MINISTRY OF ENVIRONMENT

PROVINCE OF BRITISH COLUMBIA

CAMPBELL RIVER AREA
OYSTER RIVER BASIN
WATER QUALITY ASSESSMENT AND OBJECTIVES

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Nagpal, N. K.
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SUMMARY

This report assesses the water quality of the Oyster River watershed on Vancouver Island. This assessment was undertaken following the recommendations of the Oyster River Water Management Plan (1988).

The Oyster River flows into the Strait of Georgia, south of Campbell River. Among its tributaries are Piggott Creek and Adrian Creek neat its headwaters, and Woodhus Creek and Little Oyster River closer to the mouth.

The Oyster River and its tributaries are a valuable resource for trout and salmon fisheries. They also serve as a source of drinking water supply and irrigation water. Although the recreational uses are confined primarily to the lower reaches of the mainstem Oyster River below Woodhus Creek, fishing may take place all the way to the confluence of Piggott Creek.

Among various anthropogenic activities identified in the Oyster River watershed, forestry is the most dominant activity. The lower portions of the watershed contain extensive areas of agricultural land, but much of the agricultural land is presently tree-covered and not being farmed. Several companies hold licences for mineral extraction (e.g., coal) and placer mining adjacent to or within the watershed. The mining related activities are currently limited to the exploration level, but may become active in the near future. Water quality problems due to mining have been reported for upper Piggott Creek, which receives acid mine drainage from an old, inactive copper mine on Mt. Washington (predominantly in the Tsolum River watershed). A waste management permit (PE-5123) has been issued which allows discharge of domestic sewage to Piggott Creek.

Provisional water quality objectives were set to protect existing water uses of the Oyster River and its tributaries. Water quality characteristics for which objectives were set include particulate matter, fecal coliforms, nitrogen (e.g., ammonia, nitrate, and nitrite),and a variety of metals.

INTRODUCTION

This report summarizes the results of the water quality assessment of the Oyster River and its tributaries. Receiving water quality objectives are proposed for those characteristics which may be affected by present and future land use activities in the watershed. The water quality objectives, formulated to protect the existing water uses, are based on all available data and current water quality criteria. The details of the water quality assessment in the Oyster River watershed are presented in a technical appendix which forms the basis for recommendations and objectives presented here.

In 1988, the British Columbia Ministry of Environment prepared a Water Management Plan for the Oyster River Watershed. The plan recommended to establish water quality objectives and a water quality monitoring program for the Oyster River watershed. The tasks of assessing water quality and setting water quality objectives in the watershed were undertaken in accordance with that recommendation.

HYDROLOGY

The Oyster River originates in the mountains of the Forbidden Plateau on Vancouver Island and flows east into the Strait of Georgia between Courtenay and Campbell River. In terms of the drainage area, the four most significant tributaries to the Oyster River are Piggott Creek, Little Oyster River, Adrian Creek and Woodhus Creek (Figure 1).

Estimates from a hydrometric station on the Oyster River indicated that the streamflow was the highest in November/December due to fall rains. Another peak in the streamflow occurred during May-June due to snowmelt at higher elevations. The flows were the lowest in August and September.

WATER USES

The Oyster and its tributaries provide habitat for several salmonid species which are important for both commercial and recreational purposes. Steelhead and cutthroat trout are significant fish species for recreational use. Among anadromous species, chum, coho, pink and chinook are the most important species. Several projects to enhance fish production in the watershed are currently in place or being proposed For instance, a hatchery is located adjacent to the mainstem Oyster River below the Little Oyster River confluence. A sidechannel enhancement project (near the hatchery on UBC lands) exists to transplant pink eggs from the Quinsam watershed, while others are being planned.

In addition to sport fishing, boating and swimming are popular recreational activities particularly in the lower reaches of the mainstem Oyster River. The Oyster River and its tributaries are also important sources of drinking water and irrigation water.

WASTE DISCHARGES

Forestry is by far the dominant activity in the Oyster River watershed. Forest harvesting is of concern as it may affect water quality in the watershed.

Several companies hold licences for mineral extraction (e.g., coal) and placer mining adjacent to and in the Oyster River watershed. At present much of the mining related activities are limited to the exploration level. However, Nuspar Resources is proposing to develop its Chute Creek coal project in an area which includes the headwaters of Woodhus Creek.

The lower portion of the Oyster River watershed contains extensive areas of Agricultural Land Reserve (ALR). However, much of the ALR land is presently tree-covered.

The only waste management permit (PE-5123) has been issued to Mt. Washington Resort to discharge domestic-type secondary effluent from a recreational ski development to Piggott Creek.

