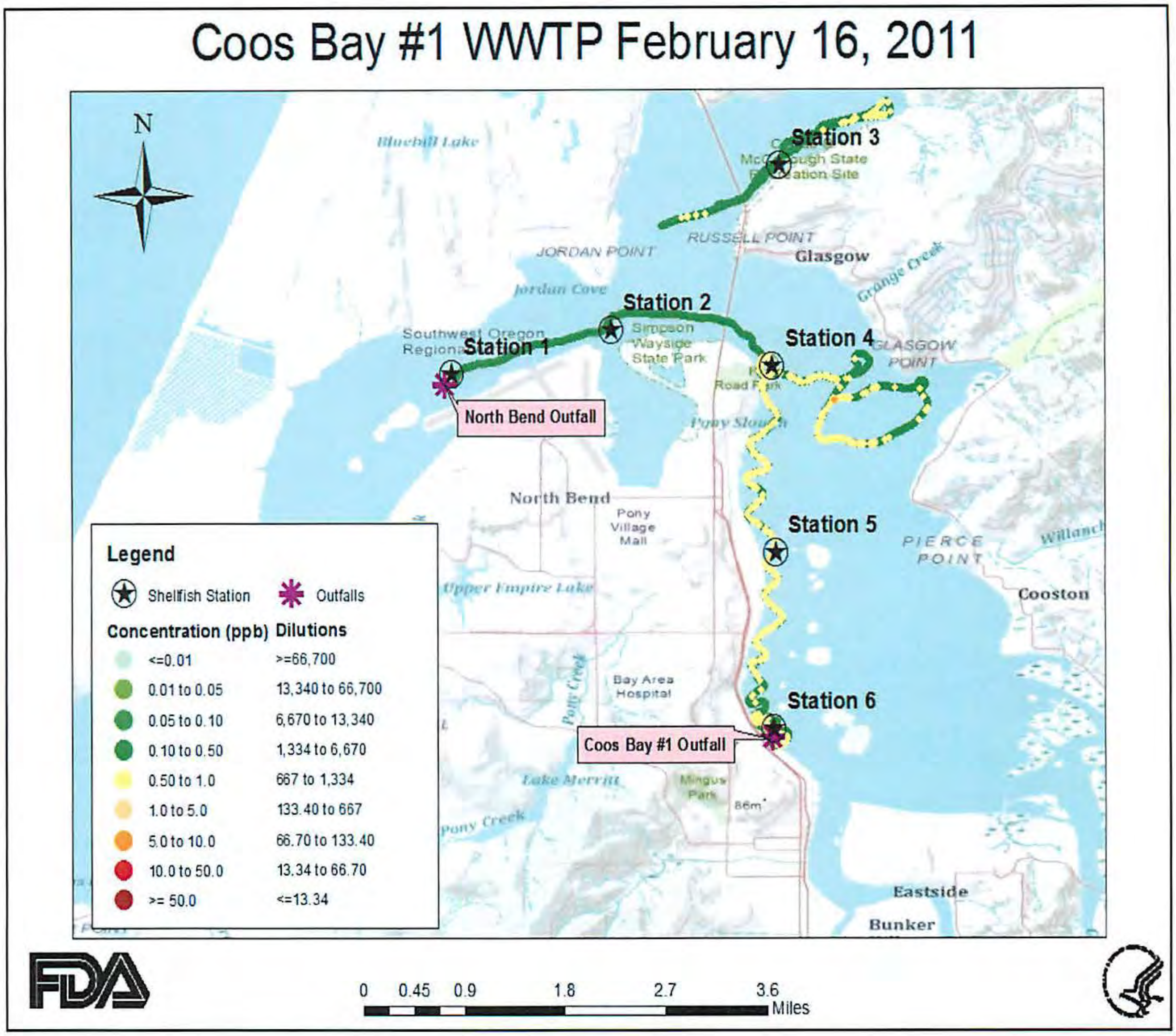

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Figure 21: Dilution Assessment for Coos Bay #1 WWTP Study

