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STATE OF WASHINGTON
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M E M O R A N D U M

December 7, 1978

To: John Hodgson

From: Darrel Anderson and Eric Egbers

Subject: Ronald and Roslyn STP Inspections and Receiving Water Surveys, May 23 and 24, 1978.

Attached are the results of the facility inspections and receiving water surveys conducted on Ronald and Roslyn STP's during May 1978.

DA/EB:cp

cc: John Bernhardt
Dick Cunningham
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Section Staff

INTRODUCTION

Ronald and Roslyn are two small communities located on the eastern slope of the Cascade Mountains, near Cle Elum (Figure 1). Concern has been expressed that handling and treatment systems that serve both towns are antiquated and provide inadequate treatment. If funds become available these plants may be considered for Federal Step I and II Facilities Planning Process.

During the spring of 1978 (May 23 and 24) surveys were conducted to determine the general layout and efficiency of the sewage treatment facilities that currently serve the two communities. In addition, water quality and biological data were collected to provide information on the condition of the respective receiving waters. These data will function as a baseline in the event that the facilities are upgraded. The results of these surveys are documented in this report.

MATERIALS AND METHODS

Ronald lagoon flows were measured at the lagoon effluent where a 90° 'V' notched weir is located (Figure 2). Roslyn lagoon flows were measured with a Manning dipper at the lagoon influent, a 12" Parshall flume. All other flows were calculated from stream velocity profiles measured with a Marsh-McBirney magnetic flowmeter.

Temperature, pH, conductivity and dissolved oxygen (Winkler Method) were measured in the field. In addition, samples of the wastewaters and receiving waters were forwarded to the DOE analytical laboratory in Tumwater for the following 16 analyses:

1. pH
2. Turbidity (NTU)
3. S. Conductance (μmhos/cm)
4. COD (mg/l)
5. BOD (mg/l)
6. F. Coliform (Col./100 ml)
7. OPO_4-P (mg/l)
8. T-PO_4-P (mg/l)
9. NH_3-N (mg/l)
10. T. Kjeldahl N (mg/l)
11. NO_3-N (mg/l)
12. NO_2-N (mg/l)
13. T. Nitrogen (mg/l)
14. Un-ionized Ammonia (mg/l)
15. TSS (mg/l)
16. TNVS (mg/l)

Composite samplers were placed at the Ronald effluent and the Roslyn influent and effluent, and left in place for 24 hours. A 250 ml sample was collected every 30 minutes during this period. Grab samples were taken at all other sampling locations (Figure 1).

The biological survey entailed sampling macro-invertebrate populations in Crystal Creek (Roslyn) at stations 1 to 5 (Figure 1). Twelve stones of approximately equal size were collected from representative stream riffles at each of these stations. Macro-invertebrates were removed from the stones and preserved in 70% ethyl alcohol. The dimensions of the rocks then were estimated by measuring the longest two right-angle axes. These data were evaluated using the Wilhm diversity index [1].

Due to low and intermittent flow conditions macro-invertebrate samples were not collected in the unnamed creek at Ronald.

RONALD EVALUATION

Facility Inspection

The treatment facility for the town of Ronald is an oxidation lagoon. There is a 90° V-notch weir at the influent and another at the chlorinated effluent. The influent weir had not been maintained and at the time of the survey a substantial amount of gravel had accumulated behind it, which made accurate instantaneous flow measurements impossible. Wastewaters flow from the lagoon directly into a wet well where chlorine is added. The chlorinated effluent then flows underground approximately 30 yards to a second wet well then directly onto the creek bed (Figure 2). This wet well is approximately four feet in diameter with a 90° V-notched weir. When we first observed the chlorinated effluent, we were not aware of the weir because considerable effluent was flowing over its top. How often this occurs is unknown.

The effluent flow, as measured at the V-notch weir, was considerably higher than expected. Influent BOD_5 loading also was high. Assuming 0.17 lbs/day[2] of BOD_5 per person and a population of approximately 125 served by the lagoon, the total BOD_5 loading at the influent should have been around 21 lbs/day. BOD results revealed a loading of 115 lbs/day. Also, assuming each person served by the lagoon contributed 100 gallons[3] per day of wastewater, typical flows at the effluent should have been approximately 12,500 gallons per day. The instantaneous flow measured at the 90° V-notch weir was many times greater at 286,000 gallons per day:

Population Served	Expected BOD Loading (lbs/capita/day)	Expected Flow (GPD)	Actual BOD Loading (lbs/capita/day)	Estimated* Flow (GPD)
125	21	12,500	115	286,000

The overall efficiency of the lagoon appeared to be quite good. Adequate BOD_5 reduction was being accomplished:

	Influent		Effluent		%
	mg/l	lbs/day	mg/l	lbs/day	Removal
BOD_5	48	115	9	22	81%
TSS	20	48	16	38	20%

* Because of spacial restrictions, an accurate flow head measurement was impossible.

