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ENVIRONMENT CANADA REVIEW

OF THE

KEENLEYSIDE - MURPHY HYDROELECTRIC PROJECTS

DETAILED ENVIRONMENTAL STUDIES

Vancouver, B.C.

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Environment Canada review of the Keenleyside - Murphy hydroelectric projects.

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ENVIRONMENT CANADA REVIEW

OF THE

MURPHY CREEK HYDROELECTRIC PROJECT

DETAILED ENVIRONMENTAL STUDIES

Vancouver, B.C.
August 1982

I. Comments on Adequacy of Impact Assessments, Conclusions and Recommendations

Report - Murphy Creek Project: Hydrology, River Morphology and Climate. Prepared by B.C. Hydro and Power Authority, Hydroelectric Generation Projects Division, Development Department. April 1981. Report No. H 1350.

Comments on section 2.3 - Sediment Regime and River Morphology - are as follows:

a) Interpretations of Tables 2-6, 2-7 and 2-8 suggest that deltas and alluvial fans will develop at the mouths of the tributaries. It is felt that B.C. Hydro's statement on page v that "There is a possibility that sediment might accumulate at the mouth of tributaries" is an understatement.

b) In the analysis of the sediment regime of the proposed reservoir on page 2-9, B.C. Hydro assumes, "... that the suspended sediments passing through these upstream reservoirs will continue on through the Murphy Creek reservoir. It is also assumed that the Keenleyside and Brilliant dams will halt any movement of bed-load upstream of these dams." No supporting information and data are provided to back up these assumptions.

Section 2.5 - Geology and Ground water - adequately describes the regional and intermediate ground water flow systems. It also provides a reasonable interpretation of ground water chemistry and identifies the locations of major aquifers. There are a few weaknesses in this section which include:

a) On page vi it is concluded that "Ground water quality will not be affected by the Murphy Creek reservoir". There is a distinct possibility that shallow unconfined aquifers hydrologically continuous with the reservoir will experience increased concentrations of Fe, Mn and similar transition series elements due to oxidation-reduction processes caused by increased water table fluctuations. In the report on "Geology and Land Forms"[1] Figures 2 to 7 identify a large number of local landforms of potential unconfined aquifers where such processes are possible. Concentrations of available constituents would increase with frequency and range of reservoir water surface fluctuations. It is not known how many wells will be affected nor if it would raise these constituents above recommended drinking water limits.

b) A second concern regarding ground water quality is with the potential interference of septic and sewage facilities in areas with high water tables. A further increase in water table elevations due to raised river level will reduce the effectiveness of these systems. This could result in local contamination of nearby dug wells, streams and parts of the reservoir by fecal coliforms, nitrates and other undesirable contaminants. This subject is addressed in section 2.5b (p. 2-31) but monitoring before, during or following completion of the project is not discussed.

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1 Murphy Creek Project: Geology and Landforms. Prepared by B.C. Hydro and Power Authority, Hydroelectric Generation Projects Division, Geotechnical Department. Report No. H 1280. August 1981.

In summary it is not known how serious these two ground water concerns are - but precautions should be taken to assure continued quality standards of existing domestic and municipal wells.

For section 3.0 - Climate - the comments are:

a) With regard to the page 3-5 discussion of the Murphy Creek Project effects on wind velocities, Environment Canada notes that the effect of a reservoir on wind is generally quite localized to the water surface and surrounding shoreline. Therefore one might not expect much effect from the Keenleyside Dam to be felt in the Castlegar to Trial area. The new reservoir of the Murphy Creek Dam, will produce some changes to the wind regime in the area around its shores, but these will not likely be very significant.

b) In section 3.4 on the discussion of fog, Table 3-5 correctly indicates that there is now a considerable incidence of fog at Castlegar Airport. Discussion with Castlegar Weather Office staff, located at the airport, suggests that the Columbia River is the source of much of the fog currently observed, although industrial pollutants are a significant contributory factor. From this perspective one could view a possible increase in fog frequency as a subject warranting close scrutiny using available data and models. Section 3.4 on "Fog" fails to meet that need and is deficient in several areas. The following are detailed comments on these deficiencies.

i) On page 3-6, although early morning radiation fogs may be the dominant type in the area it can be seen from Table 3-5 that afternoon frequencies are considerable in winter months. At that time of the year there is an average of over eight tenths of cloud cover. It is often the case that residual Arctic air masses become trapped in valley bottoms where they stagnate and become moistened by valley bottom sources of water vapour. A type of fog called a "mixing" fog or combined radiation-mixing fog often results. Such fogs often form over water bodies in the presence of colder air and may spread vertically and horizontally over the surrounding land.