WATER QUALITY ASSESSMENT AND OBJECTIVES

Several observations were drawn regarding water quality in the Oyster River watershed. They were:

(a) The concentration of particulate matter (non-filterable residue and turbidity) was high at times near the mouth of the Oyster River. Local factors (rather than forestry) combined with high flows were likely reasons for the observed conditions.

(b) Occasionally high levels of fecal coliforms were observed throughout the Oyster River watershed. The fecal contamination of Piggott Creek resulted from the effluent discharged by the Mt. Washington ski development facility, and was limited to an area immediately below the permit (PE-5123) site. The wildlife in the area was the probable source of high fecal coliforms levels in Woodhus Creek, Little Oyster River and the mainstem Oyster River upstream from Woodhus Creek. The source(s) of fecal contamination in the Oyster River near the mouth were difficult to establish with the given data.

(c) The drainage from an old, abandoned copper mine on Mt. Washington raised levels of copper, chromium, and aluminum in the tributary to Piggott Creek. The influence of the seepage on Piggott Creek and the Oyster River was minor, if any.

(d) Naturally higher levels of iron, manganese and copper were found in the Little Oyster River and Woodhus Creek.

(e) Water quality criteria for the protection of aquatic life were exceeded on several occasions for a variety of metals (e.g., copper, iron, zinc etc). Whether these discrepancies were caused by sample contamination, analytical error, or natural variability is not clear. In one case, a high value for particulate matter was traced to a rare event of high precipitation. Extreme values with no obvious reasons were considered to be anomalous.

Provisional water quality objectives were set for those characteristics which might be affected by the present and future land use activities. They include non-filterable residue, turbidity, nitrogen, microbiological indicators (e.g.,fecal coliforms), aluminum, arsenic, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, zinc, and pH. A summary of the recommended water quality objectives is presented in Table 1 at the back of this report.

Water quality objectives have no legal standing and would not be directly enforced. They, however, provide policy direction for resource managers in protecting water uses in the specific water bodies. They will guide the evaluation of water quality, the issuing of permits, licences and orders, and the management of the fisheries and of the Province's land base. They will also provide a reference against which the state of water quality in a particular water body can be checked, and serve to make decisions on whether to initiate basin-wide water quality studies.

Depending on the circumstances, water quality objectives may already be met in a waterbody, or may describe water quality conditions which can be met in the future. To limit the scope of the work, objectives are only being prepared for water bodies and water quality characteristics which may be affected by man's activity now and in the foreseeable future.

MONITORING RECOMMENDATIONS

In general, water quality monitoring in the Oyster River watershed has been performed at too low a frequency (once in a period of three or more weeks) to check objectives. Weekly samples over at least 30 days will be required to ensure that water quality objectives are being met. Figure 1 shows sites currently being monitored. The same sites should be monitored in future to check the water quality status in the watershed.

Water quality characteristics that are considered in this report are listed in Table 1. In addition to fecal coliforms, other microbiological indicators such as E. Coli, fecal streptococci, Pseudomonas aeruginosa, and enterococci should also be measured. Fecal streptococci along with the knowledge of land use may be useful in identifying sources of fecal contamination in the watershed.

Currently, several water quality characteristics such as arsenic, cadmium, cobalt, mercury and nickel are being measured using detection limits which exceed the proposed objective levels. Detection limits less than or equal to the objectives, should be used to analyze water for these characteristics. Lead and mercury levels in resident fish should also be monitored to check if the objectives for the edible (muscle) tissue of fish are being met.

N.K. Nagpal, Ph.D.
Resource Quality Section
Water Management Branch

Table 1

Provisional Water Quality Objectives for the Oyster River Basin[#]

