Mile Post 7 West Ridge Railroad Relocation, Dam Extensions, and Stream Mitigation Project

Environmental Assessment Worksheet (EAW)

Appendix J9.a 1975-76 Final EIS

DNR Document Accessibility Acknowledgment

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DNR has pulled the specific 1975-76 Final EIS cited text and compiled Appendix J9.b. Alt-text is provided for each page to provide the specified content.

DRAFT ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY'S PROPOSED ON LAND TAILINGS DISPOSAL PLAN

Prepared by:
Barton-Aschman Associates, Inc.
Midwest Research Institute

Prepared for
State of Minnesota
- Department of Natural Resources
- Pollution Control Agency

October - 1975

ACKNOWLEDGEMENTS

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The time table for preparation of a Draft Environmental Impact Statement on a subject this complex is extremely demanding. It is very difficult for the consultant to perform the necessary research, field testing, laboratory analysis, calculations, and impact analyses without the generous and unselfish assistance of the client and other interested persons and agencies. A list of the organizations and persons contacted is in Part X of the EIS. Valuable input was received in data accumulation, synthesis and review of working papers. Barton-Aschman Associates and Midwest Research Institute wish to acknowledge the superb efforts of the individuals listed below.

RESERVE PROJECT TEAM

William Brice
David Brostrom
Karen Dingle
Ronald Hays
Manousos Katsoulis
Eldon Kaul
Arlo Knoll
Edward Moersfelder
James Newland
James Schoessler
Morris Sherman
Paul Zerby
Lock Collins
Bruce Waage

POLLUTION CONTROL AGENCY

For direct input:

Curtis Sparks, Water Quality

For comments and cooperation:

Gary Eckhardt
Tibor Kosa
Al Perez

DEPARTMENT OF NATURAL RESOURCES

For direct input:

Morris Eng, Glacial Geology and Soils
Jack Skrypek, Aquatic Habitat
Paul Egar, Water Quality

For comments and cooperation:

Elwood Rafn
Jerry Kuehn
David Vesall
Earl Lhotka
Robert Hance
Richard Myshak
Rodney Rowe
Eugene Hollenstein
Eugene Gere
Terry Lejcher
Lawrence Seymour
Al Pennell
Avonell (Vonny) Hagen
Robert Jackson
Ralph Morganwicke
Earl L. Kuehnast

U.S. CORPS OF ENGINEERS

St. Paul District
Richard F. Berry

EXECUTIVE SUMMARY

SUMMARY

INTRODUCTION

Reserve Mining Company has been processing taconite ore to produce iron pellets at Silver Bay, Minnesota since 1955. Reserve is jointly owned by Armco Steel Corporation of Middletown, Ohio and Republic Steel Corporation of Cleveland, Ohio. Reserve iron pellets presently supply about one-half of the total iron units processed by the parent companies, Armco and Republic.

Reserve currently mines about 30 million long tons of crude taconite ore annually at Reserve's open pit mine located in northeastern Minnesota near Babbitt. The taconite is hauled by rail 47 miles to processing facilities at Silver Bay, Minnesota, which is on the north shore of Lake Superior. These processing facilities have an annual production capacity of 10.7 million long tons of iron pellets. The total operating cost to be incurred in 1975 by Armco and Republic for Reserve's pellets is estimated to be $17.67 per long ton. These pellets, having a current price of $24.48 per long ton FOB Silver Bay, are shipped on the Great Lakes from Silver Bay to lower lake ports and then hauled by rail to Armco's and Republic's steel mills.

Armco and Republic have invested approximately $328 million in Reserve, with almost all borrowed funds. The communities of Babbitt and Silver Bay were originally built by Reserve. Reserve presently employs almost 3,000 persons that reside in Babbitt, Silver Bay and surrounding communities. Reserve is a major contributor to the economy of northeastern Minnesota with a payroll of $46.8 million and purchases in Minnesota of $36.8 million in 1974. Estimated Minnesota taxes payable by Reserve are $15.3 million for 1975.

In 1955, Reserve was the first mining company to place in operation large scale, commercial mining and processing facilities to produce iron pellets. These pellets are tailor made, blast furnace feed for making iron in steel mills. Today, Reserve produces about 25 percent and 17 percent of the pellets produced in Minnesota and the United States, respectively.

The waste product, called tailings, from Reserve's Silver Bay processing facilities have been and are presently discharged into Lake Superior at the rate of 21 million long tons annually or 64,400 tons daily.

This tailings discharge into Lake Superior has been the subject of concern and criticism since the original permits were granted by the State of Minnesota. Since 1969, when the U.S. Secretary of the Interior convened the Lake Superior Enforcement Conference, the tailings discharge into Lake Superior and particulate emission into the air from Reserve's Silver Bay processing facilities have been the subject of extensive public debate, administrative proceding and court litigation.

BACKGROUND

On April 20, 1974, the U.S. District Court for the District of Minnesota held that Reserve Mining Company's discharges of tailings into Lake Superior and particulate matter into the air at Silver Bay, Minnesota contained asbestiform fibers that endangered the health of people exposed to the discharges. The U.S. District Court ordered an immediate halt to the discharges. The U.S. Court of Appeals postponed the U.S. District Court's closure order until it could render a decision on the appeal of the matter after a full hearing. On March 14, 1975, the U.S. Court of Appeals held that Reserve Mining Company's discharges constituted a potential hazard to public health and ordered abatement of the discharges.

The U.S. Court of Appeals ruled that the decision on the location of an on-land tailings disposal site was to be governed by the laws and administrative procedures of the State of Minnesota. It further suggested that the selection of an on-land disposal site, if one could be found which was mutually acceptable to Minnesota and Reserve, be accomplished within one year. The U.S. Court of Appeals stated that if no acceptable site could be found, Reserve Mining Company would have one additional year in which to close its Silver Bay facilities.

Since 1969, Reserve Mining Company, the federal government and the State of Minnesota have investigated numerous alternatives to the present disposal of taconite tailings in Lake Superior. One of the alternatives studied was a disposal site near Mile Post 7 of Reserve Mining Company's railroad, approximately four miles southwest of Silver Bay. Before the U.S. Court of Appeals decision, Reserve Mining Company, in November 1974, submitted applications to the Minnesota Department of Natural Resources (DNR), and the Minnesota Pollution Control Agency (MPCA) for permits to construct an on-land tailings disposal facility at the Mile Post 7 site. Minnesota had previously agreed that it would give this site full consideration.

Following submission of the permit applications, the Minnesota Environmental Quality Council determined that an Environmental Impact Statement should be prepared for Reserve's proposed Mile Post 7 plan. On May 19, 1975, the Minnesota Environmental Quality Council designated the Department of Natural Reserouces and the Minnesota Pollution Control Agency as the agencies jointly responsible for the preparation of the Environmental Impact Statement.

This Draft Environmental Impact Statement has been prepared pursuant to the Minnesota Environmental Quality Council's designation of May 19, 1975 and is based upon the state's declaration of environmental policy found in Minnesota Statutes section 116D.02 which states, in part:

> "The legislature, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high density urbanization, industrial expansion, resources exploitation, and new and expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man, declares that it is the continuing policy of the state government, in cooperation with federal and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic and other requirements of present and future generations of the state's people."

It should be noted at the outset that the intent of the Draft Environmental Impact Statement is to provide disclosure and discussion of the probable impacts on the environment of a given action and reasonable alternatives to that action. The Draft Environmental Impact Statement is not intended to determine whether a given action should be permitted, but rather is intended to provide decision-makers and the public with relevant information so that they can consider the environmental constraints and opportunities of an action.

DESCRIPTION OF THE PROPOSED ACTION

To abate the discharge of taconite tailings into Lake Superior, Reserve has proposed the Mile Post 7 plan for on-land tailings disposal. The proposed site is located 4 miles west of Silver Bay as shown in the figure entitled Proposed Mile Post 7 Disposal Area. This plan as proposed by Reserve would have a tailings disposal capacity for 40 years of production. The taconite resources in Reserve's mine pit could last longer than 40 years. The plant also provides for modification of Reserve's Silver Bay facilities to produce 9.5 million annual long tons of improved pellets having an increased iron and reduced silica content.

The proposed Mile Post 7 disposal site is in the Thirtynine Creek Valley south of Lax Lake, more than 600 feet above Lake Superior. The fine tailings basin will cover 4.6 square miles and require the construction of four major dams. The largest of the dams is 12,600 feet long and 155 feet high while the smallest is 1,700 feet long and 85 feet high. All of the major dams are proposed to be constructed of coarse tailings. The coarse tailings storage and disposal area would cover 3.0 square miles. Structures such as dams, seepage catchment areas, stream diversions, pipelines, railroad spur and access roads will require an additional 1.5 square miles. A proposed buffer zone of 5.7 square miles will surround the tailings disposal area. The total proposed project area is 14.85 square miles.

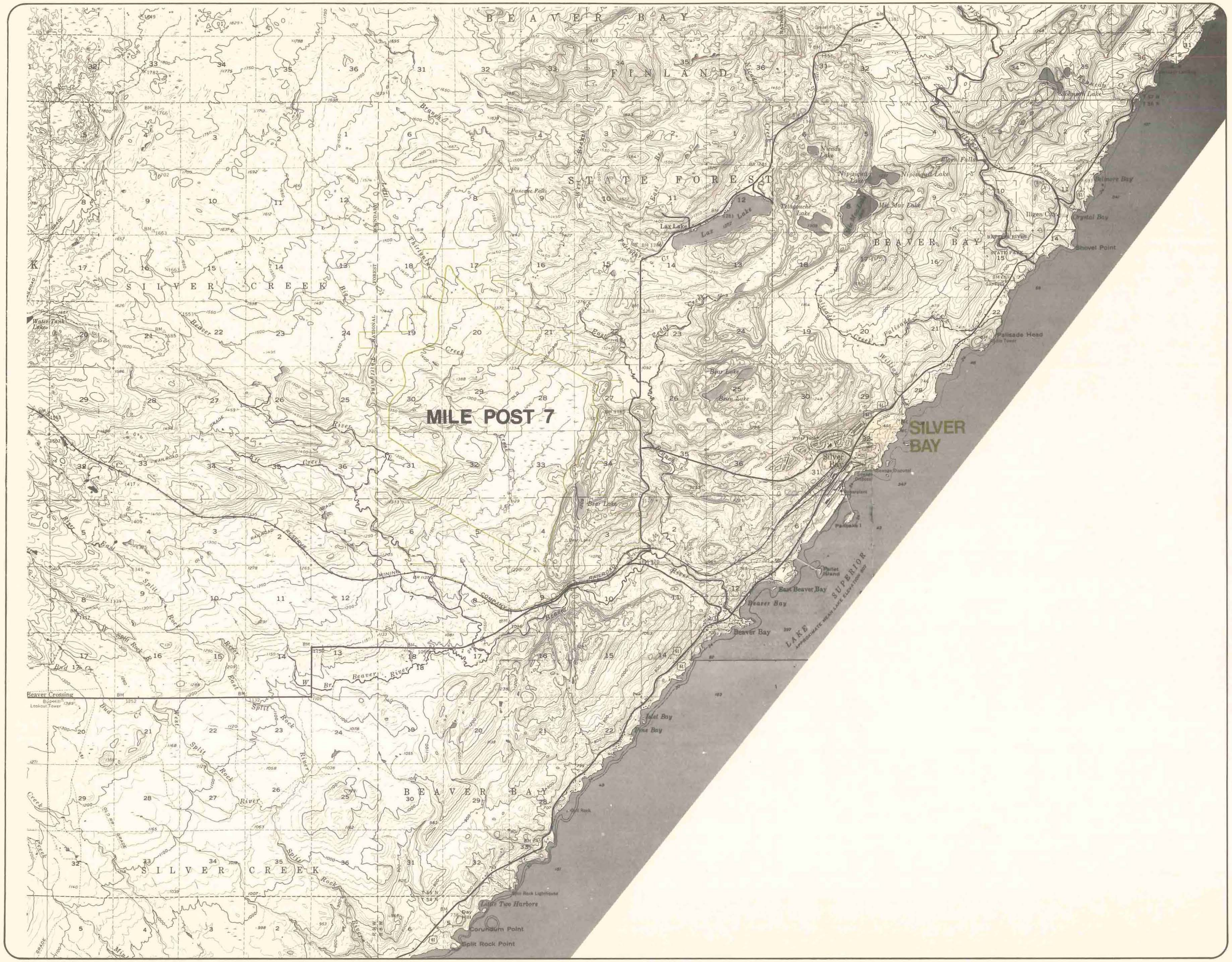
Reserve's proposed Mile Post 7 plan requires six stream diversions with the longest being 3,890 feet. These diversions will divert the flow of Big Thirtynine Creek, Little Thirtynine Creek, Bear Lake, unnamed creeks and other natural drainage areas. Seepage collection dikes or ditches are to be located downstream of all major dams to collect seepage and runoff from downstream dam slopes. All collected seepage would be pumped to the fine tailings basin.

Proposed modifications to Reserve's Silver Bay processing facilities include dry cobbing, flotation, screening, concentrate filtering, tailings filtering, and changes in use of power plant cooling water. With these modifications, Reserve would produce annually 6.6 million dry long tons of cobbed (gravel size) tailings, 2.0 million dry long tons of filtered (sand size) tailings, and 12.3 million dry long tons of fine (silt size) tailings. The filtered tailings could be dewatered to 10 percent moisture and then combined with the cobbed tailings. These coarse (cobbed and filtered) tailings would be conveyed to loading facilities and then rail hauled to the proposed Mile Post 7 site. The fine tailings would be dewatered to a 60 percent solids slurry and then pumped through a 39,000 foot long pipeline to the fine tailings basin. Another parallel pipeline will return water from the fine tailings basin to Silver Bay for use in Reserve's processing facilities.

Reserve's proposed Mile Post 7 plan would require the construction of about 8.5 miles of access and maintenance roads. Reserve proposed to construct these roads of coarse tailings. Power transmission and communication lines would be located along the fine tailings pipeline right-of-way and Reserve's railroad right-of-way, respectively.

Proposed modifications to Reserve's power plant include the direct discharge of 106,109 gallons per minute of non-contact heated water to Lake Superior through a diffuser pipe located on Beaver Island. The remaining water would be used in the process water system. Power plant fly ash would be mixed with the fine tailings and disposed of in the fine tailings basin.

Reserve proposes to stabilize the tailings delta which currently extends into Lake Superior. Mine stripping rock would be used to construct a 5,100 foot long breakwater between Beaver Island to the west and a rock point to the east.



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

PROPOSED MILE POST 7 DISPOSAL AREA

BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

Reserve's proposed Mile Post 7 plan is estimated by Reserve to require an investment of $221 million in facilities and land. The estimated total operating cost incurred ranges from $19.17 to $21.37 per long ton of pellets, depending on the method of capital funding. With this plan, Reserve would produce 9.5 million long tons of improved pellets. Using these improved pellets, with a higher iron and lower silica content than Reserve's present pellets, will result in an additional annual economic benefit to Armco and Republic of approximately $25.6 million, due to savings in iron making in their blast furnaces.

ALTERNATIVE SITES SELECTION

The State of Minnesota guidelines for the preparation of an Environmental Impact Statement (EIS) require "an objective evaluation of all reasonable alternatives to the action and the environmental impact of each."

Alternatives to Reserve's proposed Mile Post 7 plan were divided into four classifications:

1. Continuation of tailings discharge to Lake Superior.
2. Development of by-product uses and markets for tailings.
3. Termination of Reserve Mining Company operations.
4. Deposition of tailings at some on-land site other than Reserve's proposed Mile Post 7 site.

The continuation of tailings discharge into Lake Superior, or the status quo alternate, has been rejected by the states of Minnesota, Wisconsin and Michigan, the federal government, various environmental groups and the courts. Thus, alternatives requiring tailings disposal in Lake Superior were not considered in this EIS.

The development of by-product uses and markets for tailings, although possibly feasible for small quantities of the tailings, was rejected because:

1. Based on past studies and current usage of tailings in construction, it appeared unlikely that more than a small portion of Reserve's tailings could economically be utilized in construction markets.

2. Given the concern for the asbestiform fiber content of Reserve's tailings and economic uncertainties, the large scale use of tailings as a by-product should and would probably be viewed with many reservations.

Termination of Reserve's operations was viewed in this EIS as a decision that is properly left to Reserve Mining Company and its parent companies, Armco Steel Corporation and Republic Steel Corporation. Based on previous court decisions, administrative proceedings, and the economic analysis in this EIS, termination does not represent a prudent long term solution for Reserve and its parent companies.

Sites historically considered for on-land tailings disposal by Reserve Mining Company, state and federal agencies and their respective consultants, are presented in the Review of On-Land Disposal Site figure. These sixteen alternative sites include:

Site 1 Bluebill Lake
Site 2 Sawmill Creek
Site 3 Split Rock River
Site 4 Gooseberry River
Site 5 Nip Creek
Site 6 Kit Creek
Site 7 Isabella River
Site 8 Palisades
Site 9 Lax Lake
Site 10 Toimi Creek
Site 11 Mine Site
Site 12 Snowshoe
Site 13 Ridgepole Creek
Site 14 Colvin
Site 15 Embarrass
Site 16 Midway

Of the sixteen alternative sites reviewed, eleven alternative sites were rejected. The Bluebill Lake, Nip Creek and Isabella River (Sites 1, 5 and 7) sites were not given further consideration since the cost of constructing and operating a railroad or pipeline to these sites would be prohibitive and unreasonable based on professional judgment. The Palisades and Lax Lake (Sites 8 and 9) sites were not considered in detail since the Department of Natural Resources has concluded that, if only the north shore sites of Palisades, Lax Lake and Mile Post 7 are compared, Mile Post 7 has the least environmental impact. The Sawmill Creek, Split Rock River, Gooseberry River, Kit Creek, Toimi Creek and Ridgepole Creek (Sites 2, 3, 4, 6, 10 and 13) sites were not given further consideration since the sites have inadequate tailings disposal capacity for a forty year period and would require expansion of the tailings basin to cover existing roadways and rail lines and/or would require excessively high retaining dams.

As a result of this review and preliminary assessment, the five alternative sites selected to be further considered were:

Site 11 Mine Site - in Reserve's Peter Mitchell Mine pit near Babbitt.

Site 12 Snowshoe - approximately 7 miles southeast of the mine pit and along the Reserve railroad.

Site 14 Colvin - approximately 4 miles southeast of the mine pit and along the Reserve railroad.

Site 15 Embarrass - approximately 1 mile northwest of the mine pit.

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

ON-LAND DISPOSAL SITES PREVIOUSLY CONSIDERED

BARTON-ASCHMAN ASSOCIATES, INC.

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Site 16 Midway - approximately 20 miles southeast of the mine pit and along the Reserve railroad.

Four of these sites are located in the Babbitt vicinity, while one site, Midway, is located approximately halfway between Babbitt and Silver Bay. All of these alternative sites except Midway would require relocation of a major portion of the taconite processing facilities to a location adjacent to the tailings basin. For the Midway alternative, facilities could be relocated to the site or the tailings could be transported to the site in a manner similar to that for the proposed Mile Post 7 plan.

ALTERNATIVES

The Embarrass Alternative

The location of the Embarrass alternative is shown in the figure entitled Alternative Tailings Basin Sites Evaluated. Utilizing the Embarrass alternative requires the construction of new processing facilities at the site to produce iron concentrate. The concentrate would be transported in insulated rail cars to Silver Bay, where it would be pelletized. The Embarrass alternative would require 16.9 square miles of land for new processing facilities, tailings basin, and related disposal facilities.

The new facilities would be constructed on the northeast-southwest trending ridge which would also form the southern boundary of the tailings basin. The tailings basin site would cover 7.5 square miles in the upper Embarrass River watershed, which is tributary to the St. Louis River. The tailings basin requires dams along the north and westerly limits totaling 68,300 feet in length. The dams would be constructed using coarse tailings. Coarse tailings not used in dam construction would be placed in the tailings basin along with the fine tailings. The seepage collection system would consist of an intercepting ditch and dikes to collect water that seeps through the dams and runs off from the outside dam slopes. All collected seepage would be pumped to the tailings basin.

Construction required at the Embarrass site includes a railroad spur, rail car dumping facility, fine crushing, dry cobbing, concentrating, concentrate filtering, concentrate loading, tailings disposal, and related service facilities. Construction required at Silver Bay includes new concentrate unloading and handling facilities. In addition to these, an electrical transmission line would be constructed between Reserve's power plant at Silver Bay and the Embarrass alternative access road, approximately 3/4 mile long, would be constructed to the Embarrass alternative. Reserve's existing mining and coarse crushing facilities at Babbitt and the pelletizing, stockpiling, and shiploading facilities at Silver Bay would not require modification.

The new facilities at the Embarrass alternative would have a production capability of 10.7 million long tons of pellets annually to match the existing Silver Bay pelletizing plant. The concentrating process for the new concentrator at the Embarrass alternative would be essentially the same as proposed for Silver Bay in the proposed Mile Post 7 plan. However, the new concentrator would have only 10 parallel concentrating circuits rather than the 22 parallel concentrating circuits at Silver Bay. These new facilities would produce annually 7.0 million dry long tons of cobbed tailings, 2.4 million dry long tons of filtered tailings and 14.4 million dry long tons of fine tailings. The cobbed and dewatered filtered tailings would be trucked to the tailings basin for use in dam and road construction or placed in the basin. The fine tailings would be dewatered to a 50 percent solids slurry and then discharged directly into the basin by gravity flow. In addition to the process water returned from the tailings basin, process make up water could possibly be obtained from Reserve's mine pit or Birch Lake.

The estimated new investment required for the Embarrass alternative is \$391 million in facilities and land for an annual capacity of 10.7 million long tons of pellets. The total operating cost incurred is estimated to range from \$19.55 to \$22.57 per long ton of pellets, depending on the method of capital funding. When compared to Reserve's present pellets, using these improved pellets will result in an additional economic benefit of approximately \$28.8 million annually to Armco and Republic.

The Colvin Alternative

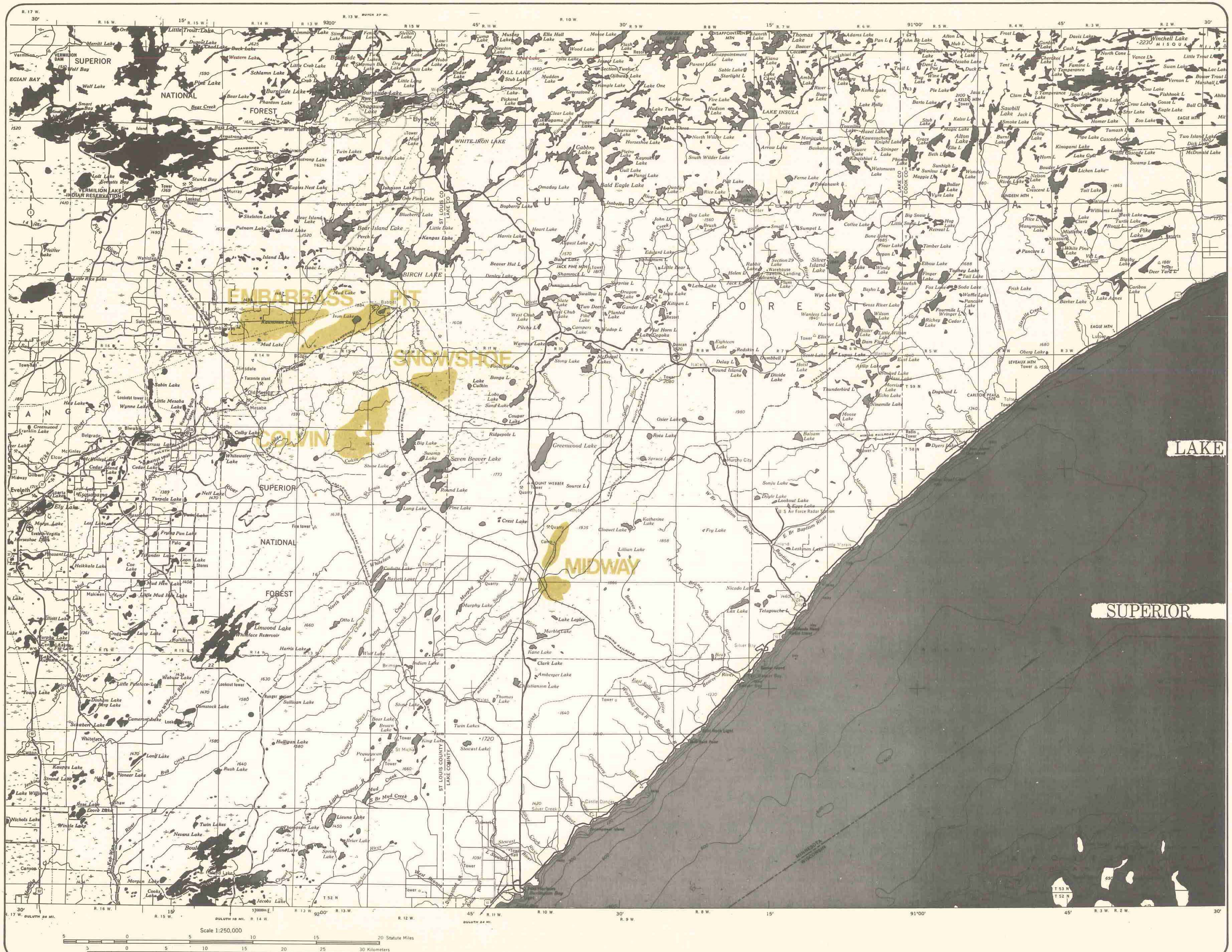
The location of the Colvin alternative is also shown in the Alternative Tailings Basin Sites Evaluated figure. Utilization of the Colvin alternative requires the construction of new facilities similar to those required for the Embarrass alternative.

The Colvin alternative would require a land area of 21.2 square miles for the tailings basin and new facilities. The new Colvin plant facilities would be located on the ridge at the north end of the tailings basin. The tailings basin would cover 12.3 square miles of the upper Partridge River watershed which is tributary to the St. Louis River. Dams totaling 62,600 feet in length would be constructed along the southern and western limits using coarse tailings. Use of the Colvin site requires diversion of the outlet of Big Lake and a portion of the watershed in the southeastern part of the basin. An intercepting ditch and dikes would be required to collect seepage through the dams and runoff from the outside dam slopes. This collected seepage would be pumped to the tailings basin.

The pellet production, estimated new investment and operating cost, and economic benefits to Armco and Republic would be approximately the same as for the Embarrass alternative.

The Snowshoe Alternative

The location of the Snowshoe alternative is shown in the Alternative Tailings Basin Sites Evaluated figure. Utilization of the Snowshoe al-



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

ALTERNATIVE TAILINGS BASIN SITES

BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

ternative requires the construction of new facilities similar to those required for the Embarrass alternative.

The Snowshoe alternative requires 11.5 square miles of land area for the tailings basin and new facilities. The new facilities would be constructed on a small ridge southwest of the tailings basin. The basin would cover 5.0 square miles, principally in the Dunka River watershed which is tributary to Rainy River. A dam constructed of coarse tailings would be required around the entire basin perimeter, totaling 53,000 feet in length. Seepage through the dam and runoff from the outside dam slopes would be collected by an intercepting ditch and dikes and pumped to the basin.

For the Snowshoe alternative, the pellet production, estimated new investment and operating cost, and economic benefits to Armco and Republic would be approximately the same as the for Embarrass alternative.

The Midway Alternative

Prior to undertaking extensive field studies, a review of the Midway alternative was made to determine the relationship of this alternative to other Reserve operations. Based on this review, it appeared that the Midway alternative would not offer any significant advantages to the public over a site near Babbitt (Embarrass, Colvin and Snowshoe), nor did it appear to offer an advantage to Reserve since operations would be divided into three geographic areas rather than two, and capital and operating costs would be greater than for Reserve's proposed Mile Post 7 plan. Thus, it was decided that a major effort would not be expended evaluating the Midway alternative. Although no longer considered, the alternative presented by the Midway site should remain open in case an agreement cannot be reached on any of the other sites during the decision-making process.

The Mine Site Alternative

A detailed analysis was made of the mine site alternative, examining the effect of placing all or a portion of the tailings in the mine pit. As a result of the analysis, it was concluded that immediate disposal of all tailings in the pit is not feasible. It was also determined to be unreasonable to dispose of excess coarse tailings (from the dam construction process) in the pit at this time. However, in 35 years, approximately 140 million long tons of tailings could be disposed of in the mine pit, increasing the life of a nearby tailings basin by 6.6 years. Implementation of this alternative would result in loss of nearly 60 million long tons of taconite ore, loss of blending flexibility in mining operations to provide a uniform feed to the processing facility, economic losses to Reserve and its parent companies, and tax losses to state governmental units as well as the federal government. It was therefore concluded that it was presently neither economical nor practical to use the mine pit for disposal of tailings.

SUMMARY TABLES

Tables A and B provide a summary of the design elements and industrial economic considerations, respectively. They provide a means of comparing the proposed Mile Post 7 plan and the three alternatives evaluated; Embarrass, Colvin and Snowshoe.

TABLE A
COMPARISON OF DESIGN ELEMENTS

	Mile Post 7	Embarrass	Colvin	Snowshoe
-Natural Pellet Production Capacity in Long Tons Per Year	9,500,000	10,700,000	10,700,000	10,700,000
-Percent Increase in Natural Iron Content	3.6	3.9	3.9	3.9
-Percent Decrease in Natural Silica Content	3.5	3.5	3.5	3.5
-Cobbed Tailings in Dry Long Tons Per Year	6,598,000	6,975,000	6,975,000	6,975,000
-Filtered Tailings in Dry Long Tons Per Year	2,042,000	2,394,000	2,394,000	2,394,000
-Fine Tailings in Dry Long Tons Per Year	12,250,000	14,410,000	14,410,000	14,410,000
-Tailings Disposal Area Cleared in Square Miles	7.6	7.49	12.34	4.98
-Additional Cleared Areas and Areas Proposed for Structures in Square Miles	1.54	3.44	3.22	3.68
-Buffer Zone Not Cleared in Square Miles	5.71	5.92	5.60	2.8
-Total Project Area in Square Miles	14.85	16.85	21.16	11.46
-Length of Dams in Feet	22,320	68,300	62,600	53,000
-Number of Diversions	6	0	1	0
-Length of Pipeline Corridor in Feet	28,000	1,000	1,000	5,000
-Length of Access Roads in Feet	4,000	4,000	1,000	15,000
-Length of Major Railroad Corridors in Feet	29,000	21,000	12,000	14,000
-Estimated Construction Period in Months*	36	48-52	48-52	48-52

* Other time factors such as land acquisition may control the implementation period.

TABLE B
COMPARISON OF INDUSTRIAL ECONOMIC CONSIDERATIONS

	Mile Post 7	Embarrass	Colvin	Snowshoe
-Capital Funding Required	$221,106,000	$390,818,000	$390,818,000	$390,818,000
-Present Discounted Value of Added Capital Cost of Alternatives with Allowance for Extra Production Capacity		$ 65,000,000	$ 65,000,000	$ 65,000,000
-100% Debt Financing Feasibility	Likely in a favorable market	Possible in a very favorable market	Possible in a very favorable market	Possible in a very favorable market
-Current Pellet Price, FOB Silver Bay Per Long Ton of Pellets	$26.18	$26.32	$26.32	$26.32
-Range of Total Operating Cost Per Long Ton of Pellets	$19.17-$21.37	$19.55-$22.57	$19.55-$22.57	$19.55-$22.57
-Rate of Return on Investment	22.3%-27.6%	17.3%-23.3%	17.3%-23.3%	17.3%-23.3%
-Present Value of Accumulated Net Cash Flow After Loan Repayment	$414,837,000	$441,551,000	$441,551,000	$441,551,000
-Advantage of Silica Reduction Per Annum	$ 25,600,000	$ 28,800,000	$ 28,800,000	$ 28,800,000

PROBABLE ENVIRONMENTAL IMPACTS

A determination of probable impacts requires a knowledge of the existing environment. The existing environmental setting is described in Part III of the Draft Environmental Impact Statement. This setting is used as a basis for superimposing the effects of actions that would occur, in order to arrive at a determination of probable environmental impacts.

Table C provides a summary comparison of probable environmental impacts. This comparison of environmental impacts is intended to summarize some of the impacts discussed in detail in Part IV of the Draft Environmental Impact Statement. In order to fully understand the probable impacts, reference should be made to Part IV. Table C is not intended to be a substitute for that which is presented in Part IV, but rather is a summary compiled through professional judgment to provide a general understanding and evaluation of selected probable impacts.

The organizational sequence of the impacts presented in Table C is in the same general order as discussed in the Draft Environmental Impact Statement. The sequence in which the impacts are presented is not a priority sequence, but rather is by environmental component or discipline. The components studied in depth in the preparation of the Draft Environmental Impact Statement included, climatology, bedrock geology, mineral potential, glacial history and soils, landforms, hydrology, water quality, aquatic habitat and biota, terrestrial habitat and biota, socioeconomics, land use, recreation, transportation, utilities, aesthetics, air quality, noise and energy.

TABLE C
COMPARISON OF ENVIRONMENTAL IMPACTS

	Mile Post 7	Embarrass	Colvin	Snowshoe
-Potential for Mineral Resources (Ranking from Highest to Lowest)	2 (low or remote)	2	1 (high)	1
-Conflicts with Potential Mineral Resource Recovery	No	No	Yes	Yes
-Potential Loss of Peat Resource in Square Miles	0	0	0	6
-Modification of Significant Landform	3 miles of East Ridge and one 20 foot waterfall	4.5 miles of Giants Ridge	No	No
-Miles of Streams Lost	9.7	5.4	13.0	2.3
-Acres of Lakes Lost or Affected	39	20	0	0
-Uncollected Seepage During Operation (gpm)	180	500	100	75
-Potential for Turbidity Increase from Stream Diversion	Yes	No	Yes	No
-Potential for Water Temperature Increase	Yes	No	Yes	No
-Potential Water Quality Impact from Pipeline Breakage Based on Number of Stream Crossings and Pipeline Length	Yes	No	No	No
-DNR Designated Trout Streams Affected	Yes	No	No	No
-Tolerance of Aquatic Habitat to Change in Water Quality (Ranking Low to Moderate)	1 (low)	2 (moderate)	2	2
-Acres of Habitat Lost Through Clearing of Land and	5,850	6,995	5,888	4,371
Relative Quality of Habitat (Ranked Highest to Lowest)	2	3 (lowest)	1 (highest)	No Data
-Construction Jobs Created	500-1,000	1,000-1,500	1,000-1,500	1,000-1,500
-Operation Jobs Affected	50-100	450-480	450-480	450-480
-Estimated State and Local Taxes Payable by Reserve Over 40 Year Life in Millions	$537-559	$597-631	$594-631	$597-631
-Estimated Federal Taxes Payable by the Parent Companies Over 40 Year Life in Millions	$678-770	$814-940	$814-940	$814-940
-Potential Conflict with Consolidation of Manageable Regional Land Use Activities (Ranking Highest to Lowest)	1 (highest)	3 (lowest)	2	2
-Acres of Public Land Lost	4,420	1,600	11,624	6,732
-Miles of State Designated Hiking and Snowmobile Trails Lost or Relocated	3.9	0	0	2.6
-Miles of Non-State Designated Trails Lost or Relocated	8.1	5.0	15.0	16.8

	Mile Post 7	Embarrass	Colvin	Snowshoe
-Adjacent Recreational Areas Which May Be Adversely Affected	Tetagouche State Park (proposed) Split Rock State Park (existing) Baptism River State Park (existing) Lake County Recreation Area (proposed) Silver Bay Golf Course (existing)	None	Seven Beaver Recreation Area (proposed)	Seven Beaver Recreation Area (proposed)
-Maximum Total Daily Transportation Cost During Operation (Employee Travel Only)	$160	$2,055	$1,670	$1,720
-Frequency of Visual Impact (Ranking from Highest to Lowest)	1 (highest)	2	4 (lowest)	3
-Increase in Suspended Particulates in $\mu g/m^3$ During Construction*,**	29	13	14	23
-Air Quality (Total Suspended Particulates) in $\mu g/m^3$ During Construction*,***	59	58	59	68
-Increase in Suspended Particulates in $\mu g/m^3$ During Operation*,**	15	13	15	17
-Air Quality (Total Suspended Particulates) in $\mu g/m^3$ During Operation*, ***	45	58	60	62
-Number of Structures Projected to Experience Major Noise Impact During Operation	0	2	0	0
-Total Annual Energy Requirements in Equivalent BTU's	$21,025 \times 10^9$	$22,787 \times 10^9$	$22,627 \times 10^9$	$22,670 \times 10^9$
-Energy Required Per Long Ton of Taconite Pellets Produced in Equivalent BTU's	2,213,158	2,129,626	2,114,673	2,118,692

* Total Suspended Particulate concentration estimates are at Silver Bay for Mile Post 7 and at Babbitt for Embarrass, Colvin and Snowshoe. The estimates do not include mitigating measures.

** The non-degradation increment of 10 $\mu g/m^3$ has been proposed by the U.S. Environmental Protection Agency.

*** Primary and Secondary Air Quality Standards are 75 $\mu g/m^3$ and 60 $\mu g/m^3$, respectively.

While every effort was made to make Table C self-explanatory, the impacts noted may be more clearly understood with the following explanations:

Modification of Significant Landforms

The 4.5 miles of Giants Ridge that would be affected by using the Embarrass alternative is being utilized in a similar fashion by other mining companies. Erie Mining Company, for example, is presently operating a tailings basin using the Giants Ridge directly west of the Embarrass alternative.

Uncollected Seepage During Operations

The values of uncollected seepage for the Embarrass and Colvin alternatives assume that these 2 cell tailings basin alternatives would be developed and operated sequentially. If the East and West Embarrass or North and South Colvin cells were operated simultaneously, the uncollected seepage during operations would be 1000 and 200 gallons per minute, respectively.

Potential Water Quality Impact from Pipeline Breakage Based on Number of Stream Crossings and Pipeline Length

The proposed Mile Post 7 plan would require several miles of pipeline to be constructed cross-country between the Silver Bay plant and the proposed Mile Post 7 tailings basin. This pipeline must also cross one stream. Failure would result in the potential discharge of tailings outside of either the plant facility or the tailings disposal area. At the remaining sites discharge of tailings due to pipeline ruptures would either flow into the tailings basin or return to the plant facility.

Operation Jobs Affected

With the proposed Mile Post 7 plan, according to Reserve, employment will increase slightly presumably for operating and maintaining the tailings basin. If this statement by Reserve does not include the presumed reduction in manpower to operate the modified concentrator, then a net labor force reduction may result.

At the Embarrass, Colvin and Snowshoe alternatives, approximately 450 to 480 employees are expected to be required to operate and maintain the on-land tailings disposal system and new concentrator/fine crusher facilities. In the short term, it is assumed that most affected employees at the Silver Bay operation would follow their jobs to the new site by daily or weekly commuting.

Estimated State Taxes Payable by the Parent Companies Over 40 Year Life and Estimated Federal Taxes Payable by the Parent Companies Over 40 Year Life

The tax estimates are higher at the Embarrass, Colvin and Snowshoe alternatives because there would be an additional pellet production capacity above the proposed Mile Post 7 plan of 1.2 million long tons per year.

Potential Conflict with Consolidation of Manageable Regional Land Use Activities

In the absence of established, stated, comprehensive and coordinated public land use policy, one regional land use planning principle that appears to be emerging is to minimize potential conflicts by encouraging the consolidation of manageable land use activities. Applied, this principle supports the consolidation of mineral processing and industrial activities adjacent to existing concentrations and supports the protection of major recreational areas and corridors.

Maximum Total Daily Transportation Cost During Operation

Transportation costs for the proposed Mile Post 7 plan are based on total automobile travel similar to the existing operation. For the Embarrass, Colvin and Snowshoe alternatives, transportation costs are based on a maximum condition where all employees working in a new Babbitt facility would commute. The transportation mix assumes 75% bus and 25% automobile travel. The cost of transportation to employees could be reduced through the implementation of a company supported transportation system.

Frequency of Visual Impact

The aesthetic impacts are, in part, based on a computer analysis that determined which areas of the tailing basins would be visible from existing cultural features including roads, developed areas, lakes and streams.

HEALTH ISSUES

It has been determined by the U.S. District Court that Reserve Mining Company's discharges into Lake Superior and into the air at Silver Bay contain asbestiform fibers and that the ingestion and inhalation of these fibers constitutes a health hazard. The U.S. Court of Appeals held that the discharges were potentially hazardous to health. Both Courts required the abatement of the discharges. Further, there is no known safe exposure level to asbestos fibers.

In view of the above, the preparation of this Draft EIS proceeded on the assumption that exposure to asbestiform fibers constitutes a potential health hazard. No reevaluation of this assumption was sought or attempted.

Reserve's proposed Mile Post 7 plan or any of the alternatives evaluated have public health implications in the areas of water and air contamination. There are four areas of potential contamination:

1. Pipeline rupture.
2. Air borne dust.
3. Uncollected seepage.
4. Uncollected runoff at the end of operations.

The degree to which asbestiform fibers represent a significant impact on public health is dependent on the use and effectiveness of mitigating measures starting with the design of the disposal facilities and continuing through management of these facilities during and after operations. In addition, continuous monitoring is necessary to judge the effectiveness of the measures adopted.

The impacts summarized in Table C do not include measures that could be taken to reduce the effect of the adverse impacts. Suggested mitigating measures are presented in Part V of the Draft Environmental Impact Statement. However, it should be recognized that all asbestiform fibers cannot be kept out of the waters and the air surrounding the proposed Mile Post 7 site or the alternative sites. This is inherent in on-land disposal of Reserve Mining Company's tailings.

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LIST OF ABBREVIATIONS

ARDC:	Arrowhead Regional Development Commission
BWCA:	Boundary Waters Canoe Area
DNR:	Minnesota Department of Natural Resources
EBI:	Effective Buying Income
EIS:	Environmental Impact Statement
EPA:	United States Environmental Protection Agency
IECO:	International Engineering Company
LTPH:	Long tons per hour
MEQC:	Minnesota Environmental Quality Council
MLMIS:	Minnesota Land Management Information System
MPCA:	Minnesota Pollution Control Agency
NEPA:	National Environmental Policy Act of 1969
NPDES:	National Pollution Discharge Elimination System
SCORP:	State Comprehensive Outdoor Recreation Plan, 1974
SMSA:	Standard Metropolitan Statistical Area
TSP:	Total Suspended Particulates
WPC:	Water Pollution Control Regulation

PART I

BACKGROUND AND APPROACH TO THE EIS

INTRODUCTION

The Minnesota Environmental Policy Act[1] is one of the many state level legislative actions inspired by the passage of the National Environmental Policy Act of 1969 (NEPA). The Minnesota Act parallels the National Act closely in requiring environmental considerations to be objectively assessed and presented to inform the public and form a basis for sound decision-making.