Adequate disinfection was apparent from the fecal coliform and chlorine residual data (Table 1). The few fecal coliform detected in chlorinated effluent (sample 23/1010) indicated that even with marginal contact design, low to moderate chlorine residuals should provide adequate disinfection:

Grab Samples of Chlorinated Effluent

Parameter	Date & Time	Date & Time	Date & Time	Date & Time
	22/1635	23/1010	23/1745	24/1000
Fecal Coliform (Col/100 ml)	<10	Est. 40	<10	<10
Chlorine Residual (mg/l)	0.75	0.0	6.0+	6.0+

Receiving Water Assessment

The lagoon effluent constituted at least 90% of the total flow in the unnamed creek below Ronald STP. Flow measurements were difficult due to low velocities and total absence of water in the lower half of the creek. An exception was station #4 where the creek surfaced and received runoff from the city of Roslyn's water reservoir (Table 1). From this point the creek flowed west for about 1/4 mile and entered the Cle Elum River. The operator (George Favero) stated that the lagoon effluent ceases to discharge by September and the entire creek dries up. Stream flow data are not available for the winter months.

Below the lagoon the creek contained moderate algal growth plus some solids deposition. There was no evidence of fish life in the watercourse. Likewise, the benthic community appeared to be non-existent.

Concentrations of all the parameters generally declined with increasing distance below the outfall; however, two indicators of organic enrichment, nitrate nitrogen and T. Kjeldahl nitrogen, increased at station 2 (Table 1). Considerable organic debris (hay bales, garbage, etc.) was observed in this section of the stream.

Fecal coliforms did not appear to be a problem in the creek. This would be expected in cases where extremely high chlorine residuals are detected in the effluent (Table 1). Cl_2 residual may have detrimental effects on aquatic organisms, however because nearly the entire stream flow was contributed by the lagoon the adverse impact of these residuals is conjectural.

Conclusions

1) The chlorinator was not operating on May 23. During the second day the system was operating. The chlorine feed system appears to be inadequate.

2) High influent flows to the oxidation pond and low influent waste strengths (dilute organic and nutrient concentrations) indicate the collection system may have considerable infiltration, inflow or interception of surface or ground water. Although treatment efficiency appears to be adequate, efficiency of the lagoon cannot be accurately determined until the deficiencies with the collection system are resolved.

ROSLYN EVALUATION

Facility Inspection

Roslyn's sewage treatment system consists of two stabilization lagoons in series (Figure 3). A 12" Parshall flume on the influent is the only means by which to measure flow. Two 8" pipes connect the two ponds. The wastewaters circulate through the two ponds then enter a contact chamber where chlorine is added. At the time of the survey, the flow was surging over the first several baffles of the contact chamber. This short-circuiting can result in inefficient disinfection. The chlorinated effluent then enters an underground line leading to a small pond, created by a break in the effluent line at the railroad track fill. This pond represents a possible health hazard.

The flow entering the lagoon was much greater than anticipated. If every household were connected to the sewage system, approximate flow should be 101,500 gallons per day assuming 100 gallons per capita per day.(2) From the instantaneous flow measurement, the estimated flow was 497,000 gallons per day. However, the influent BOD_5 loading was lower than anticipated. Assuming 0.17 lbs BOD_5/capita/day (3), the lagoon should be receiving approximately 173 lbs per day of BOD_5. From samples taken at the influent (22 mg/l BOD) and a flow of .497 mgd, results revealed a BOD_5 loading of 91 lbs/day:

Population Served	Expected BOD_5 Loading (lbs/day)	Expected Flow (GPD)	Actual BOD_5 Loading (lbs/day)	Actual Flow (GPD)
1015	173	101,500	91	497,000

The lagoons have heavy vegetation growth around their perimeters. This may cause problems when removed by leaving root channels that may accelerate erosion of the retaining dikes. A means of removal should be employed before this vegetation becomes well established.

Treatment efficiency was very good for BOD_5 and TSS:

	Influent		Effluent		%
	mg/l	lbs/day	mg/l	lbs/day	Removal
BOD_5	22	91	4	17	81%
TSS	26	108	6	25	77%

Disinfection appeared to be adequate (Table 3).