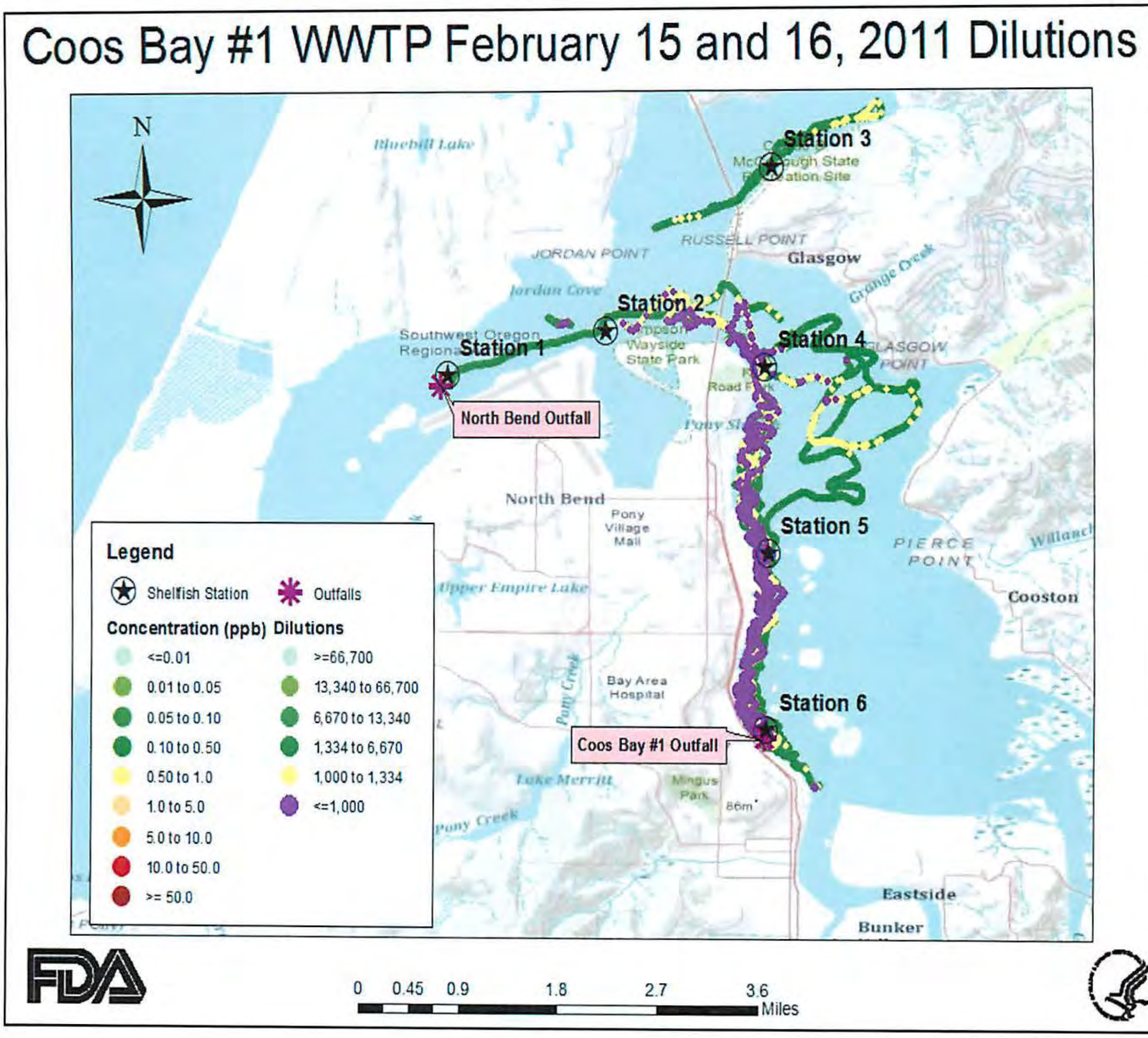

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Figure 22: Overall Dye Tracking Results for Both WWTP Studies