The Minnesota Environmental Quality Council (MEQC) has the authority to prescribe Environmental Impact Statement (EIS) regulations.[2] The purpose and intent of the MEQC EIS regulations are:

1. To provide uniform guidelines for the preparation and review of Environmental Impact Statements;
2. To insure the EIS is a disclosure document that encourages the consideration of environmental effects in planning an action; and
3. To prevent the EIS process from becoming a justification mechanism.[3]

DETERMINATION THAT AN EIS IS REQUIRED

MEQC's regulations require that an EIS be prepared for a private action when the MEQC determines that a proposed action:

1. is a major action;
2. is a private action of more than local significance; and
3. has the potential for creating significant environmental effects.[4]

The MEQC determined on December 10, 1974 that the Reserve Mining Company proposal to dispose of taconite tailings on-land near Mile Post 7 is an action which requires the preparation of an EIS.[5]

DESIGNATION OF RESPONSIBLE AGENCIES

Following this determination it was necessary for the MEQC to designate the agency or agencies responsible for preparation of the EIS. The MEQC resolved that the Department of Natural Resources (DNR) and the Minnesota Pollution Control Agency (MPCA) be designated as joint responsible agencies. MPCA and DNR were formally notified of the MEQC's designation on May 19, 1975.[6]

DRAFT EIS PREPARATION

An ad hoc group called the Reserve Project Team was formed to coordinate the State of Minnesota's work on Reserve's permit applications and on the preparation of the EIS. The Reserve Project Team consists of consultants and lawyers from the private sector and professional interdisciplinary personnel and lawyers from various state agencies. The Draft EIS has been prepared by private consultants with the assistance of the Reserve Project Team. DNR and MPCA retained responsibility for the EIS preparation and the decision on the issuance of permits applied for by Reserve.

FINAL EIS

After the Draft EIS is completed and filed with MEQC, a public hearing must be held to give concerned citizens and groups an opportunity to comment on the Draft EIS. The hearings on the Draft EIS will be incorporated into the permit hearings which commenced on June 2, 1975. The record must remain open for comment for a period of not less than 45 days, nor more than 90 days after completion of the Draft EIS. A Final EIS, containing the comments or summary of comments made and a response to significant environmental issues raised, must be prepared and filed with the MEQC by the responsible agencies not later than 30 days after the closing date for comment on the Draft EIS. Submission of the Final EIS initiates the MEQC's final review process. When the MEQC has determined the Final EIS is adequate, the EIS process is complete. The Final EIS is to precede final decisions on the proposed action and is to be included in an administrative review process.[7]

APPROACH TO THE DRAFT ENVIRONMENTAL IMPACT STATEMENT PREPARATION

This Draft EIS is intended to provide information on a specific proposal made by Reserve Mining Company and identified in this report as the proposed Mile Post 7 plan. The formulation of this document was preceded by several significant stages.

THE EIS FRAMEWORK

Prior to beginning actual field studies and data analysis, a framework was developed in order to guide the investigative effort and establish objectives, to provide information that would be of use to the reviewer, and to present that information in a logical sequence in the report itself. There are six basic elements in this framework:

1. *Identification and Detailing of the Proposed Action.* The plan proposed by Reserve to convert its present discharge of tailings into Lake Superior to an on-land site is complex and many resources of the North Shore area could potentially be affected. To isolate, identify and describe the expected impacts, one needs to know the entire project in as much detail as possible.

2. *Description of the Existing Environment.* Determination of the magnitude of the impact expected (both positive and negative) is dependent upon a knowledge of the existing environment. Once the entire project is understood, the proper range of environmental considerations or areas of concern can be established. Once they are established, a data base is developed for each from existing literature or field work. It is this data base which represents a profile of the important features of the existing environment.

3. *Determination of Impact.* Once the data characterizing the existing environment has been collected, methods of analysis are selected. The analyses essentially superimpose the effects of the proposed actions onto individual environmental considerations to arrive at a qualitative and/or quantitative determination of impact.

4. *Mitigation of Adverse Impact.* Once the magnitude of the impacts is known, it is a principal function of the EIS to re-examine the proposed actions and to single out those which will create adverse impacts which cannot be avoided. While they cannot be avoided, it may be possible that they can be mitigated given sufficient flexibility in design and an understanding of the desired environmental objective.

5. *Determination of the Significance of Impacts.* If an impact cannot be mitigated, and, often, even if it can be, the EIS process includes some judgment on the part of professionals in each area of concern as to the significance of the probable impacts. These impacts may constitute an irreversible or irretrievable commitment of a resource. Also, an impact may represent an implicit short-term use of the environment to the detriment of its long-term productivity.

6. *Exploration of Alternatives.* Given a knowledge of the environmental impacts, their significance, and the possible mitigating measures for each, the wisdom of the particular course of action proposed in its entirety may be questioned. For this reason, the EIS presents an objective evaluation of reasonable alternatives to the proposed action. The environmental impacts of alternatives are analyzed and measures of impact comparable to those of the proposed action are presented in summary form, usually a matrix. From the information presented, decisions can be made as to which alternative (if any) is preferable to the one proposed. If the proposed action or the alternatives are not found acceptable, the EIS also considers the impact of the status quo or do nothing alternative.

THE EIS STUDY DESIGN

Court testimony, Reserve documents and scientific and other published technical and general literature were reviewed during late May and early June of 1975. Engineering consultants to the Reserve Project Team toured Reserve's existing mining and processing operations during late June. From notes taken on these tours and from the other available written materials, the basic features of the proposed Mile Post 7 plan were extrapolated. Where gaps in information became evident, questions were addressed to Reserve Mining Company and its consultants.(8)(9)

Concurrent with this effort, reference files were also compiled on the history of the tailings disposal problem including all known operational and locational alternatives explored to this time. Responsiveness to the major concerns historically expressed was an objective of each work area team. The work teams could be broadly divided into two groups:

1. Those concerned with determining reasonable alternatives and developing the preliminary feasibility studies necessary to permit impact evaluation.

2. Those concerned with the analysis of environmental impact of the proposed Mile Post 7 plan and any alternative concepts generated.

Impact investigations, extending to the middle of July, were then carried out at each site (Mile Post 7 and alternatives) using the following generalized format:

1. *Site Reconnaissance.* Preliminary reconnaissance was conducted by helicopter and ground inspection to determine the basic features of each site and access to the sites.

2. *Identification of Existing Data.* From the reference files developed previously, each work area began to integrate existing data available from local, regional and national sources. This material was made available to the various consultants; consultants requested or referenced other literature. Many sources provided necessary reference information for the final stages of writing.

3. *Determination of Measures of Impact.* A matrix was developed to include a comprehensive list of actions that would occur and the expected impacts. Each consultant involved in the preparation of materials for the EIS was asked to expand upon the lists of probable actions and impacts and to develop measures by which critical impacts at Mile Post 7 and alternative sites could be quantified and compared.

4. *Team Approach.* The various consultants carried out their studies including (a) reviewing existing data, (b) carrying out field work to provide needed information, (c) describing ecological processes operating on the site, and (d) predicting impacts that will affect organisms, environmental factors, ecological processes, and human, social and cultural activities because of the project. In this latter regard, they were also asked to suggest ways to minimize any negative impact and/or suggest ways to convert impacts to a positive dimension.

5. *Presentation of Data.* As reports were brought in, they were reviewed for technical competence by staff members at DNR and MPCA and evaluated for their usefulness to the EIS itself by the Reserve Project Team and state consultants. Each consultant's report was abstracted amd cross-referenced to other reports (where pertinent) for final use in the EIS. The final report was then derived by review, compilation, extrapolation and projection, utilizing all individually presented reports and arranging results so as to be responsive to the MEQC regulations. (4)

REPORT ORGANIZATION AND CONTENT

This report, presented in two volumes, contains a great deal of information, scientifically-collected data and analysis. Detailed information is either included herein or available for reference in the files of the responsible agencies (MPCA and DNR).

Following Part I, Parts II through VII and their appendices (Volume II) present the technical and supporting data needed to complete the EIS framework previously outlined:

Part II - Description of the Proposed Action and Alternative Concepts
Part III - Environmental Setting (Regional and Site Specific)
Part IV - Probable Impacts of the Proposed Action and Alternatives on the Environment.

Part V - Measures to Mitigate Adverse Environmental Impacts
Part VI - Irreversible and Irretrievable Commitments of Resources
Part VII - Short Term Uses of the Environment Versus Long Term Productivity

The proposed action and alternatives are considered together in Parts III and IV to facilitate comparison amoung between the various sites presented in this document. Parts III and IV (Environmental Setting and Probable Impacts) are divided by work area. Within each work area in Part III the purpose of studying that work area is stated and interrelationships between that work area and others are set forth. The purpose and interrelationships establish the need for information that follows in the regional and local setting. Part IV sets forth the probable impacts that are common to all sites and those that are unique to one or more sites within the context of the work areas. Parts V, VI and VII are described with respect to the proposed action only.

Three additional parts have been included in responding to the MEQC regulations.(4) These are:

Part VIII - The Impact on State Government of Any Federal Controls Associated with the Proposed Action
Part IX - The Multi-State Responsibilities Associated with the Proposed Action
Part X - Organizations and Persons Consulted

The specific contents, major parts and subparts are listed in the Table of Contents. References are noted and appear at the end of each major part. A glossary is included at the end of the EIS for understanding technical terms that may be encountered. Volume II of the EIS contains the appendicies which are noted throughout Volume I.

CHRONOLOGICAL HISTORY

The issue of Reserve Mining Company's tailing disposal has been the subject of extensive public debate and court litigation. A chronological summary is presented here to place the content of this EIS in the context of the numerous technical and legal proposals brought forth in recent years.

December, 1947: The Minnesota Water Pollution Control Commission (predecessor of MPCA) and the Department of Conservation (predecessor of DNR) acted on Reserve's permit applications by granting permits to appropriate up to 130,000 gallons per minute of water from Lake Superior and to discharge that amount of water with taconite tailings in suspension back into the lake. The permits were granted upon several conditions including that the tailings were not to result in discoloration of water outside a delineated zone, and that the tailings were not to result in any adverse effects on fish life or public water supplies.

1956: Reserve started its first full year of commercial operations of its taconite processing facilities at Silver Bay. The permits issued in 1947 were amended to increase the amount of water permitted to be appropriated from and then discharged into Lake Superior to 260,000 gallons per minute.

1960: The permits were amended to increase the permitted appropriation and discharge to 502,000 gallons per minute.

October, 1965: The Federal Water Pollution Control Act[10] was amended by adding provisions providing for the promulgation of federal-state interstate water quality standards. Minnesota filed a letter of intent to comply with the Federal Act.

April, 1969: The Department of Interior published a report[11] which asserted that some fine tailings were not carried to the bottom of Lake Superior by the heavy density current. The theory of the heavy density current held that tailings were carried down to the bottom of the lake where they settled. The report concluded Reserve should be given 3 years to investigate and construct on-land waste disposal facilities.

April, 1969: Water Pollution Control Regulation 15 (WPC 15), a regulation to control pollution of state and inter-state waters, was tentatively adopted by the Minnesota Pollution Control Agency, formerly the Water Pollution Control Commission. MPCA submitted WPC 15 to the U.S. Secretary of Interior for approval.

May, 1969: The U.S. Secretary of the Interior convened the Lake Superior Enforcement Conference pursuant to provisions of the Federal Water Pollution Control Act for the purpose of considering the inter-state pollution of Lake Superior. The governments of the United States, Minnesota, Wisconsin and Michigan were conferees. (The conference represented the initial step in federal administrative proceedings concerning Reserve).

July, 1969: MPCA requested that Reserve comply with the state regulation WPC 15.

July, 1969: The Reserve Mining Company Engineering Task Force initiated a study of on-land disposal sites for the Lake Superior Enforcement Conference (federal administrative proceedings).

September, 1969: The Lake Superior Enforcement Conference determined presumptive evidence indicated the discharge from the Reserve Mining Company into Lake Superior potentially endangered the health and welfare of persons in states other than Minnesota.

November, 1969: In accordance with the Federal Water Pollution Control Act, the Secretary of Interior approved WPC 15 as a state pollution regulation.

December, 1969: Reserve appealed the adoption of WPC 15 to the Minnesota District Court (State of Minnesota, County of Lake, Sixth Judicial District). Reserve challenged the general validity of WPC 15 and its specific application to Reserve. The trial started in June, 1970.

February, 1970: MPCA filed its answer to Reserve's appeal in the Minnesota District Court. MPCA denied the allegations of Reserve and brought a counterclaim against Reserve. The counterclaim alleged that Reserve was polluting Lake Superior in violation of Minnesota laws and regulations, and sought an order stopping such pollution.

April, 1970: Reserve prepared a document in response to federal administrative proceedings which examined possible methods of altering its discharge. The document(13) considered eleven on-land disposal sites as well as modifications of discharge to the lake. Seven on-land sites were rejected (no specific reasons were given). Nineteen alternatives were developed around the four remaining on-land sites or deep pipe discharge to Lake Superior. The on-land sites discussed in the document involved the Lax Lake Area (including, to varying degrees, the general area now comprising the proposed Mile Post 7 Plan), Mile Post 32, disposal near the Reserve mine and disposal in a lake shore tailings pond (Lake Superior). The Reserve Engineering Task Force rejected proposals for on-land disposal near Lax Lake, Mile Post 32 and near the mine.

December, 1970: The Minnesota District Court issued its findings, conclusions and order in the case. The court drew no conclusion of law as to whether Reserve was polluting Lake Superior, concluded that certain sections of WPC 15 were not enforceable against Reserve Mining Company, ordered that MPCA negotiate a variance with Reserve, and ordered Reserve to present MPCA with plans for the modification of its discharge.(12)

January 15, 1971: Reserve presented the Lake Superior Enforcement Conference with a plan to modify their tailings discharge.(14) This plan proposed pumping the tailings 150 feet below the surface of Lake Superior (the deep pipe concept).

February 3, 1971: Reserve presented a response to the Lake Superior Enforcement Conference Technical Committee's inquiry.(15) This report rejected on-land disposal and proposed the deep pipe method of discharge into Lake Superior.

April, 1971: MPCA appealed the Minnesota District Court judgment to the Minnesota Supreme Court.

April 23, 1971: The Lake Superior Enforcement Conference Technical Committee rejected Reserve's deep pipe proposal as it did not comply with appropriate pollution abatement regulations.(16)

April 28, 1971: The U.S. Environmental Protection Agency (EPA) notified Reserve that it was in violation of federal and state water quality standards and that, under Section 10 (c) (5) of the Federal Water Pollution Control Act, Reserve had 180 days to develop appropriate pollution abatement plans and techniques.

April 28, 1971: In connection with the federal administrative proceedings, the EPA contracted a private consultant, Roy F. Weston, Inc., to develop conceptual methods for disposing of taconite wastes and to conduct an independent evaluation of feasible wastewater treatment and disposal alternatives.

October 27, 1971: The Roy F. Weston report was completed.(17) The report evaluated the 19 alternatives studied by Reserve's Engineering Task Force plus Reserve's deep pipe plan.(14) In addition, Weston proposed five alternative concept designs for an on-land disposal site to the southwest of Lax Lake.

November 29, 1971: Reserve presented a response to the Weston report to the EPA.(18) Reserve asserted the Weston report did not provide preliminary engineering on alternatives, and the Weston alternatives would not be able to meet water quality standards.

February 18, 1972: The United States, at the request of the EPA, filed suit against Reserve in the United States District Court in Minnesota seeking abatement of Reserve's discharges into Lake Superior. The suit was brought under the Federal Water Pollution Control Act, the Refuse Act of 1899, and the common law of nuisance.

February-April, 1972: Based upon earlier recommendations of alternative sites by Minnesota agencies, the EPA contracted with the International Engineering Company (IECO) to determine the engineering feasibility and costs of altering Reserve's method of disposal by constructing a new concentrator, tailings disposal pond and related facilities at Reserve's mine near Babbitt.

August, 1972: The Minnesota Supreme Court issued its opinion on the MPCA appeal. The Supreme Court affirmed the trial court's finding that WPC 15 was a valid regulation and that Reserve's appeal of it was timely, but reversed that part of the order which directed that the MCPA and Reserve should negotiate a variance. The court ruled that the appeal raised only procedural questions and that the Minnesota District Court had no power to compel negotiations between MPCA and Reserve regarding a variance. (19)

October, 1972: The 1972 Federal Water Pollution Control Act Amendments were passed and the National Pollution Discharge Elimination System (NPDES) was initiated. The amendments superseded the Refuse Act of 1899.

April, 1973: Upon the request motion of Reserve, the State of Minnesota and MPCA were ordered by the U.S. District Court to join the United States in the federal suit. This action resulted in the halting of further state court and state administrative proceedings.

May, 1973: EPA's consultant, IECO, completed its study.[20] IECO concluded that it was technically feasible for Reserve to construct a new beneficiation process, tailings disposal system, and related facilities near its mine at Babbitt. The IECO disposal system location was later called the Snowshoe alternative.

June 15, 1973: EPA announced the discovery of asbestiform fibers in Duluth, Minnesota drinking water and based on studies done for MPCA, announced that the source was believed to be Reserve's discharge.

February, 1974: The U.S. District Court indicated that the United States and the State of Minnesota had established a prima facie case on the existence of a health hazard, and urged Reserve to investigate alternatives for on-land disposal.

April 20, 1974: The U.S. District Court issued its final order. The court found that Reserve's discharges into the air and water contained asbestiform fibers and substantially endangered the health of people exposed. The court issued an injunction, ordering that the discharges be halted immediately.[21]

April 22, 1974: Reserve appealed the U.S. District Court decision to the United States Court of Appeals for the Eighth Circuit. The U.S. Court of Appeals granted Reserve a temporary postponement of the U.S. District Court's order halting discharges until a full hearing could be held.

June 4, 1974: The U.S. Court of Appeals granted a conditional postponement for 70 more days. The court tentatively held that a demonstrable health hazard had not been proven and that a substantial immediate danger had not been shown. The court ordered Reserve promptly to present a plan for abating its discharges into the air and water. The plan was to be reviewed by the United States, Minnesota and the U.S. District Court, who were to make recommendations as to whether the plan was acceptable or whether the postponement should be continued.[22]

July, 1974: Minnesota, Michigan, Wisconsin and environmental groups applied to the United States Supreme Court for an order overturning the U.S. Court of Appeals postponement. The application was denied.

June-August, 1974: Reserve presented a plan to the U.S. District Court for on-land disposal of its tailings at the Palisade Creek area near the shore of Lake Superior in the vicinity of Silver Bay. The U.S. District Court held hearings and received comments on the Palisade plan.

August 3, 1974: U.S. District Court made findings relating to the Palisade Plan. The court found the plan unacceptable from both an ecological and engineering point of view. It recommended that the postponement not be continued.

August, 1974: The U.S. Court of Appeals held several hearings in St. Paul. The court suggested that the parties investigate an on-land disposal site near Lax Lake. The court requested that the parties indicate whether a Lax Lake basin would be acceptable. Reserve indicated it would apply for permits at that site and Minnesota indicated it would give such permits full consideration. The court ordered that the postponements be continued until the appeal was heard on the merits.

September, 1974: The State of Minnesota, along with Wisconsin, Michigan and environmental groups applied again to the U.S. Supreme Court for an order overturning the latest postponement of the U.S. Court of Appeals. The United States submitted a similar application.

October, 1974: The U.S. Supreme Court denied the application to overturn the postponement. However, five justices indicated that the applications should be filed again if the case were not fully decided by the U.S. Court of Appeals by January 31, 1975.

November, 1974: Reserve Mining Company submitted applications to DNR and MPCA for permits to build an on-land tailings disposal site near Mile Post 7.

December 9, 1974: Oral argument was held before the U.S. Court of Appeals on Reserve's appeal of the U.S. District Court order for Reserve to halt discharge to the Lake.

December 10, 1974: MEQC resolved that an EIS should be prepared on the proposed Mile Post 7 plan.[5]

March 14, 1975: The U.S. Court of Appeals issued its opinion and order on the merits of Reserve's appeal of the U.S. District Court order to halt discharge to the Lake.[23] The U.S. Court of Appeals held that Reserve's discharges did contain asbestiform fibers and that abatement was justified. However, the court held that no harm to health had occurred to date and the danger to health was not imminent. The court ordered that Reserve stop its discharges but that it must be given a reasonable opportunity and a reasonable time to construct facilities and accomplish abatement. The resolution of the controversy over an on-land site was to be governed by state administrative procedures under certain constraints given by the opinion.

May 19, 1975: MEQC formally notified DNR and MPCA that they had been designated joint responsible agencies for the preparation of the EIS for Reserve's proposed Mile Post 7 plan.

June, 1975: Public hearings began on the proposed Mile Post 7 plan permit applications.

BACKGROUND RELEVANT TO THE PREPARATION OF THE E.I.S.

This section enlarges upon several aspects of the procedural history and findings and recommendations of the courts (noted in the previous CHRONOLOGICAL HISTORY) which assist in understanding the context of the proposed Mile Post 7 plan, the present administrative proceedings, and the content of the Environmental Impact Statement.

The original permit applications by Reserve to allow discharge of its taconite tailings into Lake Superior were granted in 1947 by the predecessors to MPCA and DNR. The permits were granted after several public hearings. It was represented at the hearings that the tailings were harmless and would immediately sink directly to the bottom of Lake Superior, and that if the tailings proved deleterious, the state could proceed against Reserve legally. The permits were granted subject to certain conditions, including the condition that the tailings could not cause any material discoloration of the water outside a nine square mile zone of discharge, nor could the discharge result in adverse effects on fish life or public water supplies.

In 1969, in accordance with the Federal Water Pollution Control Act,[10] MPCA enacted a water pollution control regulation (WPC 15) relating to pollution of waters and establishing limits for the amount of suspended solids in discharges. MPCA requested that Reserve comply with this regulation but Reserve contended that to comply with WPC 15 would dilute the fine tailings to such a degree that the heavy density current which carries the tailings to the lake bottom would no longer function.

At about the same time, May, 1969, the U.S. Secretary of the Interior began federal administrative proceedings to evaluate the inter-state pollution of Lake Superior. The Secretary convened the Lake Superior Enforcement Conference which met during 1969-1971 and considered the effects of Reserve's discharges and alternatives to discharging into Lake Superior. During the Enforcement Conference proceedings, several investigations were made of tailings disposal alternatives for Reserve. Reserve formed an Engineering Task Force consisting of Reserve Mining Company employees and consultants which analyzed 19 alternate concepts, including on-land disposal near Babbitt and in the vicinity of Lax Lake.(13) Roy F. Weston, Inc., an engineering consultant under contract to EPA, also analyzed on-land disposal sites and presented tailing disposal concepts involving the Lax Lake vicinity.(17) Reserve formally presented the Enforcement Conference with the deep pipe plan[14] which involved piping tailings to a depth of about 150 feet below the surface of Lake Superior. A technical committee established in the Enforcement Conference rejected this plan as unacceptable.(16) The federal administrative proceedings ended when, at the request of the EPA, and with the approval of the State, the U.S. Justice Department brought suit against Reserve in federal court for violation of various federal laws.

While the Enforcement Conference was considering Reserve's discharge, Reserve and MPCA were involved in a state court suit. Reserve appealed the adoption of pollution control regulation WPC 15 to Minnesota District Court and MPCA filed a counterclaim alleging that Reserve was polluting Lake Superior in violation of Minnesota laws and regulations. The State of Minnesota was stopped from holding permit revocation hearings on Reserve's water permits pending determination of the suit. The Minnesota District Court held a trial and concluded that although WPC 15 was a valid regulation, it was not enforceable against Reserve.[12] The court ordered MPCA to negotiate a variance with Reserve. MPCA appealed the decision to the Minnesota Supreme Court. The Minnesota Supreme Court in 1972 ruled only on a procedural issue and held that the Minnesota District Court had no power to order negotiations concerning a variance.(19) The case was returned to MPCA for further administrative proceedings.

The federal suit was begun in February of 1972 by the federal government in U.S. District Court in Minnesota. Minnesota was ordered by the U.S. District Court to join the federal suit in April of 1973. The presence of Minnesota in the federal suit halted any further state court or administrative proceedings. During 1972, the EPA entered into contract with a private consultant, International Engineering Company (IECO), to examine the alternative of creating an on-land disposal system near Reserve's mine at Babbitt, and constructing a new concentrator there. In May of 1973, IECO completed its study and concluded such a proposal for Babbitt was technically feasible.[20]

The case in the federal court was initially a water pollution abatement suit. However, after the discovery of asbestiform fibers in the drinking water of Duluth and other communities along the shore of Lake

Superior and in the ambient air around Silver Bay, the issue of a health hazard became primary. The source was alleged to be from Reserve's Silver Bay operations. The United States and the State of Minnesota alleged that asbestiform fibers were human carcinogens, causing cancer when inhaled or ingested in certain quantities. Based on observations made in other geographical areas, the cancer caused by asbestos similar to the asbestiform fibers contained in Reserve's discharges did not usually develop until after a latency period of at least 20 years after initial exposure.

In February of 1974, the U.S. District Court gave a preliminary indication that the existence of a health hazard had been established and that if no evidence were presented to contradict that tentative finding, Reserve should develop a system for disposing tailings on land.

On April 11, 1974, based on evidence of the existence of a substantial health hazard, the violation of statutes and the common law, and Reserve's reluctance to produce a plan for on-land disposal, the U.S. District Court issued an injunction immediately halting Reserve's discharges. The court issued a preliminary opinion on April 29, 1974, and a lengthy supplemental opinion on May 11, 1974, detailing its findings and conclusions.[21] The opinions are long and complex and should be read in full for a complete understanding of their content. In brief, the court found that Reserve's discharges contain asbestiform fibers which are identical to amosite asbestos, a substance known to cause cancer in humans in other situations. The court held that the discharges substantially endanger the health of persons exposed to the fibers in air and drinking water supplies. In addition, findings were made relating to the economic position of Reserve and its owners, Armco Steel Corporation and Republic Steel Corporation; and that Reserve, Armco, and Republic have the economic and engineering capability to carry out an on-land disposal system which would satisfy health and environmental concerns.[21]

On April 22, 1974, the U.S. Court of Appeals for the Eighth Circuit granted Reserve a temporary postponement of the U.S. District Court's order to halt Reserve's discharges until the postponement issue could be fully briefed and heard by the court. On June 4, the U.S. Court of Appeals granted a 70 day postponement to Reserve on condition that the company promptly present a plan to abate its discharges. The court based the continuation of the postponement on a tentative finding that Reserve's discharge only presented an unquantifiable risk and that the EPA had failed to prove that demonstrable health hazard existed.[22] The court's full analysis of the health issue, though, had to await a hearing on the merits of the appeal of the order to halt discharges.

Following the June postponement order of the U.S. Court of Appeals, Reserve presented a plan to create an on-land tailings disposal system at the Palisade site. After taking evidence and testimony on the plan, the U.S. District Court made findings on August 3, 1974, which concluded that the Palisade plan was unacceptable, based upon both engineering and environmental grounds.[21]

Following the recommendations relating to the Palisade plan, the U.S. Court of Appeals directed discussion to the Lax Lake area for a disposal site, and Reserve agreed to investigate that area. The State of Minnesota indicated that permit applications for that site would receive full consideration. Reserve formally applied for permits for the proposed Mile Post 7 plan in November of 1974. During the next several months, Reserve met with technical personnel from the State and submitted supplemental information relating to the Mile Post 7 application.

The U.S. Court of Appeals issued its final opinion March 14, 1975 on the appeal of the U.S. District Court's order to halt Reserve's discharges.[23] This opinion also is lengthy and complex, and should be read in full for a complete understanding of its content. In brief, the U.S. Court of Appeals agreed that Reserve's discharges contain fibers of amosite asbestos but held that the existence of such fibers only gives rise to a potential threat to public health. The court concluded that no harm had occurred to the public to date and that the danger to health was not imminent. Although the risk to public health was not imminent enough to justify an immediate halt to Reserve's discharges, the court determined it was of sufficient gravity to justify abatement after a reasonable time. The U.S. Court of Appeals directed that the matter of an on-land disposal site be determined in state administrative proceedings, and suggested that the state should act on the proposed Mile Post 7 plan permit applications within a one-year period.[23]

Following the U.S. Court of Appeals' opinion, the State of Minnesota announced that public hearings would be held on the proposed Mile Post 7 plan permit applications. Public hearings on the permit applications began in June of 1975. The MEQC ordered that an environmental impact statement be prepared with MPCA and DNR as joint responsible agencies.[5,6] Unique to this environmental impact statement is the determination by the courts that the present discharge shall cease and, therefore, the status quo or do nothing alternative is clearly one that is unacceptable.

REFERENCES FOR PART I

(1) Minnesota. Statutes. 1973. Section 116 D. 01 et. seq.
(2) Minnesota. Statutes. 1973. Section 116 D. 04, Subdivision 2.
(3) Minnesota Environmental Quality Council. April 4, 1974. Minnesota Regulation MEQC 22, filed with the Secretary of State and Commissioner of Administration.
(4) Minnesota Environmental Quality Council. Minnesota Regulation MEQC 28.
(5) Minnesota Environmental Quality Council. December 10, 1974. Minutes, Minnesota Environmental Quality Council meeting.
(6) Minnesota Environmental Quality Council. May 19, 1975. Letter from MEQC to Commissioner of Department of Natural Resources and Executive Director of Minnesota Pollution Control Agency.
(7) Minnesota. Statutes. Section 116 D. 04, Subdivision 4.
(8) Reserve E.I.S. Project Team and Reserve Mining Company. July 10, 1975. Reserve Mining Company's response to questions from State of Minnesota Reserve E.I.S. Team, enclosure to letter from Mr. M.R. Banovetz to Mr. Edward Moersfelder.
(9) Reserve E.I.S. Project Team and Mr. C.J. Santhanam. Memorandum to Reserve E.I.S. file, Reserve Project Team questions and responses by Mr. C.J. Santhanam of Arthur D. Little, consultant to Reserve Mining Company.
(10) U.S. Environmental Protection Agency. Supp. 1974. Federal Water Pollution Control Act 33, U.S. Code 1251, et. seq.
(11) U.S. Department of Interior. 1969. An appraisal of water pollution in the Lake Superior Basin (Stoddard Report).
(12) Reserve Mining Company v. Minnesota Pollution Control Agency. District Court, State of Minnesota, County of Lake, Sixth Judicial District, January 18, 1970.
(13) Reserve Mining Company. 1970. Engineering Task Force progress report.
(14) Reserve Mining Company. 1971. Plan to modify tailings discharge system.
(15) Reserve Mining Company. 1971. Response to inquiry from Lake Superior Enforcement Conference Technical Committee.
(16) Lake Superior Enforcement Conference Technical Committee. 1971. Report on taconite tailings disposal.
(17) Roy F. Weston, Inc. 1971. Concept evaluation report taconite tailings disposal.
(18) Reserve Mining Company. 1971. Preliminary comments on the Weston report.
(19) Reserve Mining Company v. Minnesota Pollution Control Agency. 294 Minn. 300,200 N.W. 2d 142 (1972).
(20) International Engineering Company. 1973. Cost study for new iron ore concentrating facility Reserve Mining Company.
(21) United States v. Reserve Mining Company. 380 F. Supp. 11 (D. Minn. 1974).
(22) Reserve Mining Company v. United States. 498 F. 2d 1073 (8th Cir. 1974).
(23) Reserve Mining Company v. United States. 514 F. 2d 492 (8th Cir. 1975).

DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVE CONCEPTS

PART III

SUMMARY

The following statements represent the essential features of the existing operations and proposed actions of Reserve Mining Company with respect to the proposed Mile Post 7 plan as generally described by Reserve. Also summarized here is the discussion of alternatives to the proposed Mile Post 7 plan. Each of these is presented in greater detail following the summary.

FEATURES OF THE EXISTING OPERATION

Open Pit Mine Location: The Peter Mitchell Mine is located near the eastern end of the Mesabi Iron Range in Northeastern Minnesota. It is near the City of Babbitt and approximately 47 rail miles northwest of Silver Bay, Minnesota(1) (refer to Figure 1).

Open Pit Mine Description: The mine is presently 9.9 miles long, 2,800 feet wide, 175 feet deep and wedge-shaped in cross-section. Ore is mined at a rate of 30.1 million long tons per year.(2) Waste rock and lean ore is removed from the mine at the rate of 11.8 million long tons per year and stockpiled near the mine.(3)

Coarse Crushing: The ore is hauled from the mine in 90-ton side-dump tractor pulled trailers for transfer to one of two coarse crushing plants adjacent to the mine. The crushers break the ore into 9-inch chunks or finer and then into less than 4-inch pieces in two successive stages.(4)

Railroad Transportation: The taconite ore is loaded into 85-ton railroad cars and hauled 47 miles along Reserve Mining Company's railroad in 150-car unit trains(5) (refer to Figure 1).

Concentrating and Pelletizing Plant Location: The processing plant is located in Silver Bay, Minnesota, on the shore of Lake Superior, approximately 55 miles northeast of Duluth, Minnesota on U.S. Highway 61 (refer to Figure 1).

Silver Bay Plant and Facilities: The Silver Bay plant facilities include railroad yards, fine crushing, concentrating, pelletizing, shipping, the power plant, tailings delta and administrative offices and service facilities. The most significant of these components are discussed individually below.

Fine Crushing: At Silver Bay, 4-inch taconite ore is reduced to less than 3/4-inch by two stages of crushing at the fine crushing plant. At each stage, the taconite is sized by screening; undersize material bypasses the crushers.(6)

Concentrating Process: In this process, grinding, magnetic separation and hydraulic separation are used to produce an iron concentrate.(7) As part of the process, water is taken from Lake Superior and water containing tailings is rejected and discharged to the delta and Lake Superior.(8)

Pelletizing Process: Moist concentrate is then mixed with a small amount of bentonite clay, rolled into balls in balling drums and hardened by firing in horizontal-grate pelletizing machines.(9)

Shipping Facilities: The taconite pellets may be stored prior to shipment or shipped directly from Reserve's harbor facilities to the lower Great Lakes ports via ore boats.(10)

Power Plant: Power is supplied for the processing by two steam-driven turbines with an availability of 128,000 kw. Presently, cooling water is discharged into a sump from where it is pumped to the plant for process use.(11)

Products and By-Products:

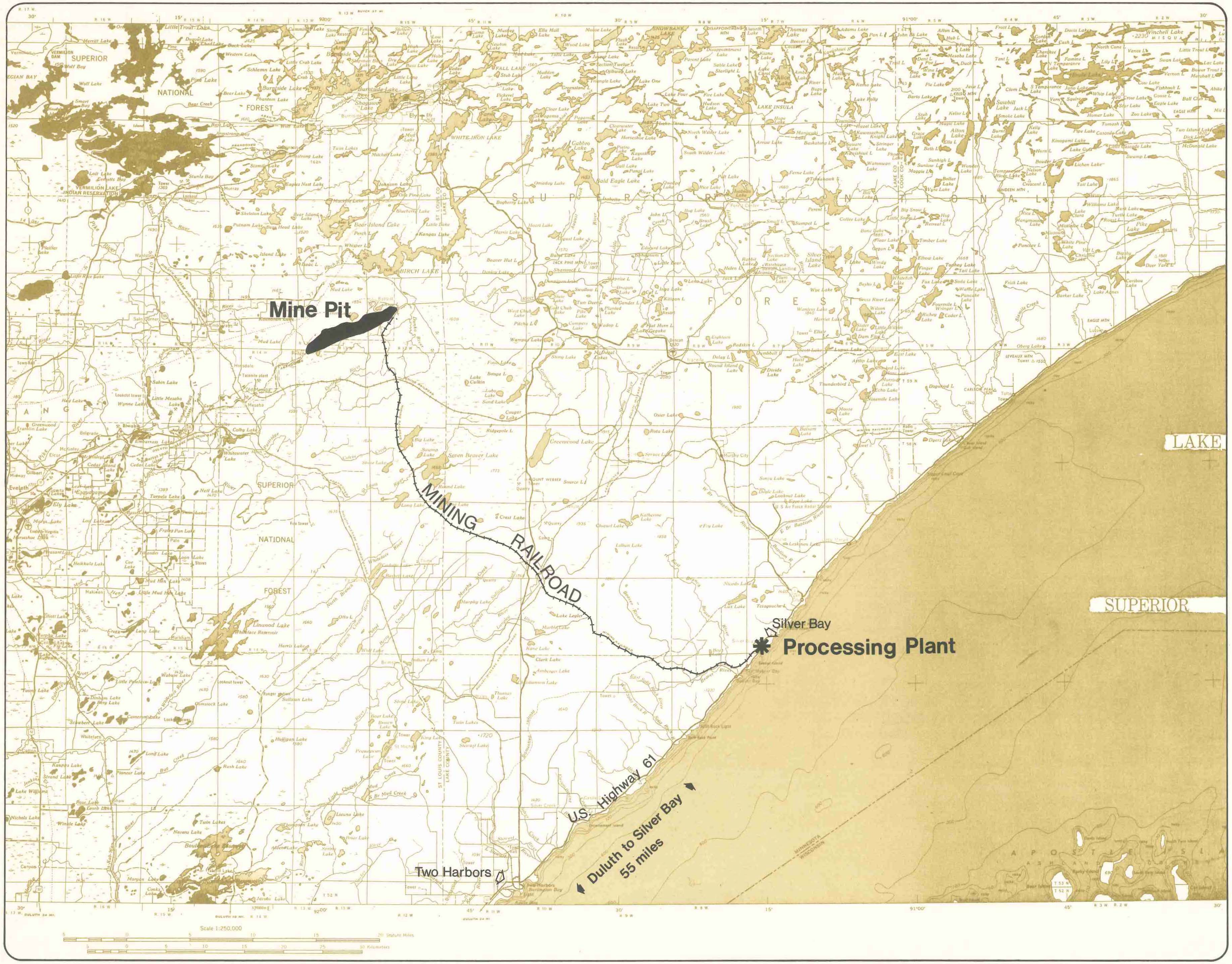
Finished Pellets:	10.7 million long tons per year (production capacity)(12)
Tailings:	20.9 million long tons per year (production capacity)(13)
Composition of Tailings:	The tailings are composed of gangue minerals, mostly quartz and iron silicates of the cummintonite-grunerite series which contain asbestiform minerals.

Iron Content of Pellets (Present Process): 60.6% natural iron content by weight.(14)

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

1 RESERVE MINING COMPANY'S MINE, PLANT AND RAILROAD



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Silica Content of Pellets (Present Process): 8.5% silica content by weight. (15)

Existing Tailings Disposal Area: Tailings are discharged from troughs onto the tailings delta where a portion stays on the delta and the remainder flows into Lake Superior.

FEATURES OF THE PROPOSED OPERATION

Name of Proposal: Mile Post 7 plan.

Purpose of Proposal: As part of the plan to cease discharge of tailings into Lake Superior from the processing of taconite at Silver Bay, Reserve proposes to (a) make major changes in plant operations to improve the physical and chemical quality of Reserve's pellets by increasing the iron content and reducing the silica content and; (b) dispose of the waste product, tailings, in a tailings basin and dry tailings storage area on land. The construction schedule is anticipated to be 3 years in duration according to Reserve Mining Company.

Life of Proposed Plan: The proposed plan is based upon a 40-year normal production operation of Reserve's mine and facilities. (16)

Product Improvement:

	Present Process	Proposed Process (17)
Iron Content (Nat.)	60.6% by weight	64.2% by weight
Silica Content (Nat.)	8.5% by weight	5.0% by weight
Annual Pellet Production Capacity (Nat.)	10.7 million long tons	9.5 million long tons.

On-Land Tailings Disposal: (17)

1. 6,598,000 dry long tons of dry cobber tailings and 2,042,000 dry long tons of filtered tailings are to be produced each year and transported by railroad to the proposed tailings basin.

2. 12,250,000 dry long tons of fine tailings are to be produced each year and pumped to the proposed tailings basin.

Babbitt Facilities: No components of the operation are to be changed including mining, coarse crushing and railroad transportation.

Silver Bay Facilities: All changes necessary to implement the proposed Mile Post 7 plan are to occur at the Silver Bay taconite processing plant or in the area of the proposed Mile Post 7 disposal site. The significant changes are identified individually.

Additional Process And Service Facilities Land Use: Additional proposed land use is to consist of additional processing buildings, a reagent storage building, a truck repair shop, conveyor systems, pipelines, etc., and 8,500 lineal feet of railroad track. These land use commitments are proposed to be made within the existing Silver Bay plant perimeter. (18)

Fine Crushing: Fine crushing is to remain unchanged.

Proposed Dry Cobbing Process: It is proposed that a dry cobbing (dry magnetic separation) building be constructed. The dry cobbers will reject coarse cobber tailings consisting of 22% of the crushed ore from the fine crusher, thereby reducing the amount of material processed in the concentrator. (19) This amounts to 6,598,000 dry long tons of coarse (gravel size) tailings that are to be rail hauled to the disposal area.

Proposed Concentrating Process: Grinding and magnetic, hydraulic and flotation separation techniques are to be utilized for concentrate separation. Several new buildings will be required to house the additional proposed facilities. Chemicals are proposed to be used in the flotation process and as a flocculent for clarifying tailings water for recirculation in the process. (20)

Tailings Transport and Water Recycling: As part of the process, water is to be recycled from the proposed tailings basin and within the plant. As necessary, new water is to be taken from Lake Superior. Fine tailings (silt and finer sizes) will make up 58.6% of the tailings produced and these are to be pumped to the disposal area via pipeline in a slurry consisting of 60% solids by weight. This amounts to 20,417,000 long tons of slurry proposed to be pumped per year. The somewhat coarser (sand-size) tailings are to be filtered and, with the cobbed tailings, are to be transported by conveyor and rail to the proposed tailings disposal area. When transported, the filtered tailings (9.8% of total tailings) and the cobbed tailings (31.6% of total tailings) are to contain 10% and 1.5% moisture respectively. (20)

Pelletizing Process and Shipping Facilities: This portion of the existing operation is to remain unchanged.

Proposed Power Plant Modifications: The 106,000 gallons of water per minute (gpm) of non-contact (not exposed to any process materials) cooling water from the power plant is to be discharged directly to Lake Superior. (21)

Proposed Tailings Delta Stabilization: The lakeside edge of the tailings delta in Lake Superior is proposed to be stabilized by rail hauling mine stripping rock to the delta area and constructing a long breakwater, using Beaver Island on the west side and a rock point on the east side as anchor points. (22)

Location of Proposed Disposal Area: The proposed Mile Post 7 disposal site is located west of the Silver Bay processing plant in Thirtynine Creek Valley, Lake County, Minnesota, south of Lax Lake (refer to

Figure 2). It is approximately 3,000 to 8,000 feet north of the Reserve Mining Company Railroad at Mile Posts 5 through 8. It is 625 feet above Lake Superior which lies about 2.6 miles southeast. Beaver Bay is 3 miles east/southeast; Silver Bay, 4 miles east; and Two Harbors, 23 miles southwest.(23)

Proposed Disposal Area Land Use: The actual area over which fine tailings are proposed to be deposited (i.e., the tailings basin proper) is 4.6 square miles. An additional 3.0 square miles is included in Reserve's proposal for utilization as a coarse tailings storage and disposal area.(24) The total proposed tailings disposal area is therefore 7.6 square miles (refer to Figure 3). Surrounding this proposed disposal area, an additional 7.1 square miles is proposed to be utilized as follows:

Cleared Areas and Areas Proposed for Structures	Square Miles
Dams	0.58 (within ultimate dam toes)
Seepage Catchment Areas	0.53 (exclusive of collection ditches for Dams 4 and 5)
Stream Diversions	0.07
Pipeline Terminus	0.05
Railroad Spur	0.08
Access Roads	0.08
Area Not Cleared	
Buffer Zone	5.71

The total proposed project area shown on Figure 3 is to be comprised of both the proposed disposal area (7.6 square miles) plus the 7.1 square miles of proposed ancillary land used for structures, cleared areas and buffer zones.

Not included within the proposed project area is the proposed pipeline corridor which is to extend from the eastern boundary of the project area to the concentrator at Silver Bay. Approximately 0.15 square miles of land will be required for the 200 foot wide corridor proposed in Reserve's Mile Post 7 plan.

The total proposed land use exclusive of the area within the perimeter of the Silver Bay plant is therefore 14.85 square miles.