Receiving Water Assessment

Water quality in Crystal Creek below the city of Roslyn was not good. Two main factors appeared to be involved, lagoon effluent and community impact. The community appeared to be creating a major fecal coliform problem, as demonstrated by data collected at stations 6 and 7 (Table 4). Below station #7 the creek enters a culvert which passes under the city, then reappears below town approximately 1/8 mile above station #6. The station #2 (one mile below station #6) fecal counts were much lower than station #6. Below station #3, the lagoon effluent bacterial counts were very low, probably due to high chlorine residual in the effluent (Table 3).

An increase in algae growth in the creek bed below stations #4 and #5 could be attributed to the high $O\text{-}PO_4\text{-}P$ concentrations (Table 3).

The high lagoon effluent and downstream pH values (stations 4 and 5) violated Class A standards. These high values combined with high temperature could increase the concentration of un-ionized ammonia in the stream to levels toxic to aquatic life during some periods. The lethal threshold for this chemical is 0.02 mg/l (Table 3).

Macro-invertebrate sampling at five stations indicated the creek was under stress (Table 3). Diversity indices are marginal (<2) indicating that the aquatic communities in the stream have comparatively few species. Pollution and stress tolerant species (midge larvae, Balted mayfly nymphs) were dominant, although more sensitive groups (free living caddisfly larvae and stonefly larvae) were found at some locations. The effluent appeared to have no clearcut effect on diversity. The reason for the stream's overall moderate to low organism diversity is unknown.

Conclusions

Roslyn itself appeared to be the main source contamination of Crystal Creek. The lagoon effluent in comparison had a marginal impact. Important findings were:

1. Under present conditions, the lagoon effluent has little effect on the creek due to low waste strength. The low influent BOD loading indicate that domestic sewer lines serve only about 50% of the residents of Roslyn. Low influent waste strength may indicate substantial infiltration, inflow, or interception of surface or groundwaters.

2. The high fecal coliform counts in Crystal Creek at station 6 indicate sewage is contaminating the watercourse as it passes through town. The health department should be contacted about counts at both station #6 and the pond at the base of the railroad track fill..

3. The Roslyn area has high recreational use along Crystal Creek south and east of town. This is mostly off-road vehicles and camping and should be considered when waste treatment upgrading is planned.