ii) Regarding the effect of the proposed project on radiation fog frequency (pages 3-7 and 3-8) the formula referenced to Beers is, as indicated, a theoretical one for the concentration of small droplets given cooling below some initial point of saturation. In its application, daily minimum temperatures and monthly average 4 a.m. dew point temperatures were used. Since air mass dew points are highly correlated to temperatures (colder air masses have lower dew points) one would expect the results of the above exercise to be of little value. Such an approach would merely predict fog on all cold nights and no fog on all warm nights. The real situation is far more complex depending on air mass moisture levels. In order to more usefully apply the method one would necessarily have to make use of hourly temperature and dew

point data (such records are available for Castlegar Airport on magnetic tape from the Atmospheric Environment Service climatological archive). Relating results derived in such a way with fog frequency data might then be expected to produce more realistic relationships.

iii) Furthermore, on pages 3-9 and 3-10 two factors were identified which lead to increased evaporation. The first was a second-order thermodynamic effect (i.e., the change of the latent heat of vaporization with water temperature) which can safely be ignored. What should have been included in its place is the much larger effect on saturation vapour pressure over a water surface due to any increase in temperature. An increase of 1°C would result in a saturation vapour pressure increase of about 7% for temperatues in the 0° to 10°C range. Evaporation from a water surface is roughly proportional to $e_s - e_a$, where e_s is the saturation vapour pressure at the water and e_a is the vapour pressure of the air just above. Therefore an even larger percentage change would occur in evaporation. The discussion provided on the effect of an increase in water surface area is reasonable.

iv) On page 3-11, the relationship between actual and potential evapotranspiration is not relevant to evaporation losses from a reservoir. Note in Table 3-6 that both potential and actual evapotranspiration are

indicated to be zero for December, January and February. Similar tables are available for Robson, Warfield and other stations on the Canadian side of the border. They are based on the Thornthwaite water budget model which produces values of zero for months with a mean temperature below 0°C. At such times, plant activity is minimal and land surfaces are considered to be frozen. The situation with an open reservoir is far different. Fall and winter evaporation can be quite significant as cold, dry air crosses a relatively much warmer water surface. The contention that a larger water surface would have no impact in the months October to April (page 3-13) is, therefore, unfounded. In fact, one might expect relatively significant impacts during the cold season. For a general discussion of evaporation and evapotranspiration as related to the impact of reservoirs, see "Climatological Impacts of Peace River Regulation and a Review of Possible Effects of Climatic Change on Agriculture in the Area - A Report Prepared for British Columbia Hydro and Power Authority by D.G. Schaefer, Scientific Services, Atmospheric Environment Service, June 9, 1976".

In conclusion, further effort will be required to resolve the issue of the possible increase in fog frequency due to the Murphy Creek Project and contrary to the statement on page 3-13, the assumptions made cannot be termed conservative.

Report - Murphy Creek Environmental Assessment Water Quality Study. Prepared by IEC Limited. September 15, 1981.

Comments on the potential water quality impacts of the proposed project are as follows:

a) The discussions on the impact of the Murphy Creek Project on nitrogenous and phosphorous water quality indicate changes should be minimal but the report isn't clear on the basis for why the changes would be expected in the first place (e.g., nutrient regeneration in a lake environment?).

b) With respect to the B.C. Timber operation at Castlegar:

   i) The statements on page 1.2 that "The reservoir will not change the characteristics of B.C. Timber effluent dilution and dispersion", and on page 5.37 that "The installation of the Murphy Creek Dam and the resultant change in the river elevations will have no significant effect on the dispersion of the B.C. Timber plume" are not substantiated by the data and analyses provided. Although page 2.0 acknowledges the B.C. Ministry of Environment Phase II environmental investigations[2] which concluded that the Murphy Creek Dam would reduce flow velocities and effluent dispersion rates, the potential for periodic ponding of

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2 Kootenay Air and Water Quality Study Phase II: Water quality in the lower Columbia River basin. B.C. Ministry of Environment, Water Investigations Branch, April 1979.

pulpmill wastes near the B.C. Timber outfall following the dam construction is not addressed. Consequently the possibilty of such ponding leading to slugs of organics being passed over the Murphy Creek Dam and transported across the International Boundary is not ascertained by the studies.

The Inland Waters Directorate's Water Quality Branch considers the dispersion model developed in section 5.2.7 pages 5.31-5.38 to be inadequate. The reasons are as follows:

1) The effluent from the different pulpmill and woodmill processes of the B.C. Timber operations are not documented for the two surveys conducted. Information on the levels of resin acids, mercaptans, chlorinated organics, sulfides etc., and the type of bleaching operation are not presented.