Sampling Site	Oyster River u/s Woodhus Ck.	Oyster River d/s Woodhus Ck.	Woodhus Ck.	Little Oyster River
Designated Water Uses	Drinking Water Aquatic Life	Drinking Water Aquatic Life Irrigation Recreation	Aquatic Life	Aquatic Life Irrigation
Fecal Coliforms	<100 CFU/cL (90th percentile)		not recommended	
Turbidity	5 NTU (maximum)	<7 NTU (90th percentile)	not recommended	
Non-Filterable Residue	12 mg/L (maximum)	<15 mg/L (90th percentile)	not recommended	
Ammonia-N	as stated in Tables 2 and 3			
Nitrite-N	≤ 0.02 mg/L (average) 0.06 mg/L (maximum)			
Nitrate-N	10 mg/L (maximum)			
pH	pH ≥ 6.5 (minimum) pH ≤ 8.5 (maximum)	pH ≥ 6.5 (95th percentile) pH ≤ 8.5 (maximum)	pH ≥ 6.5 (minimum) pH ≤ 8.5 (maximum)	
Dissolved Al	≤ 0.05 mg/L (average) 0.1 mg/L (maximum)			
Total As	0.05 mg/L (maximum)			
Total Cd	0.2 µg/L (maximum)			
Total Cr	2 µg/L (maximum)			
Total Co	50 µg/L (maximum)			
Total Cu	≤ 3 µg/L (average) <5 µg/L (90th percentile)		<10 µg/L (90th percentile)	
Dissolved Fe	<0.3 mg/L (90th percentile)		not recommended	
Total Pb	$\leq 3.31 + e^{\{1.273\ \ln(\text{av. hardness}) - 4.705\}}$ µg/L (average at hardness ≥ 8 mg/L $CaCO_3$) 3 µg/L (maximum at hardness ≤ 8 mg/L $CaCO_3$) $e^{\{1.273\ \ln(\text{hardness}) - 1.46\}}$ µg/L (maximum at hardness >8 mg/L $CaCO_3$) 0.8 µg/g (maximum) in the edible (muscle) tissue of fish			
Total Mn	0.05 mg/L (maximum)			not recommended
Total Hg	≤ 0.02 µg/L (average) 0.1 µg/L (maximum) 0.5 µg/g (maximum) in the edible (muscle) tissue of fish			
Total Ni	0.025 mg/L (maximum)			
Total Zn	≤ 0.01 mg/L (average) 0.03 mg/L (maximum)			

[#]Averages (5 weekly samples) and the percentiles (10 samples; 2 per sampling time) are based on samples collected over a 30-day period. The objectives do not apply within the initial dilution zones of discharges.

Table 2#

Average 30-day Concentration of Total Ammonia-N for Protection of Aquatic Life

Temp. °C	0.0	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0.
pH	- mg/L Ammonia-Nitrogen -										
6.5	2.08	2.02	1.97	1.92	1.88	1.84	1.81	1.78	1.64	1.41	1.22
6.6	2.08	2.02	1.97	1.92	1.88	1.84	1.81	1.78	1.64	1.41	1.22
6.7	2.08	2.02	1.97	1.92	1.88	1.84	1.81	1.78	1.64	1.41	1.22
6.8	2.08	2.02	1.97	1.92	1.88	1.84	1.81	1.78	1.64	1.42	1.22
6.9	2.08	2.02	1.97	1.92	1.88	1.84	1.81	1.78	1.64	1.42	1.22
7.0	2.08	2.02	1.97	1.92	1.88	1.84	1.81	1.79	1.64	1.42	1.22
7.1	2.08	2.02	1.97	1.92	1.88	1.84	1.81	1.79	1.65	1.42	1.23
7.2	2.08	2.02	1.97	1.92	1.88	1.85	1.81	1.79	1.65	1.42	1.23
7.3	2.08	2.02	1.97	1.92	1.88	1.85	1.82	1.79	1.65	1.42	1.23
7.4	2.08	2.02	1.97	1.92	1.88	1.85	1.82	1.79	1.65	1.42	1.23
7.5	2.08	2.02	1.97	1.93	1.88	1.85	1.82	1.80	1.66	1.43	1.23
7.6	2.09	2.03	1.97	1.93	1.89	1.85	1.82	1.80	1.66	1.43	1.24
7.7	2.09	2.03	1.98	1.93	1.89	1.86	1.83	1.80	1.66	1.44	1.24
7.8	1.78	1.73	1.69	1.65	1.62	1.59	1.56	1.54	1.42	1.23	1.07
7.9	1.50	1.46	1.43	1.39	1.36	1.34	1.32	1.31	1.21	1.04	0.904
8.0	1.26	1.23	1.20	1.17	1.15	1.13	1.11	1.10	1.02	0.878	0.762
8.1	1.00	0.976	0.952	0.932	0.914	0.899	0.887	0.878	0.812	0.704	0.611
8.2	0.799	0.777	0.759	0.743	0.730	0.718	0.709	0.703	0.651	0.565	0.491
8.3	0.636	0.620	0.606	0.594	0.583	0.575	0.568	0.564	0.523	0.455	0.396
8.4	0.508	0.495	0.484	0.475	0.467	0.461	0.456	0.453	0.421	0.367	0.321
8.5	0.405	0.396	0.387	0.380	0.375	0.370	0.367	0.366	0.341	0.298	0.261
8.6	0.324	0.317	0.310	0.305	0.301	0.298	0.297	0.296	0.277	0.242	0.213
8.7	0.260	0.254	0.249	0.246	0.243	0.241	0.240	0.241	0.226	0.198	0.175
8.8	0.208	0.204	0.201	0.198	0.197	0.196	0.196	0.197	0.185	0.164	0.145
8.9	0.168	0.165	0.162	0.161	0.160	0.160	0.161	0.162	0.153	0.136	0.121
9.0	0.135	0.133	0.132	0.131	0.131	0.131	0.132	0.134	0.128	0.114	0.102