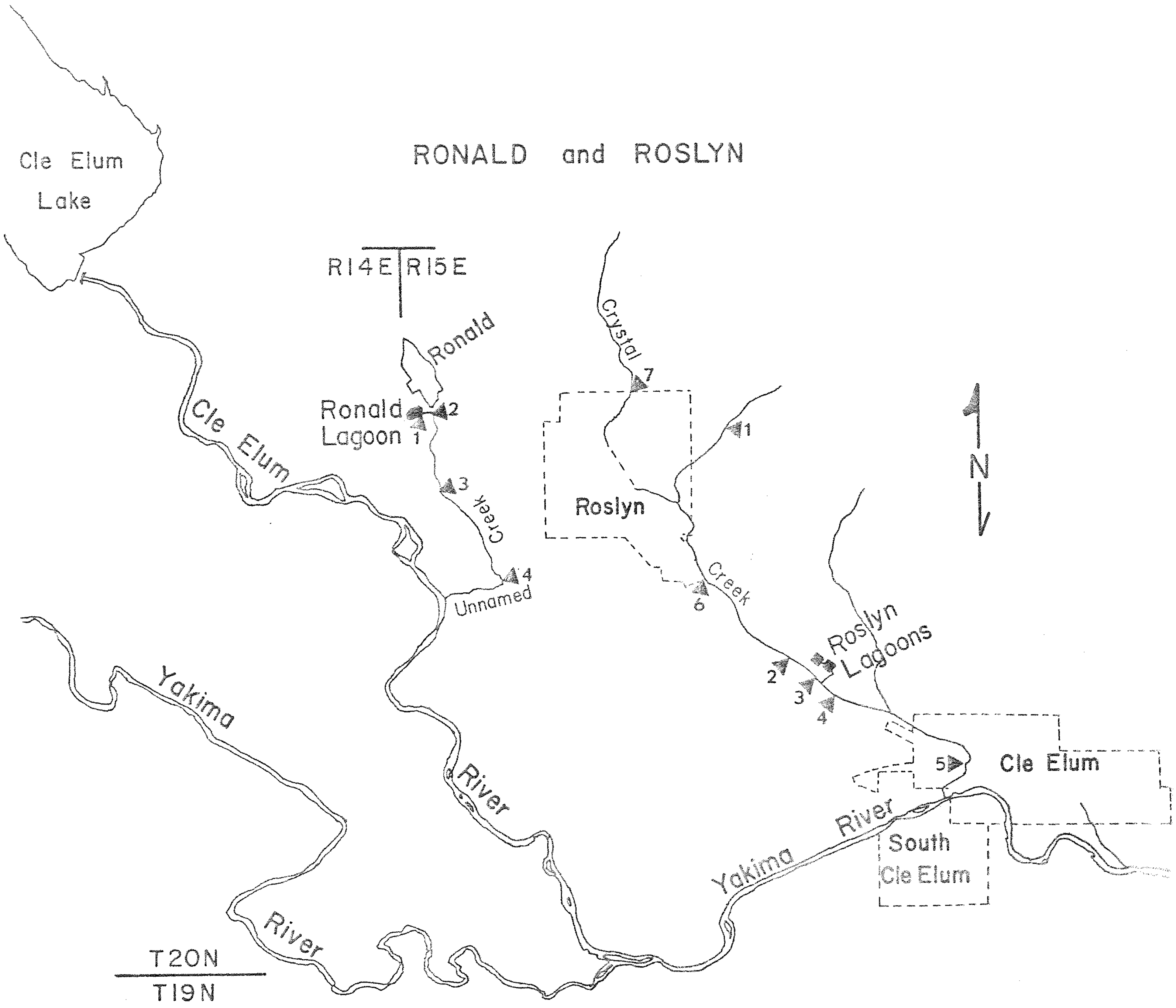
Literature Cited

(1) Wilhelm, J. L., 1970. "Range of Diversity Index in Benthic Invertebrate Populations", Journal WPCF, May 1970.

(2) Joint Committee of the Water Pollution Control Federation and the American Society of Civil Engineers, 1977. Wastewater Treatment Plant Design, Lancaster Press. P. 5.

(3) McGaughey, P. H., 1968. Engineering Management of Water Quality, McGraw-Hill Inc., P. 36.

