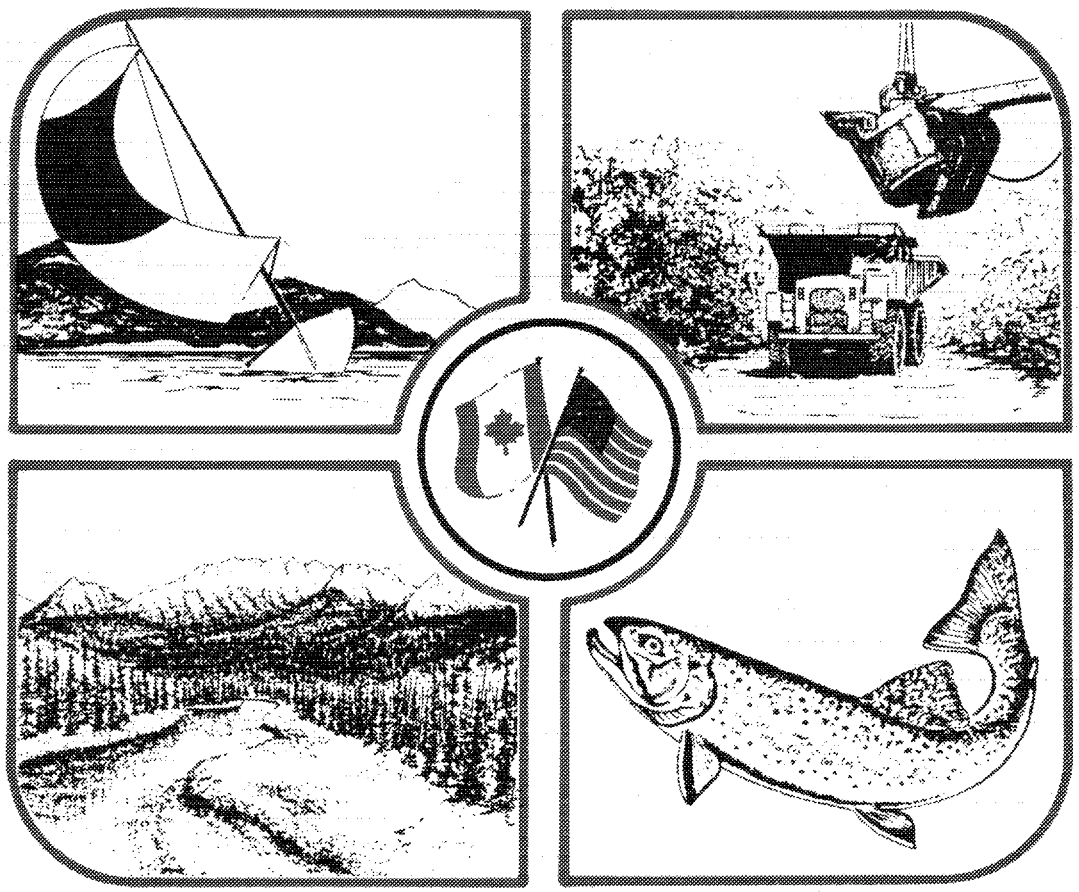
Flathead River
International Study



Mine Development Committee
Technical Report Summary
December, 1986

Introduction

This report was written to provide the Flathead River International Study Board and its other technical committees with mine site and design information on the proposed Sage Creek Coal Limited project as a basis for water quantity and quality impact assessment.

Sage Creek Coal Limited proposes to mine 2.2 million tonnes (2.4 million U.S. tons) of thermal coal per year over a 21-year period by open-pit methods. The proposed mine site is located near the confluence of Howell and Cabin Creeks in the Flathead River valley of British Columbia. *[Maps are on page 6, color, and page 7, grayscale high resolution for printing.]* The proposal includes a water management plan utilizing ditches and ponds on the mine site to control contaminated runoff. The proposal also includes a main haul road and transmission line routed from the north down the Flathead River valley as well as some of the tributaries to the Flathead River.