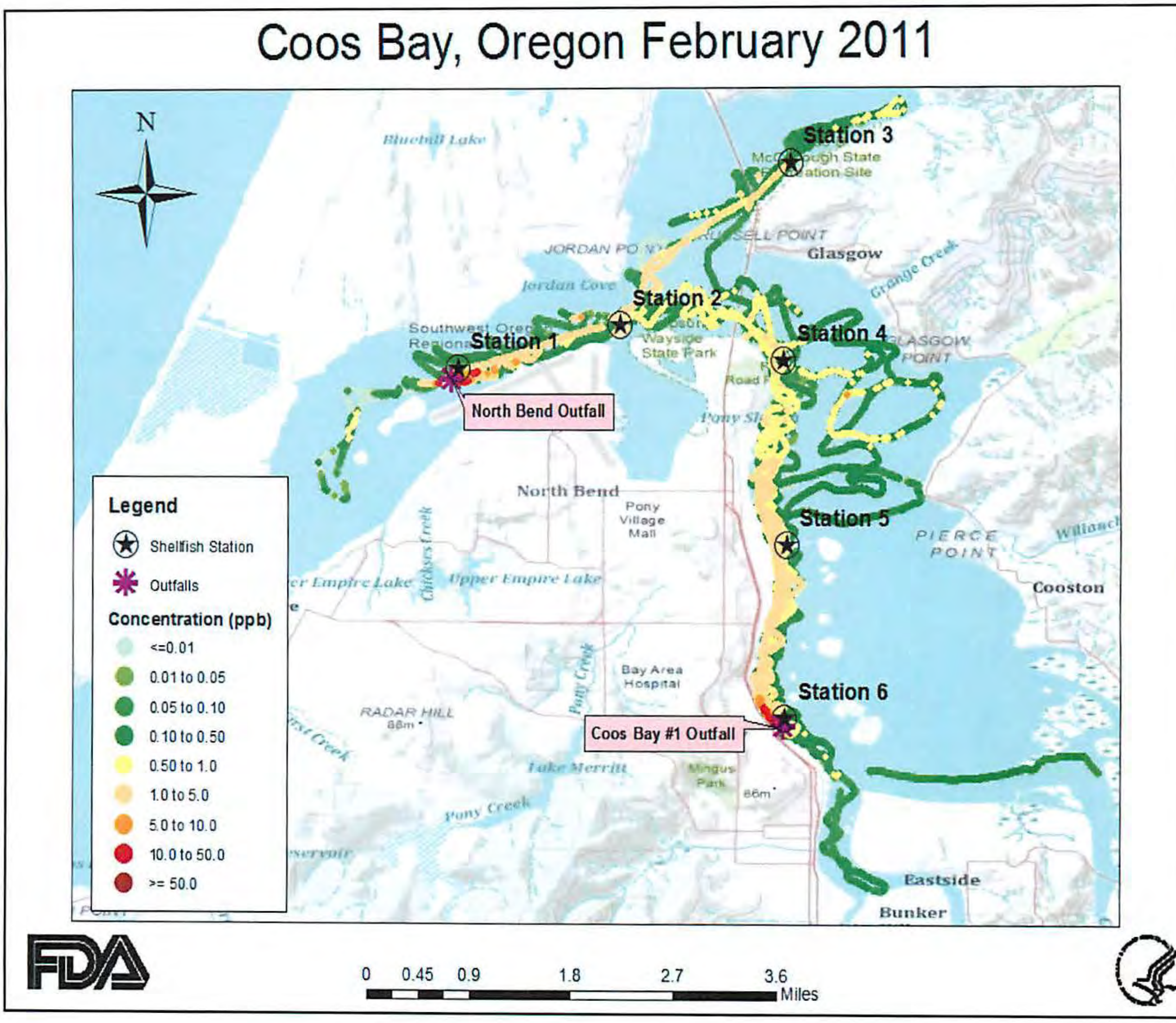

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Figure 23: Dilution Assessment for Both Studies in Relation to Shellfish Growing Area Classifications