RONALD and ROSLYN



STREAM SAMPLING STATION LOCATIONS

Figure 1

GENERAL LAYOUT OF RONALD LAGOON

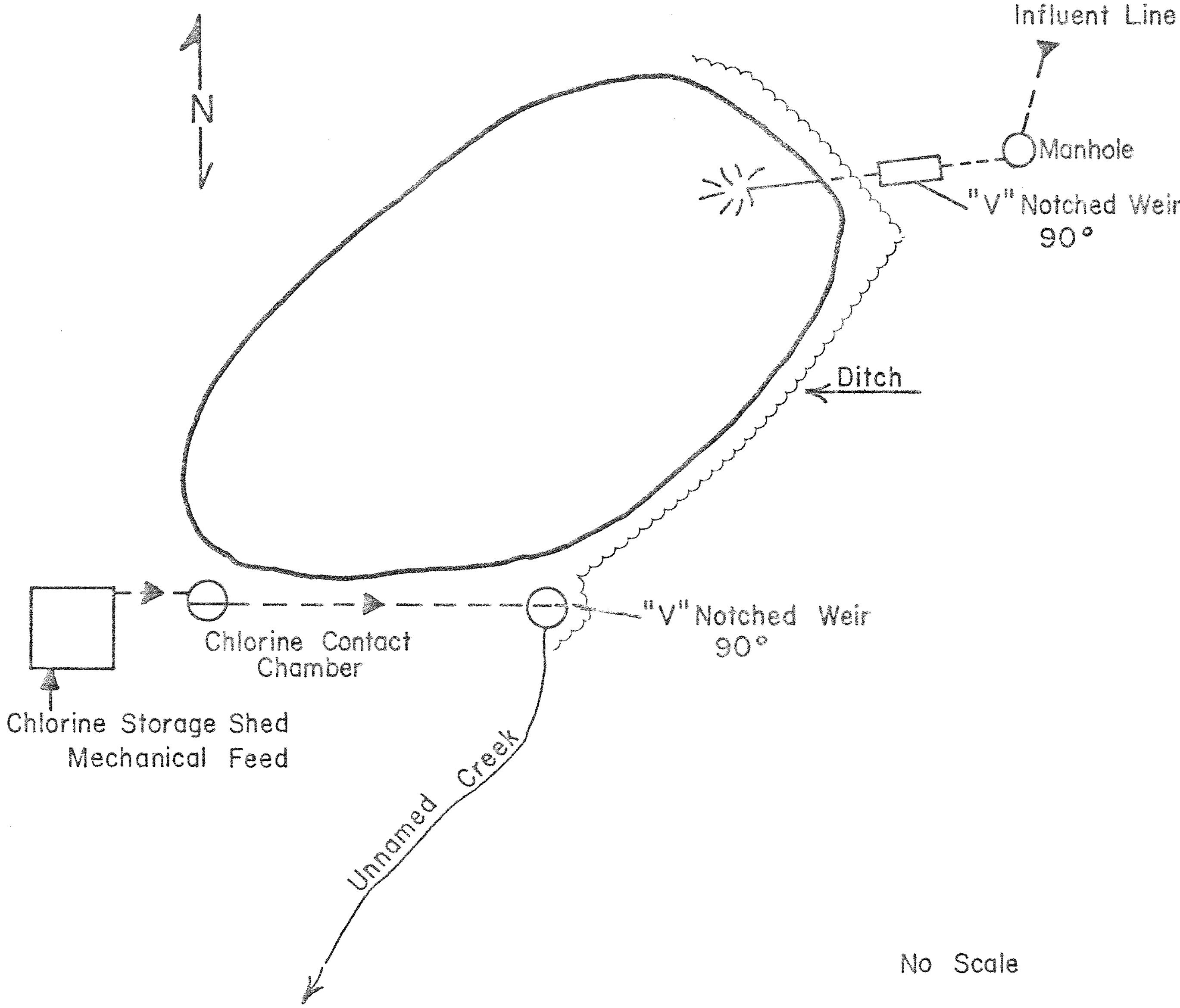


Figure 2

GENERAL LAYOUT OF ROSLYN LAGOON SYSTEM

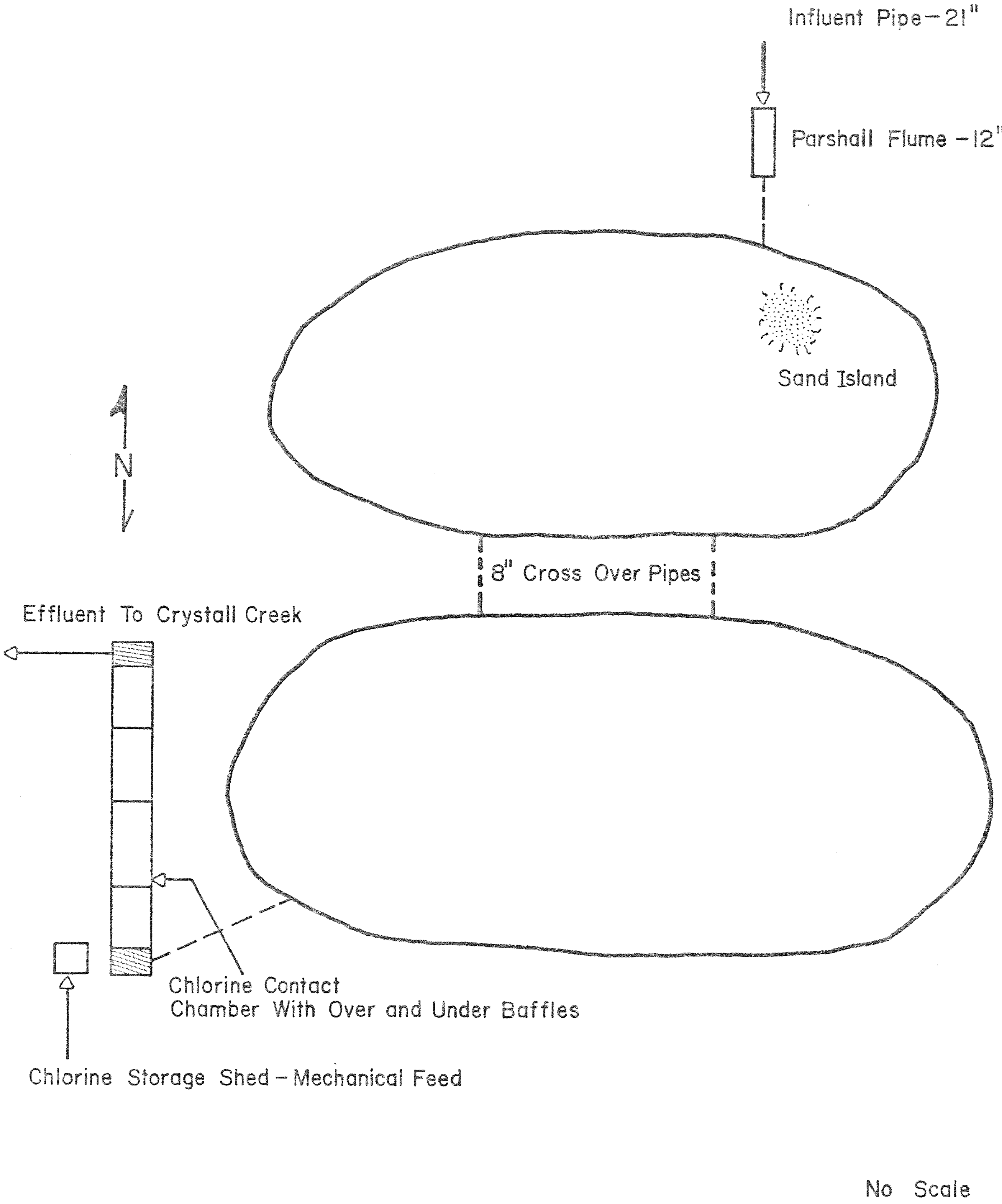


Figure 3

Table 1. Water Quality Data Collected by DOE during Ronald Survey, May 23 to 24, 1978

Parameter	Lagoon Influent	Unchlorinated Effluent	Chlorinated Effluent	Sta. #1	Sta. #2	Sta. #3	Sta. #4
FIELD							
Flows (MGD)	--	- -	* .29	.03	.06	- -	.01
Temp. (°C)	10	15	13.0	13.0	11.4	9.7	9.9
Dissolved Oxygen (mg/l)	- -	- -	- -	9.3	8.4	- -	5.7
% D.O. Saturation	- -	- -	- -	96.2	83.8	- -	54.6
LABORATORY							
pH	7.0	8.5	9.3	9.0	7.4	8.4	6.9
Turbidity (NTU)	13	6	6	6	5	5	2
Specific Conductance (µmhos/cm)	417	383	358	328	291	282	198
COD (mg/l)	103	63	87	4	36	16	8
BOD (mg/l) (lbs/day)	48/115	14/33	9/22	- -	- -	- -	- -
Fecal Coliform (col/100 ml)	- -	- -	- -	20	32	26	<1
Orthos.-P. (mg/l)	.65	.95	.75	.62	.36	.25	.04
Total Phos.-P (mg/l)	.95	.95	1.05	.85	.40	.33	.06
Ammonia-N (mg/l)	.95	.15	.20	.26	.06	.02	.02
Nitrate Nitrogen (mg/l)	1.95	<.02	.05	.05	.42	.30	.06
Nitrite Nitrogen (mg/l)	<.02	<.02	<.02	<.02	<.02	<.02	<.02