Design Elements: A summary of the dimensions, materials and special features for structures and facilities proposed by Reserve to implement the proposed Mile Post 7 plan is provided in the following tables:

Tables 1 and 2 - Dams
Table 3 - Seepage Recovery System
Table 4 - Diversions
Table 5 - Pipelines
Table 6 - Access Roads

TABLE 1
SUMMARY OF PROPOSED STARTER DAMS

	Starter Dam #1	Starter Dam #2 - 3
Crest Length	3,900 feet	1,900 feet
Height	45 feet (El. 1,170 feet)	10 feet (El. 1,170 feet)
Crest Width	40 feet	40 feet
Base Width	405 feet (El. 1,125 feet)	160 feet (El. 1,160 feet)
Slopes	Two 1:3 slopes, at each face, with an 80 foot wide berm at elevation 1,150 feet, both upstream and downstream	Upstream: 1:5 Downstream: 1:5
Composition	Compacted glacial till in 9 inch lifts	Compacted glacial till in 9 inch lifts
Special Features (All four features listed are for Dam #1)	-Vertical sand drains underneath it, except middle 80 feet of dam -Drainage blanket five feet thick, over sand drains, except middle 80 feet of dam -36 inch diameter diversion culvert, existing under starter dam (until tailings discharge begins) to bypass runoff -200 foot wide emergency spillway kept 5 feet below crest of embankment	
Construction	First stage: up to elevation 1,150 feet in one season Second stage: up to elevation 1,170 feet in second season	One stage to elevation 1,170 feet in one season

Note: No starter dams are required for Dams 4 and 5.

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

2 PROPOSED MILE POST 7 DISPOSAL AREA

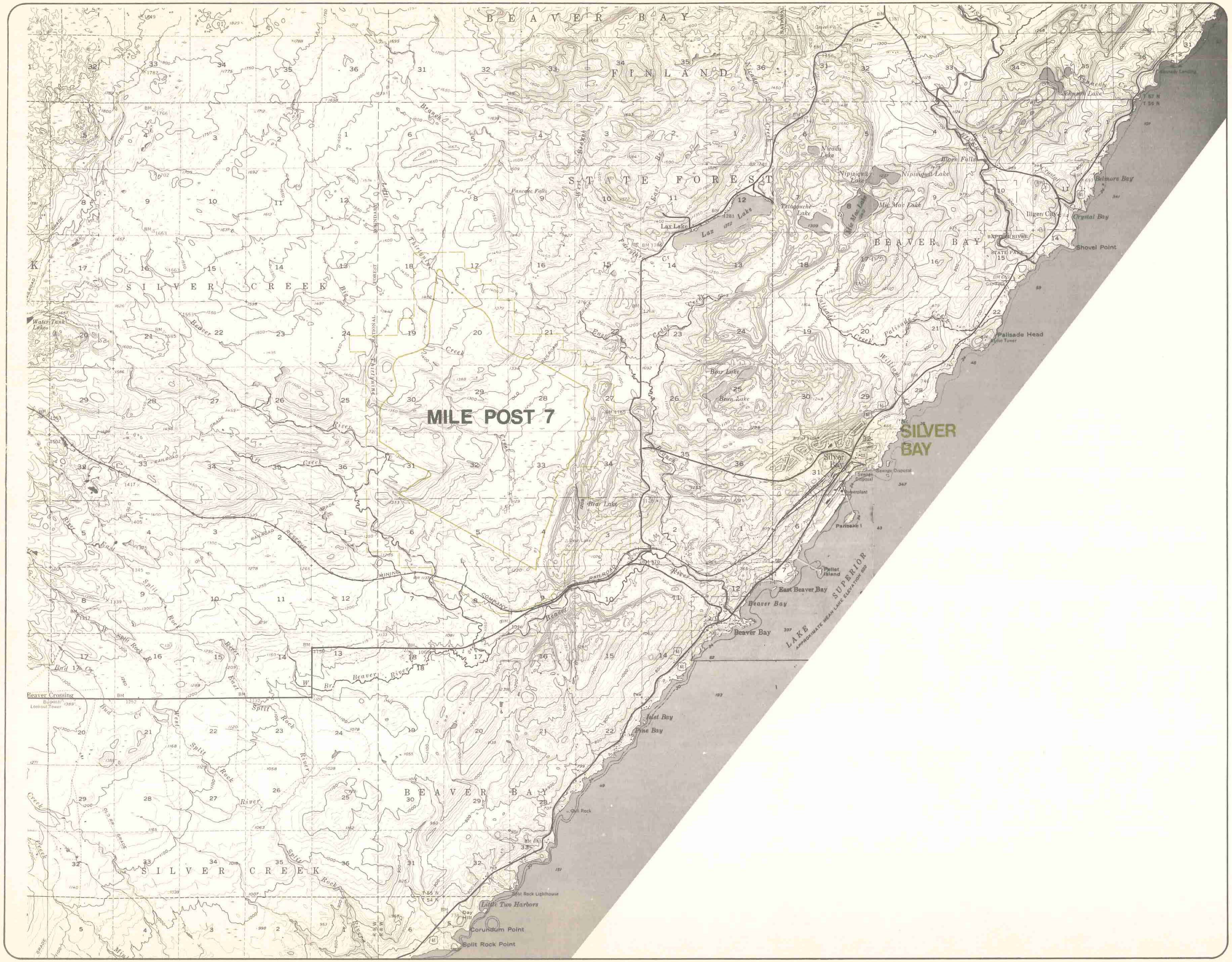

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TABLE 2
SUMMARY OF PROPOSED MAIN DAMS

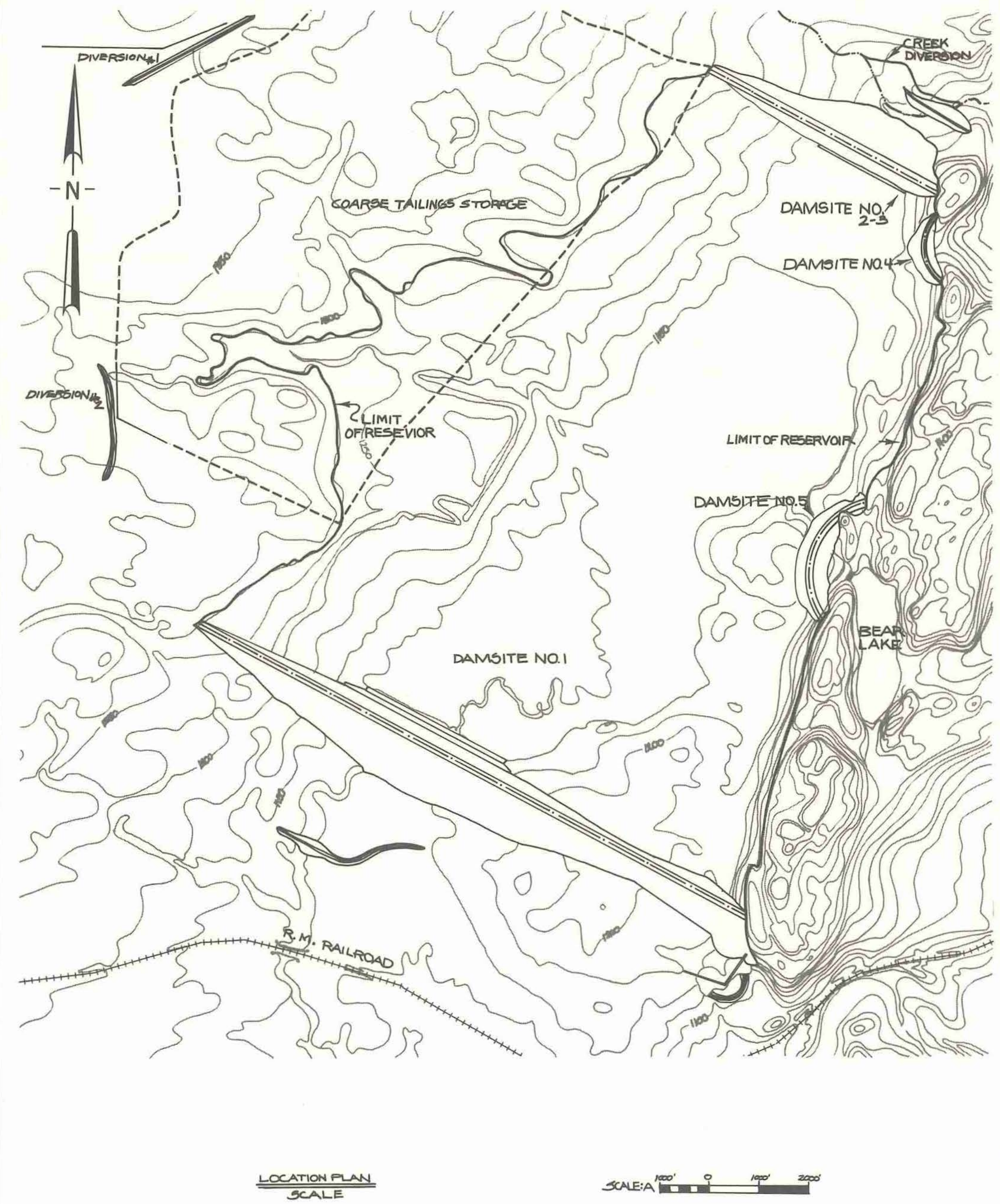
	Main Dam #1	Main Dam #2-3	Main Dam #4	Main Dam #5
Crest Length	12,600 feet	5,200 feet	1,700 feet	2,800 feet
Height	155 feet (El. 1,280 feet)	120 feet (El. 1,280 feet)	85 feet (El. 1,280 feet)	135 feet (El. 1,280 feet)
Crest Width	150 feet	150 feet	50 feet	150 feet
Base Width	1,485 feet (El. 1,125 feet, incl. starter dam)	1,180 feet (El. 1,160 feet, incl. starter dam)	515 feet (El. 1,195 feet)	900 feet (El. 1,145 feet)
Slopes	Upstream: 1:2.5 Downstream: 1:4 faces with berms in between, making overall slope 1:6	Upstream: 1:2 Downstream: same as Dam #1	Upstream: 1:2.5 Downstream: 1:2.5	Upstream: 1:2 Downstream: 1:4
Special Features	3 feet thick horizontal drainage layer of coarse tailings, underneath the main dam	3 feet thick horizontal drainage layer of coarse tailings underneath the main dam		
Area Covered by Base	284 acres (within ultimate toes)	80 acres (within ultimate toes)	13 acres (within ultimate toes)	31 acres (within ultimate toes)
Composition	75%-25% dry cobbs-middling. Zones of heavily and lightly compacted material	Same as Dam #1	Core of impervious compacted glacial till. Shells of compacted coarse tailings	About 1/5 of dams, small saddle, of compacted till. Rest of dam source as Dam #1.

TABLE 3
SUMMARY OF PROPOSED DIVERSIONS

	Diversion #1	Diversion #2	Bear Lake Diversion Dam	Diversion Channel Under Starter Dam #1	Diversion Canal at Catchment A Dam #1	Creek Diversion Dam #2-3
Length	Ditch: 3,890 feet Dike: 3,030 feet	Ditch: 2,300 feet Dike: 2,270 feet	160 feet	2,380 feet	650 feet	2,375 feet
Height-Depth	Ditch: 0 feet-5 feet Dike: 5 feet minimum	Ditch: 0-6 feet Dike: 6 feet minimum	12 feet			
Bottom Width Crest Width	Ditch: 10 feet-30 feet Dike: 10 feet	Ditch: 50 feet Dike: 10 feet				
Top Width Base Width	Ditch: 30 feet-50 feet Dike: 30 feet	Ditch: 74 feet Dike: 34 feet				
Slopes	Ditch: 1:2 Dike: 1:2	Ditch: 1:2 Dike: 1:2				
Composition	Dike of compacted glacial till, 12 inches layers	Same as Diversion #1	Compacted till			
Special Features	-Invert slopes 0.5% crosswise -15 inches rip-rap on upstream face of dike -9 inches filter at upstream face of dike -Dry cob drain at downstream toe of dike -Ditch slopes of 0.2% lengthwise	-Invert slopes 0.5% crosswise -36 inches rip-rap on upstream face of dike -12 inches filter at upstream face of dike -Dry cob drain at downstream toe of dike -Ditch slopes 0.15%		-Includes 36 inches concrete pipe underpassing starter Dam#1		

TABLE 4
SUMMARY OF PROPOSED SEEPAGE RECOVERY SYSTEM

	Dam #1		Dam #2-3	Dam #4	Dam #5
	Area A	Area B			
Area of Catchment	214 acres	47 acres	78 acres		
Crest Length	3,080 feet	1,675 feet	1,785 feet	No recovery dam	No recovery dam
Height	26 feet (El. 1,147)		42 feet (El. 1,165)		
Crest Width	30 feet		30 feet		
Base Width	340 feet (El. 1,121)		420 feet (El. 1,123)		
Slopes	Upstream: 1:6 Downstream: 1:6		Upstream: 1:4 Downstream: 1:4		
Composition	Compacted glacial till		Compacted glacial till		
Special Features	-18 incnes tnick horizontal drain layer over downstream portion -Thin layer of fine rock blanketing the surfaces to protect against erosion				
Features of Area of Catchment	-Collection ditch just south of toe of ultimate Dam #1 between basins A & B -650 feet long diversion canal, the canal under Starter Dam #1 -Pumping station at each basin -Initial and ultimate points of discharge from tailings pond along with reclaim line		-Pump Station -Initial and ultimate points of discharge along with reclaim line	-Collection ditch along the ultimate downstream toe of Dam #4 -Sump and pump in ditch	-Collection ditch with sump and pump just downstream from the ultimate impervious northern saddle Dam #5 -Pump station discharge point and reclaim line between toe and natural topographic crest, downstream from main portion (coarse tailings) Dam #5



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

3 PROPOSED MILE POST 7 DISPOSAL AREA

SOURCE: Reserve Mining Company

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TABLE 5
SUMMARY OF PROPOSED PIPELINES - MILE POST 7 PLAN

	Between Pumphouse #1 and Pumphouse #4	Between Pumphouse #4 and Northern Distribution Station (Pumphouse #5)
Length	30,000 feet	12,000 feet
Right-of-Way	200 feet	--
Number of Pipes for Tailings	2 (24 inches in diameter)	1 (24 inches in diameter)
Additional Pipes	2 (1 reclaim, 1 seal water)	
Elevation	625 feet	0

TABLE 6
SUMMARY OF PROPOSED ACCESS ROADS

	North Access Road	East Valley Wall Access Road	Pipeline Maintenance Road
Right-of-Way	100 feet	200 feet	200 feet*
Width	40 feet	--	24 feet
Approximate Length	4,000 feet	13,000 feet	28,000 feet
Construction Material	Coarse Tailings	Coarse Tailings	Coarse Tailings

* Within pipeline right-of-way.

FEATURES OF ALTERNATIVE OPERATIONS*

Names of Alternatives: A total of 16 alternative disposal plans were reviewed. Of these, four were considered to be viable alternatives. These four proposed alternatives are identified as Embarrass, Colvin, Snowshoe, and Midway. Tailings disposal areas for each alternative are shown on Figure 4. Because the Midway alternative would open a third area of development for Reserve Mining Company, and other rationale, this alternative, although considered viable, was not investigated to the same level as the remaining alternatives. The construction schedule for any alternative which would involve the relocation of processing facilities would be 48 to 52 months as indicated in Appendix B.* The time required for the construction of the proposed Mile Post 7 plan and for the alternatives will be preceeded by acquisition of land. These activities will follow the decision as to which course of action is preferred. Because of the diverse land ownership at each of the sites and the uncertainties of projecting the time required to acquire land (see Appendix F), it is not possible to predict the length of time required for acquisition on a site by site basis.

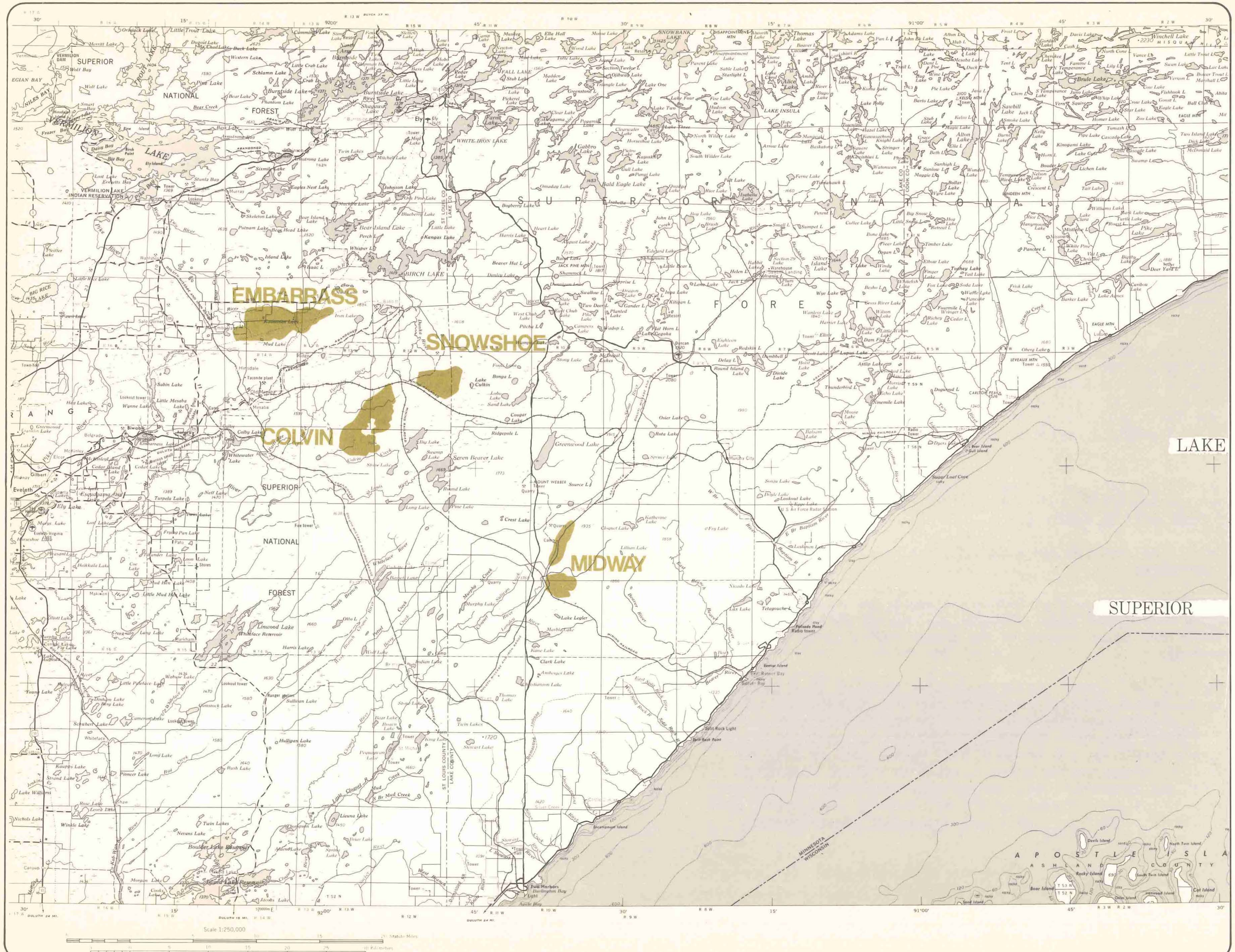
Purpose of Alternative Operations: Same as Reserve's proposed Mile Post 7 plan.

Life of Proposed Alternative Plans: Alternative plans are based upon a 39-year production operation of Reserve's mine and existing pelletizer facilities.

Product Improvement:

	Present Process	Mile Post 7 Proposal	Alternate Proposals
Iron Content (Nat.)	60.6% by weight	64.2% by weight	64.5% by weight
Silica Content (Nat.)	8.5% by weight	5.0% by weight	5.0% by weight
Annual Pellet Production Capacity (Nat.)	10.7 million long tons	9.5 million long tons	10.7 million long tons

* All alternatives except Midway would require the relocation of a major portion of the taconite processing facilities to a location adjacent to the tailings disposal area. For the Midway site, either facilities could be relocated at the site or the tailings could be transported to the site in a manner similar to that for the proposed Mile Post 7 plan. Therefore, the features of the proposed alternative operations as described are applicable to all sites including Midway. But Midway represents a special case in that the general features described for the proposed Mile Post 7 plan, except for increased tailings transport distance, also have potential applicability.



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

4 EMBARRASS, COLVIN, SNOWSHOE AND MIDWAY ALTERNATIVES

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On-Land Tailings Disposal: For relocation of facilities the following yearly disposal rates are to apply:

1. 6,975,000 dry long tons of dry cobber tailings and 2,394,000 dry tons of filtered tailings are to be produced and transported to the tailings basin by truck.

2. 14,410,000 dry long tons of fine tailings are to be produced each year and discharged from the concentrator into the adjacent tailings basin.

Silver Bay Facilities: Changes are to occur to the Silver Bay taconite processing plant to implement any of the alternates. For relocation of facilities, these changes are to include the construction of concentrate unloading and handling facilities and the removal of the existing rotary car dumpers, the fine crushing operations and the concentrating facilities.

Babbitt Facilities: No Components of the existing operation at the mine pit are to be changed for any of the alternative proposals except that the distance over which coarse crushed crude ore is transported by railroad would be decreased. Tailings disposal areas and new processing facilities for the proposed alternatives, except for the Midway site, are to be located within a radius of seven miles of the existing mining operation.

Processing Facilities Land Use: Proposed land use at alternative sites is to include new processing and service facilities. Varying lengths of railroad track will be required.

Fine Crushing: Fine crushing and associated rail car dumping facilities are to be constructed.

Dry Cobbing Process: Dry cobbing facilities are to be constructed as in the proposed Mile Post 7 plan. However, unlike the Mile Post 7 plan, these facilities are to be located in the same building as the fine crushing facility.

Concentrating Process: Concentrating facilities provided at alternative sites are to be essentially the same as for the proposed Mile Post 7 plan except for the greater production capacity at the alternative sites. The major difference between a new concentrator and the modified existing Silver Bay concentrator for the proposed Mile Post 7 plan is that the number of parallel concentrating circuits would be reduced from 22 to 10 with the new concentrator. This reduction in concentrating circuits occurs because of the current availability of larger grinding mills with more than double the capacity of mills available when the Silver Bay facility was constructed in 1955.

Tailings Transport and Water Recycling: As in the proposed Mile Post 7 plan, water is to be recycled from the alternative tailings basins and within the new processing facilities. Unlike the proposed Mile Post 7 plan, new water is not to be taken from Lake Superior. During the initial years of operations, new water is to be obtained from accumulated runoff stored in the basin. The alternative would permit operation for one year under drought conditions, with no further runoff within the basin and no outside water supply. Due to the expense that would result if no outside source of water were to be provided, during startup of operations, an outside source of water is to be provided at all alternative sites. During continued operation, under conditions of average wetness, this outside source would also be necessary at all but one stage of the Colvin alternative operation. Mine pit water discharged from the Peter Mitchell Pit and/or water from the Birch Lake Reservoir are to be potential sources.

Fine tailings (silt-sized) are to be discharged into the tailings basin. Coarse tailings including dry cobbed tailings (gravel-sized) and filtered tailings (sand-sized) are to be transported to the tailings basin by 120-ton trucks. These coarse tailings are to be used for dam and road construction or placed in the basin.

Pelletizing Process and Shipping Facilities: This portion of the existing operation is to remain unchanged for any alternative.

Power Plant Modifications: The 106,000 gallons of water per minute (gpm) of non-contact (not exposed to any process materials) cooling water from the power plant is to be discharged dirctly to Lake Superior under any alternative plan.

Tailings Delta Stabilization: Stabilization of the existing delta which extends into Lake Superior would be the same as required for Reserve's proposed Mile Post 7 plan.

Land Use for Proposed Alternative Disposal Areas: Table 7 presents a summary comparison of land use elements for Reserve's proposed Mile Post 7 plan and alternative plans.

Design Elements: Table 8 presents a summary comparison of design elements of Reserve's proposed Mile Post 7 plan and alternative plans.

TABLE 7
SUMMARY COMPARISON OF LAND USE ELEMENTS (All Values in Square Miles)

	Mile Post 7	Embarrass	Colvin	Snowshoe
Tailings Disposal Area	7.6	7.49	12.34	4.98
Cleared Areas and Areas Proposed for Structures:				
Dams	0.58	2.62	2.18	2.63
Plant		0.20	0.20	0.20
Seepage Catchment Areas	0.53	0.43	0.72	1.06
Diversions	0.07			
(Pipeline)	0.20	0.01	0.01	0.04
Spurs (Railroad)	0.08	0.17	0.10	0.10
Access Roads	0.08	0.01	0.01	0.01
Area Not Cleared				
Buffer Zone	5.71	5.92	5.60	2.8
TOTALS	14.85	16.85	21.16	11.46

TABLE 8
SUMMARY COMPARISON OF DESIGN ELEMENTS

	Mile Post 7	Embarrass	Colvin	Snowshoe
Main Dams				
Final Dam Elevation	1,280 feet	1,580 feet	1,670 feet	1,830 feet
Crest Width	150 feet	40 feet	40 feet	40 feet
Composition	Coarse Tailings	Coarse Tailings	Coarse Tailings	Coarse Tailings
Slopes	6:1 (Terrace 4:1)	6:1 (Terrace 4:1)	6:1 (Terrace 4:1)	6:1 (Terrace 4:1)
Diversions				
Number	6	0	1	0
Pipelines				
Corridor Length	About 30,000 feet	About 1,000 feet	About 1,000 feet	About 5,000 feet
Right-of-Way	200 feet	200 feet	200 feet	200 feet
Access Roads				
Length	About 4,000 feet	About 4,000 feet	About 1,000 feet	About 15,000 feet
Right-of-Way	100 feet	100 feet	100 feet	100 feet
Width	40 feet	40 feet	40 feet	40 feet
Railroad Spurs				
Corridor Length	About 29,000 feet	About 21,000 feet	About 12,000 feet	About 14,000 feet
Right-of-Way	100 feet	100 feet	100 feet	100 feet

THE EXISTING OPERATION

Taconite is a hard, gray rock in which are embedded fine particles of magnetite, a black magnetic oxide of iron. It is found in the geological formation known as the Biwabik Iron Formation in Northeastern Minnesota.

Reserve Mining Company is one of several companies which mine taconite ore from the Biwabik formation and through a process, technically known as *beneficiation*, separate the taconite into an iron-rich concentrate which is made into iron pellets and a nearly barren waste product called tailings. These pellets provide a uniform blast furnace feed for Armco and Republic Steel Companies, parent companies of Reserve, and the market for Reserve's pellets.

Reserve differs from most other Minnesota taconite mining companies, in that the mining and processing phases of its operations are geographically separated. The beneficiation process occurs at Silver Bay, 55 miles northeast of Duluth, Minnesota on the north shore of Lake Superior (return to Figure 1). Their taconite ore is actually mined near Babbitt, Minnesota, located about 47 rail miles to the northwest of Silver Bay, and then rail hauled by Reserve's private railroad to Silver Bay.(1) While all other taconite mining companies in Minnesota transport only the finished pellets to shipping points on Lake Superior, with tailings disposal occurring on-land, Reserve transports the taconite ore itself and disposes of its tailings via discharge into Lake Superior. It is this latter aspect of Reserve's current operations that the courts have decreed shall cease.

Taconite mining and processing involves basically four sequential steps:

1. Mining
2. Crushing
3. Concentrating
4. Pelletizing

A brief description of each segment follows.

MINING, COARSE CRUSHING AND RAIL HAULAGE

After the ore deposit has been cleared, the glacial overburden stripped off and the waste rock overburden and lean ore removed and stockpiled; the taconite ore is drilled, blasted, loaded and hauled from the pit (Figure 5, Area 1). Each year, approximately 30.1 million long tons of ore are mined.(2) In order to get to this quantity of ore annually, about 11.8 million long tons (estimated) of waste rock and lean ore (exclusive of glacial overburden) must be removed and stockpiled.(3)

Blast holes are prepared by rotary drilling in waste rock and jet piercing in the taconite ore. After the holes are drilled, they are loaded with explosives and blasted. Broken waste rock and lean ore are loaded into large end dump trucks by large shovels. Broken ore is loaded into 90 ton side-dump tractor trailers by 12-cubic yard electric shovels. The waste rock and lean ore are transported to stockpiles located either in the pit or near the pit. Ore is then transported up to 3 miles to either of two primary crushing plants where the crusher operator dumps the ore into large bins feeding 60 inch gyratory crushers (first stage) that reduce the mine run ore to approximately 8 inches. Following this first stage of crushing are four 30-inch crushers (at each crushing plant) (second stage) that crush to a rail haul ore product that is less than 4 inches in size. Ore is fed from these crushers onto a conveyor belt and discharged into loadout bins. An 85-ton railroad car is gravity loaded from the bins in one to two minutes. Cars are then assembled into approximately 150-car unit trains that carry the crushed taconite on Reserve's private railroad southeast about 47 rail miles to Silver Bay.

FINE CRUSHING

The primary crushing plants are included in the mining operation because these plants are part of the Babbitt facilities near the mine. The final crushing is included in the fine crushing segment which occurs at the processing facilities in Silver Bay.

When the ore trains arrive in Silver Bay, the cars are dumped by two rotary car dumpers in tandem, and the ore is conveyed to storage bins (Figure 5, Area 2). The 4 inch and finer ore is withdrawn from these bins as required and transferred by conveyor to ten crushing sections in the fine crushing plant (third stage). Ore is crushed from 4 inches to 1-1/4 inch taconite during the third stage of crushing, and subsequently to less than 3/4 inch size during the fourth stage. Prior to third and fourth stage crushing, the finer ore fraction is removed by screening and bypasses the third and/or fourth stages of crushing. The final 3/4 inch or finer ore is then conveyed to the concentrator storage bins in the concentrator.

CONCENTRATING PROCESS

The 3/4 inch and finer taconite is drawn from the concentrator storage bins at a controlled rate and is conveyed to 22 parallel concentrating circuits. Each of the 22 circuits is basically identical (Figure 5 , Area 3). Crushed taconite ore and water are introduced to the system and waste tailings and concentrate both containing water are the output of the system. The concentrating process is not particularly complex, although difficult to explain. The process is simply one of repeated grinding, magnetic separation, hydraulic separation, sizing, rejection of non-magnetic waste material as tailings and removal of water (or dewatering). At each succeeding stage of separation, a higher grade of magnetic concentrate is produced.

Figure 6 illustrates 1 of the 22 parallel concentrating circuits and the recycling concept used in concentrating. Tailings are discharged at five points during the process. During this process, the taconite ore is subjected to three stages of grinding, three stages of magnetic separation, three stages of sizing and three stages of dewatering and hydraulic separation. The plant can also be operated without the regrind circuit, shown within the dashed line in Figure 6. In this case, coarse material from the magnetic separators G, is sent directly to the hydroseparators K. The tailings are collected from each step of separation and then transported down a series of troughs or launders. The tailings from the two main launders are discharged onto the tailings delta which has formed out into Lake Superior. A portion of these tailings stays on the delta and the remainder flows into Lake Superior.

PELLETIZING

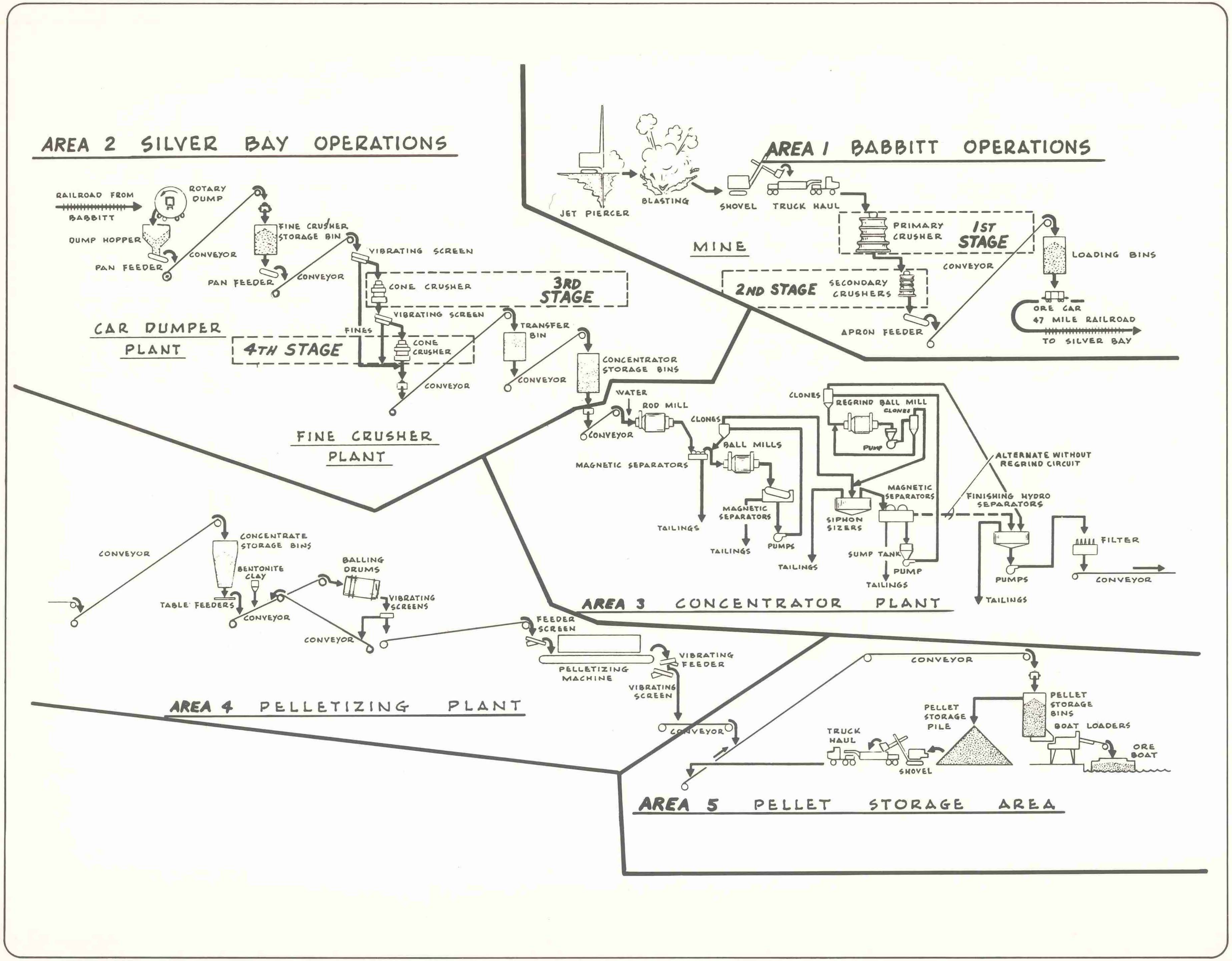
After the iron concentrate leaves the concentrator on a conveyor, it is stored in bins and is withdrawn as needed (Figure 5 , Area 4). At the pelletizing plant, the concentrate is mixed with bentonite (approximately 1.1% added). The bentonite adds strength to the pellets before firing, aids in the retention and control of moisture during the forming and handling of pellets prior to firing, and controls the release of moisture during firing. The mixture is conveyed to balling drums where small balls are formed in horizontal, rotating, drums. As the pellets are discharged from the drums, they are roll-screened, removing pellets (less than 5/16 of an inch) to be returned to the drum feed, while finished pellets (larger than 11/32 of an inch) are sent by conveyor for firing. The pellets are spread onto horizontal-grate pelletizing machines in which the product is advanced through stages including up and down-draft drying, up and down draft heating, burning and two stages of cooling. During this process of induration (hardening), the temperature reaches as high as 2400°F. A chemical change occurs in which the magnetic oxide of iron (magnetite-Fe_3O_4) is converted to the hematite (Fe_2O_3) form. The fuel currently used for pelletizing is natural gas. The hardened pellets, after leaving the traveling grate, are passed over a shaking screen, quenched and conveyed to storage bins ready for shipment, or are stockpiled.

SHIPPING FACILITIES

From the pelletizer, the pellets are conveyed to the loading and storage areas adjacent to the harbor (Figure 5 , Area 5). The harbor at Silver Bay is formed by breakwaters which reach from the shore to Beaver Island and Pellet Island. Ore boats from the lower Great Lakes ports enter the harbor and are loaded at the dock by boat loaders. Through a system of belt conveyors, pellets from the plant can be stockpiled and simultaneously loaded onto ships. Reserve ships pellets 9 to 10 months each year.[10]

POWER PLANT

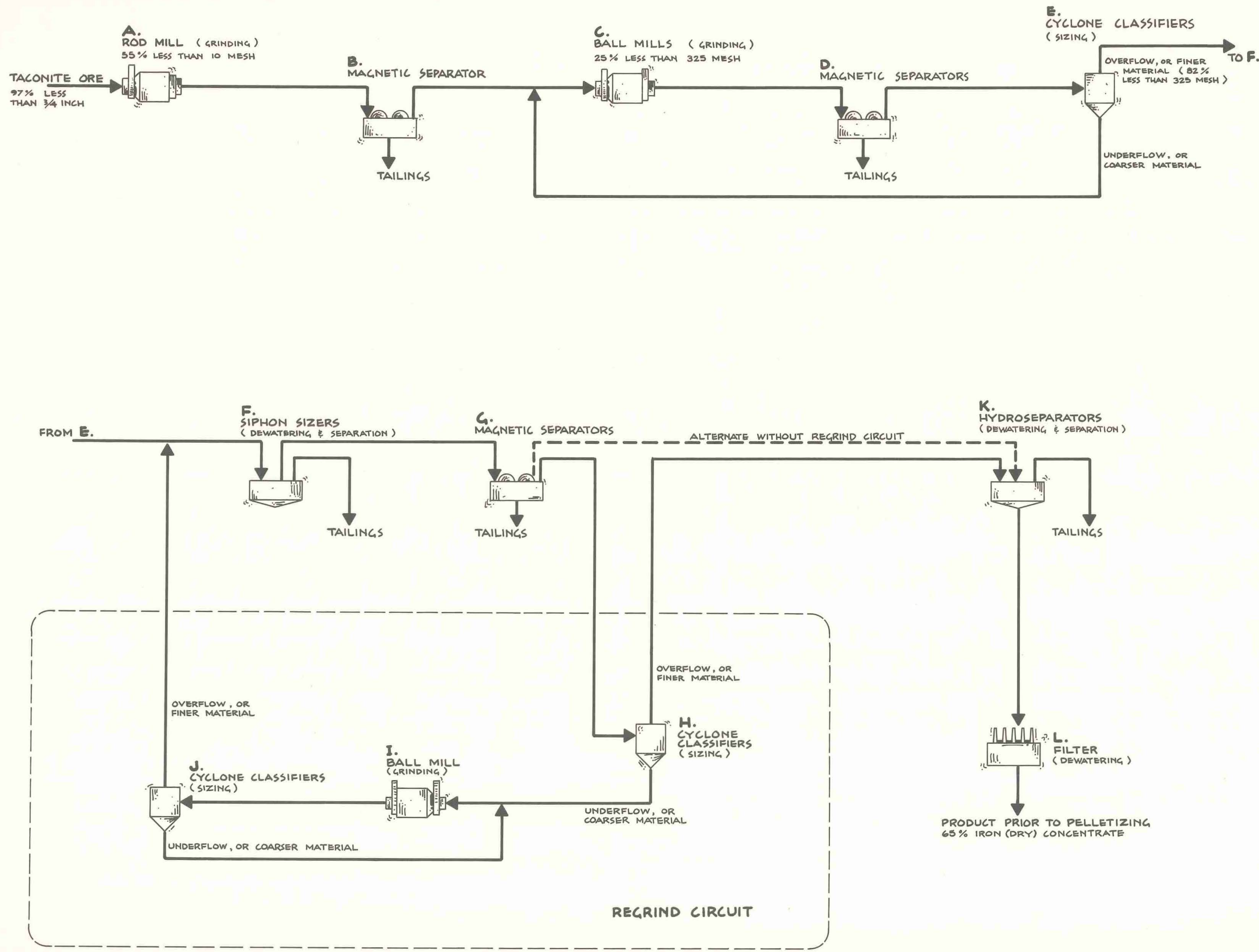
Power is supplied for the processing by two steam-driven turbines with a total availability of 128,000 kw. Boilers are fired with natural gas, when available, or with coal. Lake Superior water is used in the turbine condenser. The water temperature rises 12°F in this step and is presently discharged into a sump, where it is mixed with lake water being pumped into the plant for process use.[11]



5 SCHEMATIC FLOW DIAGRAM OF RESERVE'S EXISTING OPERATIONS

SOURCE: Reserve Mining Company

BARTON-ASCHMAN ASSOCIATES, INC.
MINNEAPOLIS/ST. PAUL, MINNESOTA 55454



6 PRESENT CONCENTRATING CIRCUIT

BARTON-ASCHMAN ASSOCIATES, INC.
MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

THE PROPOSED OPERATION

As part of the plan to cease discharge of tailings to Lake Superior resulting from the processing of taconite at Silver Bay, Reserve proposes to: (a) make major changes in plant operations to improve the physical and chemical quality of pellets by increasing the iron content and reducing the silica content and; (b) to dispose of the waste product, tailings, in a tailings basin and dry tailings storage area on land. To carry out these purposes, Reserve has proposed: major changes in its existing concentrating plant and its concentrate dewatering (filtering) system, a tailings dewatering system, a tailings transport system, on-land tailings disposal and delta stabilization. The major proposed processing plant changes include: dry cobbing, flotation, screening, concentrate filtering, tailings filtering, and changes in use of power plant cooling water. The proposed tailings transport system involves conveyor transport of coarse cobbed and sand-sized filtered tailings, railroad transport of cobbed and filtered tailings, and pipeline transport of fine tailings and return water to the plant. The proposed on-land tailings disposal plan includes tailings dams, fine tailings basin, coarse tailings stockpiles, seepage collection, stream diversions, railroad spur and access road construction. Proposed delta stabilization involves the construction of a rock dike around the perimeter of the delta shoreline.

PROPOSED DRY COBBING PROCESS

A new building is proposed to be constructed between the existing fine crusher and the concentrator on the east side of U.S. 61 to house the dry cobbing equipment (Figure 7). Dry-magnetic separators are to be used to treat the 97% less than 3/4 inch size taconite ore coming from the fine crusher (Figure 8, Area 3). This dry magnetic separation process is to reject 22% of the taconite ore as coarse cobbed tailings, 6,598,000 dry long tons/yr.(2) With this proposed reduced feed rate, subsequent grinding phases of the process will produce finer sized products with better liberation of the magnetite, resulting in a finer sized wet tailings.[25]

PROPOSED CONCENTRATING PROCESS

The partially concentrated ore from the proposed dry-cobber building will be stored in the concentrator storage bins as in the present process, and then drawn out at a controlled rate and conveyed into the 22 parallel concentrating circuits (Figure 8, Area 5). However, each of these circuits are proposed to be modified as follows (Figure 9).[26]

1. Fine screening is to replace one stage of cyclone separation (Figure 9, H).

2. Primary and secondary flotation is to be added to the circuit to selectively remove quartz (silica) and amphibole (silicate) particles.(27) (Figure 9, K and Q). A chemical reagent (Arosurf MG-98A) will be required, and a reagent handling system and building will be constructed.