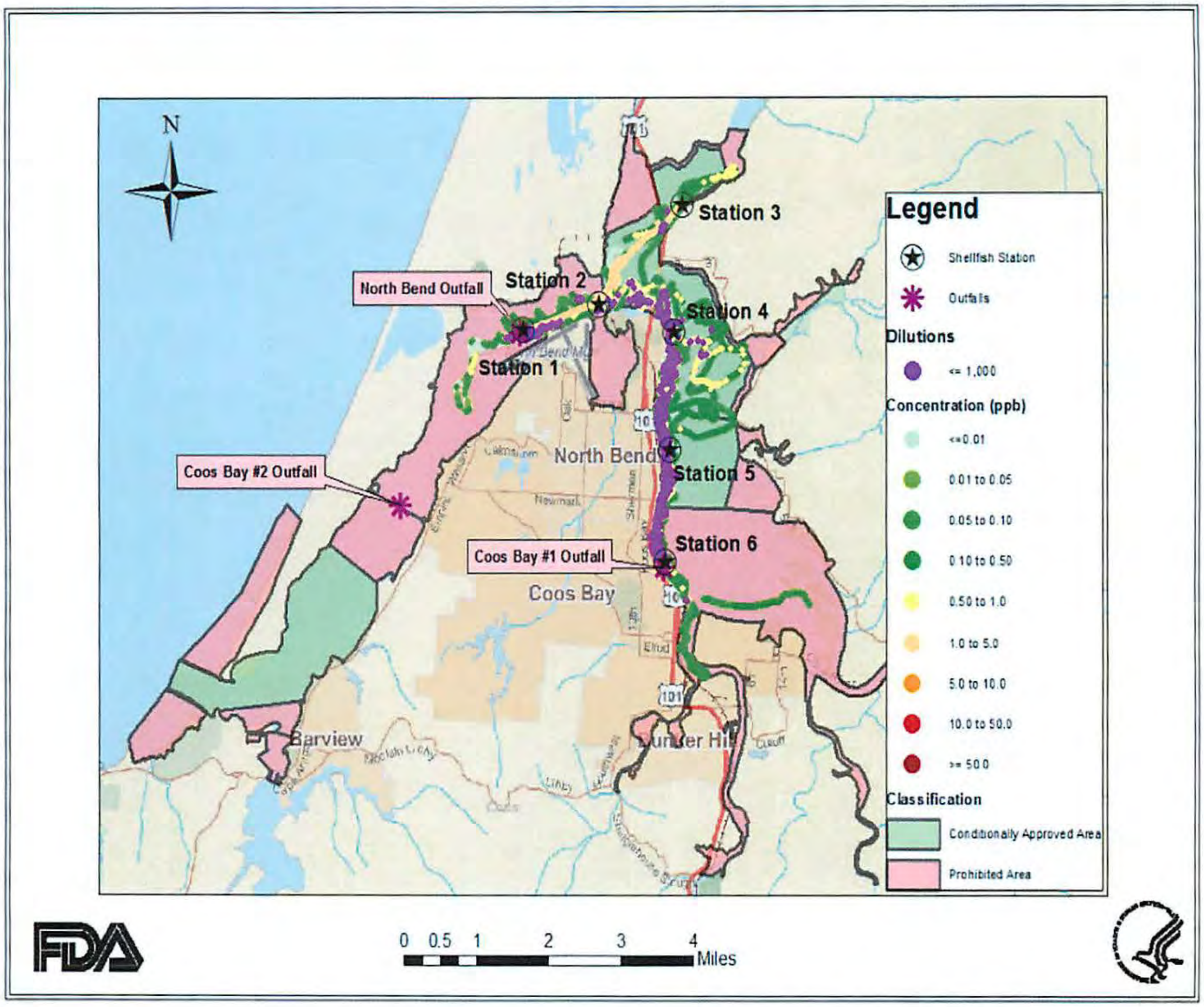

EXHIBIT 9

Table ES.2 – Existing Wastewater Flows

Summary of Existing Wastewater Flows	
Parameter	**2010 Flow (MGD)**
Dry Weather Flows	
Average Dry Weather Flow (ADWF)	0.84
Average Daily Flow (ADF)	1.06
Maximum Month Dry Weather Flow (MMDWF)	1.29
Wet Weather Flows	
Average Wet Weather Flow (AWWF)	1.28
Maximum Month Wet Weather Flow (MMWWF)	1.79
Peak Week Flow	3.05
Peak Daily Average Flow (PDAF)	5.39
Peak Instantaneous Flow (PIF)	7.00

Table ES.3 shows the current plant influent loading and concentration of organics.

Table ES.3 – Existing Wastewater Composition

Current Wastewater Composition Summary								
Flow Parameter	**BOD**		**TSS**		**PH**		**Ammonia NH3-N**	
	Composition (mg/L)	Loading (lbs)	Composition (mg/L)	Loading (lbs)	min	max	Composition (mg/L)	Loading (lbs)
Annual Average	245.3	1992.9	309.4	2498.6	6.8	7.6	25.1	207.5
Winter Average	200.5	1992.6	255.3	2501.3	6.7	7.5	20.3	208.1
Summer Average	290.1	1993.2	363.6	2495.9	6.9	7.6	29.9	206.9
Maximum Month	467.3	2830.0	557.2	3960.0	–	–	39.2	270.0
Maximum Day	511.6	3900.0	732.8	5800.0	5.9	8.2	47.8	320.0

Table ES.4 depicts the average temperatures for the current wastewater flows discharged at the existing treatment plant. Based on the temperature data, the recommended design temperatures are 13 degrees Celsius for summer months and 10 degrees for winter months.