T. Kjeldahl-N (mg/l)	- -	- -	- -	.17	.91	.63	.16
T. Nitrogen (mg/l)	- -	- -	.25	.33	1.35	.95	.24
Nitrogen to phosphate ratio (mg/l)	- -	- -	.24	.39	3.38	2.88	4.00
Total Solids (mg/l)	276	261	244	242	189	174	112
Total Non-Volatile Solids (mg/l)	204	203	177	181	162	157	102
Total Suspended Solids (mg/l)(lbs/day)	20/48	23/55	16/38	13	12	6	1
Total Non-Vol. Suspended Solids (mg/l)	1	1	1	1	1	1	1
Color	42	46	50	46	46	46	8
Copper (mg/l)	- -	- -	.02	.02	.02	.02	.02
Lead (mg/l)	- -	- -	.05	.05	.05	.05	.05
Zinc (mg/l)	- -	- -	.02	.01	.01	.01	.01
Cadmium and Chromium (mg/l)	- -	- -	.01	.01	.01	.01	.01

* Because of spacial restrictions an accurate flow head measurement was impossible. Therefore the instantaneous flow should be regarded as an estimate.

Table 2. Sample Times and Station Descriptions - Ronald Survey, May 23 and 24, 1978

Location	Grab Samples & Field Analyses	Composite Samples	
	5-23-78	5-23-78 to	5-24-78
Lagoon Effluent	- -	1010	1000
Station #1	1030		
Station #2	1100		
Station #3	1145		
Station #4	1220		

Sta. #1 - Directly below chlorinated effluent wet well.

Sta. #2 - Approximately 300 yards downstream of Station #1 at road crossing NW¼NW¼Sec. 18, T20N, R15E.