The British Columbia Government has granted the project Stage II approval-in-principle, which includes a number of water quantity and quality conditions to be met at Stage III. Stage II is the conceptual mine planning stage, whereas Stage III, which has not yet been reached by this proposed mine, is the detailed planning stage during which detailed mine plans are submitted and applications are made for various permits and licences.

In addition to project and area descriptions, the report includes both qualitative and quantitative assessments of the potential effects of the project. Optimal and adverse operational case scenarios are described to allow the evaluation of a range of effects that could potentially result from the proposed project, if developed. The optimal case is based on the Stage II design, as well as the assumption that standards and conditions specified in British Columbia Government regulations and guidelines for coal developments would be met. The adverse case is based on past instances where existing Elk Valley mines do not appear to have met those standards and conditions.

Existing Elk Valley mines were used for this evaluation because of geological and biophysical similarities between the Elk and Flathead River valleys and because of similarities between the operating Elk River valley mines and the proposed Sage Creek Coal Limited project. In many cases it was not possible to provide precise or detailed quantitative estimates of mining effects because the data base was too weak. Appropriate application of data from the existing mines in the Elk River valley to the proposed mine site required the use of best professional judgement. It is possible that certain conditions or impacts may occur at the proposed Sage Creek Coal Limited mine site that are not adequately depicted by the available data.

Qualitative Description Of Potential Effects

During the construction phase of the project, the activities would include logging, land clearing, earth moving, and construction of roads, bridges, sediment control structures, transmission line, plant site facilities, and a tailings pond. Not all of these would occur within a discrete time period.

These construction activities could increase sedimentation, nutrient additions, organic debris loadings, and oil and grease contributions to streams, as well as disrupt stream geomorphology. Sediment controls, good "housekeeping" practices, appropriate construction timing, and revegetation have been proposed by the mining company to reduce impacts to water quality in the vicinity of the mine site during this phase.

The mining phase would involve pit and waste and refuse dump development, blasting operations, and coal processing. It would also involve use of mine roads, bridges, tailings pond, sewage disposal facilities, and a water management system. Mining phase activities would potentially result in sediment and/or inorganic nitrogen loadings to surface and groundwater from the pits and dumps, as well as nitrogen and phosphorus loadings from sewage disposal. Surface and groundwater discharges as well as pit dewatering would probably significantly alter surface water temperatures.

A water management plan has been proposed by the company to handle surface water. Any contaminated waters would be collected in ditches and routed to any of four settling ponds. Three of these ponds would discharge to the Flathead River while one would discharge to Cabin Creek. Runoff from the coal processing area would enter the tailings pond. Uncontaminated water diversion ditches would convey upslope water around mine facilities and discharge to Cabin, Howell, and Couldrey Creeks.

Sage Creek Coal Limited has proposed standard reclamation practices for this project. These would involve removal of mine site structures, grading waste dump slopes to approximately 26^{o}, ripping the surface of roads and the plant site, applying salvaged soil materials (topsoil), and revegetation. The water-related impacts during the reclamation phase are expected to be similar to those identified during the mining phase.

Impacts to groundwater flow are expected to commence during construction and to continue through mining and reclamation. The following sequence is anticipated.

1. Initially, increased inflow to underlying aquifers and concomitant increased outflow to areas of groundwater discharge.
2. Leakage of as much as 75 percent of ditch and pond waters to the ground.
3. Later, local reduction of groundwater upwelling to creeks, decreased flow at springs, and reduced inflow to deep aquifers.
4. After proposed pits extend below creek elevations, there could be loss of Cabin or Howell Creek water to the groundwater system which would later be returned to the Flathead River system from pit dewatering and pond discharges.
5. During reclamation, groundwater flow rates would increase toward former levels, but surface inflow to the ground would remain greater than before initial disturbance.

Contamination of groundwater with various constituents, although low during initial construction, is expected to increase throughout mining and gradually decrease with time after mining. Groundwater temperatures would be affected most where ponds recharge the groundwater system. Conversely, groundwater temperatures would likely influence surface water temperatures in areas of discharge (outflow).