Table ES.4 – Existing Effluent Temperatures

Temperature Range (in Degrees Celsuis)			
Time	Minimum	Average	Maximum
Annual	11.2	15.9	20.9
Summer	14.2	17.9	20.9
Winter	11.2	13.8	17.4

The projected flows are based on the assumption that the addition of population will proportionally increase the flow rate for each of the flow parameters, including the inflow and infiltration components of the flow. This planning amendment document also includes analysis of the inflow and infiltration rates and peaks for the collection system transmitting flows to the Wastewater Treatment Plant No. 2. Inflow and infiltration is excessive in the collection system and an ongoing capital investment for the City of Coos Bay.

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The projected flows for the 20-year planning period are presented in Table ES.5. Table ES.6 provides the expected future organic loads at the end of the planning period, on which a new treatment facility design is based.

Table ES.5 – Projected Wastewater Flows

Summary of Projected Wastewater Flows	
Parameter	**2037 Flow (MGD)**
Dry Weather Flows	
Average Dry Weather Flow (ADWF)	0.99
Average Daily Flow (ADF)	1.24
Maximum Month Dry Weather Flow (MMDWF)	1.51
Wet Weather Flows	
Average Wet Weather Flow (AWWF)	1.50
Maximum Month Wet Weather Flow (MMWWF)	2.09
Peak Week Flow	3.57
Peak Daily Average Flow (PDAF)	6.31
Peak Instantaneous Flow (PIF)	8.20

Table ES.6 – Projected Wastewater Loads

Projected Loading			
Parameter	**2037 Loading** (lbs)		
	BOD	TSS	NH-3
Annual Average	2334	2926	243
Winter Average	2334	2929	244
Summer Average	2334	2923	242
Maximum Month	3314	4638	316
Maximum Day	4567	6792	375

Treatment Requirements

The City of Coos Bay is cognizant of protecting the environment and water quality of the water in Coos Bay. Coos Bay provides important fish and shellfish habitat as well as public recreational opportunities. Because the wastewater treatment plant discharges to critical aquatic habitat, the Oregon Department of Environmental Quality (DEQ) and the U.S. Environmental Protection Agency (EPA) require that the facility meet Class I reliability standards. The NPDES permit regulated by the DEQ governs the quality of effluent discharged by the wastewater treatment facility.

Table ES.7 summarizes the effluent discharge limits. Table ES.8 provides other constituent discharge limits and Table ES.9 shows an expected upcoming modification to the permit introducing a limit on the Enterococcus bacteria.

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Table ES.7 –NPDES Discharge Limits Summary

(1) May 1 – October 31:					
Parameter	Average Effluent Concentrations (Monthly)	Average Effluent Concentrations (Weekly)	Monthly Average (lb/day)	Weekly Average (lb/day)	Daily Maximum (lbs)
BOD_5	20 mg/L	30 mg/L	340	510	670
TSS	20 mg/L	30 mg/L	340	510	670

(2) November 1 – April 30:					
Parameter	Average Effluent Concentrations (Monthly)	Average Effluent Concentrations (Weekly)	Monthly Average (lb/day)	Weekly Average (lb/day)	Daily Maximum (lbs)
BOD_5	30 mg/L	45 mg/L	510	760	1000
TSS	30 mg/L	45 mg/L	510	760	1000

Table ES.8 – Other Discharge Limits

(3) Other	
Other Parameters (year-round)	Limitations
Fecal Coliform Bacteria	Shall not exceed a monthly median of 14 organisms per 100 mL. Not more than 10 percent of the samples shall exceed 43 organisms per 100 mL.
pH	Shall be within the range of 6.0 – 9.0
BOD_5 and TSS Removal Efficiency	Shall not be less than 85% monthly average for BOD5 and 85% monthly for TSS
Total Residual Chlorine	Shall not exceed a daily median value of 0.5 mg/l and no single sample shall exceed 1.0 mg/l
Ammonia-N (May 1 - October 31)	Shall not exceed a monthly average concentration of 20 mg/L and a daily maximum concentration of 30 mg/L
Excess Thermal Load (May 1 - October 31)	Shall not exceed 37 Million kcals/day as a weekly average.