the average of the measured values must be less than the average of the corresponding individual value in this Table. Each measured value is compared to the corresponding individual values in this Table; no more than one in five of the measured values can be greater than one-and-a-half times the corresponding values in the Table. Linear interpolation may be used to determine average concentrations at water temperatures between the limits shown in the Table.

Table 3#

Maximum Concentration of Total Ammonia-N for Protection of Aquatic Life

Temp. °C	0.0	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0.
pH	- mg/L Ammonia-Nitrogen -										
6.5	27.7	27.9	27.2	26.5	26.0	25.5	25.0	24.6	24.3	24.0	23.8
6.6	27.9	27.2	26.4	25.8	25.2	24.7	24.3	23.9	23.6	23.3	23.2
6.7	26.9	26.2	25.5	24.9	24.4	23.9	23.5	23.1	22.8	22.6	22.4
6.8	25.8	25.1	24.5	23.9	23.4	22.9	22.5	22.2	21.9	21.7	21.5
6.9	24.6	23.9	23.3	22.7	22.2	21.8	21.4	21.1	20.8	20.0	20.4
7.0	23.2	22.5	21.9	21.4	20.9	20.5	20.2	19.9	19.6	19.4	19.2
7.1	21.6	20.9	20.4	19.9	19.5	19.1	18.8	18.5	18.3	18.1	17.9
7.2	19.9	19.3	18.8	18.3	17.9	17.6	17.3	17.1	16.8	16.7	16.5
7.3	18.1	17.5	17.1	16.7	16.3	16.0	15.7	15.5	15.3	15.2	15.1
7.4	16.2	15.7	15.3	15.0	14.7	14.4	14.1	13.9	13.8	13.6	13.5
7.5	14.4	14.0	13.6	13.3	13.0	12.7	12.5	12.4	12.2	12.1	12.0
7.6	12.6	12.2	11.9	11.6	11.4	11.2	11.0	10.8	10.7	10.6	10.5
7.7	10.8	10.5	10.3	10.0	9.83	9.65	9.50	9.37	9.26	9.81	9.12
7.8	9.26	8.98	8.77	8.57	8.40	8.25	8.12	8.02	7.93	7.87	7.82
7.9	7.82	7.60	7.42	7.25	7.10	6.98	6.88	6.79	6.72	6.67	6.64
8.0	6.55	6.37	6.22	6.08	5.96	5.86	5.78	5.71	5.66	5.62	5.60
8.1	5.21	5.07	4.95	4.84	4.75	4.67	4.61	4.56	4.53	4.50	4.49
8.2	4.15	4.04	3.95	3.86	3.80	3.74	3.69	3.65	3.63	3.61	3.61
8.3	3.31	3.22	3.15	3.09	3.03	2.99	2.96	2.93	2.92	2.91	2.91
8.4	2.64	2.57	2.52	2.47	2.43	2.40	2.37	2.36	2.35	2.35	2.36
8.5	2.11	2.06	2.01	1.98	1.95	1.93	1.91	1.90	1.90	1.90	1.92
8.6	1.69	1.65	1.61	1.59	1.57	1.55	1.54	1.54	1.54	1.55	1.57
8.7	1.35	1.32	1.30	1.28	1.26	1.25	1.25	1.25	1.26	1.27	1.29
8.8	1.08	1.06	1.04	1.03	1.02	1.02	1.02	1.02	1.03	1.05	1.07
8.9	0.871	0.856	0.844	0.836	0.832	0.831	0.834	0.842	0.853	0.870	0.891
9.0	0.703	0.692	0.685	0.681	0.680	0.682	0.688	0.698	0.711	0.729	0.752

Linear interpolation may be used to determine average concentrations at water temperatures between the limits shown in the Table.

FIGURE 1 : OYSTER RIVER WATERSHED SHOWING LOCATIONS OF WATER QUALITY SAMPLING SITES, HATCHERY, HYDROMETRIC STATION , EFFLUENT DISPOSAL, AND WATER LICENCES.