Quantitative Estimates Of Potential Effects

The water quality issues of madin concern appear to be those related to phosphorus (P), nitrogen (N), total suspended solids (TSS), temperature, and accidental chemical losses.

Particulate P is expected to increase in Howell Creek downstream of its confluence with Cabin Creek by 0.050 mg/L and 0.150 mg/L, respectively, for the optimal and adverse cases (both figures are maximum daily average increases above background concentrations in any given year). Average annual loadings would probably range from 250 to 500 kg (550 to 1100 lbs). About 80 percent of this loading would occur during freshet.

For soluble reactive phosphorus (SRP), which is considered the most biologically available component of total P, the estimated increases are 0.002 mg/L and 0.004 mg/L (again, both are maximum daily average increases above background in any given year). If both surface water and groundwater discharges are considered, the estimated annual loading of SRP would be about 270 kg (594 lbs). A maximum range of 100 to 500 kg (220 to 1100 lbs) would be anticipated. These figures do not meet the phdosphorus objective in the British Columbia Stage II approval-in-principle for the Sage Creek Coal Limited project, which stipulates no phosphorus increase in receiving streams, except for increases in sediment-related P.

The estimates for nitrate-N concentrations, primarily coming from explosive residues, are <5 and <10 mg/L (maximum daily average concentrations in any given year) in Howell Creek downstream of Cabin Creek for the optimal and adverse cases respectively. These would be within the British Columbia Government's approval-in-principle objective of 10 mg/L. Annual nitrate loading is estimated to be 120 tonnes (134.4 U.S. tons). Nitrate would comprise over 95 percent of the total inorganic nitrogen loading.

Nitrite-N concentrations are estimated to be 0.01 and 0.02 mg/L (maximum daily average concentrations in any given year) in Howell Creek below the confluence with Cabin Creek. These estimates were based on company data which may have over-estimated nitrite-N concentrations. The B.C. Government objective levels for this project are 0.060 mg/L at any time and 0.020 mg/L for prolonged periods.

Maximum daily average concentrations of total ammonia-N in any given year are estimated as 0.05 and 0.15 mg/L in Howell Creek below its confluence with Cabin Creek. These may be underestimates, based on the data used. The calculated total ammonia-N objective for this project is 0.838 mg/L.

For the adverse case, TSS concentrations would probably exceed the Sage Creek Coal Limited objective of a 10 mg/L increase above background levels on four occasions during freshet in an average year and once every four years during late summer or fall due to storm events. The average peak daily increase above background during these occasions is estimated to be 43 mg/L in Cabin or Howell Creeks above their confluence over a three-day period for each occasion. This peak estimate would apply to the construction and mining phases only. Peak concentration data cannot be used for generating loading estimates. The environmental objective of no greater than a 10 mg/L increase above background would be met during the remainder of the year; increases should frequently be much lower than 10 mg/L.

In the optimal case the 10 mg/L objective for TSS would not be exceeded. During non-freshet periods on Cabin Creek and all periods on Howell Creek, TSS increases above background should frequently be much less than 10 mg/L.

Temperature effects on Howell Creek below the confluence would include estimated changes of -1^{o} to $+1^{o}$ C (-1.8^{o} to 1.8^{o}F) and -2^{o} to $+3^{o}$C (-3.6^{o} to 5.4^{o}F) changes, respectively, for the two scenarios as compared with the objective of a $\pm$ 1^{o}C ($\pm .8^{o}$F) change.

A variety of other parameters are discussed in the text with respect to receiving or mine effluent water concentrations. These include dissolved oxygen, pH, total dissolved solids, metals, and other cations and anions.

Land disturbance would be expected to increase runoff from the mine site by 20 percent, and to cause a three-fold increase in groundwater discharge from the mine site at maximum mine development. The average overall increases are estimated to be 0.91×10^{6} m^{3} /yr (2.4×10^{8} gal/yr) for surface water and 1.82×10^{6} m^{3} /yr (4.81×10^{8} gal/yr) for groundwater.