Sta. #3 - NW¼SW¼, Sec. 18, T20N, R15E.

Sta. #4 - Approximately 15 yards above mouth. SW¼ NE¼, Sec. 19, T20N, R15E at road crossing.

Table 3. Water Quality Data Collected by DOE during Roslyn Survey, May 22 to 24, 1978

Parameter	Lagoon Influent	Unchlorinated Effluent	Chlorinated Effluent		
FIELD					
			1	2	3
pH	7.3	9.7	- -	- -	9.5
Specific conductance (μmhos/cm)	320	265	- -	- -	230
Temperature (°C)	9.5	14.0	- -	- -	14.0
Chlorine Residual (ppm)	- -	- -	0	1.0	1.5
LABORATORY					
pH	7.4	9.1	9.9		
Turbidity (NTU)	15	3	3		
Specific Conductance (μmhos/cm)	291	243	237		
COD (mg/l)	55	40	44		
BOD_5 (mg/l) lbs/day	22/91	< 4/<17	<4/<17		
Fecal Coliform (Col/100 ml)	- -	- -	<10/<5/<10		
Orthophos.-P (mg/l)	0.95	1.05	1.05		
Total Phos.-P (mg/l)	1.4	1.3	1.2		
Nitrate-N (mg/l)	0.5	0.2	0.25		
Nitrite-N (mg/l)	< 0.2	<0.2	<0.2		
Ammonia-N (mg/l)	1.35	0.25	0.2		
Un-ionized ammonia in aqueous ammonia solutions (mg/l)	.003	.05	.09		
Total Solids (mg/l)	178	169	164		
Total Non-volatile solids (mg/l)	131	123	108		
Total Suspended Solids (mg/l) / lbs/day	26/108	3/12	6/25		
Total Non-Volatile Suspended Solids (mg/l)	<1	<1	<1		
Color	38	67	46		
Copper (mg/l)	- -	- -	<.01[4]		
Lead (mg/l)	- -	- -	<.05		
Zinc (mg/l)	- -	- -	.01		
Cadmium and Chromium (mg/l)	- -	- -	<.01		

[1] 5-22-78
[2] 5-23-78
[3] 5-24-78
[4] Grab Sample

Table 4. Water Quality Data Collected by DOE during Roslyn Survey, May 23 to 24, 1978

Parameter	Sta. #7	Sta. #6	Sta. #1	Sta. #2	Sta. #3	Lagoon Eff[1]	Sta. #4	Sta. #5
FIELD								
Flows (MGD)	- -	.40	.187	- -	.73	0.497[2]	1.50	1.60
Temp (°C)	- -	10.0	10.4	13.0	12.0	14.0	12.9	10.7
Dissolved Oxygen (mg/l)	- -	9.9	10.2	9.8	10.0	- -	10.3	11.5
% D.O. Saturation	- -	95.0	99.1	100.4	100.2	- -	105.3	111.5
Chlorine Residual (mg/l)	- -	- -	- -	- -	- -	1.5	- -	- -
LABORATORY								
pH	8.1	7.5	8.2	8.0	8.1	9.9	8.6	8.5
Turbidity (NTU)	2	5	6	4	3	3	4	3
Specific conductance (μmhos/cm)	202	172	349	194	204	237	325	355
COD (mg/l)	8	59	4	24	32	44	12	8
BOD_5 (mg/l)	- -	- -	- -	- -	- -	4	- -	- -
Fecal Coliform (Col./100 ml)	<1[4]	6,600[3] 3,200	< 1[3]	48[3]	28[3]	< 5[3]	< 1[3]	30[3]
Orthophos.-P (mg/l)	.04	.05	<.02	.04	.03	1.05	.24	.25
Total Phos.-P (mg.l)	.04	.06	<.02	.04	.05	1.20	.24	.26
Ammonia-N (mg/l)	.01	.04	<.02	.03	.02	.20	.06	.03
Nitrate Nitrogen (mg/l)	.02	.16	.83	.22	.17	.25	.23	.23
Nitrite Nitrogen (mg/l)	<.01	.02	.02	.02	.02	< .02	.02	.02
T. Kjeldahl-N (mg/l)	.23	.25	.11	.25	.19	- -	.47	.35
T. Nitrogen (mg/l)	.25	.43	.96	.49	.38	> .45	.72	.60
Nitrogen to phosphate ratio	6.25	7.17	> 48	12.25	7.6	7.38	3.0	1.35
Un-ionized ammonia in aqueous ammonia solutions (mg/l)	- -	.0002	.0004	.0008	.0004	0.09	.005	.0017
Total Solids (mg/l)	108	111	220	125	135	164	218	237
Total Non Volatile Solids (mg/l)	101	77	164	85	93	108	164	156