2) The future mixing patterns at the confluence of the Kootenay and Columbia rivers and the compexities of varying discharges from the two systems (e.g. when low discharges from the Keenleyside Dam could result in backwater effects) have not been studied.

3) It is not clear whether the analysis takes into account effluent changes from proposed expansion of the operations at B.C. Timber.

ii) Toxicity of the B.C. Timber effluent discharge should be discussed. The toxicity of pulp and paper mill effluents to fish is well known. The potential for concentrations of effluents occurring in the vicinity of B.C. Timber operations and resulting in sub-lethal and/or lethal affects to fish has not been addressed in the Water Quality Study Report.

iii) The report could be enhanced by simply identifying all the concerns on a parameter by parameter basis as outlined in the B.C. Ministry of Environment-Phase II report[2] as they relate to he river now and the present level of treatment at B.C. Timber. It could then be clarified how biological treatment and how a doubling of production might affect these concerns, i.e., BOD_5, TSS, settleable solids, toxicity and nutrients. Considering biological treatment could be in by 1985 and the dams not until 1989 this would be of some interest. Thus, discussions on stratification, dispersion, etc., might be considered in light of a potentially improved effluent.

iv) It is agreed that B.C. Timber is the major anthropogenic source of N and P in the study area, but comparing loadings on an annual average concentration and flow basis is very superficial. If the point the report is trying to make, by this type of comparison, is that the anthropogenic loadings are small in relation to background loadings that is fine but, it would also be of interest in knowing if

any eutrophication or other problems have been identified in the system as it is now. Are there periods when the system is more sensitive (i.e., extended periods of low flow) and anthropogenic sources may be of some concern?

c) There does not appear to be any information on the lands that are to be flooded (i.e., will landfill sites and snow dumps be flooded? What type of chemicals are expected to be leached from the sites?). Information on the land areas that are to be flooded should be reviewed because the areas flooded could result in water quality changes in the Columbia River.

Report - Murphy Creek Hydroelectric Development: Land Use Study. Prepared by Urban Systems Ltd., Consulting Engineers and Planners. November 1981.
AND
Report - Murphy Creek Hydroelectric Project: Agriculture Studies for B.C. Hydro and Power Authority. Prepared by Talisman Land Resource Consultants. June 1981.

Both reports were reviewed and considered to be good overviews. We concur with the consultants that impact on land use will be severe for reservoir levels above 427 m.

The recommendations and proposed mitigation measures presented in both reports are thorough and appropriate. However, the commitment to implement the proposed mitigation measures is not discussed.

Report - Murphy Creek Hydroelectric Project: Forestry Studies. Prepared by Talisman Land Resource Consultants. June 1981.
AND
Report - Murphy Creek Hydroelectric Project: Vegetation Studies. Prepared by Talisman Land Resources Consultants. June 1981.

Considering the terrain up to the elevation of the predicted reservoir levels, the above reports make a realistic assessment of the general situation pertinent to the proposed hydroelectric development.

It is anticipated that existing provincial guidelines would suffice to assure that disturbances of terrain, vegetation and forests are kept to a minimum and that appropriate mitigative measures are taken.

Report - Murphy Creek Project: Wildlife Studies. Prepared by Beak Consultants Limited. July 1981.

In general, the consultants have done a fairly thorough job.

One mitigative measure offered is that B.C. Hydro investigate the possibility of artificial nesting structures for ospreys to mitigate the destruction of any natural structures due to the flooding of the reservoir.

Under Mitigation Measures (page 77) the consultant states that reservoir flooding should take place after July to avoid inundating the breeding efforts of birds. Since migratory birds may establish nests below the high water mark during the period of drawdown, not refilling the reservoir until after July would allow time for the hatching of eggs. However, the proposed operating regime indicates the reservoir will normally be filled to the full-pool level between April and June. Although the absolute numbers of migratory birds, particularly shore birds, affected may not be large, the numbers relative to the local populations may nevertheless be significant. Therefore, it is recommended that further investigations be conducted into what could be done for those species which may be displaced by the annual reservoir flooding.