Other Effects

The water-related effects of other mine-related events such as fugitive dust emissions and stream channel encroachment, have not been quantified. Nor have the effects of uncertain events, such as extreme flood flows and waste dump failures, been quantified. Nevertheless, they have been qualitatively evaluated or discussed in Section 6 of this report.

All settling ponds would contain two outflow structures: the normal decant to handle flows up to the 50-year flood, and a free crest spillway capable of passing the peak flow from a 200-year flood. A 50-year flood flow could decrease retention times in settling ponds or cause short circuiting of control structures. Debris could limit peak flows from discharge structures, or could cause a breach of a diversion ditch. Such an event could increase TSS contributions to the receiving waters, but other parameters would likely not be increased significantly due to dilution associated with the increased runoff. However, direct impacts to control structures from a 50-year flood flow should not be severe.

Probability estimates indicate that there is a 40 percent chance of a flood flow occurring that would equal or exceed the capacity of the normal pond decant (50-year) design, resulting in a flow from the emergency spillway during the active project life (25 years). The probability of a flood flow equalling or exceedinq the design capacity of the emergency spillway is 12 percent during the active project life. These probabilities increadse when the project life is increased to 35 years to include 10 additional years into the reclamation period.

There had been no failures of settling ponds or tailings pond structures in the existing Elk Valley mining area of British Columbia until settling pond failures occurred at one mine in the spring of 1986. These failures are discussed in Appendix 7. Because of the considerable differences in settling pond design between those that failed and those proposed by Sage Creek Coal Limited, it would be unreasonable, from the standpoint of design, to consider additional risk of failure of the proposed Sage Creek Coal Limited settling ponds in light of the failures at the existing operation.

A number of waste dump failures have occurred in the Elk Valley area. Although visual observations indicated that limited and short-term water quality deterioration occurred as a result of these failures, quantitative data on these effects were not collected. While geotechnical information and dump design data indicate some potential for dump failure at the proposed Sage Creek Coal Limited mine site, proper dump construction and management practices would be expected to significantly decrease the likdelihood of a failure. However, if a large enough failure of a proposed dump adjacent to Cabin or Howell Creeks were to occur, it would most likely cause a significant elevation of suspended solids in, as well as altering the geomorphology of, those creeks.

Conclusion

Table 6 of the text illustrates a comparison of effects predicted by the MDC with conditions set for approval-in-principle by the British Columbia government. The parameters that will tend to exceed the conditions for approval-in-principle as shown by Table 6 are soluble reactive phosphorus, temperature, and total suspended solids. Reduced nitrogen species may be of concern at locations of groundwater upwellings in Cabin and Howell Creeks.