3. Three new sets of magnetic separators are to be installed.

PROPOSED CONCENTRATE FILTER PROCESS

Concentrates from each of the 22 concentrating circuits are to be pumped to two new 75 feet hydroseparators and then a proposed new concentrate filter building (Figure 8, Area 6), where the concentrates are to be dewatered by vacuum filtering and conveyed to the pelletizer. Water is proposed to be recycled.(28)

PROPOSED TAILINGS SEPARATION AND FILTERING PROCESS

Tailings from the concentrator are to be collected in two troughs or launders and sent to the tailings separation and filtering system (Figure 8, Area 7). They are to first enter two hydroseparators, where a size separation between larger sand size (filtered) and finer silt size tailings is to be made (at about 65 mesh) by gravity settling. The dewatering of the sand size and fine tailings is proposed to be as follows:(28)

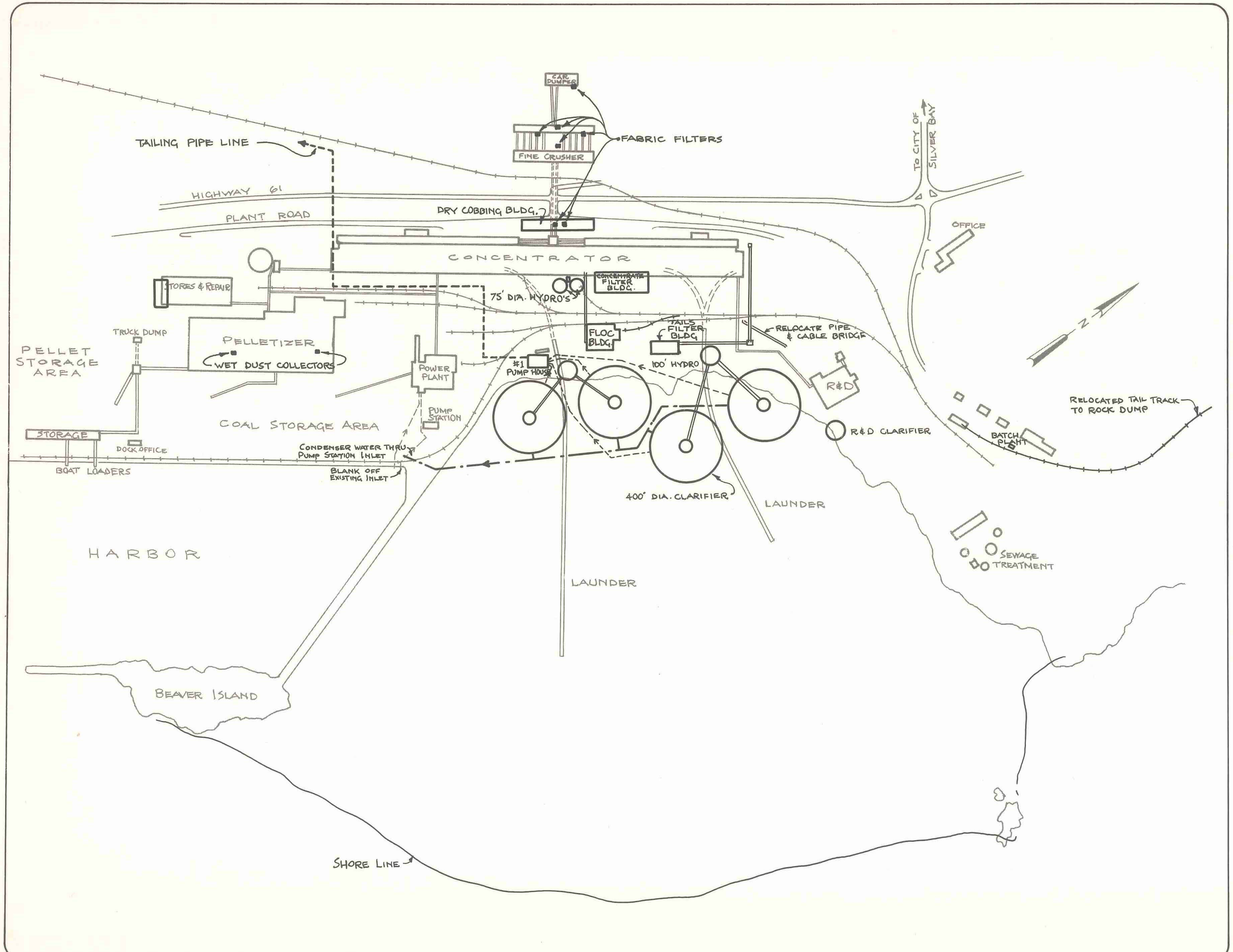
1. Sand size (filtered) tailings. The sand size tailings are to be reduced to 10% moisture by cyclones and belt type filters. Water is to be recycled to the concentrator.

2. Fine tailings. The fine tailings are to be sent to clarifiers and dewatered to a 60% solids by weight slurry. Settling is to be aided by a flocculent (Polymer M-502). The overflow water is to be recycled to the concentrator.

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

7 PROPOSED PROCESSING PLANT LAYOUT



SOURCE: Reserve Mining Company

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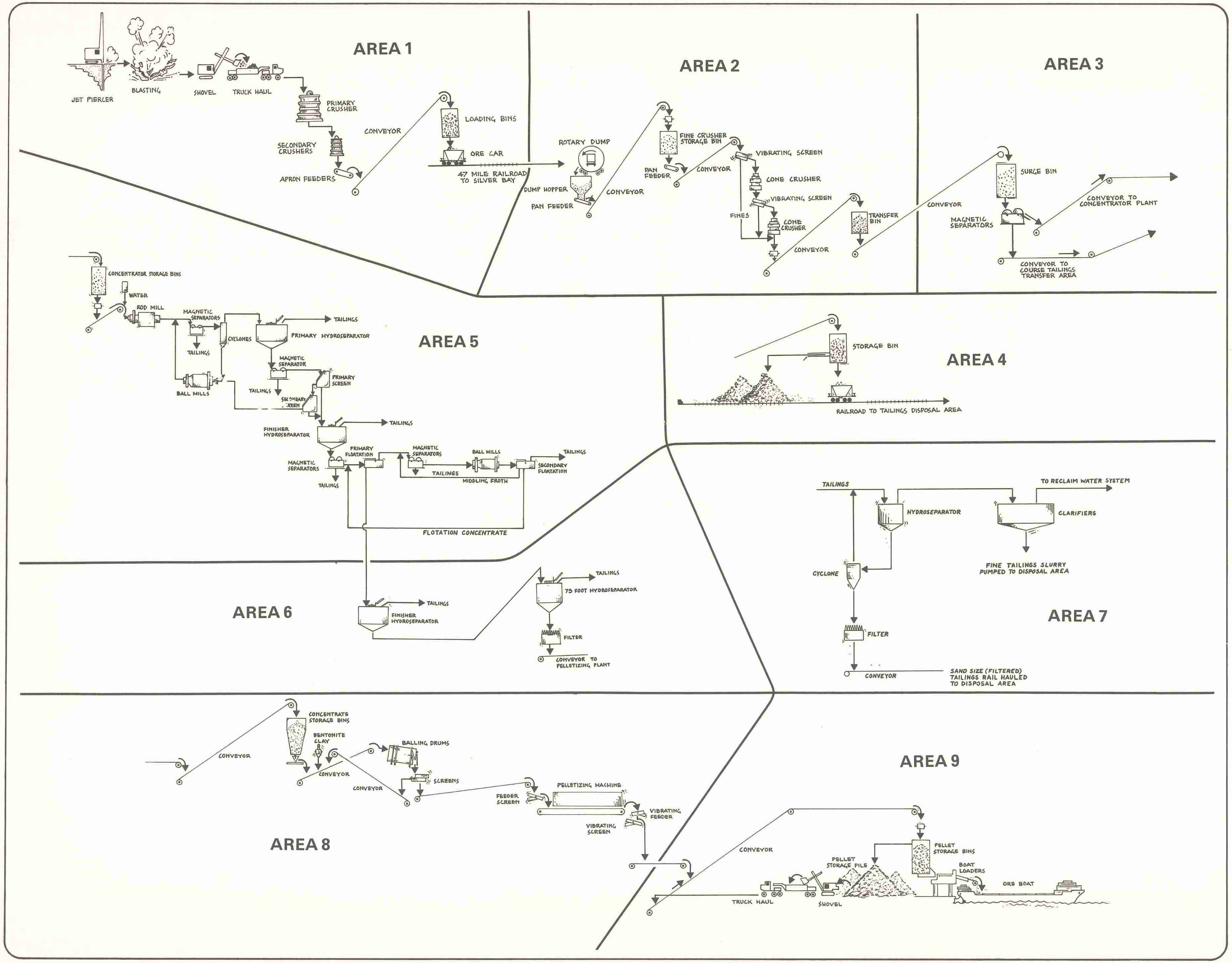
ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN



8 SCHEMATIC FLOW DIAGRAM OF RESERVE'S PROPOSED OPERATIONS

BARTON-ASCHMAN ASSOCIATES, INC.

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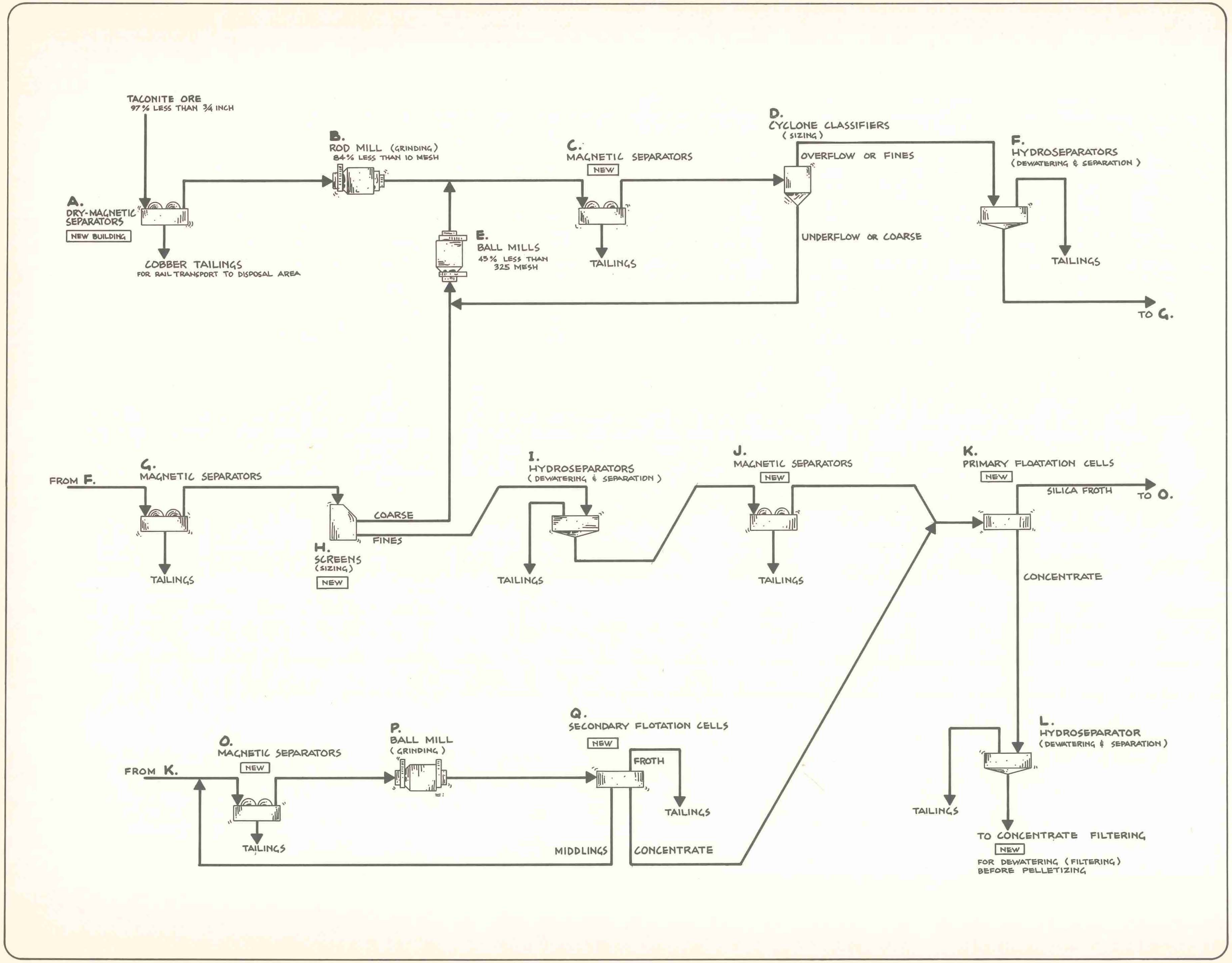
ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

9 PROPOSED CONCENTRATING CIRCUIT



LEGEND

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PROPOSED TAILINGS TRANSPORT AND WATER RECYCLING

Tailings are proposed to be transported by two systems. Cobbed and filtered tailings are to be conveyed across U.S. Highway 61 to loading facilities and then rail hauled to the proposed Mile Post 7 disposal area. Fine tailings and fly ash are to be pumped through pipelines to the proposed Mile Post 7 disposal area. Reserve also proposes a water recycling system. The systems outlined above may be described as follows:

1. Coarse (cobbed and filtered) tailings. The proposed conveyor system for transporting these tailings to the railroad load out bins will rise 315 feet over a distance of 6,300 feet. Two proposed belt lines will require 790 brake horsepower each. The proposed conveyor system is to cross U.S. Highway 61 northeast of the concentrating plant (Figures 10 and 11).

   Reserve proposes to construct 8,500 feet of railroad track in the Silver Bay yard and five and one half miles of double track spur from the existing Reserve railroad at Mile Post 6.5 for the proposed Mile Post 7 plan. Two 25 car trains, each requiring three 2,000 horsepower locomotives, are proposed to be used in coarse tailings transport.[29]

2. Fine tailings. A double pipeline 33,500 feet long and with an outside diameter of 24 inches, rising 625 feet, is to be used in the pumping of a 60% solids (by weight) slurry to the fine tailings disposal basin (Figures 12 and 13). One pipeline is to serve as a spare. Four pumphouses will be required outside the basin. Pumphouses 2 and 3 are to have dump valves and holding basins for tailings. A service road is to be constructed along the pipelines.

   An additional 15,000 feet of pipeline will be required to distribute tailings within the proposed Mile Post 7 basin. The slurry will contain four long tons per hour (LTPH) of fly ash from the power plant along with 1,476 LTPH of tailings.[29]

3. Reserve's proposed water recycling system involves water recycling within the concentrating, tailings filtering and concentrate filtering systems. Water is also to be returned from the proposed Mile Post 7 fine tailings basin. A proposed pumphouse floating on the basin and a 24 inch diameter water reclaim pipeline will return water from the proposed tailings disposal site to the processing plant. A 10 inch seal water steel pipeline, for the tailings pipeline pumps, will also be required. A proposed 50,000 gallon holding tank is to be constructed near pumphouse 4 for the seal water line.[30] All pipelines are to follow the same route. Figure 14 shows the estimated process water balance. Some new make up water will be required in the proposed new processing plant. These water requirements as estimated are shown in Figure 15.

PROPOSED DAM CONSTRUCTION

Topography of the proposed tailings basin area is such that a natural valley will contain the fine tailings in conjunction with four proposed dams.[31][32] The proposed dams are required to close the valley and bridge gaps in the ridges forming the valley (refer to Figure 16).

With the exception of Dam #4, dams are proposed to be built over a period of 10 years. They are to primarily consist of coarse (cobbed and filtered) tailings. Of the total quantities of cobbed and filtered tailings estimated to result from Reserve's proposed operation over 40 years, about one-fifth is proposed to be used for dam, dike and road construction. This is to be virtually the entire quantity produced in the proposed process over a period of about eight years.

Starter Dam #1 and starter Dam #2-3 are to consist of compacted glacial materials borrowed from within the perimeter of the proposed fine tailings disposal basin. Site preparation for the proposed starter dam construction is to include tree and brush removal, stump removal and stripping of topsoil (0.5 to 2.5 feet thick) to expose underlying clay soils.

In the first construction season, 34 acres will be cleared and stripped in this manner for starter Dam #1.[33] Prior to placement of coarse tailings at the end of the second construction season, an additional 253 acres will also be cleared and stripped as above (for Dam #1). Preparation for construction of the remaining proposed dams is to include tree and brush removal and stump removal.

The starter dam for Dam #1 is proposed to be constructed in two stages:[34] one stage from Elevation 1,125 to Elevation 1,150 in one season; the second stage to Elevation 1,170 in the following construction season. The starter dam for Dam #2-3 is to be about 10 feet high (Elevation 1,160 to 1,170). Construction is to follow immediately the construction of the starter dam at Dam #1.[35]

The construction procedure for the starter dam for Dam #1 is to provide for a 200 feet wide zone that will be about 5 feet lower than the remaining crest. This low zone is to be an emergency spillway to allow overflow in a restricted area in the event of a large storm (exceeding the capacity of the diversion culvert discussed in a following section). The starter dam arrangement for Dam #1 is shown in Figure 17.

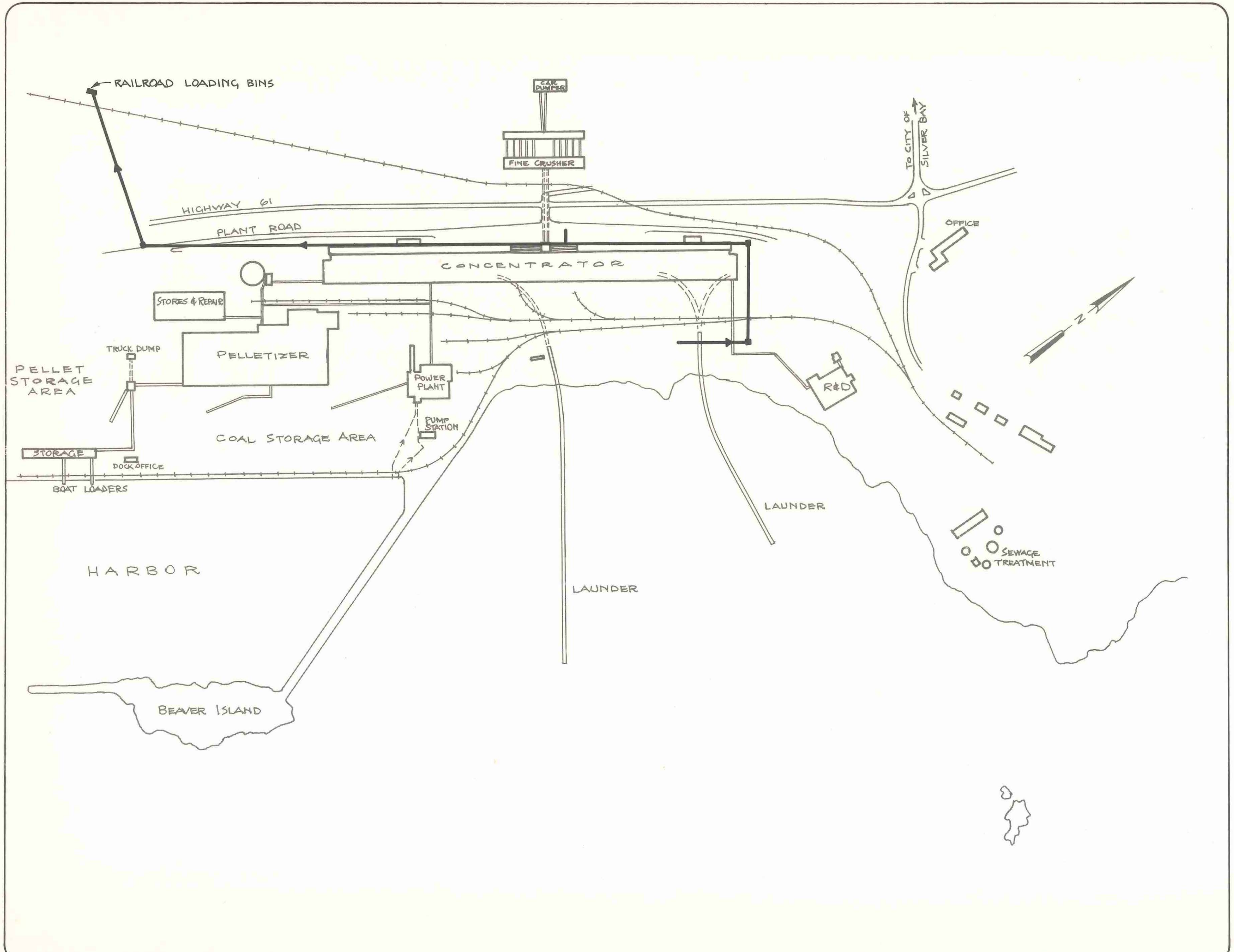
The coarse tailings are to be rail hauled to the dams where the material is to be spread by graders and compacted by rollers. For typical cross-section of Dam #1 see Figure 18.[36]

The lowest elevation in this area is approximately 1,120 feet. Final dam elevation would be 1,280 feet. Dam #1, to the southwest, is to be the principal dam, and would be 12,600 feet long and 155 feet high, running northwest to southeast. Figure 18 presents a typical section of Dam #1, illustrating final height after 40 years and initial starter dam con-

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

10 SCHEMATIC DRAWING OF PROPOSED CONVEYOR SYSTEM



SOURCE: Reserve Mining Company

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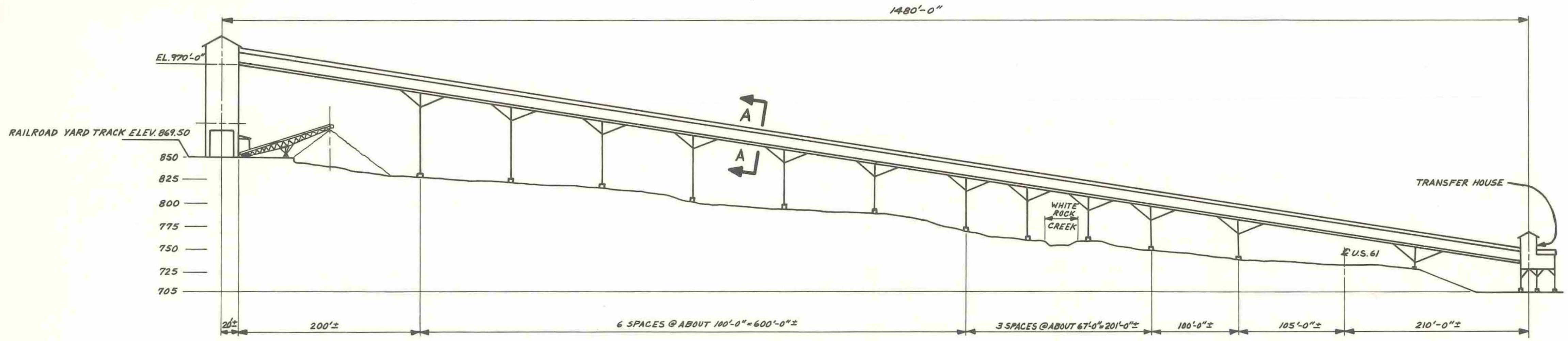
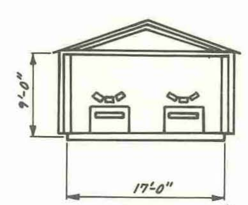
ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

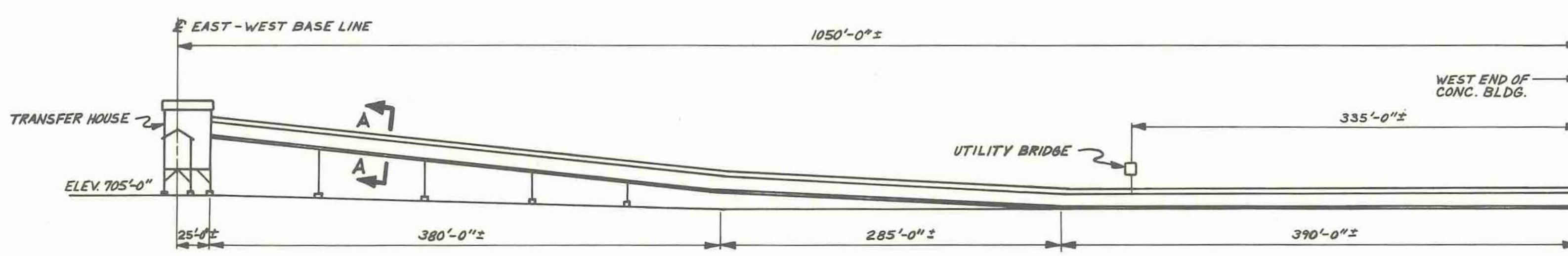
11 ELEVATION OF PROPOSED CONVEYOR OVER U.S. 61 AND WHITE ROCK CREEK



ELEVATION-CONVEYOR 205 & 206



SECTION A-A



SEE RESERVE MINING DWG. 29-7090 FOR CONTINUATION

ELEVATION CONVEYOR 203 & 204

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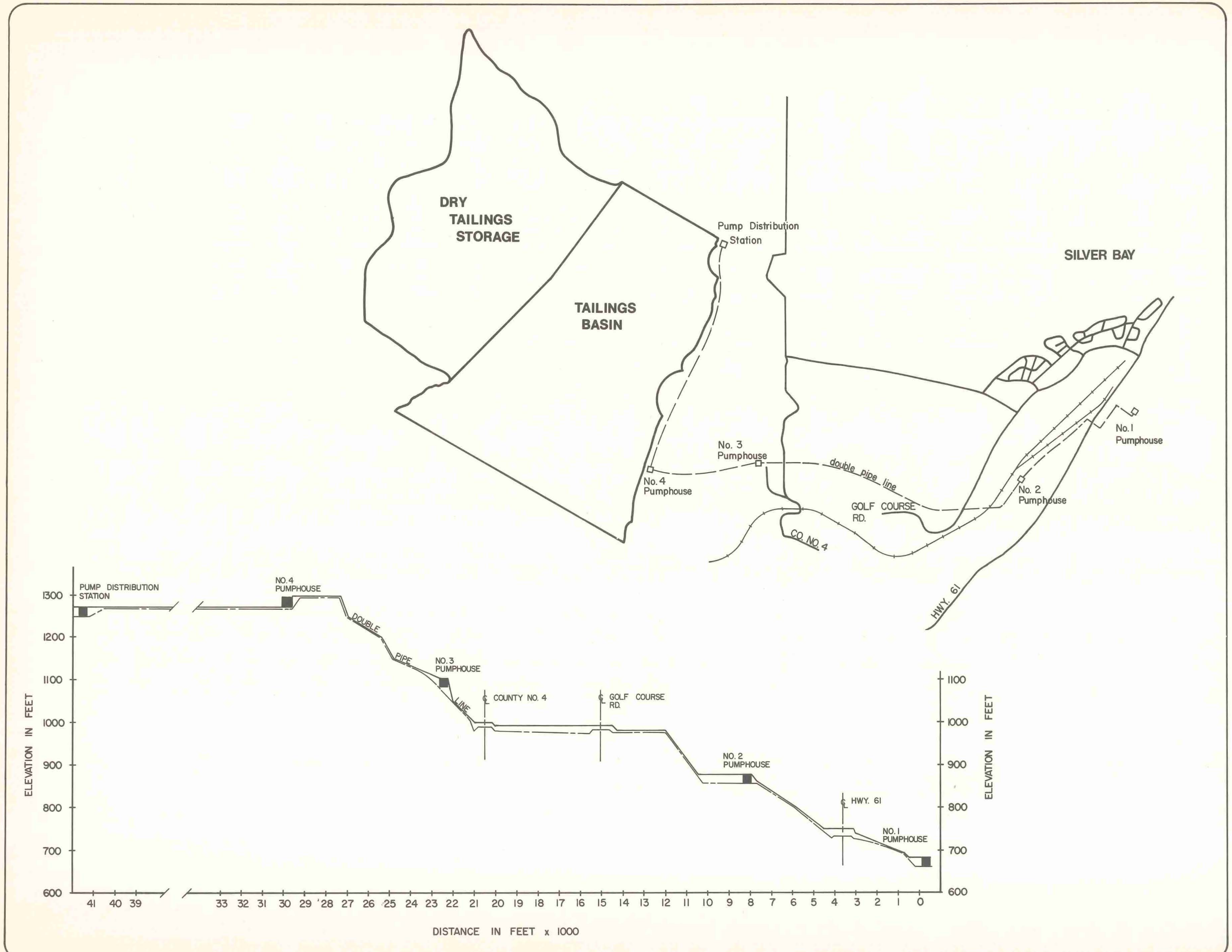
ENVIRONMENTAL IMPACT STATEMENT
RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

12 PROPOSED MILE POST 7 PIPELINE ROUTE AND ELEVATION



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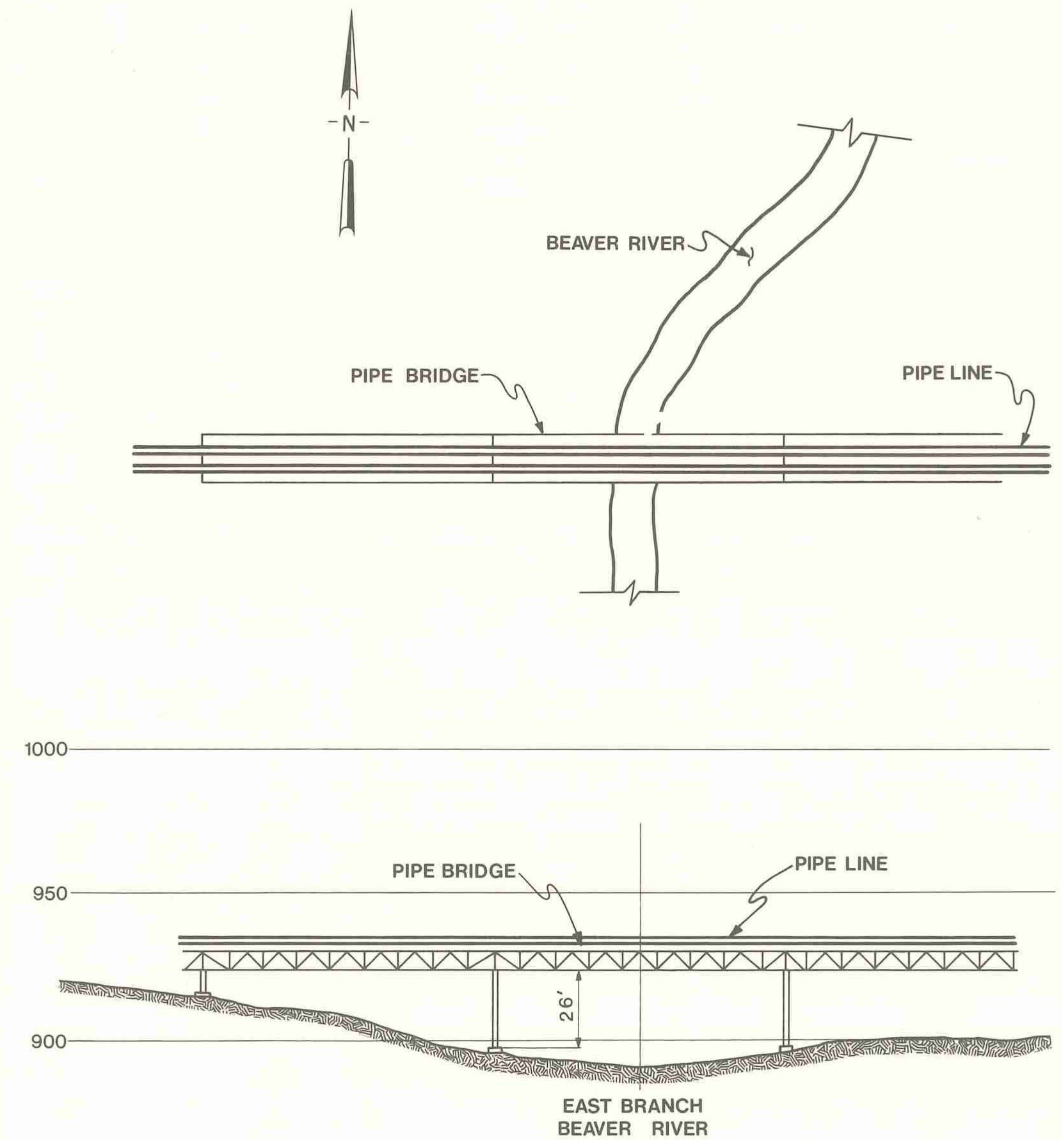

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

13 PROPOSED PIPELINE CROSSING - EAST BRANCH BEAVER RIVER - PLAN AND ELEVATION

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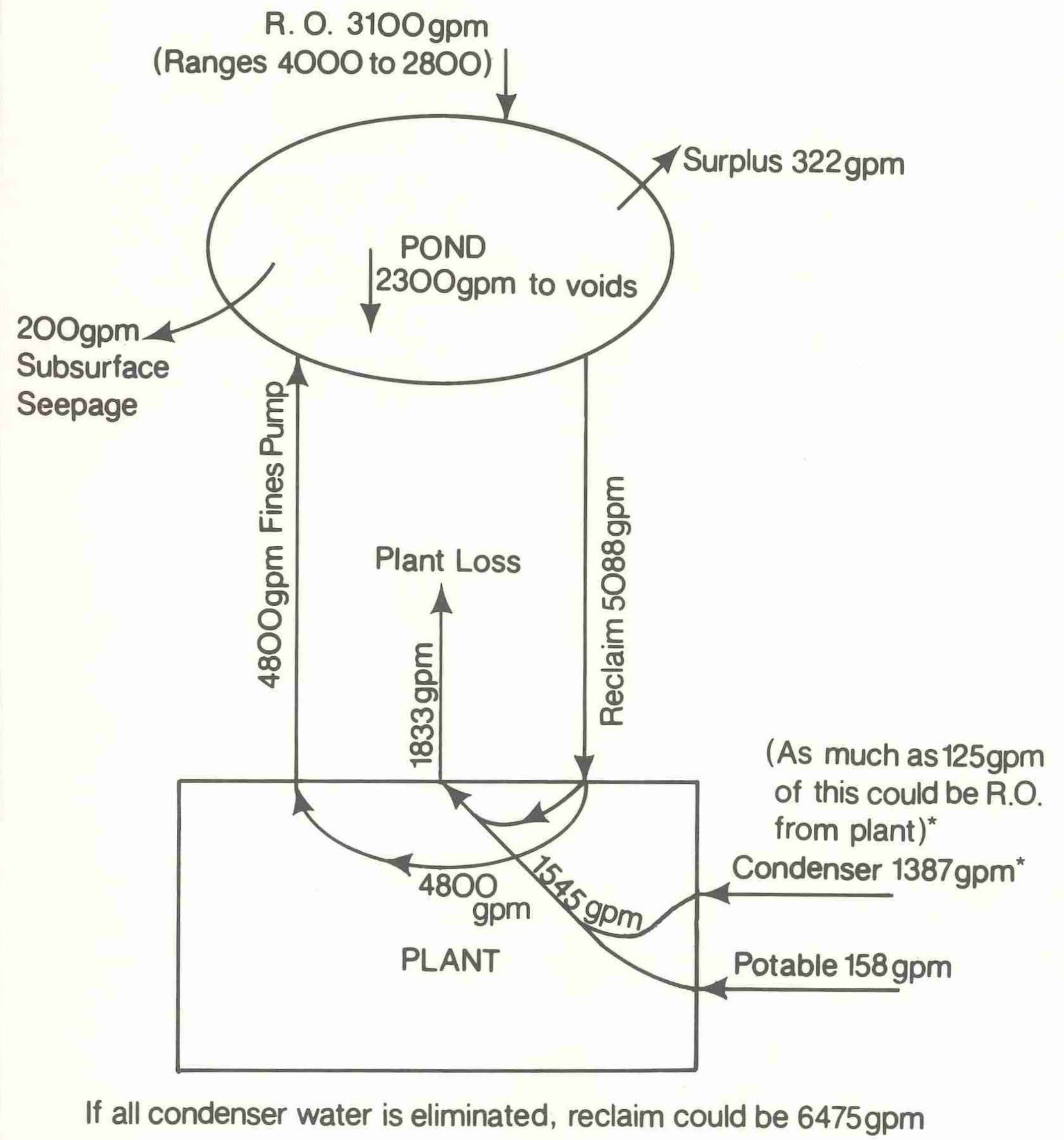


ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

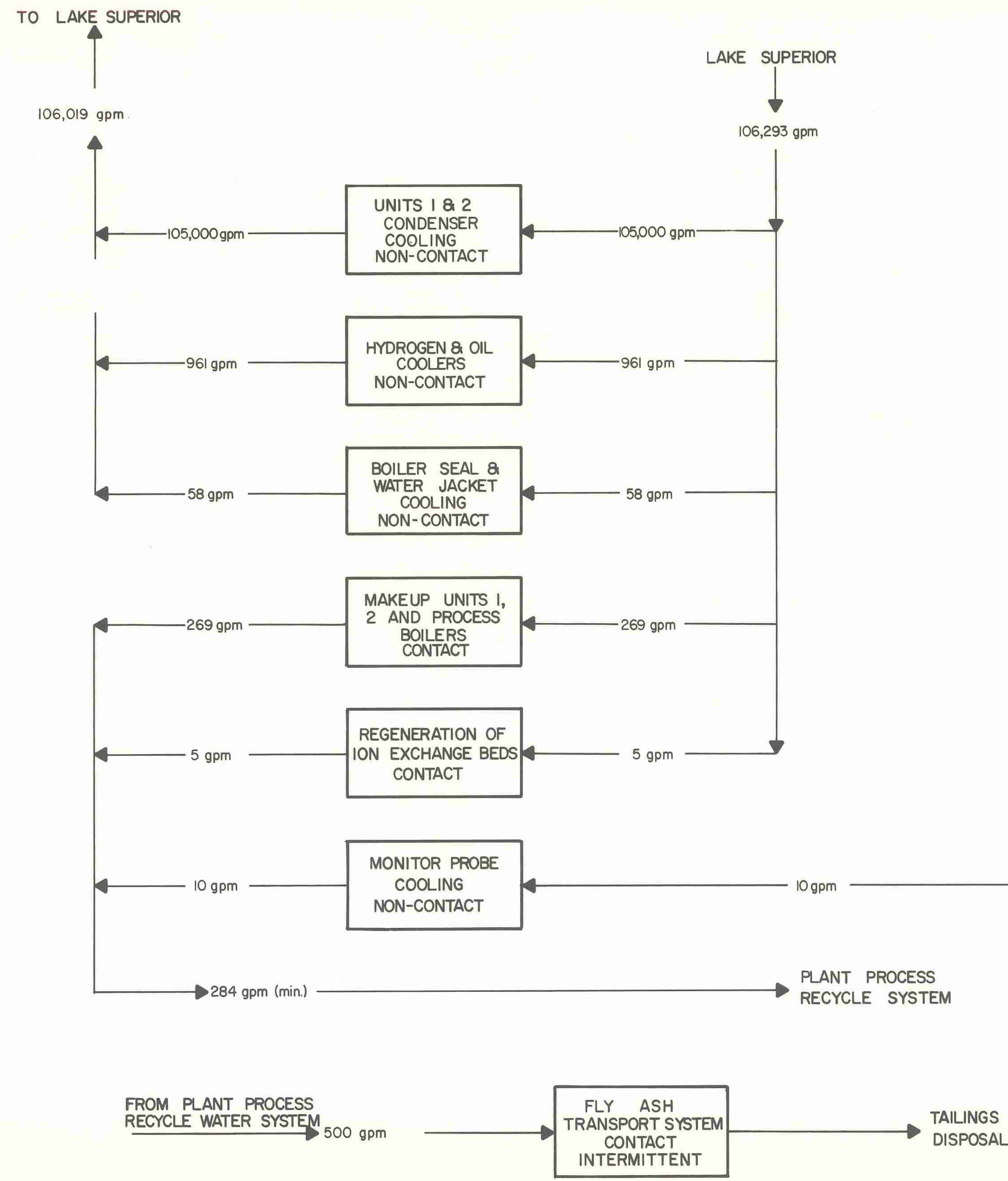
14 ESTIMATED PROPOSED PROCESS WATER BALANCE

LEGEND

NOTE: 1"/yr.
over 5600
acres = 290gpm

BARTON-ASCHMAN ASSOCIATES, INC.

BARR ENGINEERING



ENVIRONMENTAL IMPACT STATEMENT
RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

15 POWER PLANT WATER FLOW AND PROPOSED PROCESS MAKE-UP WATER REQUIREMENTS

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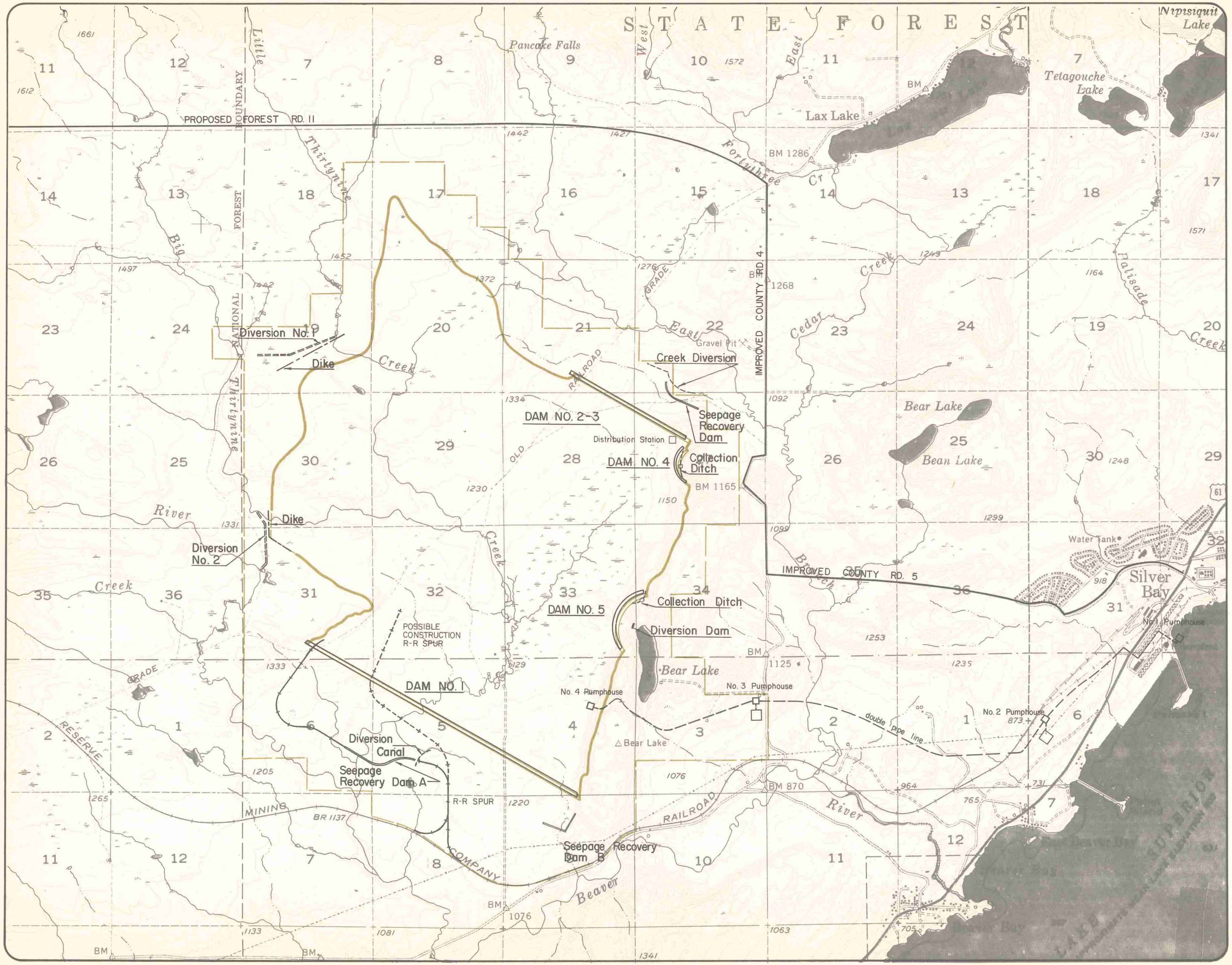

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

16 PROPOSED MILE POST 7 PLAN, TAILINGS BASIN AND ANCILLARY FACILITIES

LEGEND

- TAILINGS BASIN
- PROPOSED SITE BOUNDARY

SOURCE: Reserve Mining Company

BARTON-ASCHMAN ASSOCIATES, INC.