Table 4 (Continued)

LABORATORY								
Total Suspended Solids (mg/l)	1	5	6	3	5	6	8	4
Total Non-Volatile Suspended Solids (mg/l)	1	1	4	1	1	1	2	1
Color	17	17	13	25	21	46	29	25
Copper (mg/l)	<.02	<.02	<.02	<.02	<.02	<.02[5]	<.02	<.02
Lead (mg/l)	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05
Zinc (mg/l)	.01	<.01	<.01	<.01	<.01	.01	<.01	<.01
Cadmium and Chromium (mg/l)	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Macro-invertebrate species diversity[6]	- -	- -	1.06	0.61	1.75	- -	1.86	0.89

[1] Data from chlorinated effluent
[2] 24-hour flow measured using Manning dipper at the influent
[3] Taken 5-23-78
[4] Taken 5-30-78
[5] Heavy metals taken from grab sample
[6] Species diversity usually varies between 3.0 and 4.0 in clean-water stream areas and is usually less than 1.0 in polluted stream areas (Wilhm, 1970).
[7] Toxic level is 0.02 mg/l un-ionized ammonia (Quality Criteria for Water, EPA-440/9-76-023, Pg. 18)

Table 5. Sampling Times and Station Descriptions - Roslyn Survey, May 23 and 24, 1978

Location	Grab Samples & Field Analyses 5-23-78	5-30-78	Composite Samples 5-23-78 to 5-24-78
Station #7	- -	1600	
Station #6	1715	1630	
Station #1	1640		
Station #2	1545		
Station #3	1510		
Lagoon Effluent	0925		0900 - 0915
Station #4	1430		
Station #5	1310		

Sta. #7 - Upstream 10 feet from culvert that runs under city of Roslyn. Gravel road - north boundary of city.

Sta. #6 - Upstream from bridge crossing at 'A' Street.

Sta. #1 - Upstream 50 yards of road crossing on Section Line 17, 16, T20N, R15E.

Sta. #2 - Bridge crossing SE¼ SE¼ Sec. 21, T20N, R15E.

Sta. #3 - Below Station #2 approximately 1000 yards, above outfall.

Sta. #4 - Mixing zone, below outfall of ponds to Crystal Creek (150 feet below outfall).

Sta. #5 - Upstream approximately 10 yards of Cle Elum-Roslyn Highway E½ Sec. 27, T20N, R15E.

Table 6. Species Distribution of Benthic Invertebrates in Crystal Creek, May 23 and 24, 1978

Phylum Family Genus species	Station #1		Station #2		Station #3	
	count	d*	count	d	count	d
Diptera						
Tendipedidae						
unidentified species	29	268	5	68	15	120
Simuliidae						
unidentified species	3	26			2	17
Tipulidae						
unidentified species					1	10
Tricoptera						
Hydropsychidae						
unidentified species			1	14		
Limnephilidae						
unidentified species						
Rhyacophilidae						
Glossosoma sp.					24	190
unidentified species (gills)					1	8
unidentified species (smooth)					1	8
Plecoptera						
unidentified species			1	14	1	8
Perlodidae						
Isogenus			1	17	1	8
unidentified species			3	50		
Ephemeroptera						
Baetidae						
Baetis sp.	56	513	24	370	13	166
Hemiptera						
Corixidae						
unidentified species						
Macro-invertebrate species diversity	1.06		0.61		1.75	

* density per sq. ft.

Table [illegible] (Continued)

Phylum Family Genus Species	Station #4		Station #5			
	count	d	count	d		
Diptera						
Tendipedidae						
unidentified species	42	636	95	1150		
Simuliidae						
unidentified species	16	258	11.0	129		
Tipulidae						
unidentified species						
Tricoptera						
Hydropsychidae						
unidentified species	1	10				
Limnephilidae						
unidentified species	1	13				
Rhyacophilidae						
Glossosoma sp.	10	147				
unidentified species (gills)						
unidentified species (smooth)						
Plecoptera						
unidentified species	1	17	1	11		
Perlodidae						
Isogenus						
unidentified species						
Ephemeroptera						
Baetidae						
Baetis sp.	7	70	23	263		
Hemiptera						
Corixidae						
unidentified species	3	30				
Macro-invertebrate species diversity	1.86		0.89			