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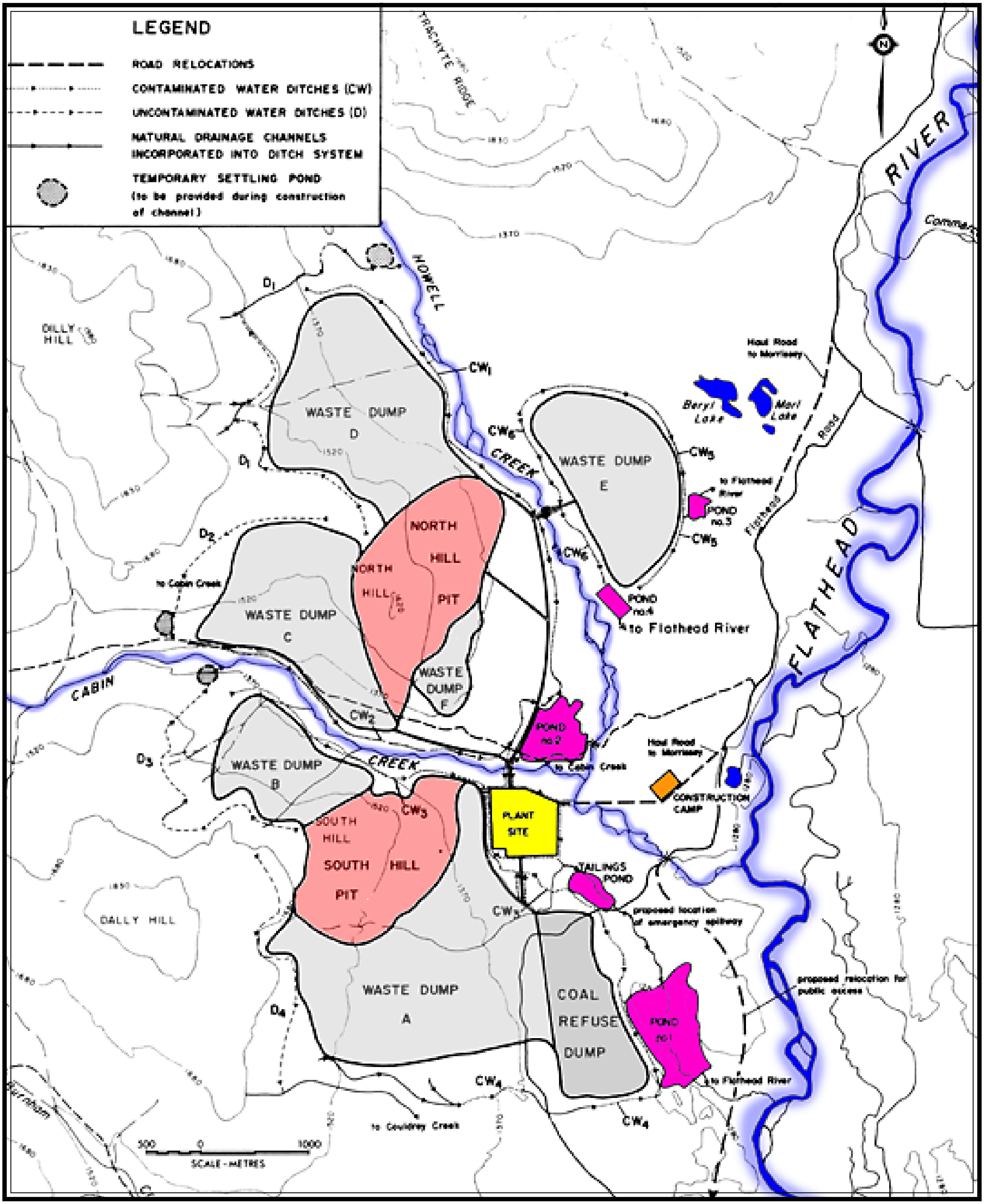
LEGEND
ROAD RELOCATIONS
CONTAMINATED WATER DITCHES (CW)
UNCONTAMINATED WATER DITCHES (D)
NATURAL DRAINAGE CHANNELS INCORPORATED INTO DITCH SYSTEM
TEMPORARY SETTLING POND
(to be provided during construction of channel)
TRACHYTE RIDGE
HOWELL CREEK
CABIN CREEK
FLATHEAD RIVER
DILLY HILL
DALLY HILL
WASTE DUMP D
WASTE DUMP C
WASTE DUMP B
WASTE DUMP A
WASTE DUMP E
WASTE DUMP F
NORTH HILL PIT
NORTH HILL
SOUTH HILL PIT
SOUTH HILL
COAL REFUSE DUMP
PLANT SITE
TAILINGS POND
POND no.1
POND no.2
POND no.3
POND no.4
CONSTRUCTION CAMP
Beryl Lake
Marl Lake
Haul Road to Morrissey
Flathead Road
to Flathead River
to Cabin Creek
to Couldrey Creek
proposed location of emergency spillway
proposed relocation for public access
SCALE - METRES
500 0 1000

Note. This map is optimized for printing. It will look terrible on your computer's monitor, but it will print nicely on a laser or inkjet printer. It's inserted into the PDF as a prescreened bilevel TIFF, as that provides the greatest compression.