II. Comments on Technical Accuracy of Data Reported

Report - Murphy Creek Project: Hydrology, River Morphology and Climate. Prepared by B.C. Hydro and Power Authority, Hydroelectric Generation Projects Division, Development Department. April 1981. Report No. H 1350.

a) In section 2.1, Water Survey of Canada discharge data up to 1978 for the Columbia and Kootenay rivers are cited. More recent discharge data are available from Inland Waters Directorate.

b) Pages 2-17 to 2-22 includes information on river water temperatures and ice formation. However the daily measurement of water temperatures reported for Trail since 1967 should be referenced.

c) Under "Climate" most of the sections on temperature and precipitation seem adequate. The source of the numbers [i.e., Atmospheric Environment Service normals, Intensity Duration Frequency (IDF) curves, etc.] should be referenced. On page 3-1 it would have been preferable to use the standard "mm" unit for precipitation. A map showing the locations of climatological stations would have been helpful.

d) Rainfall IDF curves have been updated since the set shown were produced (Figures 3-4 and 3-5). Atmospheric Environment Service originals indicate the specific years of data used in each analysis. Curves are also now available for Castlegar Airport. It should be noted that, for the climatological station

Castlegar BCHPA Dam, the curves shown correspond to the 2, 10 and 25 year curves rather the 2, 5 and 10 year set.

Report - Murphy Creek Environmental Assessment Water Quality Study. Prepared by IEC Limited. September 15, 1981.

a) The report describes two surveys which were undertaken to establish B.C. Timber effluent dispersion in the Columbia River. The first survey was undertaken on August 12 and 13, 1980 and the second survey of the B.C. Timber plume was undertaken on September 18 and 19, 1980. Although there is a summary of the data, all the data collected for the two surveys should be included.

b) Much of the discussion in section 5.2 might be better discussed earlier in section 4 under the appropriate heading. This would give a clearer understanding of the system early on in the report, e.g., thermal stratification and dispersion.

Report - Fisheries Inventory and Impact Assessment in Relation to the Proposed Murphy Creek Development on the Columbia River, B.C. Prepared by RL&L Environmental Services Limited. April 1982.

a) The report (page 4) makes reference to the Water Survey of Canada station no. 08 NE003. This station number is in error since this station at Trail has data available only from 1913 to 1937 and its average annual discharge does not correspond to the one referred to in the report. As well there is more recent streamflow data available for the area than that reported. This information can be obtained from Inland Waters Directorate.

Report - Murphy Creek Project: Wildlife Studies. Prepared by Beak Consultants Limited. July 1981.

The migratory bird data which is presented in the report appears to be comprehensive.

Comments relating to the technical accuracy of the report are as follows:

a) On page 45, 2nd line above the footnote, "divers" should be defined.

b) On page 45, footnote, the scientific names of birds are provided in appendix 8, not appendix 7 as indicated. Appendix 7 lists furbearers.

c) Appendix 8, the list of bird names is difficult to use when it is done alphabetically. It would be much more conveniently used if the names were organized according to the accepted American Ornithologists Union format. Further, there are errors in spelling or scientific nomenclature in at least the 11 names listed below:[3]

American Wigeon	Anas americana
Bald Eagle	Haliaeetus leucocephalus
California Gull	Larus californicus
Common Loon	Gavia immer
Eared Grebe	Podiceps nigricollis
European Wigeon	Anas penelope
Northern Shoveler	Anas clypeata
Osprey	Pandion haliaetus
Snow Goose	Anser caerulescens
Spotted Sandpiper	Actitis macularia
Western Grebe	Aechmophorus occidentalis

3 Based on the most recent (1973 & 1976) revisions of the A.O.U. checklist.

ENVIRONMENT CANADA REVIEW

OF THE

KEENLEYSIDE POWERPLANT AND KEENLEYSIDE - MURPHY CREEK TRANSMISSION PROJECTS

DETAILED ENVIRONMENTAL STUDIES

Vancouver, B.C.

March 1983

ENVIRONMENT CANADA REVIEW

Summary Statement

As a result of the Task Force review, Environment Canada has no significant environmental concerns to raise regarding the Keenleyside Powerplant and Keenleyside-Murphy Creek Transmission Projects.

General Recommendation

Because the planned Keenleyside-Murphy hydroelectric projects are likely to result in changes in total dissolved gas concentrations and in their downstream distribution in the lower reaches of the Columbia River, it is recommended that a detailed study of gas supersaturation be carried out.

The study area should include the Columbia River between the Hugh Keenleyside Dam and the International Boundary. Measurements of dissolved gas concentrations should commence prior to the installation of the generators at Hugh Keenleyside Dam and should be made under all changing operating conditions within the study area particularly at times when gas supersaturation is expected to be greatest.

Such data are needed to quantify the changes and would be necessary in assessing the gas supersaturation effects of subsequent hydro dam proposals for the lower Columbia River.

Comments on Keenleyside Powerplant and Keenleyside-Murphy Creek Transmission Reports

Report - Fisheries Inventory and Impact Assessment for the Proposed Keenleyside Powerplant Project on the Columbia, B.C. Prepared by R.L. and L. Environmental Services Ltd. May 1982.