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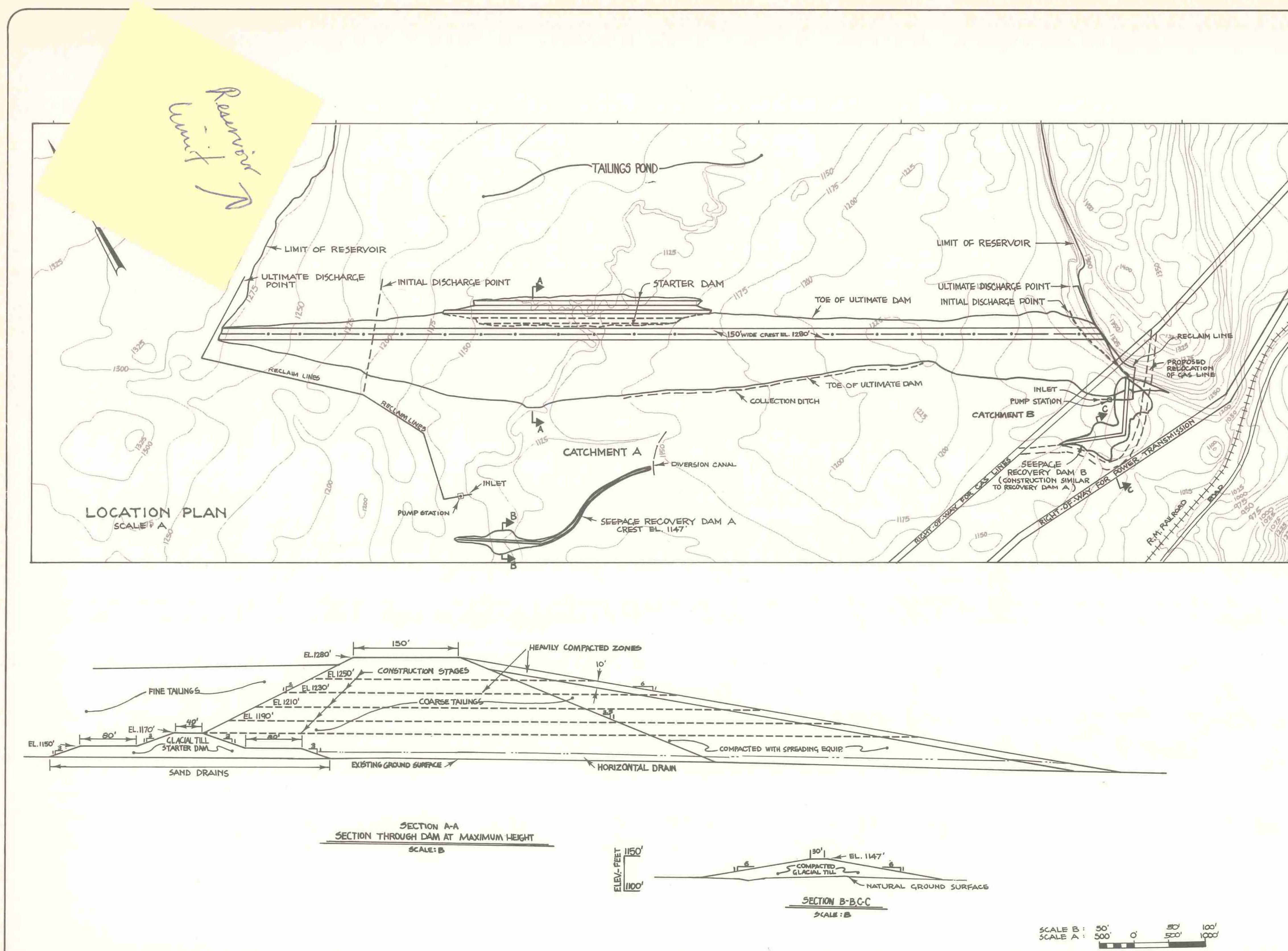
ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

17 PROPOSED STARTER DAM #1 - GENERAL ARRANGEMENT PLAN



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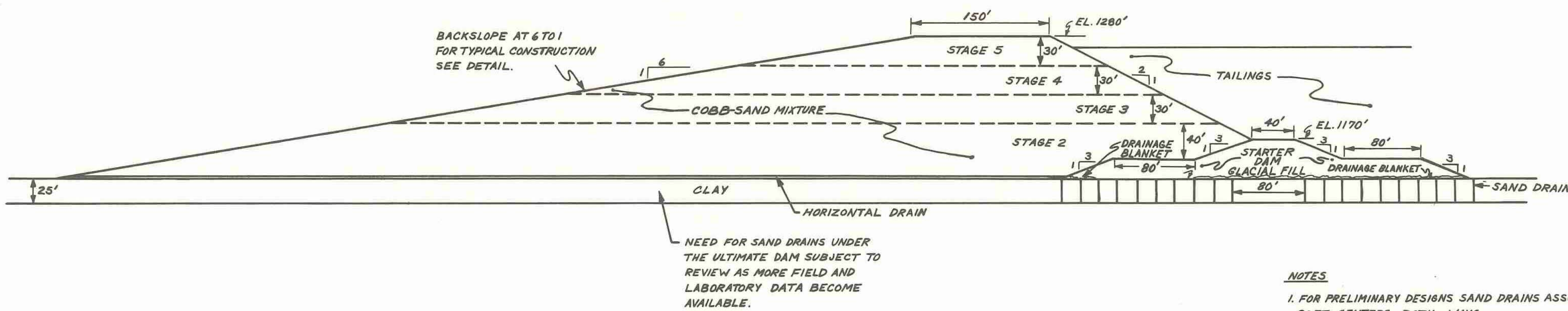
ENVIRONMENTAL IMPACT STATEMENT

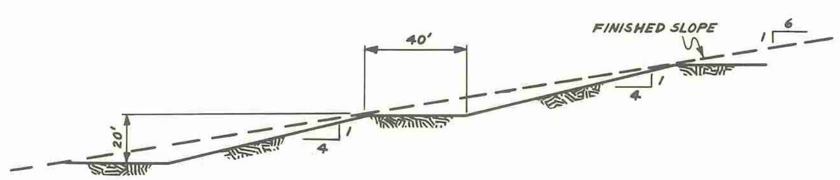
RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

18 TYPICAL CROSS-SECTION - PROPOSED DAM #1



NOTES

1. FOR PRELIMINARY DESIGNS SAND DRAINS ASSUMED AT 20FT. CENTERS, BOTH WAYS.
2. SAND DRAIN DIAMETER 18".
3. SAND DRAIN ARE REQUIRED ONLY UNDER THAT SECTION OF THE DAM UNDERLAIN BY CLAY. (CENTRAL SECTION OF VALLEY)
4. CONSTRUCTION STAGES SHOWN ARE TENTATIVE AND MAY BE REVISED AS REQUIRED TO SUIT FINAL CONSTRUCTION SCHEDULES.



DETAIL
TYPICAL BACKSLOPE CONSTRUCTION

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struction. Dam #2-3 (a single dam which replaces prior plans for two separate dams) to the northwest, would run southeast to northwest and be 5,200 feet long and 120 feet high. Dam #4 would be 1,700 feet long and 80 feet high, and run approximately north-south (See Figure 19). Dam #5 (Bear Lake Dam) would be 2,800 feet long and 130 feet high running approximately north-south, on the southeastern side of the basin, and separate the tailings pond from Bear Lake. (37)

PROPOSED COARSE TAILINGS STORAGE/DISPOSAL AREA

The proposed Mile Post 7 plan includes a separate storage/disposal area for dry cobbed and filtered tailings. The proposed coarse tailings storage/disposal area is to be located to the northwest of the proposed fine tailings disposal basin (refer to Figure 16). This area is to be cleared prior to operation.[36]

During the first 10 years of operation, the proposed coarse tailings area is to be used for stockpiling the coarse and filtered tailings for use in construction of the dams, roads and dikes if winter construction proves unfeasible. After the first 10 years, the coarse tailings are proposed to be disposed via side-dump rail cars in the proposed coarse tailings storage/disposal area. The ultimate height of the coarse tailings disposal area is 1,430 feet, or 150 feet above the tailings dams.

PROPOSED SEEPAGE COLLECTION

Proposed seepage collection dikes are to be located downstream of Dam #1 and Dam #2-3. Dam #4 and Dam #5 will not have seepage collection dikes, but are to have collection ditches along their ultimate downstream toes.

The function of these dikes and ditches as proposed is two-fold.[38]

1. To collect any water that passes through the dams.

2. To permit monitoring of the dam structure.

In addition to the water seeping through the tailings dam, the seepage recovery ponds will collect runoff from the downstream slopes of the dams and from the small natural watersheds between the tailings dams and the seepage recovery dams.[39]

Two seepage recovery dikes are to be used for the collection of seepage downstream of Dam #1 (refer to Figure 17). Each of the two dikes is to serve to collect the seepage through a segment of Dam #1 plus the runoff from a catchment area or basin. The dike serving the first catchment area (designated A) is proposed to be 3,080 feet long and 26 feet high. A second catchment area (designated B) is to have a dike 1,675 feet long and 26 feet high.

Along with the proposed dikes, a seepage collection ditch is to be constructed between the two catchment areas and parallel to the dam face. A 650 foot long diversion canal (to be discussed in the following section) is to be constructed to divert runoff from the area between Catchment Area B and Catchment Area A for the first four years of operation.

The proposed seepage recovery dike downstream of Dam #2 and #3 is to be 42 feet high and 1,785 feet long. An unnamed creek is to be diverted as part of the seepage recovery system. This also will be discussed in the following section.

The bases of the dikes will require clearing, stump removal and stripping of topsoil to expose firm mineral soil. Over the downstream portion of each proposed dike, and 18 inch thick horizontal drain layer, of the same material used in the starter dam drains, is to be placed. The dikes are to be homogeneous, compacted earthfill sections with flat (6 horizontal to 1 vertical) downstream slopes. Proposed construction materials and procedures are to be the same as for the starter dam.[39]

PROPOSED STREAM DIVERSIONS

Six primary diversions are to be constructed in the proposed Mile Post 7 plan: three to reduce the amount of water entering the basin to a manageable level,[40] two as part of the seepage collection facilities, and one to permit construction of starter dam #1. These will be discussed in the approximate sequence in which implementation is proposed.[41]

Diversions #1 and #2 are to be constructed first. Both will require construction of a dike with a minimum height estimated at 5 to 6 feet[42] and a maximum height of 20 feet.[43] Diversion dike #1 (refer to Figure 20) is to be 3,030 feet long[44] and will divert Little Thirty-nine Creek to Big Thirty-Nine Creek. It is to be approximately 10 feet wide at the top and 30 feet wide at the bottom, with the sides having a slope of 1:2.[44] Construction material is to consist of glacial till buttressed with mine stripping rock, and further downstream, with the large mass of coarse tailings stockpiled in the proposed storage area.[45]

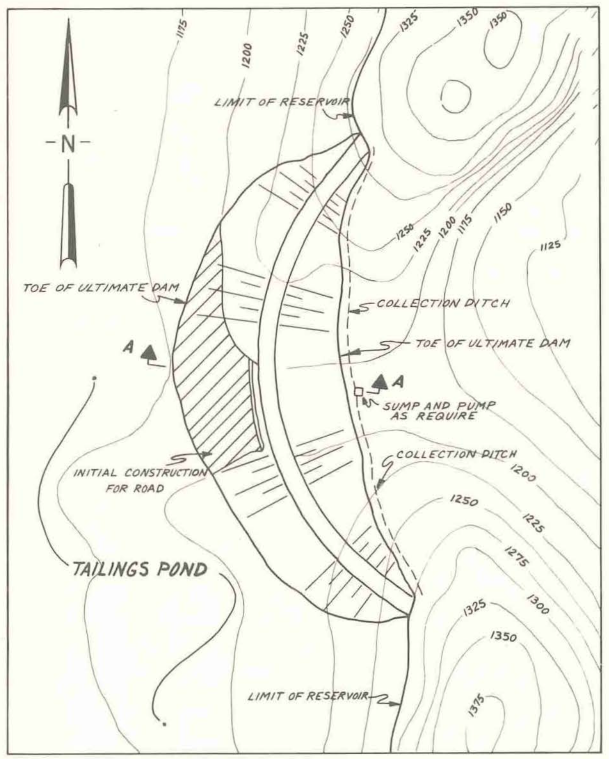
Diversion #1 will also require excavation of a channel 3,890 feet long and varying in depth between 0 and 5 feet.[44] The channel is to have a bottom width varying from 10 to 30 feet and a top width of 30 to 50 feet.[44] Side slopes are to be 1:2; bottom slopes are to be 0.5% crosswise, and the grade is not to exceed 2 feet per 1,000 feet.[46]

Diversion dike #2 (refer to Figure 21) is to be 2,270 feet long[47] and will divert Big Thirtynine Creek to the Beaver River. It is to be approximately 10 feet wide at the top and 34 feet wide at the bottom, with the sides having a slope of 1:2.[47] Construction material is to be the same as proposed for diversion dike #1.

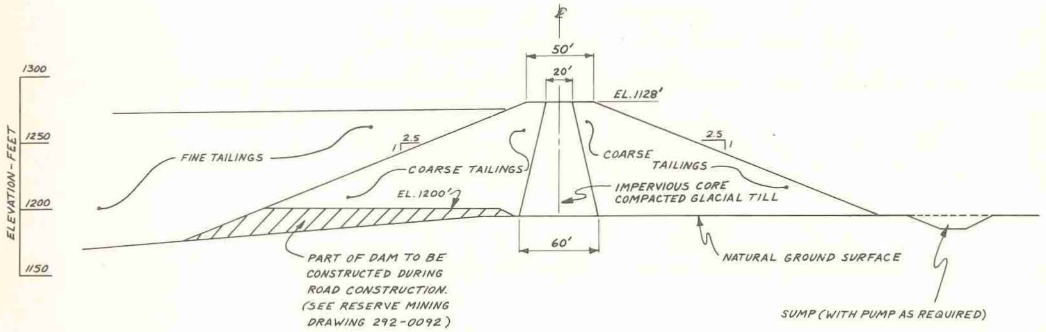
ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

19 DAM #4 GENERAL ARRANGEMENTS



LOCATION PLAN



SECTION A-A

The diversion channel #2 is to be 2,300 feet long and vary in depth from 0 to 6 feet.(47) The bottom is to be 50 feet wide and the top 74 feet wide.(47) Side slopes are to be 1:2; bottom slope is to be 0.5% cross-wise, and the grade is not to exceed 1.5 feet per 1,000 feet.(48)

Proposed diversions #1 and #2 are to divert 22.6 square miles of the 31.3 square miles of Little Thirtynine and Big Thirtynine Creek watersheds tributary to the tailings basin.(49) It is estimated that 23 cubic feet per second (cfs) would be diverted.(49)

However, diversion channels #1 and #2 are to be sized to flows of 4,000 cfs and 10,000 cfs respectively. For comparison, the estimated diversion flows during an average year are 5.6 cfs for diversion channel #1 and 23.0 cfs for diversion channel #2.(50)

An unnamed creek to the north of proposed Dam #2-3 will be diverted by the seepage collection dike mentioned previously (refer to Figure 22). A new channel 2,375 feet long is to be constructed to the north of the existing channel, which will be used for seepage collection.(51)

After the proposed stripping of topsoil for the starter dam for Dam #1, the natural drainage is to be diverted by a dike (refer to Figure 23). It is to be channeled approximately 1,200 feet to a 160 foot long, 36 inch diameter culvert in an area in the valley floor beneath Dam #1 which is to provide a firm bedding for the culvert under loading of the starter dam. From the exit of the culvert, a channel is to be dug to return water approximately 1,100 feet to the natural stream course. This drainage route would continue until such time as the valley floor is utilized for tailings disposal and the culvert is closed.(52)

Also, as a part of the proposed seepage recovery system for Dam #1, a 650 foot diversion canal (return to Figure 17) is to divert the drainage from the area between Catchment Area A and Catchment Area B. Seepage recovery facilities are not proposed at Area B until the elevation of tailing pond reaches 1,175 feet above sea level.(53)

Ten years after commencement of fine tailings disposal, it will be necessary to close off a drainage outlet from Bear Lake to prevent tailings from spilling into Bear Lake.(54) Reserve proposes a 160 foot long, 12 foot high diversion dike of compacted till (refer to Figure 24)(55) to change the flow from the present to an unnamed flow into East Branch Beaver River.(54)

Three alternative methods are proposed for handling the Bear Lake discharge.(56) These are:

1. Construct a discharge canal at the south end of the lake.

2. Construct a discharge canal at the east side of the lake.

3. Remove water by pumping over Dam #5 and into the tailings pond.

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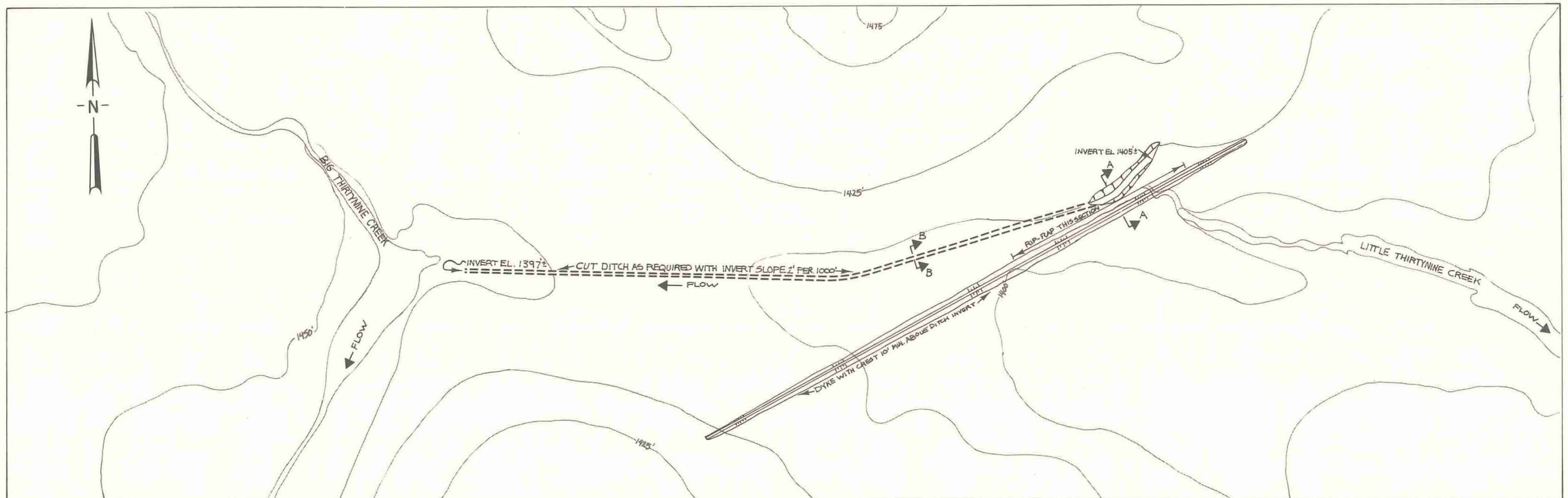
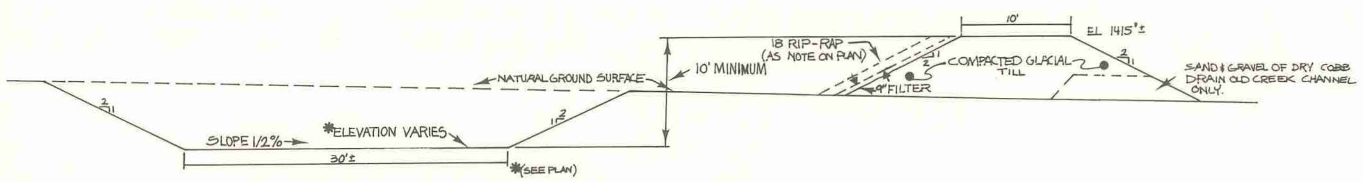
ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

20 PROPOSED DIVERSION #1

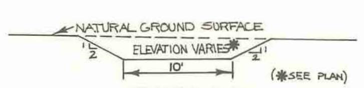


LOCATION PLAN
SCALE: A

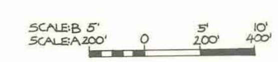


SECTION A-A
SCALE: B

REFERENCE DRAWINGS



SECTION B-B
SCALE: B



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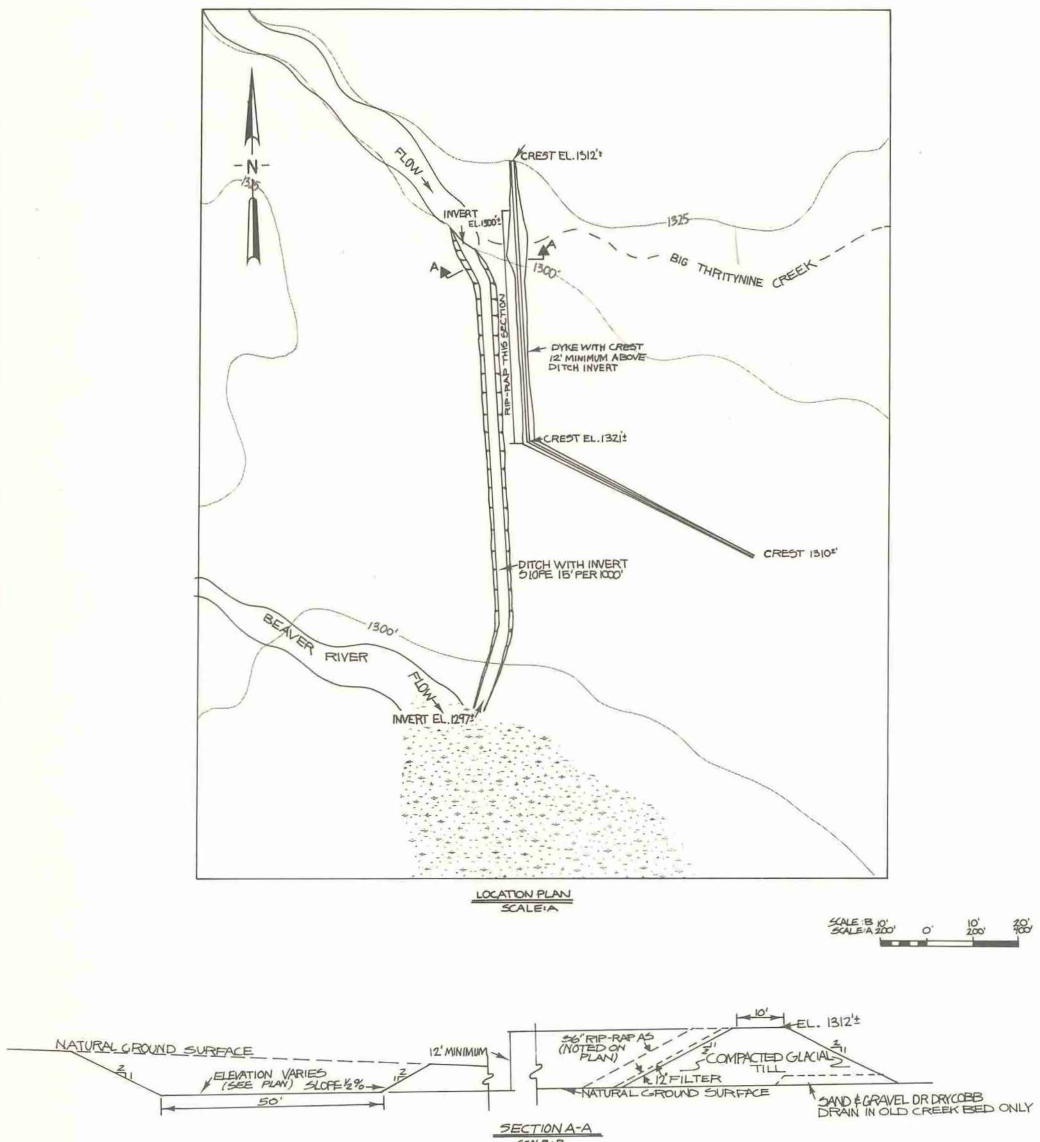

21 PROPOSED DIVERSION #2

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PROPOSED ACCESS ROADS

Three major access roads and several maintenance roads are to be constructed in the proposed Mile Post 7 plan. These are discussed separately in the following text and shown on the proposed Mile Post 7 plan (refer back to Figure 16). The major routes have been identified as:

1. North access road
2. East valley wall access road
3. Pipeline maintenance road

The proposed north access road, constructed of coarse tailings,(57) is to be used to carry construction equipment for the pipeline and the tailings basin.(58) The clearing width required is to be approximately 100 feet over a lineal distance of 4,000 feet. The proposed road width is 40 feet.(59) The general location of this proposed access road is shown in Figure 16. It will cross the East Branch of the Beaver River in Section 22, T56N, R8W. A cross-section of the channel modification proposed is also shown on Figure 25.

Early in the proposed construction schedule, a 200 foot wide access road, also comprised of coarse tailings, is to be constructed along the east valley wall of the tailings pond to an elevation of 1,200 feet.(60) A plan and typical section are shown on Figure 26. As part of this roadway, a small part of the upstream toe of Dam #4 and the entire base of Dam #5, or Bear Lake Dam, (consisting of one million cubic yards of coarse tailings)(61) will be constructed. The east side is to be elevated from 1,175 to 1,200 feet above sea level in the location of Dam #5. By comparison, Bear Lake is at elevation 1,212.(62)

Eventually, as the tailings pond approaches elevation 1,200 in about ten years, the road, including dam portions, will be raised in increments to elevation 1,280, the ultimate proposed tailings pond level(63) (refer to Figures 26 and 16).

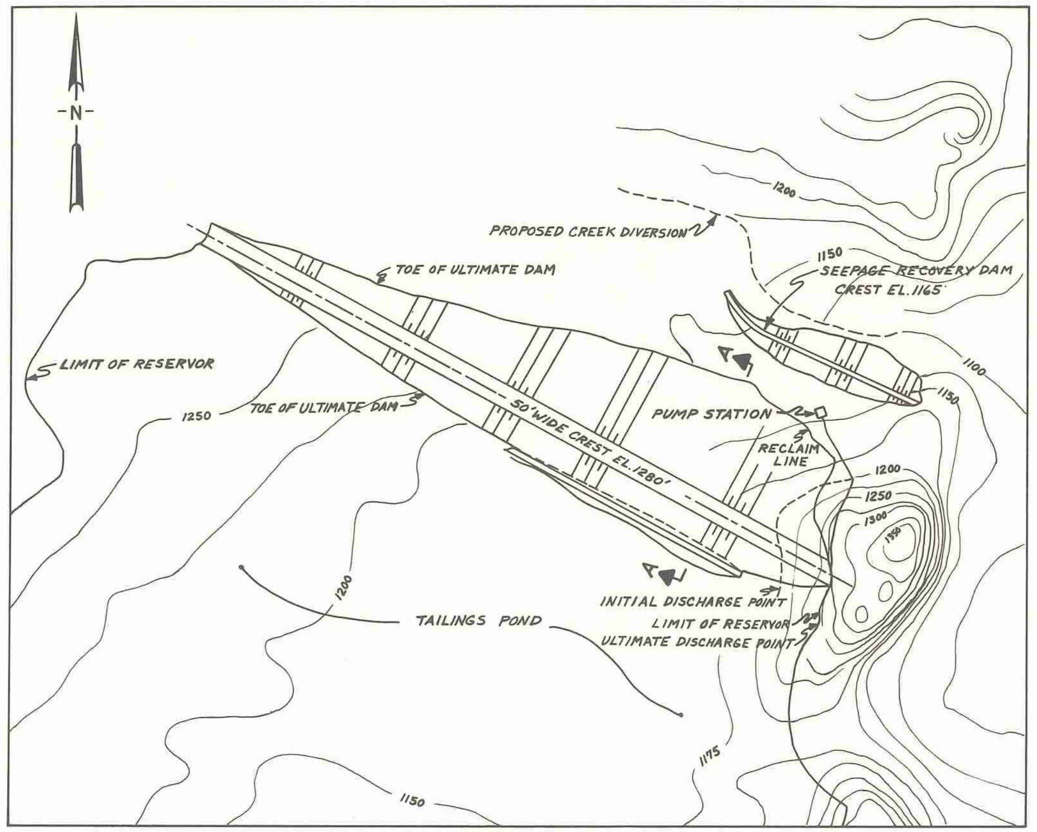
Construction of the east valley wall access road is proposed to proceed as follows: The initial grade will probably be established by a relatively narrow cut and fill operation with bulldozers and scrapers following the 1,200 foot contour. A rail line, established on this initial grade, is to be used to haul coarse tailings that will be used to widen the road to about 200 feet. Excepting Dams #4 and #5, no compaction is contemplated for the coarse tailings. However, the portions of Dams #4 and #5 that will become part of the access road are to be installed in thin, compacted layers.(63)

Proposed site preparation for most of the access roads is to involve clearing trees and organic material from beneath fill areas. At Dams #4 and #5, some organic pockets may be found in the lower depressions. These organic layers are to be removed to expose firm mineral soils prior to fill placement.

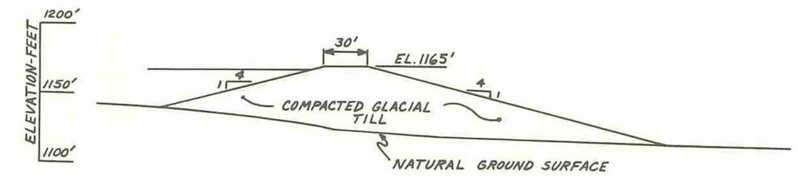
ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

22 PROPOSED DIVERSION #3



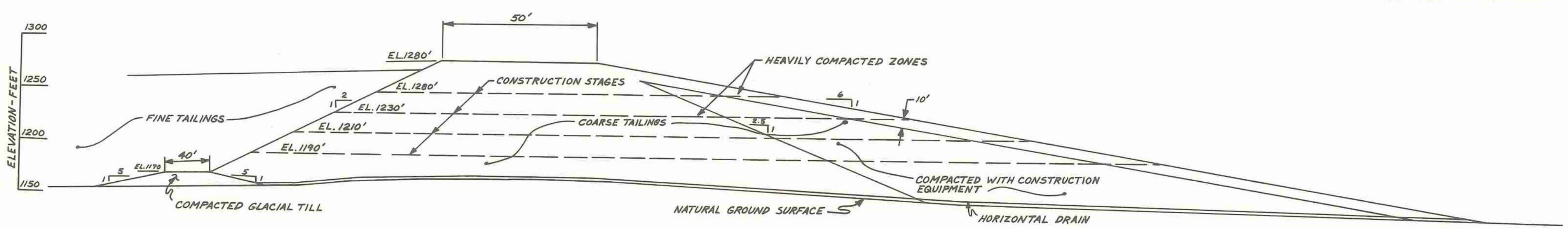
LOCATION PLAN
SCALE: A



SECTION B-B
SCALE : B

NOTE: SEE RESERVE MINING DRAWING 292-0048 FOR DETAILS OF SEEPAGE RECOVERY PUMPSTATION

SCALE: B 50' 50' 100'
SCALE: A 500' 500' 1000'



SECTION A-A
SECTION THROUGH DAM AT MAXIMUM HEIGHT
SCALE B

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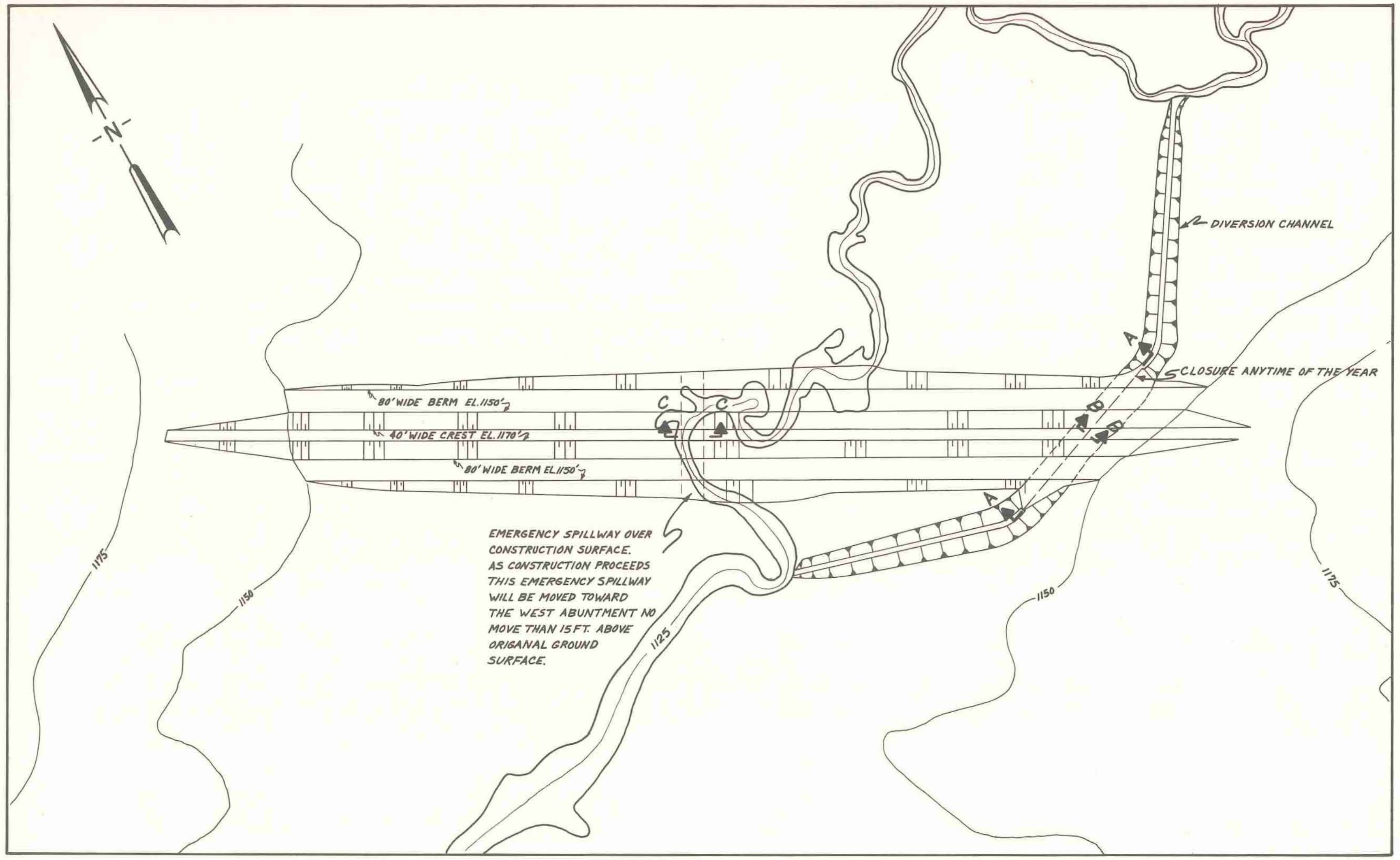
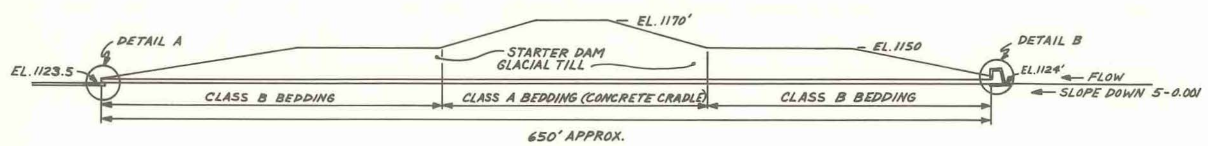
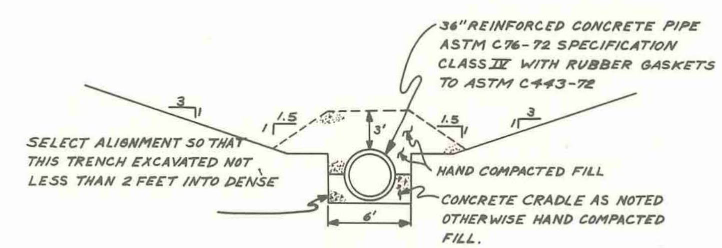


LOCATION PLAN
SCALE A



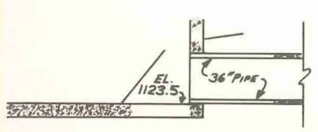
SECTION A-A
SCALE B



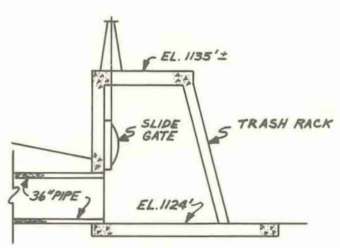
SECTION B-B
SCALE: C

REFERENCE DRAWING
SEE RESERVE MINING DRAWING NO. 292-0041 FOR GENERAL LOCATION OF STARTER DAM

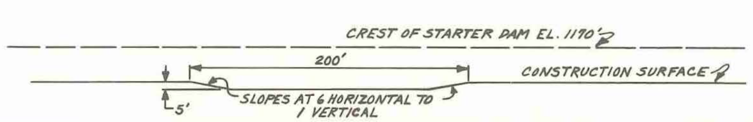
	5'	5'	10'
	50'	50'	100'
SCALE: A	200'	200'	400'



OUTLET STRUCTURE
DETAIL A
SCALE C



INLET STRUCTURE
DETAIL B
SCALE: C



TYPICAL SECTION LOOKING UPSTREAM
AT EMERGENCY SPILLWAY
SECTION C-C
SCALE: B

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

23 PROPOSED STARTER DAM #1 DIVERSION

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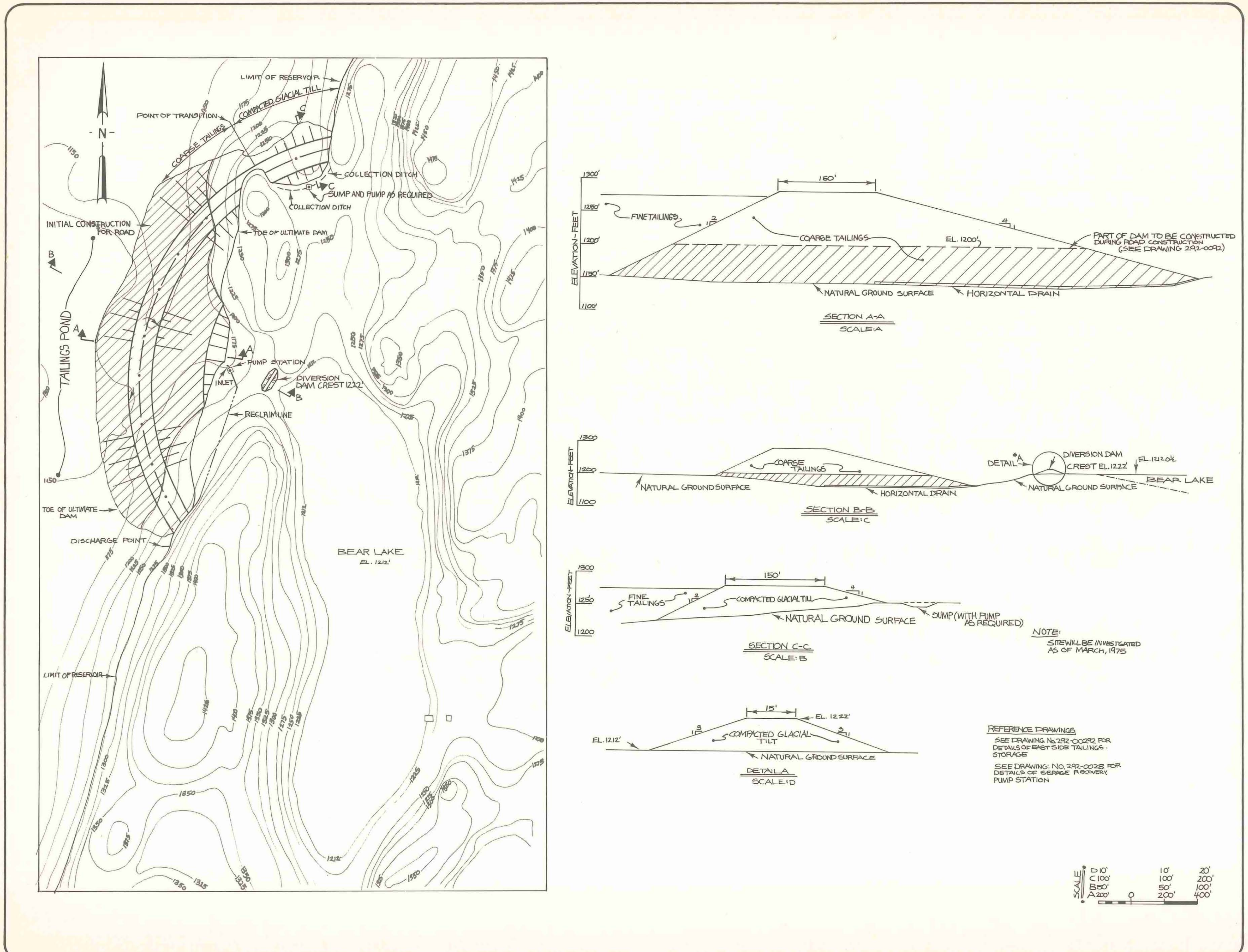

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

24 PROPOSED BEAR LAKE OUTLET DIVERSION

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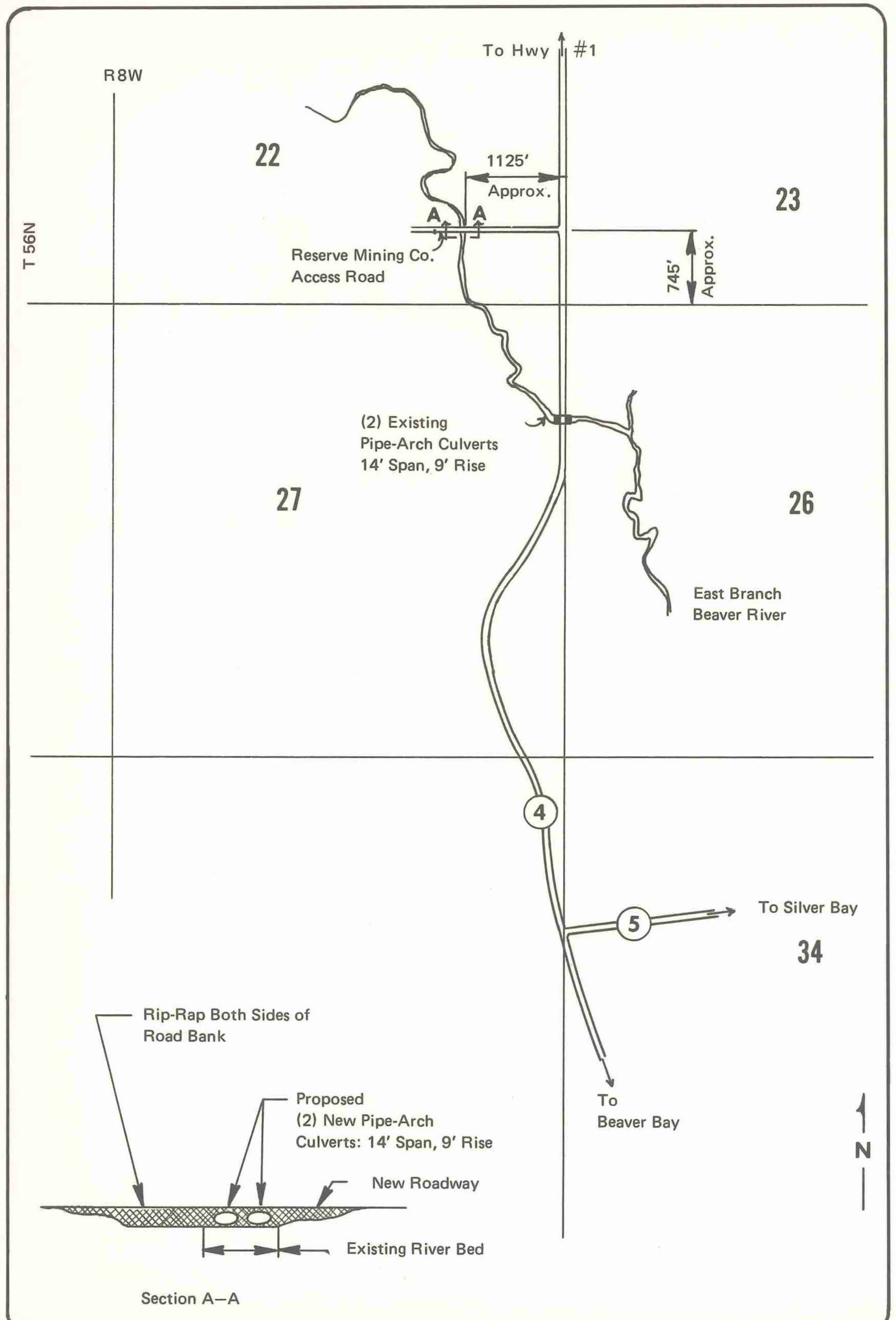

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

25 PROPOSED NORTH ACCESS ROAD AND CROSS-SECTION OF EAST BRANCH BEAVER RIVER CROSSING

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While this access road is to serve as a maintenance road for the tailings pipelines, water reclaim line and pump seal line between #4 pumphouse and the pump distribution station, additional access will be required to the pipeline route from #4 pumphouse to a point north of Whiterock Creek. A 24 foot wide roadway, extending 28,000 feet, is to be constructed of coarse tailings within the proposed pipeline corridor[64] (refer to Figure 27). The only stream crossing will be at the East Beaver River, which is to be crossed by a bridge.[65]

Access roads will also be required immediately adjacent to railroad spurs. In areas outside of the proposed tailings disposal area proper (south of Dam #1), the railroad access road is to run on top of the seepage collection embankment[66] for at least some portion of the way.

Access roads are also proposed for on-ground examination of potential routes for stream diversion channels #1 and #2.[67]

PROPOSED POWER PLANT MODIFICATIONS

The power plant proposed modifications involve water appropriation and discharge. Presently, Reserve Mining Company's power plant water is used in the processing system. Most of this water will not be needed in the new system. Process make up water will be taken as needed from the contact water (water exposed to process material), plus a portion of the non-contact condenser water and other cooling water. Therefore, it will be necessary to discharge up to 106,019 gallons per minute of non-contact heated water to Lake Superior. Reserve does not propose to discharge contact water. The water is proposed to be discharged through a diffuser pipe located on Beaver Island as shown in Figure 28.

Reserve also proposes to mix the power plant fly ash (Figure 15) with the fine tailings and dispose of them in the fine tailings basin at the rate of 4 long tons per hour.[68]

PROPOSED TAILINGS DELTA STABILIZATION

The proposed delta stabilization plan is to involve the following conceptual steps and is illustrated in Figure 29.

1. An initial broad dike 5,100 feet long, 25 feet high and 100 feet wide of mine waste rock will be constructed on a line about 600 feet back from the present lakeside edge.

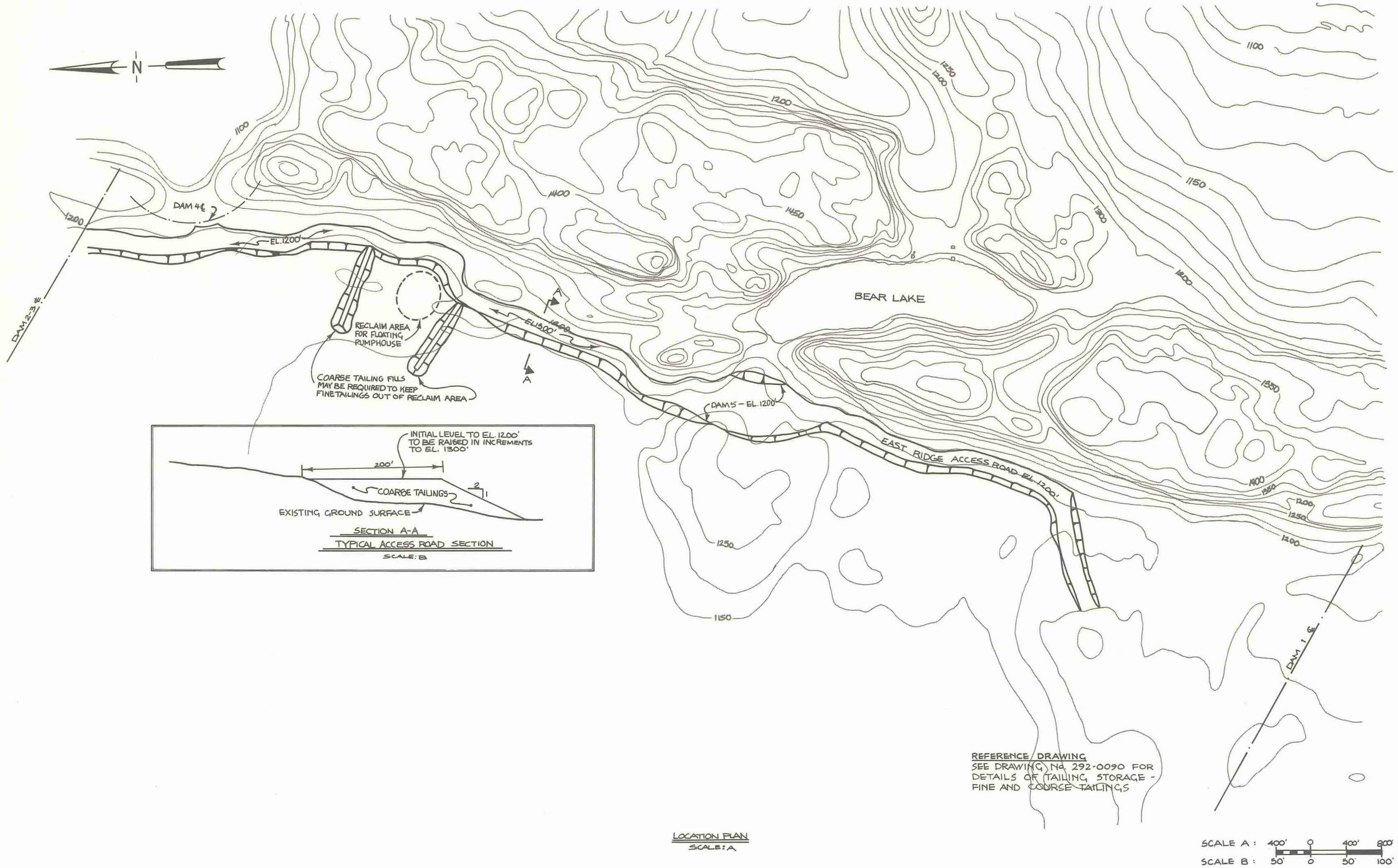
2. The Lake Superior wave action will erode a natural beach on the marginal beach.

3. When the tailings beach erosion has progressed sufficiently to permit the waves to reach the dike, the initial dike on the lake side will be flattened by wave action and rock will be spread over the beach.

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

26 PROPOSED EAST SIDE ACCESS ROAD - PLAN AND TYPICAL SECTION



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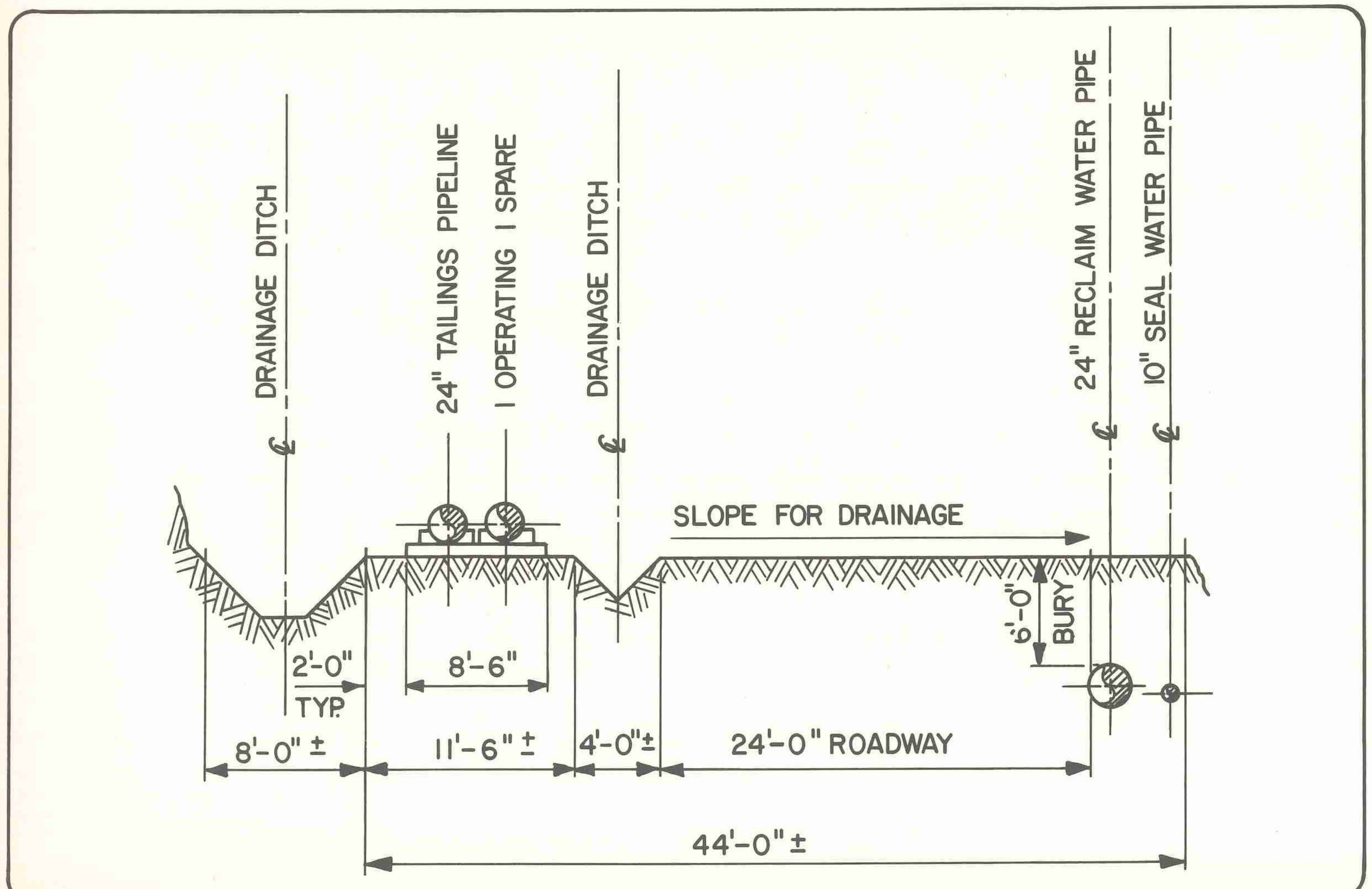
27 A PROPOSED CROSS-SECTION OF TAILINGS PIPELINE SYSTEM



4. Periodically, mine waste rock will be added along the lakeside face at the dike to add to the protective layer being formed on the beach and to compensate for losses due to changes in water level.

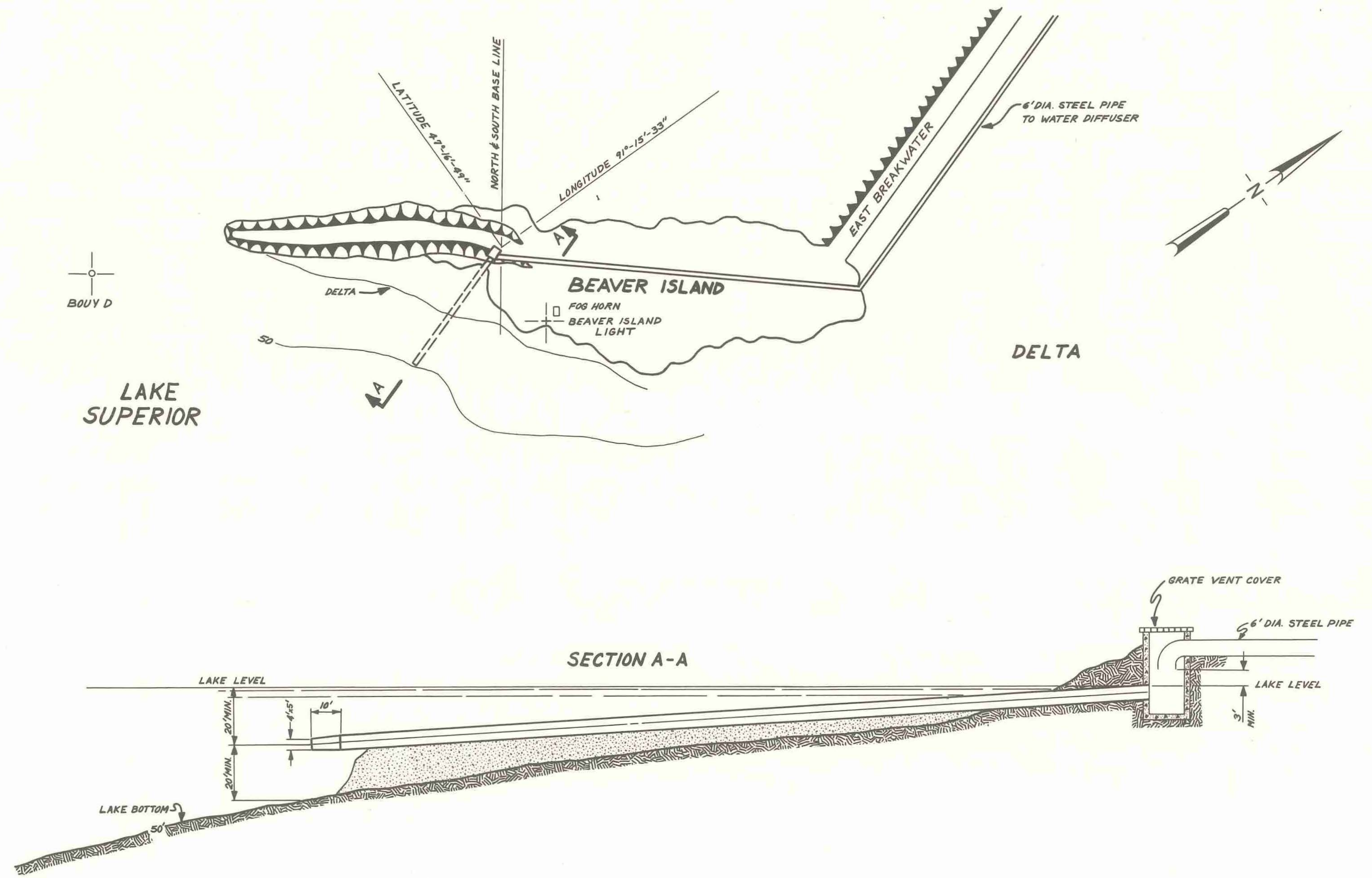
   As a part of this plan, it is anticipated that about 4 million cubic yards of fine tailings will be washed into Lake Superior.(69)

5. Behind the dike, Reserve proposes to revegetate the delta.

PROPOSED UTILITIES

The utilities required for the proposed Mile Post 7 site are to be accommodated in a corridor that would be 200 feet wide. This corridor is to be along the alignment which Reserve Mining Company has shown for the pipeline (refer back to Figure 12). A power transmission line is to be located within the pipeline right-of-way to serve power demands at each of the pumphouses along the way. The crossing of the one major obstacle along this route, East Brach Beaver River, would be as shown in Reserve Mining Company Exhibit 268, Figure 13.

Telephone communication lines are to be brought into the site from the existing railroad right-of-way telephone line. Should the need arise to have telephone communication to the pumphouses, a telephone line also will be accommodated in the pipeline corridor.



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

28 PROPOSED DIFFUSED PIPE LOCATION AND CROSS-SECTION

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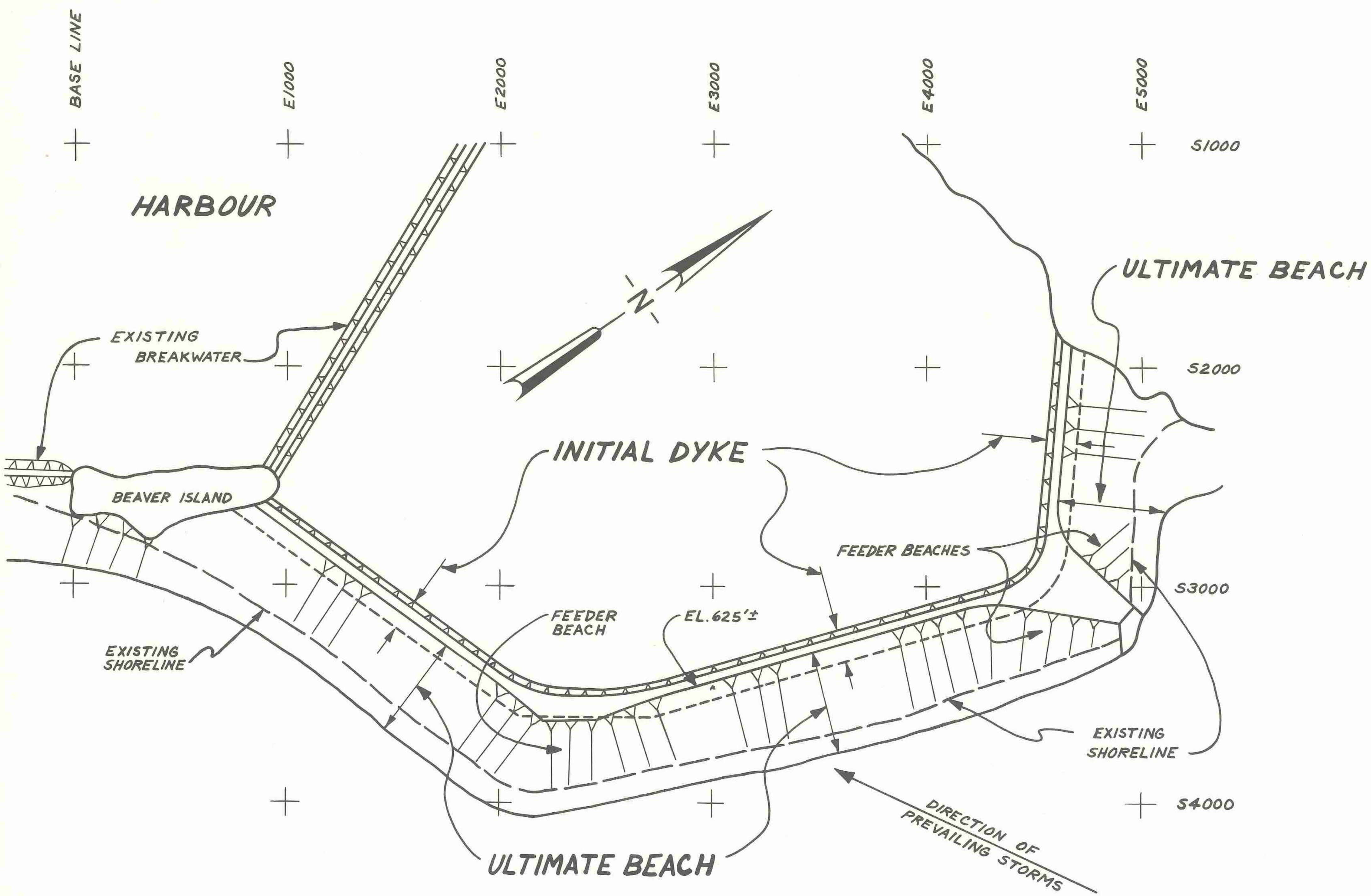

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

29 SCHEMATIC DRAWING OF PROPOSED DELTA STABILIZATION PLAN

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REASONABLE ALTERNATIVES

The Minnesota guidelines for the preparation of Environmental Impact Statements require "an objective evaluation of all reasonable alternatives to the action and the environmental impact of each".[70] (emphasis supplied).

The purpose of exploring alternatives is to provide adequate information on sufficiently diverse options to the proposed action to make it possible for decision-makers to arrive at conclusions of their own.

A federal court stated in the Natural Resources Defense Council versus Morton[72]:

> "The impact statement provides a basis for (a) evaluation of the benefits of the proposed project in light of its environmental risks, and (b) comparison of the net balance for the proposed project with environmental risk presented by alternative courses of action . . .
>
> "What is required is information sufficient to permit a reasoned choice of alternatives so far as environmental aspects are concerned." (Emphasis supplied).

It is the purpose of this section to identify those sites which could be considered reasonable as the word is commonly applied in everyday usage.

REVIEW OF ALTERNATIVES

Alternatives to the proposed Mile Post 7 plan may be divided into four classifications:

1. Continuation of tailings discharge to Lake Superior.
2. Development of by-product uses and markets for taconite tailings.
3. Termination of Reserve Mining Company operations.
4. Deposition of tailings at some on-land site other than Mile Post 7.

Continuation of Tailings Discharge to Lake Superior (Status Quo)

This alternative has been rejected by the State of Minnesota, the Federal Government and the courts. The legal background and findings of fact upon which this decision was based have been presented in Part I of this EIS. In the course of this present study, no investigations have been undertaken which would relate to this alternative.

By-Product Uses and Markets

The most fundamental alternative to on-land disposal is the utilization of taconite tailings as a by-product, including crushed rock for construction, aggregate for concrete and/or asphalt paving, landfill, railroad ballast and other applications. The tailings also could be used as a sand substitute. Arthur D. Little[73] projected that Reserve could supply from 4 to 13 percent of the sand market in the Great Lakes area in eight lakeside Standard Metropolitan Statistical Areas (SMSA) and Minneapolis-St. Paul. However, the operation of recovery, screening, storage and shipping would together result in an annual operating cost increase to Reserve of $825,000. The use of tailings as a sand substitute would only amount to 1.1 million long tons per year of Reserve's tailings (less than 6 percent of current tailings production).

In 1970, the Roy F. Weston Company included in their study[74] an attempt to determine the feasibility of tailings for the fabrication of bricks and building blocks. Preliminary findings indicated that bricks and building blocks made from tailings had a higher compressive strength and lower water absorption than those made from common materials. Further, the cost per 1,000 could potentially be $9 to $13 cheaper than the market price for standard bricks in the Great Lakes area. If the Great Lakes brick market represented 10% of the total domestic market and if Reserve could capture all of this market which is highly unlikely, the total tailings utilization would total 9.1 million tons per year out of the ten year average of 19.9 million tons of tailings currently produced annually.

The use of taconite tailings as aggregate material for bituminous paving has also been examined. Tailings are currently used in what is called, by the Minnesota Highway Department, a 2361 mix. This is basically a thin 3/4" bituminous overlay for existing pavement.

Transportation costs are the major limitation for use of tailings outside the Iron Range. Private contractors have reached successful agreement with Erie Mining Company for separate storage of tailings (five months/year) and reduced rates for transportation of the tailings. It has been noted recently,[75] however, that total taconite tailings used in bituminous pavement on Minnesota State Highways in the summer of 1975 amounted to about 50,000 long tons, which is equivalent to less than one day's production by Reserve Mining Company.

In general, given the concern for the asbestiform fiber content of Reserve's tailings and the uncertainty of economic investments, the large scale deployment of tailings for the uses cited above should and would probably be viewed with many reservations. This option for tailings disposal is not explored further in this report.

Termination of Reserve Mining Company Operations

The taconite industry and Reserve Mining Company in particular have long represented significant economic elements of the State of Minnesota. Therefore, the premise of this EIS (and previous court decisions) is that conversion to on-land tailings disposal at any site represents a long term solution to the potential health hazard identified. Shutdown only represents a viable alternative if significant impacts identified, particularly those related to questions of health, cannot be mitigated. The decision to terminate operations is one that is properly left to Reserve Mining Company and its parent companies, Armco Steel Corporation and Republic Steel Corporation.

On-Land Disposal Sites Other Than Mile Post 7

All sites historically considered for on-land tailings disposal by Reserve Mining Company, state and federal agencies and their respective consultants are presented on Figure 30.

Reserve's Initial Alternate Sites

In April of 1970, Reserve published Engineering Task Force Progress Report,[76] a compilation of studies initiated in July, 1969. Reserve stated that "eleven (11) locations . . . appeared to have possibilities initially", but that "investigation revealed that only four sites appeared to have any possibilities whatever". The sites rejected without specific reasons presented include:

Site 1 Bluebill Lake
Site 2 Sawmill Creek
Site 3 Split Rock River
Site 4 Gooseberry River
Site 5 Nip Creek
Site 6 Kit Creek
Site 7 Isabella River

Preliminary feasibility considerations were presented for on-land disposal at the four remaining sites:

Site 8 Palisades*
Site 9 Lax Lake*
Site 10 Mile Post 32**
Site 11 Mine Pit***

In abandoning proposals for either partial or total on-land tailings disposal in the Lax Lake area and total disposal using both the Lax Lake/Toimi areas, Reserve cited the following major unresolved problems:[76]

1. Conservation of prime hunting, fishing and resort land around Lax Lake.
2. Dust from blowing tailings would affect the region.
3. Excess watershed drainage would enter the Beaver River and eventually Lake Superior.
4. Fine tailings "diluted" in river water would disperse in surface layers of Lake Superior.
5. High dams could be a safety hazard.
6. Heated rail cars or improved thaw sheds would be needed for tailings transported during the winter.
7. The conveyor system used to load the rail cars from the concentrator would suffice for only five years operation.

For total tailings disposal near the mine pit, the problems of heated rail cars and conveyor systems are also stated.

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*Feasibility considerations developed for "Lax Lake Area", a non-specific reference to both Site 8 (Palisades) and Site 9 (Lax Lake).

**Also called Toimi Creek in a later study.

***Feasibility considerations developed for "near the mine pit" - no specific location identified in report.

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

30 ON-LAND DISPOSAL SITES PREVIOUSLY CONSIDERED

BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

International Engineering Company Alternate Site

The general area of Site 12, Snowshoe, (refer to Figure 30) was originally proposed by International Engineering Company (IECO) in May of 1973.(77) IECO was contracted by EPA to determine technical feasibility, and to estimate order-of-magnitude capital and operating cost of constructing a new concentrator, tailings disposal basin and related facilities near Babbitt. The criteria used for site selection were:

1. The area must be within a reasonable distance of the concentrator location.
2. The tailings could be safely deposited with little detrimental effect on the environment.
3. The tailings disposal would not interfere with possible future mining nor encroach upon neighboring mining company property.

Dam construction at this site would be difficult due to the presence of peat and soft clay, but the peat deposits, once compressed, would limit the amount of seepage from the pond into the groundwater.

Criteria for tailings basin and plant design and layout which were established by IECO to permit cost estimation included:

1. Ultimate dam height - 100 feet.
2. Average tailings depth - 75 feet.
3. Crude ore processed - 33.1 million long tons/year
4. Pellet production - 10.8 million long tons per year.
5. Tailings disposal rate - 22.3 million long tons per year.
6. Maximum makeup water (outside source) - 5,860 gallons per minute.
7. Average makeup water (outside source) - 3,210 gallons per minute.

From these criteria, IECO determined that approximately seven square miles would be required to hold the tailings. The actual basin configuration, however, was located only as a circle with its center being approximately one mile due west of the northern end of Lake Culkin, north of the Erie Mining Company railroad, and about 7 miles east of Reserve's mine. The area, having a diameter of 3.2 miles, is approximately eight square miles and would be completely surrounded by a dam ten miles long.

Other factors or assumptions in IECO's plant design and operation included:

1. Coarse cobbing was not included in the process as sufficient data was not available at the time. Coarse tailings were assumed to be available in sufficient quantities to construct the ultimate dams.
2. A flotation process would be added to increase the natural iron content of the pellet from 60.6% to 62.6% Fe and decrease the silica content of the pellet from 8.6% to 5.6% SiO_2.
3. Excess runoff to Birch Lake during wet periods would be pumped to the site and impounded there for use during dry periods.
4. The concentrate would be shipped by rail to the Silver Bay pelletizing plant using heated, insulated, covered rail cars powered by a separate car (one per train) containing a diesel generating system.
5. Power to the new concentrator (projected to require 70,000 kw) would be supplied by a 120 kv power transmission line parallel to the railroad from the Silver Bay power plant.

Conclusions of the IECO study were as follows:

1. It is technically feasible for the Reserve Mining Company to construct a new beneficiation process, tailings disposal system, and related facilities near its present mine at Babbitt, Minnesota.
2. The total new capital investment required for a plant capacity of 10,800,000 annual long tons per year of pellets has been estimated to be $187,316,716. This amount is exclusive of costs for land vacating, demolition, salvage and personnel relocation.
3. The operating costs associated with the new capital investment have been estimated to be $1.258 per ton of crude ore for a 10,800,000 long ton per year pelletizing plant. It has been estimated the crude ore processed will amount to approximately 33,100,000 long tons per year.

Reserve Mining Company Palisades Alternate Site

At the conclusion of the trial in U.S. District Court (April, 1974), Reserve presented a detailed concept developed for the Palisades Creek area (previously identified as Site 8(78); refer to Figure 30).

The proposal involved pumping the fine tailings and hauling the coarse tailings by truck to a basin formed by constructing dams to close the Palisades Creek Valley and the Cedar Creek Valley, adjacent to Lax Lake. (see Figure 4). One very large dam (7,500 feet long and 450 high) would be required to block the mouth of the valley, and several small dams would be required to fill breaks in the two ridges. Coarse tailings would be used for dam construction and later stacked outward from the main dam, sloping toward Lake Superior. This proposed pile was estimated to eventually cover 500 acres outside the basin area and reach several hundred feet in height.

The United States District Court made findings rejecting the Palisades proposal on both environmental and engineering grounds.

Department of Natural Resources Alternate Sites

DNR testified before the Lake Superior Enforcement Conference in 1971, relating to the economics of implementing an on-land tailings disposal site near Babbitt. DNR has since examined several specific Babbitt sites and made recommendations.(79) The sites examined are shown on Figure 30 and referred to in this report as:

Site 10 Toimi Creek (previously examined by Reserve as Mile Post 32)
Site 12 Snowshoe (previously studied by IECO)
Site 13 Ridgepole Creek
Site 14 Colvin
Site 15 Embarrass

Criteria for site selection in this study were as follows:

1. The tailing capacity requirement was assumed at approximately 651 million cubic yards as contained in the IECO (International Engineering Company) report.

2. This volume could be disposed of in one large basin or two smaller basins.

3. To provide sufficient capacity for 40 years of tailings, two basins were used. Each would have to be at least three square miles in area, or more than two basins would be required.

4. The alternatives should be either near the mine or adjacent to a railroad due to transportation and right-of-way requirements for transporting tailings.

5. Tailings would be deposited to a maximum depth of 100 feet. With 10 feet of freeboard at the end of the project, this would mean a maximum dam height of 110 feet.

6. Tailings sites with natural topographic barriers would be selected to minimize dam construction and dam materials. The exception to this is the IECO site which DNR called the Snowshoe Area.

7. It was not the purpose of this study to do a detailed survey of the entire area, but rather to locate areas with potential. Therefore, additional sites may be available. For the sites selected, a detailed environmental and engineering analysis was not undertaken.

The search for suitable tailings basin sites was further restricted as follows:

1. Basins containing first and second order streams were excluded, plus any area within 660 feet of a shoreline. It was assumed that the largest rivers were first order, (St. Louis and Kawishiwi Rivers) and those directly tributary to them were assumed to be second order (Dunka, Partridge and Embarrass Rivers).

2. Basins containing existing railroads were excluded.

3. Basins containing large lakes that had either inlets and/or outlets (Big Lake and Birch Lake) were excluded.

4. Basins which contained long-term iron ore open pit mining potential were excluded.

Areas larger than three square miles not containing excluded areas were then evaluated using the seven criteria listed above. The five areas previously identified were selected and the capacity of each was determined using twenty foot contour intervals. Preliminary environmental and feasibility data for each of the sites was collected in three areas; physical description, land use and accessibility and surface hydrology.

The capacity calculations showed the "Toimi Area" (Site 10) and the "Ridgepole Area" (Site 13) (see Figure 30) to be much too small to contain the tailings from 40 years of operation. The "Embarrass Area" (Site 15) and "Colvin Area" (Site 14) showed slight deficiencies in capacity, but they were recommended for further study. The dam height of 100 feet used to select areas of potential could be raised twenty feet enabling both of these areas to meet capacity requirements.

Alternative Sites Generated in U.S. District Court(78)

Site 16, Midway (refer to Figure 30), resulted from a suggestion during the United States District Court proceedings that Reserve and the state investigate a site midway between Babbitt and Silver Bay. Barr Engineering Company (a consultant to DNR in 1974) completed a preliminary engineering feasibility study and basin layout, concluding that two separate areas would be required to attain sufficient storage: Area A for fine tailings disposal and Area B for coarse tailings disposal. It was assumed that the concentrator would remain at Silver Bay, with fine tailings pumped to the site and coarse tailings transported by rail. Reserve Mining Company found this alternative to be less desirable economically than a site on the north shore, while the Department of Natural Resources found the alternative less desirable environmentally than a site in the Babbitt area.

A concept related to site 11, Mine Site was presented to U.S. District Court in August, 1974. Reserve Mining Company presented expert testimony related to the feasibility of placing tailings in the Reserve Mine Pit at some point in time. The conceptual design presented to the court suggested that, in 20 to 25 years, tailings could be placed in the mine pit and that the capacity available would amount to 15 years of tailings production.

SELECTION OF SITES FOR EVALUATION

The studies of the 16 alternate sites to Mile Post 7 (reviewed in the preceding section) were conducted with a variety of objectives and within different time constraints. While it was recognized early in the preparation of this EIS that each of these sites is an alternative, it was equally clear that none had been studied in sufficient detail to permit the degree of evaluation that would be required by the decision-maker. It was further concluded that there was little possibility of studying each of the 16 sites to this level of detail due to time and economic constraints placed upon the development of the EIS.

Based on the need to reduce the number of sites to a manageable few, the reasonable alternatives were determined by a process of elimination.

1. *The cost of extending the Reserve Mining Company railroad to several of the sites would be prohibitive and unreasonable based on professional judgment alone.* If pipeline transport were provided instead, the cost of this sytem would also be prohibitive and unreasonable. Further consideration of the following sites was abandoned:

   Site 1 Bluebill Lake
   Site 5 Nip Creek
   Site 7 Isabella River

2. *The Department of Natural Resources concluded*[80] *that if only the north shore sites of Palisades, Lax Lake, and Mile Post 7 are compared, Mile Post 7 has the least environmental impact.* Since Reserve has proposed Mile Post 7, no purpose would be served by further consideration of sites 8 and 9.

3. *It would be unreasonable to select a tailings disposal area which would not have the capacity for total tailings disposal over a forty year period based on the maximum processing rate of Reserve's facilities.* Six sites would require expansion of the basin boundaries over roadways and rail lines and/or excessively high dams to provide the required storage. This was considered unreasonable and the following sites were discarded:

   Site 2 Sawmill Creek
   Site 3 Split Rock River
   Site 4 Gooseberry River
   Site 6 Kit Creek
   Site 10 Toimi Creek
   Site 13 Ridgepole Creek

As a result of this preliminary assessment, five alternative sites remained of the 16 listed originally. These sites are:

Site 11 Mine Site
Site 12 Snowshoe
Site 14 Colvin
Site 15 Embarrass
Site 16 Midway

ALTERNATIVES EVALUATED

The five alternative tailings basin sites identified in the selection process were considered in detail. These included four sites located in the Babbitt area and one site located midway between Silver Bay and Babbitt. All alternative sites would use taconite ore mined at Reserve's Peter Mitchell Mine at Babbitt. These alternative sites and their general location (Figure 31) are:

1. Embarrass site - approximately 1 mile northwest of the mine pit

2. Colvin site - approximately 4 miles southeast of the mine pit and along the Reserve railroad

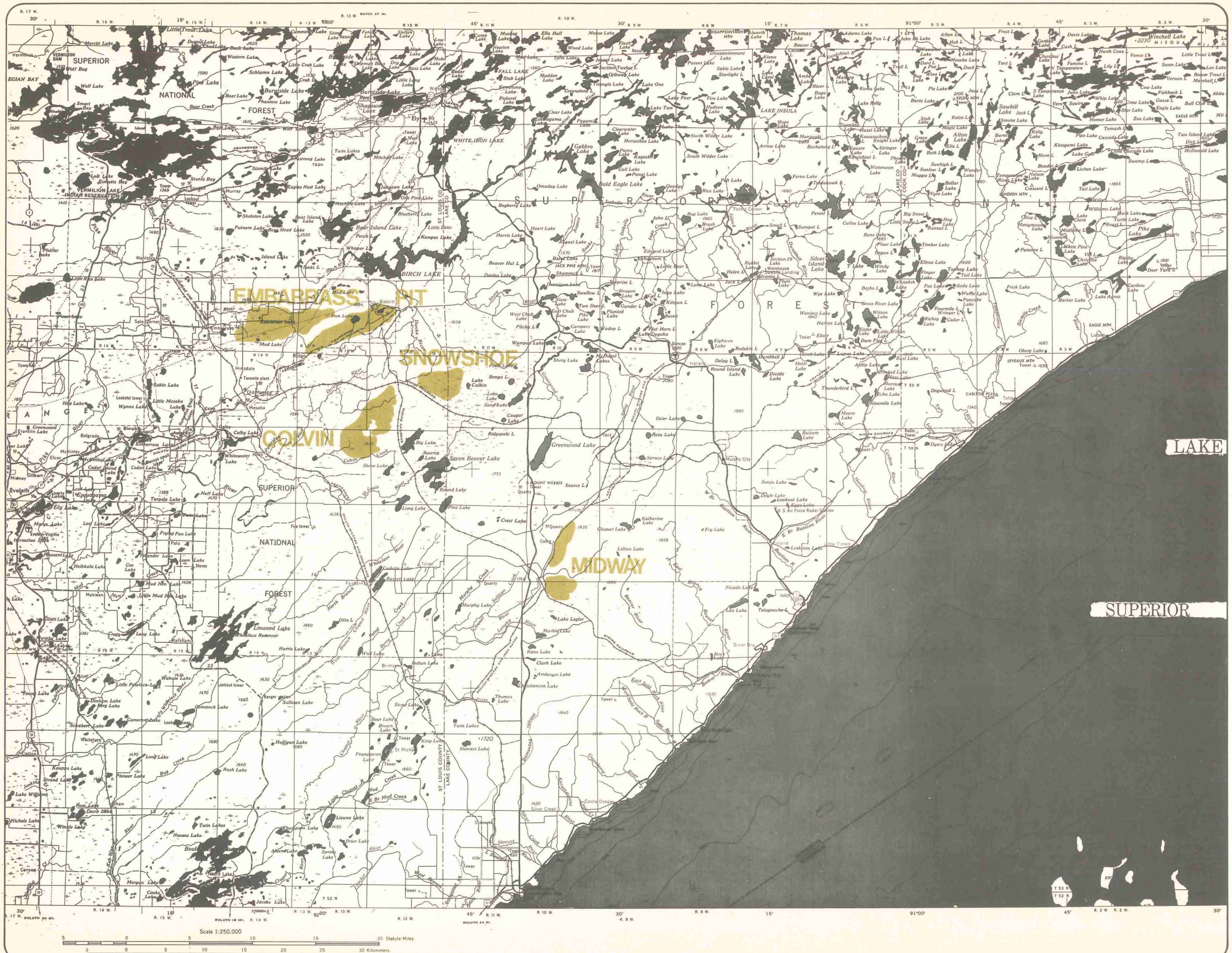
3. Snowshoe site - approximately 7 miles southeast of the mine pit and along the Reserve railroad

4. Midway site - approximately 15 miles west-northwest of the Silver Bay plant and along the Reserve railroad

5. Mine site - in the mine pit

All of these alternative sites except the Midway site would require the relocation of a major portion of the taconite processing facilities to a location adjacent to the tailings basin. For the Midway site, facilities could be relocated to the site or the tailings could be transported to the site in a manner similar to that for the proposed Mile Post 7 plan.

The relocation of facilities adjacent to the tailings basin requires the construction of new fine crushing, dry cobbing, concentrating, and concentrate loading facilities. The pelletizing plant would remain at Silver Bay, since it is technically feasible to transport iron concentrate produced in the concentrator from any of the alternative sites to Silver Bay.



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

31 ALTERNATIVE TAILINGS BASIN SITES

LEGEND

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THE EMBARRASS ALTERNATIVE

The Embarrass tailings disposal area would be located adjacent to the present Peter Mitchell Mine, northwest of the western end of the mine pit (Figure 32). The utilization of the Embarrass site requires the construction of a railroad bed from the existing coarse Crusher No. 2 to newly constructed rail car dumping, fine crushing, dry cobbing, concentrating, concentrate filtering, concentrate loading, and tailings disposal facilities. The concentrate filter cake would be transported in insulated rail cars to Silver Bay, where the cars would be unloaded and the concentrate fed to the existing pelletizing plant.

The new facilities at the Embarrass site would be constructed on the linear ridge trending northeast-southwest, which would form the southern boundary of the Embarrass tailings basin, as shown in Figure 33. In addition to the new rail car dumping, fine crushing, dry cobbing, concentrating, concentrate filtering, concentrate loading, and tailings disposal facilities, other facilities would be required for reagent storage, office and change rooms, heating, sewage treatment, electrical substation, etc. Exclusive of lands for rail car storage at the car dumper and turn around for the concentrate loadout, these new facilities would require approximately 130 acres. The coarse cobbed and sand-sized filtered tailings would be transported to the 4,794 acre basin by truck and the fine tailings would be discharged directly to the basin. Water from the basin would be returned to the concentrator by a return water pipeline. The Embarrass on-land tailings disposal alternative includes tailings dams, fine tailings basin, coarse tailings basin, seepage collection, and access road construction.

These new facilities would process 34.8 million natural long tons of crude taconite ore annually. The concentrate produced would have the same iron and silica content as the modified Silver Bay concentrator for the proposed Mile Post 7 plan. However, the new facility would have a production capability to match the existing Silver Bay pelletizing plant, resulting in pellet production of 10.7 million long tons per year rather than 9.5 million long tons per year with the proposed Mile Post 7 plan.

Rail Haulage of Coarse Crushed Ore

Coarse crushed taconite ore, minus 4 inch in size, would be loaded into 85-ton railroad cars at Crushers No. 1 and 2. These cars then would be assembled into unit trains that would carry the crushed taconite about 7 miles to the car dumper at the Embarrass site. This requires a new private railroad between the Crusher No. 2 and the car dumper. The new road bed would be about 4 miles long with a double track, as shown in Figure 34.