1. The report's discussion of dissolved gas supersaturation (d.g.s.) in the Columbia River documents the elevated dissolved gas levels which are generated at the Hugh Keenleyside Dam and which at times reach critical levels for aquatic biota. Of particular interest to Environment Canada's Inland Waters Directorate is the fact that high concentrations of dissolved gases are maintained for a substantial distance downstream in the Columbia. For example, measurements made of Columbia River water at Beaver Creek Park[1] (approximately 8 km upstream of the International Boundary) have recorded total d.g.s. in excess of 130%. Total dissolved nitrogen levels above 120% saturation in water entering Lake Roosevelt have been attributed to upstream dams on the Columbia River in Canada.

   It is expected that the installation of generators at the Hugh Keenleyside Dam and the creation of higher tailwater elevations by the Murphy Creek Project (when completed some three years later) will in combination reduce total d.g.s. generated at Hugh Keenleyside Dam. However, the Murphy Creek Project is also likely to produce higher total dissolved gas concentrations below the Murphy Creek

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1 Environmental Protection Dissolved Gas Study Data Summary. Province of B.C. Ministry of Environment. May 1977 Report No. 77-10

damsite during certain periods when the reservoir is drawn down. The magnitude of these changes in total dissolved gas supersaturation and its downstream distribution in the lower reaches of the Columbia River remains unknown. For this reason, it is recommended that a detailed study of gas supersaturation be carried out. The study area should include the Columbia River between the Hugh Keenleyside Dam and the International Boundary. The study should commence prior to the installation of the generators at Hugh Keenleyside Dam and measurements of dissolved gas concentrations should be made under all changing operating conditions within the study area (paritcularly at times when gas saturation is expected to be greatest). Such data are needed to quantify the changes and would be necessary in assessing the gas supersaturation effects of subsequent hydro dam proposals for the lower Columbia River (e.g. Murphy Creek and other dams being considered by B.C. Hydro downstream of Trail).

2. The report states that the nutrient levels (phosphorus and nitrogen) within the Columbia River System are low (p. 35). This is not entirely correct since phosphorus levels downstream of Trail can be as high as 200 µg/l (at Waneta) and are regularly in the 30-50 µg/l range. The Cominco smelter and fertilizer complex is a major point source loading of nutrients which does have a significant influence on the receiving waters downstream of Trail.

3. The water quality data collected for the Arrow Lakes provides only a limited amount of information and can not be considered an adequate background water quality data base for Lower Arrow Lake.

Report - Keenleyside Powerplant Project

Environmental Impact Evaluation. Water Use Study Prepared by Kerr Wood Leidal Associates Ltd. Consulting Engineers. May 1982.

The report indicates that the normal discharge pattern of the Hugh Keenleyside Dam would be maintained through the construction phase of the project. Therefore, the dilution of existing point source discharges to the Columbia River should not be affected and this would not be a concern.

Report - Preliminary Environmental Assessment Studies for Murphy Creek Transmission. Prepared by TERA Environmental Consultants Ltd. May 1982.

AND

Report - Preliminary Environmental Assessment Studies for Hugh Keenleyside Transmission. Prepared by TERA Environmental Consultants Ltd. May 1982.

1. The B.C. Ministry of Forest Strategic Studies Branch and the Regional Manager's Office in Nelson were consulted regarding the corridor alternatives and the impact of transmission lines on the forest resource. Environment Canada's Forestry Service concurs with the B.C. Ministry of Forests that the South of Montrose and the Slocan corridors are the preferred ones. Since there is no alternative for the Murphy Creek corridor, it is recommended that its impact on

highly productive forest and plantations be minimized by B.C.H.P.A. deciding on the final location of the corridor in consultation with the B.C. Forest Service.

2. Little material on climate was presented but is considered to be adequate from the point of view of an impact assessment. In the section on recommendations for detailed assessment of the chosen corridors of both reports it was suggested that wind/ice loading be studied along the length of the route. This is more a matter for engineering design than for environmental assessment although it may be that a need for heavier construction might entail greater impacts. Hydro's engineering consultants should assess the problem, design the line and then ask for an environmental mitigation study (relevant to this particular question).

3. In the present documents there are no commitments to any of the proposed mitigation measures on behalf of the proponent, the mitigations are only suggestions from the consultants.

4. Water Survey of Canada discharge data are cited in Tables 4.3-2 of both reports. There are a number of errors in these tables which include the discharge data for China, Glade, Bear, Topping and Trail Creeks.