Fine Crushing

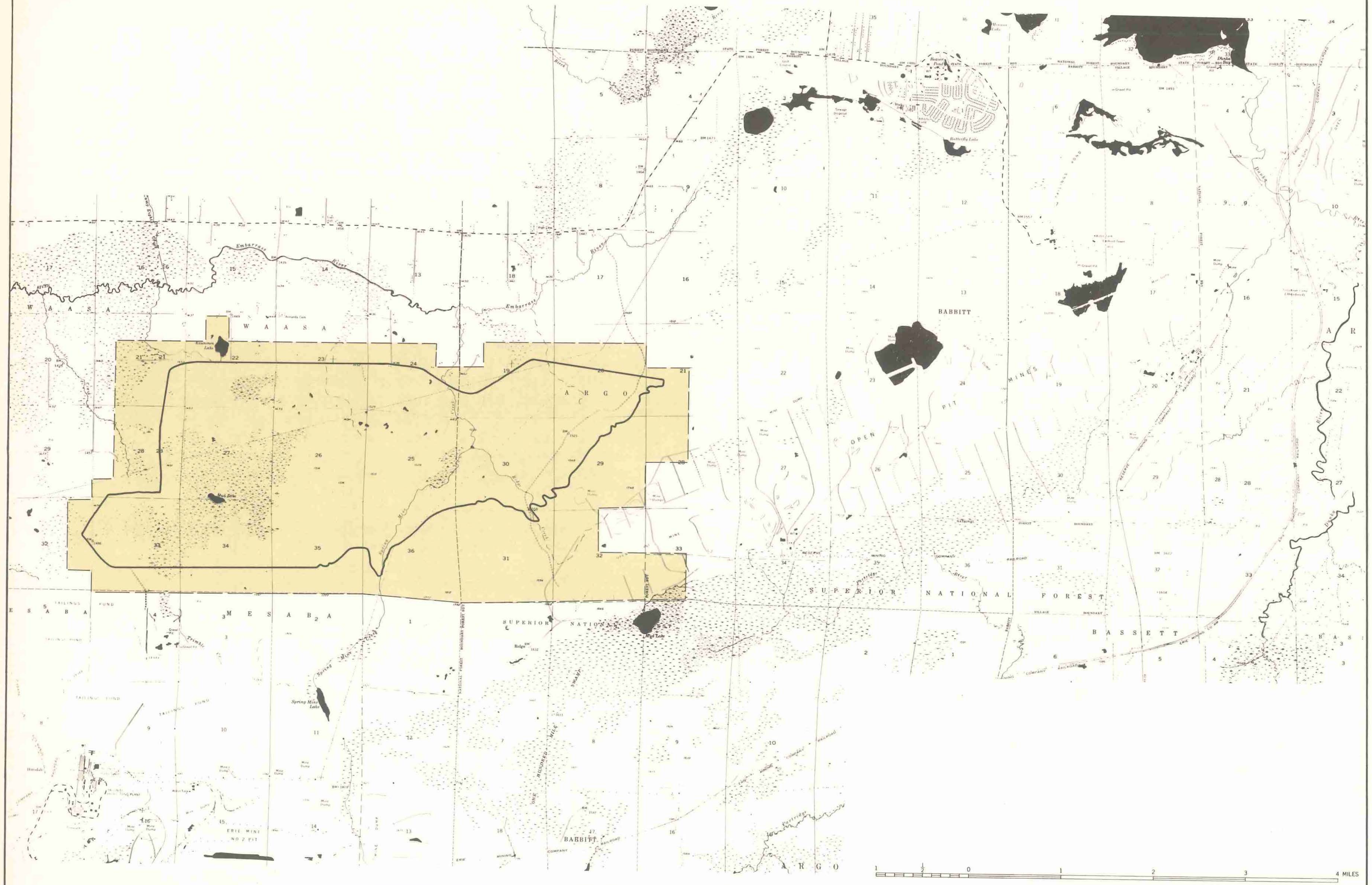
When the ore trains arrive at the new car dumper at the Embarrass site, the cars would be dumped by one of two rotary car dumpers in parallel, and the ore conveyed to bins. Apron feeders would withdraw the 4 inch and finer taconite ore and transfer the ore onto ten conveyors feeding ten parallel crushing lines in the new fine crushing and dry cobbing building (Figure 35, Area 2). In the third stage of crushing, the ore would be reduced (the initial two stages of crushing occur at the mine pit as explained for the existing operations) from 4 inches to approximately 1-1/4 inches. Material discharged from the third stage crushers would pass over double deck screens. Screened material larger than 3/4 inch in size would be fed to the fourth stage crushers. Material smaller than 3/4 inch would bypass the fourth stage crushers, where it would rejoin the smaller than 3/4 inch product discharged from the fourth crushing stage. The 97 percent less than 3/4 inch size taconite ore then would be conveyed to distribution bins before the dry magnetic cobbers.

Dry Cobbing

The finely crushed taconite ore in the dry cobbing distribution bins would be fed to double drum dry magnetic cobbers (Figure 35, Area 3). The dry magnetic separation would reject approximately 20 percent (6,974,700 dry long tons per year) of the taconite ore as a coarse cobbed tailing. This coarse cobbed tailing would be conveyed from the new fine crushing and dry cobbing building and placed in loadout bins or stacked in stockpile. The dry magnetically concentrated material would be conveyed from the fine crushing and dry cobbing building to storage bins in the concentrator building.

Concentrating

The partially concentrated taconite ore, 3/4 inch and finer in size, would be drawn out of the concentrator storage bins at a controlled rate



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

32 EMBARRASS ALTERNATIVE

BARTON-ASCHMAN ASSOCIATES, INC.

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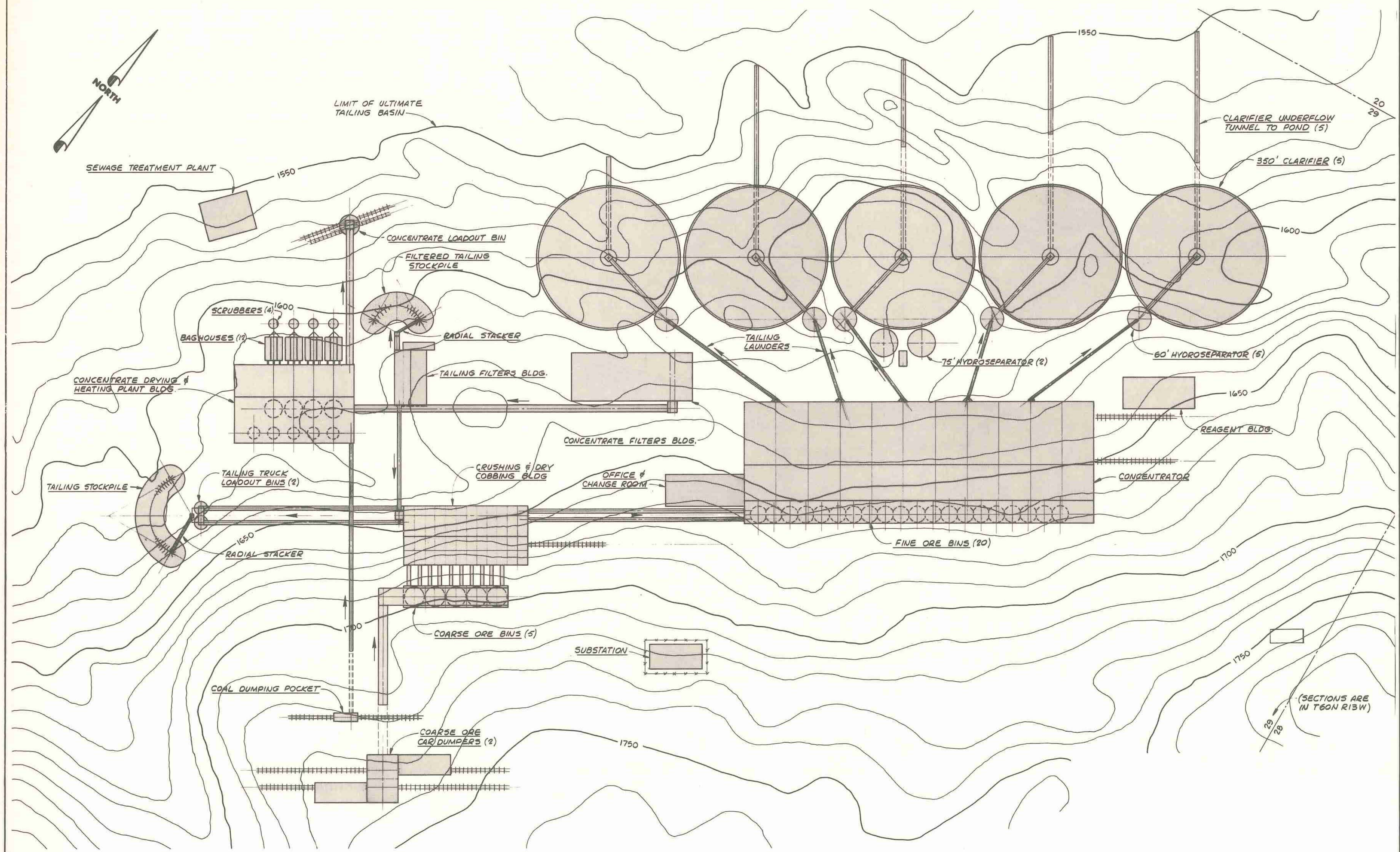
ENVIRONMENTAL IMPACT STATEMENT

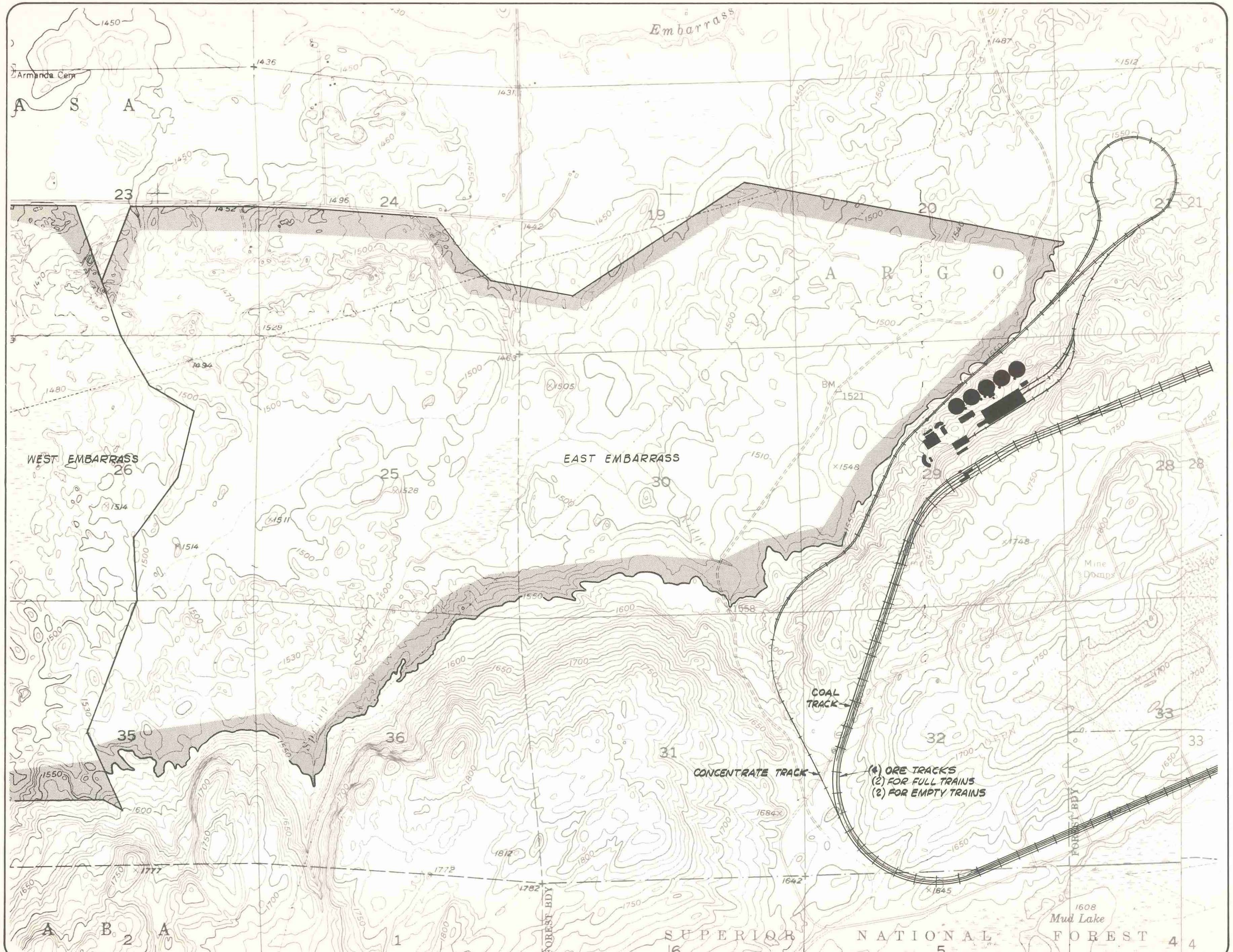
RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

33 EMBARRASS ALTERNATIVE - PROPOSED FACILITIES



BARTON-ASCHMAN ASSOCIATES, INC.

F. C. TORKELSON COMPANY



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

34 EMBARRASS ALTERNATIVE - RAILROAD

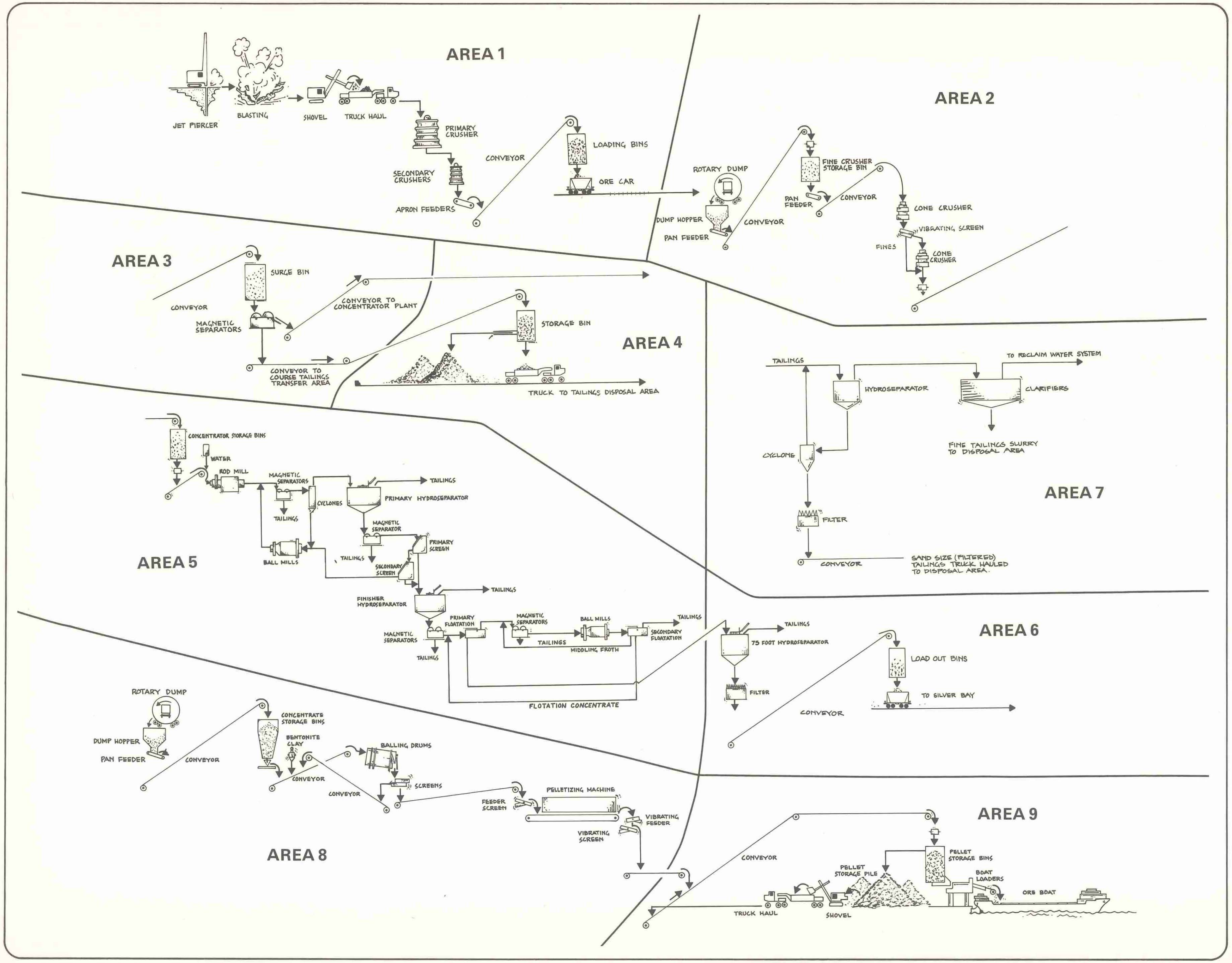
BARTON-ASCHMAN ASSOCIATES, INC.

F. C. TORKELSON COMPANY

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

35 SCHEMATIC FLOW DIAGRAM OF ALTERNATIVE OPERATIONS



BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

and conveyed to ten identical parallel concentrating circuits (Figure 35, Area 5). The partially concentrated ore and water would be introduced to the system and waste tailings and concentrate, both containing water, would be the outputs of the system. The process is one of repeated grinding, magnetic separation, hydraulic separation, flotation separation, sizing, and dewatering to reject a non-magnetic waste material as tailings.

The concentrating process for the new concentrator at the Embarrass site would be essentially the same as for the modified existing Silver Bay concentrator for the proposed Mile Post 7 plan. The process consists of one stage of rod mill grinding, two stages of ball mill grinding, four stages of magnetic separation, three stages of sizing, including fine screening, two stages of flotation, and two stages of dewatering and hydraulic separation. Tailings would be discharged at seven points during the process, with all tailings discharges flowing to the tailings separation and filtering system.

The major difference between a new concentrator and the modified existing Silver Bay concentrator for the proposed Mile Post 7 plan is that the number of parallel concentrating circuits would be reduced from 22 to 10 with the new concentrator. This reduction in concentrating circuits occurs because of the current availability of larger grinding mills with more than double the capacity of mills available when the Silver Bay facility was constructed in 1955.

Concentrate Filtering

Concentrate from the ten concentrating ciruits would flow to two 75 foot hydroseparators outside the concentrator building. The overflow from the hydroseparators would be pumped to the tailings separation and filtering system. The underflow or concentrate from the hydroseparator would be pumped to the concentrate filtering building where the steam heated concentrates would be dewatered to approximately 10 percent by vacuum filtering. The concentrate filter cake would be conveyed to the concentrate loadout bin over the railroad track.

Concentrate Loading

Concentrate filter cake would be loaded from the concentrate loadout bin over the railroad track into insulated railroad cars for haulage to Silver Bay.

Rail Haulage of Concentrate

Concentrate filter cake would be hauled approximately 50 miles from the Embarrass site to Silver Bay on Reserve's private railroad in 85-ton railroad cars. To retard freezing of the wet concentrate filter cake while in transit in the winter months, insulated, open-top cars would be used. Each car would have a 2 inch layer of polyurethane foam insulation on exterior sides, ends, and bottom. The interior of each car would have a polyurethane coating covered with 1/2 inch painted plywood.

Concentrate Unloading and Handling

When railroad cars loaded with concentrate filter cake arrive at Silver Bay, the cars would be dumped by two new parallel rotary car dumpers. The concentrate would be conveyed from the dump hopper to three new concentrate surge bins. The concentrate would be discharged from the surge bins into the existing pelletizing plant feed system.

Tailings Separation and Filtering

Tailings from the concentrator would flow to the tailings separation and filtering system. This system would consist of five identical parallel circuits for tailings separation, with each parallel circuit processing the tailings from two of the ten parallel concentrating circuits. The tailings would first flow to a hydroseparator, where the finer silt size tailings would be separated from the larger sand size tailings. The finer silt size tailings would flow to clarifiers, where they would be dewatered to a 50 percent solids by weight slurry and then discharged by gravity flow into the tailings basin (14,410,300 dry long tons per year). Settling would be aided by a flocculent. The clarifier overflow water would be reclaimed and pumped to the concentrator process water system. The larger sand size tailings from the hydroseparators would be pumped to the tailings filtering building, where the tailings would be reduced to 10 percent moisture by cyclones and belt type filters. Water would be returned to the concentrator for recovery. The filtered tailings (2,393,700 dry long tons per year) would either be conveyed to a stacking conveyor and stockpiled, or conveyed to and mixed with the dry cobber tailings.

Tailings Transport and Water Recycling

Coarse (cobbed and filtered) tailings would be transported to the Embarrass tailings basin by 120-ton trucks. These coarse tailings would be used for dam and road construction or placed in the basin. The fine tailings would be discharged directly into the tailings basin by gravity flow.

Dam Construction

The Embarrass tailings disposal area is located in the upper Embarrass River watershed, which is tributary to the St. Louis River Basin. Figure 36 shows the approximate basin and watershed limits. The basin would be created by construction of a dam along the north and westerly limits of the site, utilizing the prominent ridge running in a northeast-southwest direction for its southern boundary (refer to Figure 37). The basin has been divided into the East Embarrass and West Embarrass portions, referring to stages of development. The east site would be developed first utilizing a starter dike, and raising the basin, utilizing a tailings dam along the northerly limits. The basin would be raised to approximately elevation 1,570 feet. Following this, tailings disposal would be shifted to the west basin. The starter dike would be constructed.

using tailings, and the basin would be raised to the same height as the east basin. The south limit of the west basin was selected in anticipation of some expansion of the tailings basin for Erie Mining Company.

Separation of the Embarrass site into two basins provides a better control over runoff tributary to the settling pond. This has advantages which are discussed later relative to accumlation of excessive runoff caused by extreme runoff conditions. Also, the amount of tributary drainage area removed from the Embarrass River at any one time is reduced by this procedure. Following stabilization of the east basin, runoff and seepage could be possibly treated and released to the Embarrass River or diverted for make-up water to the east basin. During periods of heavy runoff, the relatively small size of the West Basin would offer advantages in minimizing accumulation of excess runoff. More detailed limits of clearing, dam construction, and seepage collection facilities are shown later in Appendix A.

Coarse Tailins Disposal

The proposed method of disposal at the Embarrass site differs from the Reserve proposal at Mile Post 7, in that dry cobber tailings and filtered tailings would also be deposited in the basin at the alternate sites. At Mile Post 7, Reserve Mining Company proposes to deposit coarse tailings in the western portion of the basin area at elevations which lie above the tailing pond used for deposition of fine tailings. At Embarrass, the coarse tailings would be used to construct or raise the dams from the starter dike height to ultimate height. It is proposed to dispose of the additional coarse tailings within the limits of the basin. While the tailings placed inside the basin may initially be above pond level, they would eventually lie below pond level. The coarse tailings used in the dams will likely be compacted to a density higher than the coarse tailings placed inside the basin. Therefore, the average density of total tailings will increase with the amount of coarse tailings used in the dams. Using an average density of approximately 105 pounds per cubic foot resulted in a total storage volume requirement of 460,000 acre-feet or 740 million cubic yards at the Embarrass site.

Seepage Collection System

A seepage collection system is proposed on the outside of the basin to intercept seepage through the dams and runoff from the outside dam slopes. This system consists of an intercepting ditch and dikes to collect the combined seepage and runoff. Temporary storage ponds and pump stations are proposed for collection and return of the water to the basin. Because the seepage collection system is generally located from 500 to 1,000 feet outside of the top of dam, an additional drainage area, located between the seepage collection ditches and top of dam, is added to the watershed tributary to the basin. Criteria for design of the collection system and return water pumping stations is based on the estimated seepage rate plus pumping capacity and temporary storage to collect a 10-year frequency runoff event from the drainage area tributary to the collection system. Figure 36 shows the approximate limits of the seepage collection system and pumping stations for the Embarrass site. The drainage area tributary to the seepage collection system is also shown.

Access Roads

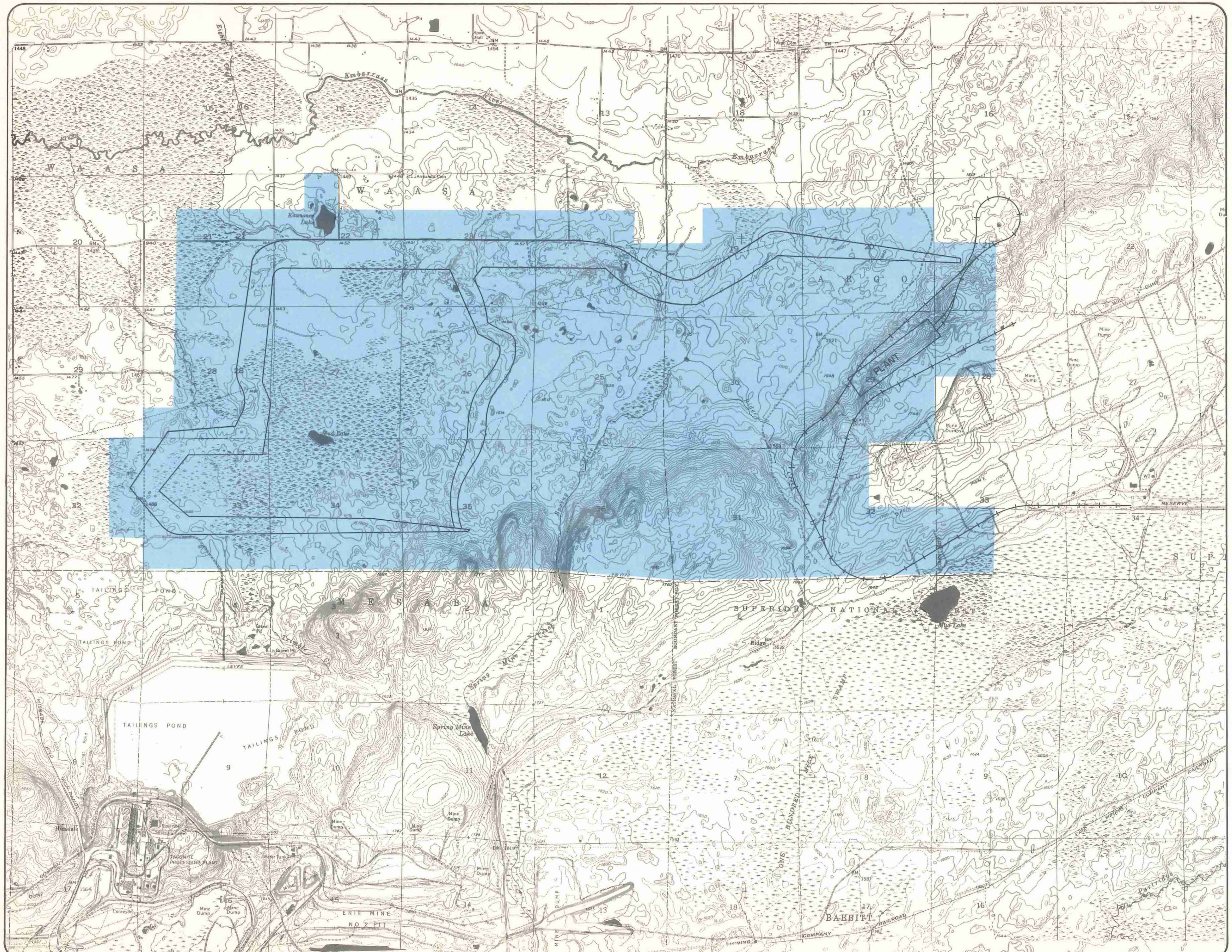
Access corridors will be required from existing roads in the vicinity of the Embarrass site as indicated on the layout (Figure 37). An existing road runs within about one-half mile of the tailing basin limits. Access roads around the basin perimeter would also be required, as well as a pipeline maintenance road between the basin and the plant. It is likely that the cleared access width to the basin areas would be in the range of 100 to 200 feet with a road width of about 50 feet. Additional access corridors will be required for construction of the plant facilities. The Embarrass plant site would require an access road approximately three-quarters of a mile in length. Long access routes would likely be limited in width to a cleared area of about 100 to 150 feet and a surface width of from 30 to 40 feet.

Delta Stabilization

Delta stabilization would occur as required for Reserve's proposed Mile Post 7 plan.

Utilities

The new facilities at the Embarrass site will require the construction of a high voltage electrical transmission line between Reserve's power generating plant at Silver Bay and the Embarrass site. The transmission line would be double pole construction within the railroad right-of-way. A right-of-way of 50 feet would be required to accommodate this construction. Reserve's Silver Bay generating plant would possibly supply 75 MW. If Reserve's Silver Bay generating plant is not capable of supplying the total electrical power demands for facilities at the Embarrass site as well as concentrate unloading and handling, pelletizing, and dock facilities at Silver Bay, then Reserve would have to purchase additional power from Minnesota Power and Light. Modifications to Reserve's Silver Bay generating plant would be the same as described for Reserve's proposed Mile Post 7 plan.



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

37 EMBARRASS ALTERNATIVE - TAILINGS BASIN

LEGEND

ASSUMED SITE BOUNDARY

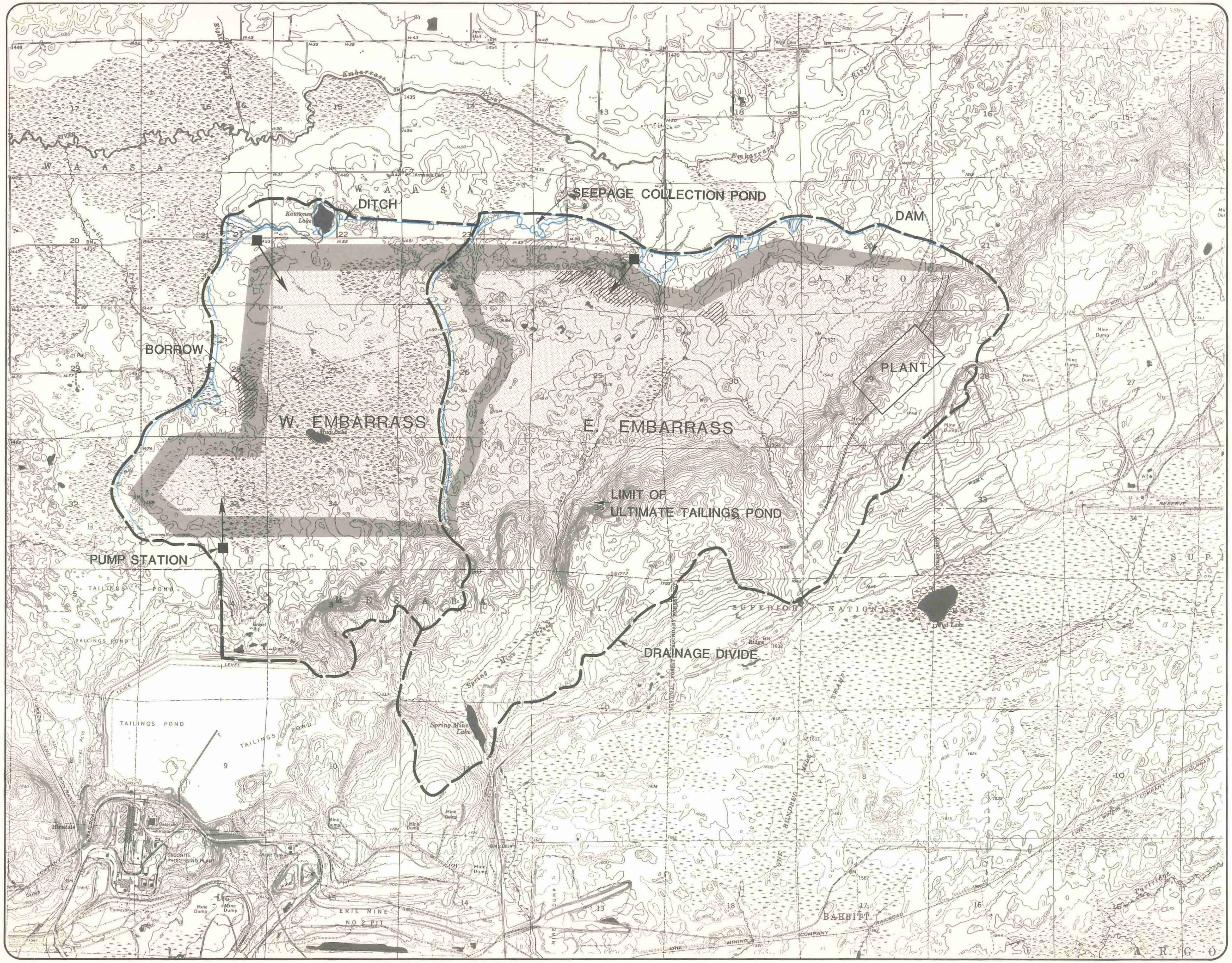
TOE OF DAM

BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

ENVIRONMENTAL IMPACT STATEMENT
RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

36 EMBARRASS ALTERNATIVE - DRAINAGE AND SEEPAGE COLLECTION SYSTEM



BARTON-ASCHMAN ASSOCIATES, INC.

BARR ENGINEERING

THE COLVIN ALTERNATIVE

The Colvin tailings disposal area would be located in the upper Partridge River watershed, about 4 miles southeast of the Peter Mitchell Mine and adjacent to the Reserve railroad (Figure 38). The utilization of the Colvin site requires newly constructed rail, car dumping, fine crushing, dry cobbing, concentrating, concentrate filtering, concentrate loading, and tailings disposal facilities. The concentrate filter cake would be transported to Silver Bay in insulated railroad cars where the concentrate would be unloaded and fed to the existing pelletizing plant.

The new facilities for fine crushing, dry cobbing, concentrating, concentrate filtering, concentrate loading, concentrate unloading and handling, tailings separation and filtering, and tailings transport and water recycling would be essentially the same as described for the Embarrass alternative. These new facilities at the Colvin site would be constructed on the ridge at the north end of the basin. Utilities would also be the same, except for the shorter length of the electrical transmission line. New facilities for rail haulage of the coarse crushed taconite ore and concentrate filter cake would differ from those for the Embarrass alternative.

Rail Haulage of Coarse Crushed Ore

Coarse crushed taconite ore would be loaded into 85-ton railroad cars at Crushers No. 1 and 2. These cars would then be assembled into unit trains that would carry the crushed taconite approximately 7 miles to the car dumper at the Colvin site. This requires the construction of a railroad spur from the present Reserve railroad and a car yard at the Colvin site.

Rail Haulage of Concentrate

Concentrate filter cake would be hauled approximately 40 miles from the Colvin site to Silver Bay on Reserve's private railroad in 85-ton railroad cars. Insulated, open-top cars, as described for the Embarrass alternative, would be used to retard freezing of the wet concentrate filter cake during winter months.

Dam Construction

The Colvin site is located in the upper Partridge River watershed which is also tributary to the St. Louis River Basin. This tailings basin would be developed by construction of dams along the southern and western limits, using natural topography along the remainder of the basin (refer to Figure 39). The approximate basin limits and tributary drainage area are shown on Figure 40.

As with the Embarrass site, it is proposed that the Colvin site be developed in two stages. The North Colvin Basin would be developed first, by construction of a starter dam near the east quarter corner of Section 25, T59N, R13W. The starter dam would be constructed from borrow material, and the dam would be raised and extended using tailings. The tailings basin would be raised to an ultimate height of approximately 1,660 feet. During the final stages of development in the North Colvin Basin, a dike would be constructed using tailings to create the South Colvin Basin. This basin would also be raised, using tailings for dam construction, to an elevation of 1,660 feet.

Again, separation of the Colvin site into a North and South Basin enables better control of tributary drainage area during periods of heavy runoff. Also, the impact on quantity of runoff downstream of the basin is minimized, since the drainage area removed from the Partridge River watershed at any one time is reduced.

Coarse Tailings Storage

Coarse tailings storage would be the same as that proposed for the Embarrass site.

Seepage Collection System

A seepage collection system is proposed on the outside of the basin to intercept seepage through the dams and runoff from the outside dam slopes. This system consists of an intercepting ditch and dikes to collect the combined seepage and runoff. Temporary storage ponds and pump stations are proposed for collection and return of the water to the basin. Because the seepage collection system is generally located from 600 to 1,000 feet outside of the top of dam, an additional drainage area, located between the seepage collection ditches and top of dam, is added to the watershed tributary to the basin. Criteria for design of the collection system and return water pumping stations is based on the estimated seepage rate, plus pumping capacity and temporary storage to collect a 10-year frequency runoff event from the drainage area tributary to the collection system. Figure 40 shows the approximate limits of the seepage collection system and pumping stations for the Colvin site. The drainage area tributary to the seepage collection system is also shown.

Stream Diversions

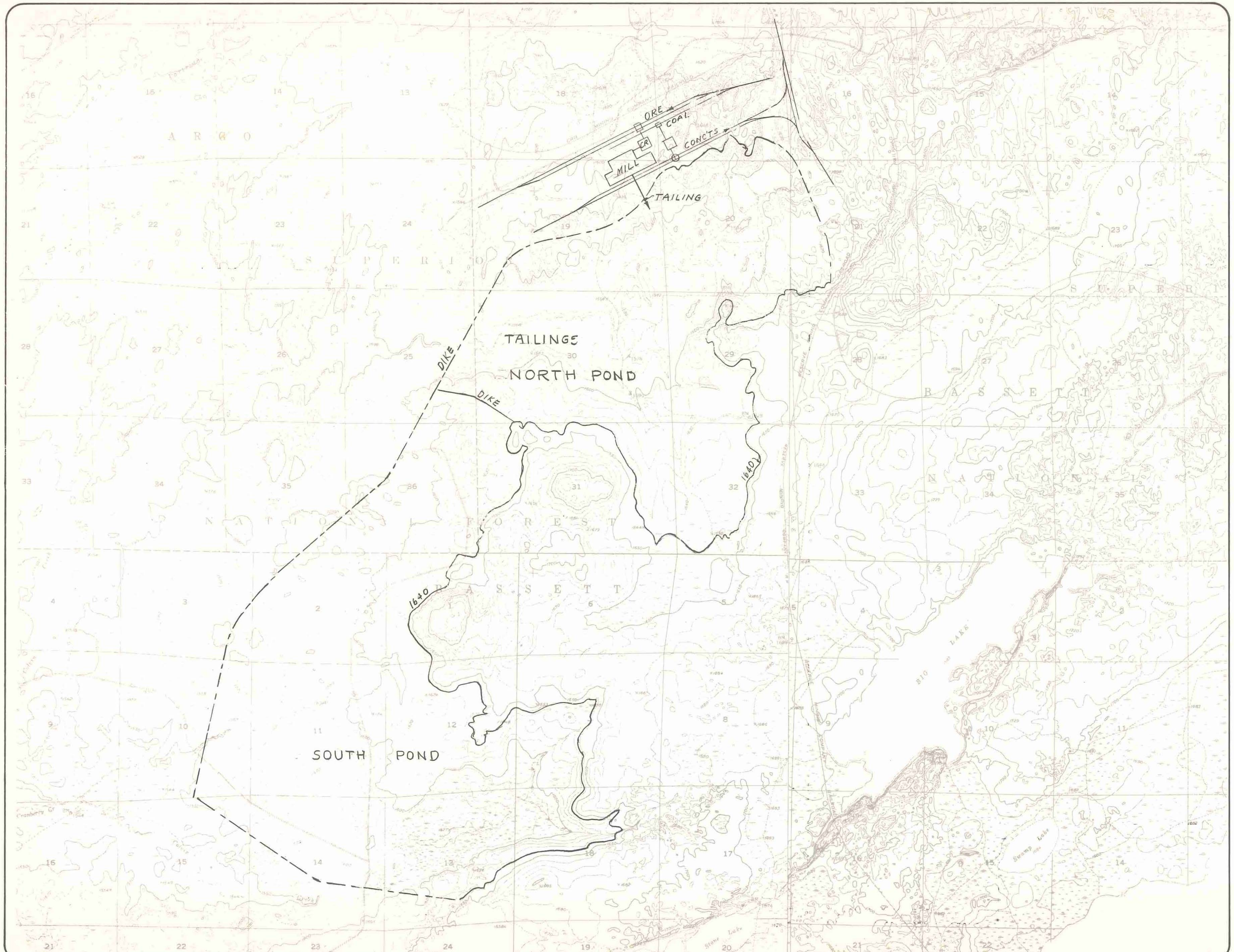
Construction of diversion facilities within the tributary drainage area would be required to direct runoff as desired during operations. Following completion of the North Colvin Basin, it is proposed that the outlet of Big Lake and a portion of the tributary area lying southeast of the North Basin be diverted to the west, into the South Colvin site. Following stabilization of the North Colvin Basin, runoff from this site could be possibly treated and released to the Partridge River. More detailed information concerning clearing limits, dam construction and seepage collection facilities is presented in Appendix A.

Access Roads

Access corridors will be required from existing roads in the vicinity of the Colvin site as indicated on the layout (Figure 39). An existing road runs within about one-half mile of the tailings basin limits. Access roads around the basin perimeter would also be required, as well as a pipeline maintenance road between the basin and the plant. It is likely that the cleared access width to the basin areas would be in the range of 100 to 200 feet, with a road width of about 50 feet. Additional access corridors will be required for construction of the plant facilities. In the case of Colvin, the proposed plant site lies within about one-quarter mile of an existing road. Access routes would likely be limited in width to a cleared area of about 100 to 150 feet and a surface width of from 30 to 40 feet.

Delta Stabilization

Delta stabilization would occur as required for Reserve's proposed Mile Post 7 plan.



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

38 COLVIN ALTERNATIVE

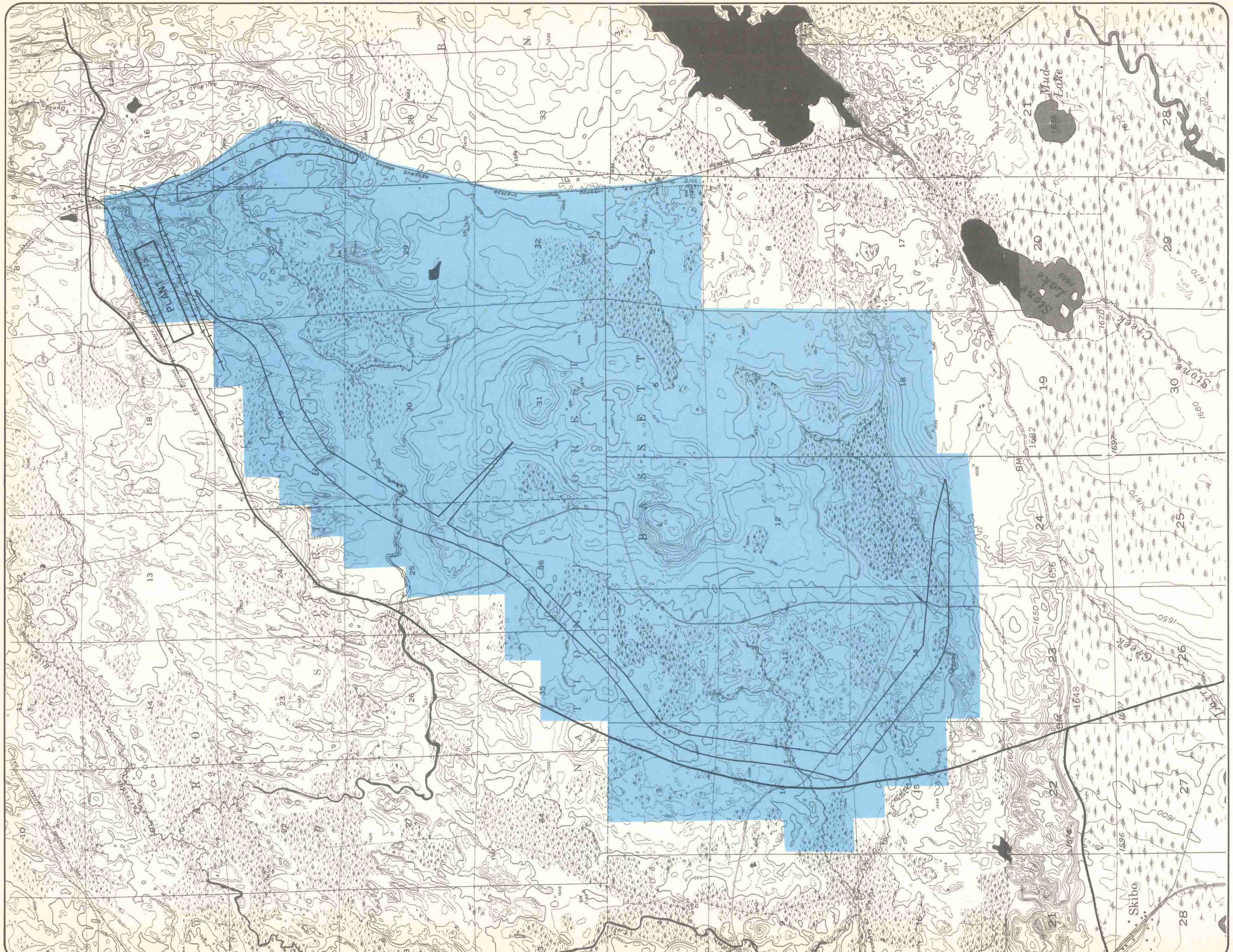
BARTON-ASCHMAN ASSOCIATES, INC.

F. C. TORKELSON COMPANY

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

39 COLVIN ALTERNATIVE - SITE PLAN



LEGEND

ASSUMED SITE BOUNDARY

TOE OF DAM

BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

40 COLVIN ALTERNATIVE - DRAINAGE AND SEEPAGE COLLECTION SYSTEM

BARTON-ASCHMAN ASSOCIATES, INC.

BARR ENGINEERING

THE SNOWSHOE ALTERNATIVE

The Snowshoe tailings disposal area would be located approximately 7 miles southeast of the Peter Mitchell Mine and adjacent to the Reserve's railroad (Figure 41). The utilization of the Snowshoe site requires the construction of new rail, car dumping, fine crushing, coarse cobbing, concentrating, concentrate filtering, concentrate loading, and tailings disposal facilities. The concentrate filter cake would be transported to Silver Bay in insulated railroad cars, where the concentrate would be unloaded and fed to the existing pelletizing plant.

The new facilities would be constructed on a small ridge southwest of the basin. Facilities for fine crushing, dry cobbing, concentrating, concentrate filtering, concentrate loading, concentrate unloading and handling, and tailings separation and filtering would be essentially the same as described for the Embarrass alternative. Utilities would also be the same, except for the shorter length of the electrical transmission line. However, new facilities for rail haulage of coarse crushed taconite ore and concentrate filter cake and tailings transport and water recycling would differ from those for the Embarrass alternative.

Rail Haulage of Coarse Crushed Ore

Coarse crushed taconite ore would be loaded into 85-ton railroad cars at Crushers No. 1 and 2. These cars would be assembled into unit trains that would carry the crushed taconite approximately 10 miles to the car dumper at the Snowshoe site. This requires the construction of a railroad spur from the present Reserve railroad and a car yard at the Snowshoe site.

Rail Haulage of Concentrate

Concentrate filter cake would be hauled in insulated, open-top railroad cars approximately 40 miles from the Snowshoe site to Silver Bay on Reserve's railroad.

Tailings Transport and Water Recycling

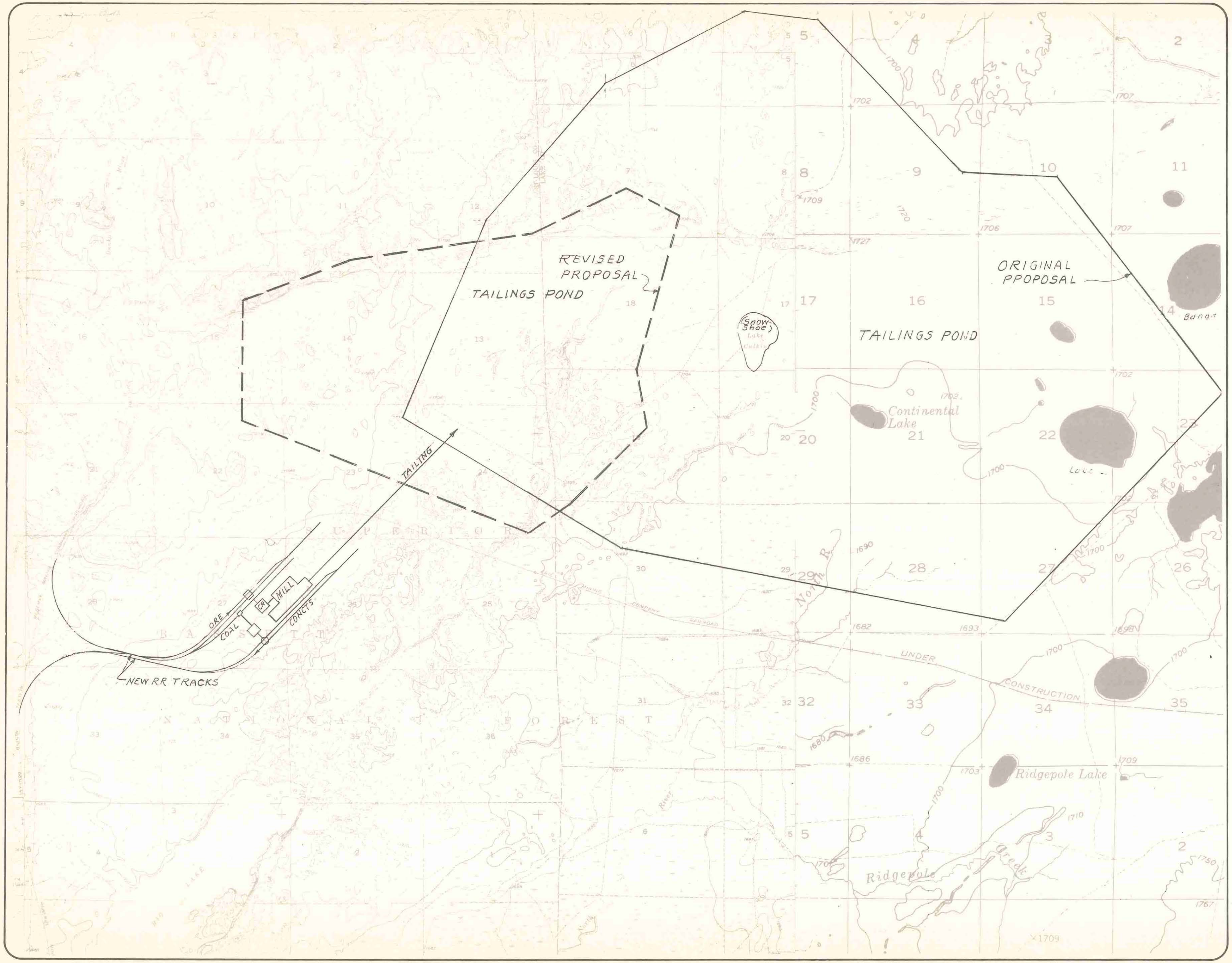
Coarse (cobbed and filtered) tailings would be transported to the basin by 120-ton trucks. These coarse tailings would be used for dam and road construction or placed in the basin. The fine tailings would be pumped from the clarifiers to the basin.

Dam Construction

As shown in Figure 42, the proposed Snowshoe tailings disposal area is located to the northeast of the Colvin site. The Snowshoe tailings disposal area was originally proposed by IECO. The basin has been considerably reduced in area (refer to Figure 41), reflecting a greater required height than the Colvin or Embarrass sites. Selection of the basin limits was based primarily on engineering judgment and anticipated reduced costs for dam construction. The Snowshoe area has flat terrain, and clearing and peat removal are anticipated. It will be necessary to pump fine tailings to the basin. The small basin size offers advantages in minimizing the accumulation of runoff within the basin during wet cycles. However, due to the small area of the basin, problems during drought cycles are accentuated.

No staging was incorporated into the Snowshoe alternative site, due to dam construction requirements and its comparatively smaller surface area.

The basin would be created initially by construction of a starter dike along the westerly basin limits. A dam constructed of coarse tailings would then be required around the entire basin perimeter. The basin would rise during a period of 40 years to an ultimate elevation of 1,820 feet. The basin occupies an area primarily tributary to the Dunka River. A small portion along the east limits of the basin may be tributary to the North River upstream of Seven Beaver Lake. However, since this area is rather small, and a detailed field survey would be required to identify the actual divide between the Dunka and North Rivers, for practical purposes, the east limits of the basin are assumed to approximately follow the divide. This watershed divide is part of the Laurentian Divide, separating runoff of the Dunka River watershed, which is tributary to Hudson Bay from runoff of the North River, which is tributary to the St. Lawrence Seaway. More detailed information concerning clearing limits, dam construction limits and seepage collection facilities for this site is presented in Appendix A.



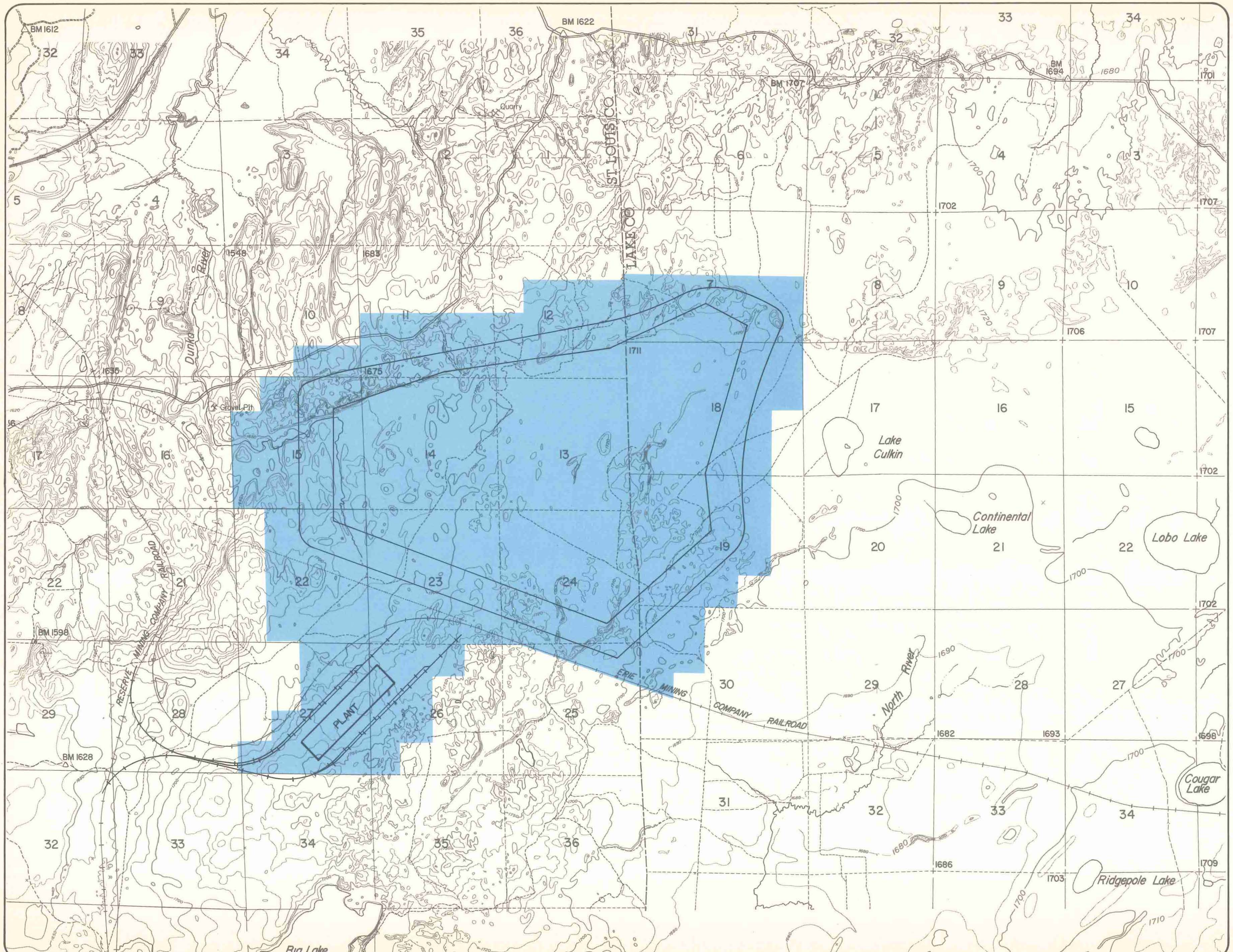
ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

41 SNOWSHOE ALTERNATIVE

BARTON-ASCHMAN ASSOCIATES, INC.

F. C. TORKELSON COMPANY



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

42 SNOWSHOE ALTERNATIVE

LEGEND

ASSUMED SITE BOUNDARY

TOE OF DAM

BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

Coarse Tailings Disposal

Coarse tailings disposal would be the same as proposed for the Embarrass and Colvin alternatives, except that, because of the larger proportion of tailings used in the dams of Snowshoe, the density is greater (about 115 pounds per cubic foot). This higher density allows a lower storage volume of 420,000 acre-feet or 680 million cubic yards.

Seepage Collection System

A seepage collection system is proposed on the outside of the basin to intercept seepage through the dams and runoff from the outside dam slopes. This system consists of an intercepting ditch and dikes to collect the combined seepage and runoff. Temporary storage ponds and pump stations are proposed for collection and return of the water to the basin. Because the seepage collection system is generally located from 500 to 1,000 feet outside of the top of dam, an additional drainage area, located between the seepage collection ditches and top of dam, is added to the watershed tributary to the basin. Criteria for design of the collection system and return water pumping stations is based on the estimated seepage rate, plus pumping capacity and temporary storage to collect a 10-year frequency runoff event from the drainage area tributary to the collection system. Figure 43 shows the approximate limits of the seepage collection system and pumping stations for the Snowshoe site. The drainage area tributary to the seepage collection system is also shown.

Access Roads

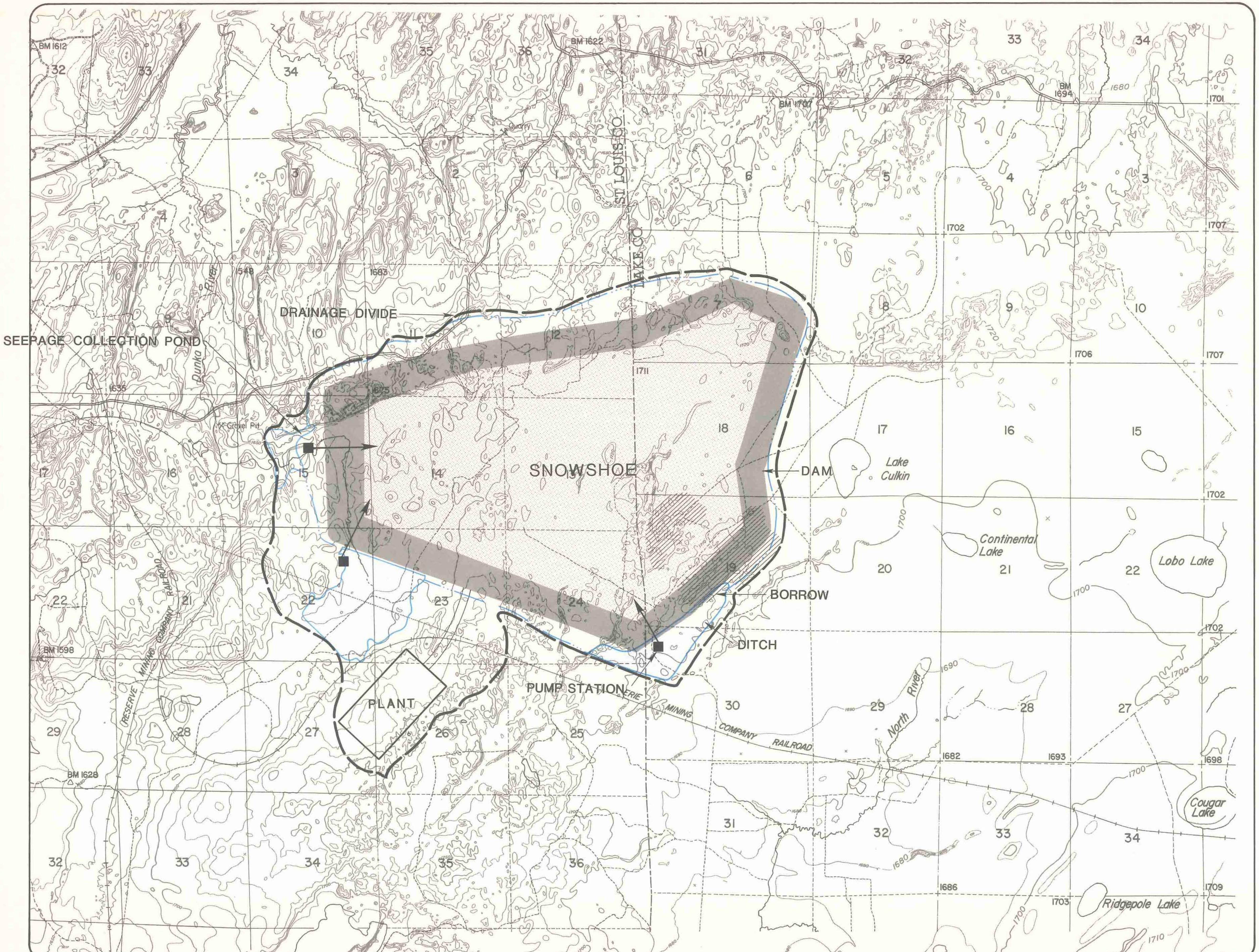
Access corridors will be required from existing roads in the vicinity of the Snowshoe site as indicated on the layouts (Figure 42). An existing road runs within about one-half mile of the tailings basin limits. Access roads around the basin perimeter would also be required, as well as a pipeline maintenance road between the basin and the plant. It is likely that the cleared access width to the basin areas would be in the range of 100 to 200 feet with a road width of about 50 feet. Additional access corridors will be required for construction of the plant facilities. The Snowshoe site may require an access road approximately 2.5 to 3 miles in length. Access routes would likely be limited in width to a cleared area of about 100 to 150 feet and a surface width of from 30 to 40 feet.

Delta Stabilization

Delta stabilization would occur as required for Reserve's proposed Mile Post 7 plan.

ENVIRONMENTAL IMPACT STATEMENT
RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

43 SNOWSHOE ALTERNATIVE - DRAINAGE AND SEEPAGE COLLECTION SYSTEM



BARTON-ASCHMAN ASSOCIATES, INC.
BARR ENGINEERING

THE MIDWAY ALTERNATIVE

The Midway tailings disposal area would be located approximately 20 rail miles from Reserve's facilities at Silver Bay, adjacent to the Reserve railroad (Figure 31). Two methods of operation have been considered at the Midway site. Reserve has analyzed the site based on a plan similar to Reserve's proposed Mile Post 7 plan, in which the fine tailings would be thickened to a 60 percent solid slurry and pumped via a pipeline to the basin. Coarse tailings would be rail hauled from Silver Bay to the tailings disposal site.

The other proposal, as indicated in Figure 44, would be similar to the Embarrass alternative, which requires new facilities for car dumping, fine crushing, dry cobbing, concentrating, concentrate filtering, and concentrate loading in addition to the tailings disposal facilities at the Midway site. The concentrate filter cake would be transported to Silver Bay and unloaded as for the Embarrass alternative. Utilities would also be the same, except for the shorter length of the electrical transmission line. New facilities for rail haulage of the coarse crushed taconite and concentrate filter cake would differ from those for the Embarrass alternative.

Coarse crushed taconite ore would be hauled about 30 miles from Crushers No. 1 and 2 to the Midway site. This requires the construction of a railroad spur from the present Reserve railroad and a car yard at the Midway site. Concentrate filter cake would be hauled about 20 miles from the Midway site to Silver Bay in insulated, open-top cars on Reserve's existing railroad.

Prior to undertaking field studies at the Midway site, a review of the Midway alternative was made to determine the relationship of this alternative to other Reserve operations. Based on this review, it appeared that the Midway alternative would not offer any significant advantages to the public over a Babbitt site (Colvin, Embarrass, and Snowshoe), nor did it appear to offer an advantage to Reserve, since operations would be divided into three areas rather than two, and capital and operating costs would be greater than for Reserve's proposed Mile Post 7 plan.

Thus, it was decided that a major effort would not be expended evaluating the Midway alternative. Although no longer considered in future sections of this EIS, the alternative presented by the Midway site should remain open, in case an agreement cannot be reached on any of the other alternative sites or Reserve's proposed Mile Post 7 plan during the decision-making process.

Dam Construction

Five basins in the vicinity of Mile Post 21 along the Reserve rail line were examined in July, 1974, by Barr Engineering Company. This preliminary analysis identified two basins which would accommodate the storage/disposal of tailings for a period of 40 years. The tailings basin layout as presently depicted in Figure 45 shows that one basin (Basin A) would be required for tailings disposal and the other (Basin B) for storage of coarse tailings. Both of these basins would lie entirely within the St. Louis River watershed. The subwatersheds involved would be the Cloquet River and Kinney Creek.

It was determined that filling Basin A to a uniform depth of approximately 120 feet would provide a volume of 259,100 acre-feet (398 million cubic yards) for disposal of the fine tailings. To fill the basin to a uniform depth of 120 feet, the fine tailings in the upper portion of Basin A would have to be stacked at approximately a +1.0 percent grade from the south to north, and in the lower portion of Basin A at approximately a grade of +0.5 percent from the south to the north. This volume would provide for disposal of the tailings for approximately 40 years.

In the 1974 concept, make-up water for the concentrating and pelletizing operations would be obtained from Lake Superior. If this were the case, it would be desirable to eliminate as much inflow from other sources into the basin as possible and reduce problems related to excess water in the fine tailings basin. Also, the amount of excess water in the fine tailings basin would affect the size of the return waterline required from the basin to the concentrator. To minimize the inflow from runoff into the fine tailings basin, the drainage area to the basin would be kept as small as possible. Developing the upper portion of Basin A as the initial disposal area would minimize the drainage area.

If the upper portion of Basin A were developed first, the approximate elevation of the starter dam would be 1,910 feet. This would provide for disposal of the fine tailings slurry and freeboard for flood control and wave protection for approximately two years after the start of operations. The total volume of the starter dam at elevation 1,910 feet would be 2,440,000 cubic yards. If the lower portion of Basin A were devloped first, the approximate elevation of the starter dam would be 1,840 feet. This would also provide for disposal of the fine tailings slurry for approximately two years and freeboard for flood control and wave protection. The total volume of the starter dam at elevation 1,840 feet would be 2,380,000 cubic yards.

Seepage Collection System

Available soils data in the areas of Basins A and B indicate that fairly thick deposits of pitted outwash sands and gravels are the dominant soil type and, therefore, seepage from these basins can be expected to be significant. However, seepage and runoff can be collected, as in other alternatives. Approximately 180 acres of drainage area to Basin A would be intercepted by ditches and collected in a seepage collection pond.

Coarse Tailings Disposal

The runoff from the coarse tailings disposal area (Basin B) would also be collected. Approximately 10 percent of Basin B will be developed for the initial coarse tailings disposal area. Two areas have been identified that would minimize the drainage area to the collection facilities. The two areas are shown as area "B1" and area "B2" in Figure 45. In the case of both areas, "B1" and "B2," the coarse tailings disposal areas are approximately 250 acres and the drainage areas which must be collected are approximately 490 acres.

Delta Stabilization

Delta stabilization would occur as required for Reserve's proposed Mile Post 7 plan.

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

44 MIDWAY ALTERNATIVE - SITE PLAN

LEGEND

— TAILINGS BASIN

--- ASSUMED SITE BOUNDARIES

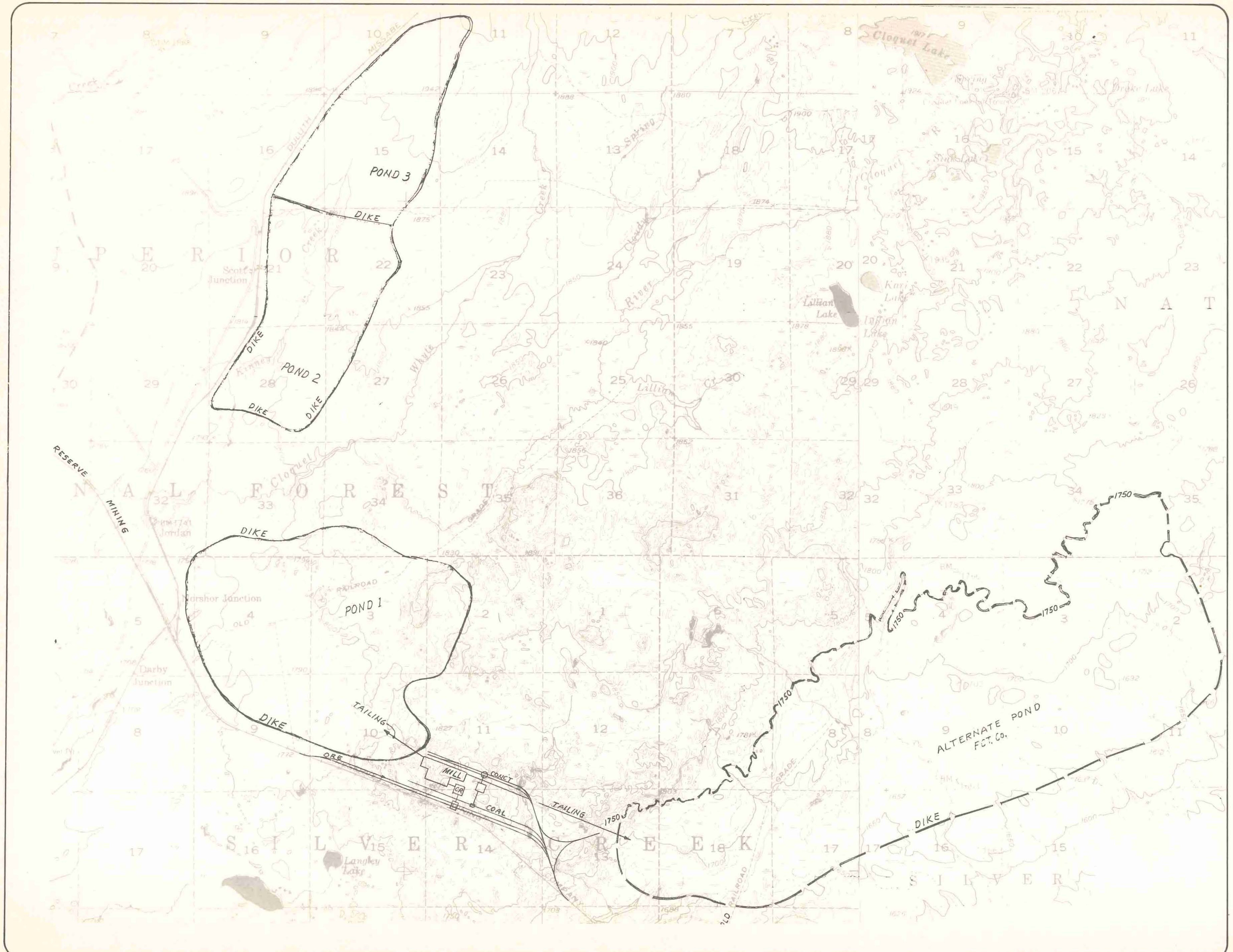
BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

45 MIDWAY ALTERNATIVE - BASIN LAYOUT



BARTON-ASCHMAN ASSOCIATES, INC.

F. C. TORKELSON COMPANY

THE MINE SITE ALTERNATIVE

The Mine pit tailings disposal area would be located within the Peter Mitchell Mine pit. The utilization of the Mine site requires newly constructed rail, car dumping, fine crushing, dry cobbing, concentrating, concentrate filtering, concentrate loading, and tailings disposal facilities. The concentrate filter cake would be transported to Silver Bay in insulated rail cars, where the concentrate would be unloaded and fed to the existing pelletizing plant.

The new facilities for rail hauling coarse crushed taconite ore, fine crushing, dry cobbing, concentrating, concentrate filtering, concentrate loading, rail haulage of concentrate filter cake, concentrate unloading and handling, tailings separation and filtering, and water recycling would be essentially the same as described for the Embarrass alternative. Tailings transport would differ from the Embarrass alternative in that the distance would be greater. These new facilities would probably also be constructed on the same linear ridge trending northeast-southwest as in the Embarrass alternative (return to Figure 33).

DAM CONSTRUCTION

Three concepts were evaluated for tailings disposal in the Mine pit. These were:

1. All tailings disposed of within some portion of the Mine pit, beginning now.

2. Cobbed tailings minus 3/4 inch in size disposed of within the pit during the operating life of the Mine pit.

3. All tailings disposed of within the eastern end of the Mine pit, beginning in 35 years.

Appendix C contains a description of the evaluation of Mine pit alternatives.

First Concept

For the first concept, with all tailings disposed of within some part of the Mine pit beginning now, the specific design criteria were:

1. Tailings must not be placed upon exposed commercial taconite (i.e., only on exposed footwall rock).

2. The dam needed to contain tailings (as shown in Figure 46) is typical of that proposed at all alternate sites, with dam height limited to 80 feet. Heavy blasting nearby would create strong and possibly dangerous vibrations, requiring careful analysis to ensure safe working conditions for persons working below the dam in the Mine pit.

3. In-pit disposal must start at the same time as production starts at the new facilities located near the pit's west end, close to the Embarrass site.

4. Blending of mined crude taconite ore is necessary.

Based on these design criteria it was concluded that it is not possible to place all the tailings in the operating pit. To contain the fine tailings produced in one year would require 11.8 miles of dam 80 feet high. However, only enough coarse tailings are produced in one year to construct one mile of dam. To construct the additional dam needed would require over 2-1/2 billion tons of additional material.

The area of footwall exposed each year as mining continues down dip does not provide enough footwall disposal area. At the north side of the Mine pit, a thinning wedge of taconite ore is mined, resulting in substantial footwall rock being exposed per unit of mining time. As mining proceeds down dip and further south, the ore is thicker, so that a lesser amount of footwall is exposed per unit of mining time. Such a long dam is required because of the slope of the pit bottom. To provide a safe dam at a 3 to 1 slope on the down-slope side requires about 1,000 feet of cross-section length to provide 500 feet of up-dip storage area. In addition, the up-dip pool thins out. Thus, a dam on a slope is very inefficient as compared to a dam on flat terrain.

The costs for total in-pit disposal have not been estimated, since it was determined that in-pit disposal of all tailings is not a feasible concept.

Second Concept

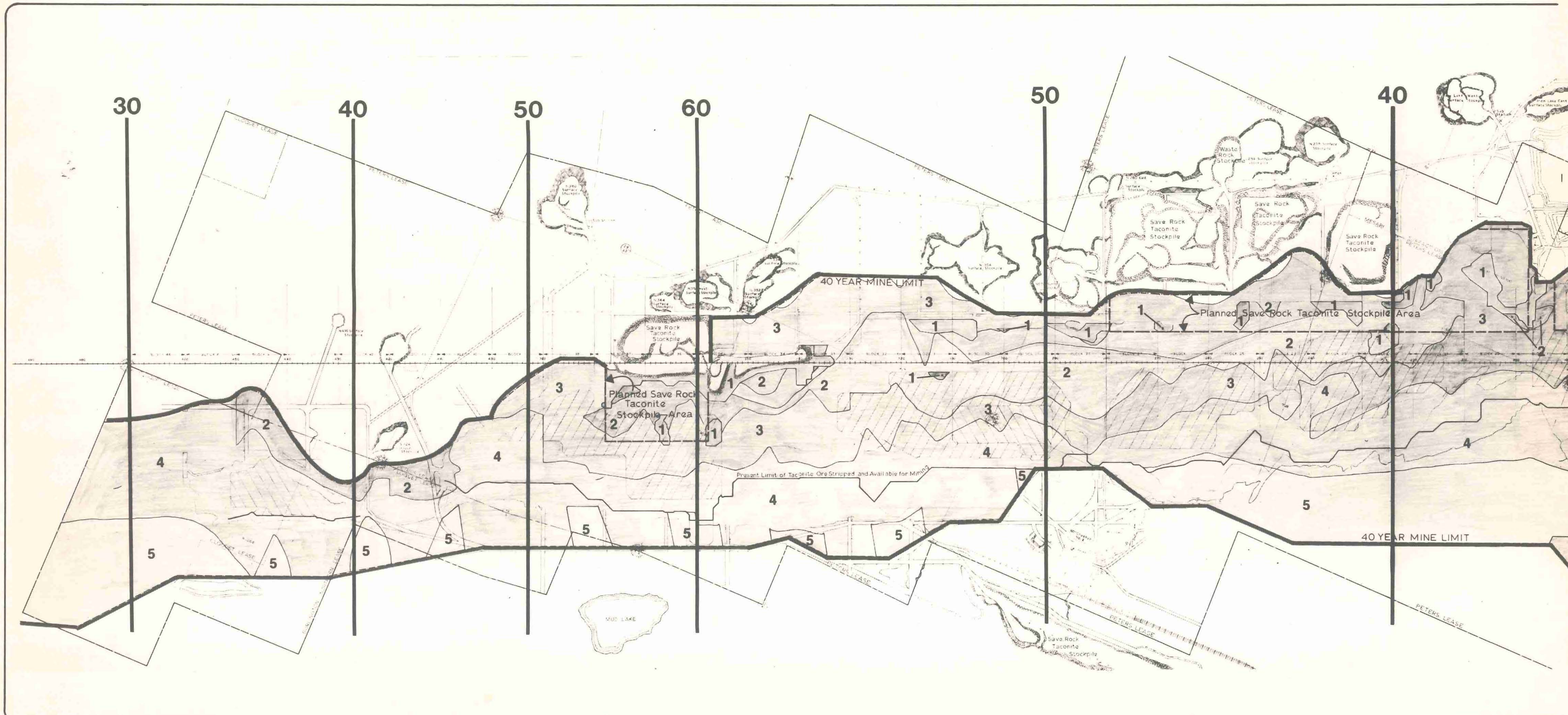
The second concept consists of placing the dry cobbed tailings (6,975,000 dry long tons per year) in the pit during the operating life of the

Mine pit. These tailings which are minus 3/4 inch in size can be stockpiled, and will not require a retaining dike or dam.

This concept requires a tailings basin located outside the Mine pit for disposal of filtered and fine tailings. Substantial tonnages of the coarse cobbed tailings would be required for dam construction at the tailings basin outside the Mine pit. At best, only the remaining coarse cobbed tailings could be placed in the pit.

Two methods were considered for placement of coarse cobbed tailings in the Mine pit. One was to place the tailings wherever footwall save-rock is exposed; the other was to place the tailings on footwall save-rock only in the eastern end, where the deep-lying Lower Cherty taconite layer is less than 30 feet thick, and is not likely to become a future ore source.

The overall conclusion for this concept is that it is not reasonable to place valueless material on any part of the present pit bottom. Covering the Lower Cherty horizon which underlies the present pit bottom would result in a substantial economic and resource loss. Placing tailings in the pit would also have an adverse economic impact on future mining of the save-rock footwall layer as well as interfere with haulage and ore blending.



If coarse tailings were placed in the east end of the pit in an attempt to increase the life of the Embarrass or other tailings disposal areas, a new problem would be created in finding a disposal site outside the pit for redisposal of the coarse tailings. This would involve added haulage costs and energy usage.

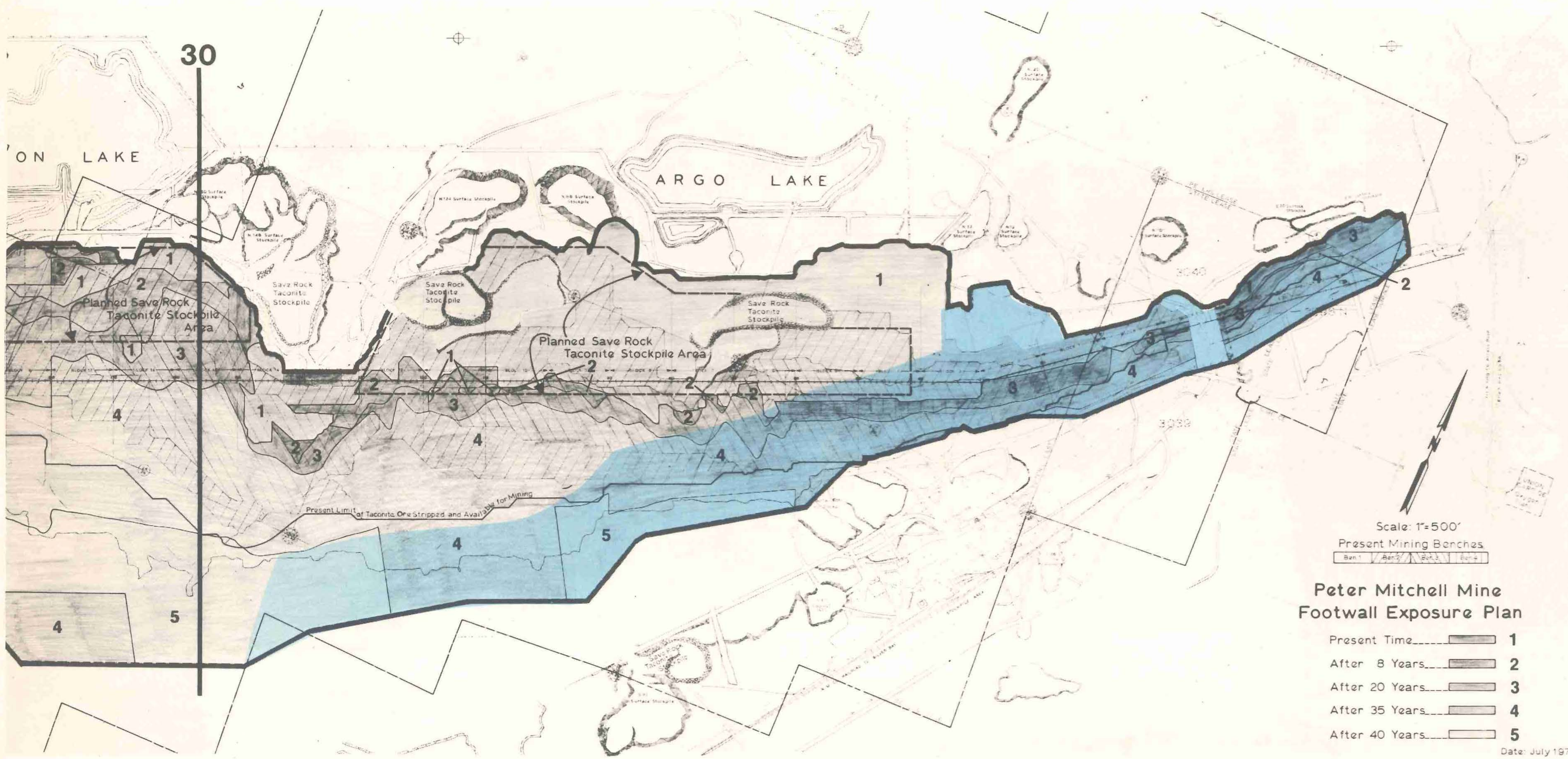
While the life of a tailings disposal area outside the pit might be extended by three years, there would be environmental losses, such as a substantial resource loss of over 52 million long tons of save-rock, substantial increased costs, and substantial tax losses to governmental units.

Third Concept

The third concept is to place all tailings in the eastern end of the pit, *beginning in 35 years.*

This concept requires that a tailings dam be constructed from the south boundary of the Mine pit, northerly up the dip-slope to the same elevation as top-of-rock at the south side of the pit.

A dam location was selected with placement of tailings to begin in year 35. The year 35 was selected because, at that time, much of the area



46 MINE PIT DAM REQUIRE TO CONTAIN TAILINGS

LEGEND

TAILINGS BASIN

BARTON-ASCHMAN ASSOCIATES, INC.
PROFESSOR YARDLEY

will have been mined out. While a change in mining plans would be required, this would be less costly than an earlier beginning and hence more likely to be a viable concept. Also, the placing of tailings cannot be done until mining has reached the south boundary. The dam location shown in Figure 46 was selected because:

1. The Lower Cherty taconite to the east averages under 20 feet in thickness (i.e., it would not encumber potential open pit, Lower Cherty ore).

2. The length of dam required is minimized.

3. The potential tailings basin volume is large.

4. The balancing of reserves between the two primary crushers can be maintained longer.

The amount of tailings that could be placed in this area is about 2,750,000,000 cubic feet or 6.6 years of tailings production.

The storage capacity provided by a north-south dam is not very great, since both the surface and top-of-rock slope down to the south. For example, the 40 year elevation of top-of-rock along the dam is 1,600 feet at the south boundary and 1,800 feet at the north boundary. Thus, storage of tailings can be only to an elevation of 1,600 feet. This would also be the height of the potential lake surface after mining is completed. Northern areas of the pit bottom above 1,600 feet could be used for stockpiling of coarse tailings. If this were done, existing and planned save-rock stockpiles in these areas would have to be loaded and hauled to another stockpile area.

Conclusion

It is concluded that placing a north-south dam in the mine pit to retain tailings is not a reasonable alternative. There would be economic losses to both Reserve and the state. While disposing of 137.9 million tons of tailings in the Mine pit could increase the life of nearby tailings disposal areas outside the pit by 6.6 years, implementation of this concept would result in:

1. Loss of 59.4 million long tons of taconite ore.

2. Loss of 91.3 million long tons of save-rock.

3. Loss of blending flexibility in mining operations.

4. Additional haulage costs for tailings.

5. Tax losses to state governmental units.

Overall Conclusion

Investigations of the three concepts for disposing of tailings in the Mine pit demonstrate that none of them provides a viable solution for tailings disposal. The second concept for the disposal of cobbed tailings in the Mine pit has the least problems. Substantial tonnages of coarse tailings could be stockpiled along the northern edges of the pit. However, there would be added costs and associated resource losses. Because much of the coarse tailings will be needed for tailings dams, the coarse tailings placed in the pit will not greatly extend the life of the tailings basin outside the Mine pit.

INDUSTRIAL ECONOMICS

Financial considerations are being discussed at this time in the report for the following reasons:

1. Past actions have dictated that Reserve Mining Company is to stop disposal of tailings in Lake Superior. As a result, Reserve Mining Company and its parents (Armco Steel Corporation and Republic Steel Corporation) will have to make a decision as to whether or not they are going to develop a new on-land disposal site. Implicit in this decision are questions on the level of investment that Armco and Republic can commit and still maintain a reasonable rate of return, protection and utilization of past investments in plant and equipment, and maintenance of competitive position. The industrial economics impacts will directly affect Reserve Mining Company and its parents. They alone will make the decision as to whether an investment is made for an on-land tailings disposal site.

2. The level of financing for the proposed action, or an alternative, involves hundreds of millions of dollars. The discussion of the financial considerations involves great detail and numerous comparisons. Thus, it was decided that understanding would be maximized if the entire financial discussion is presented in one location in this report. Further, it was decided that before proceeding into the other areas of impact, those who study this report in detail should be aware of the financial implications of the proposed action and alternatives for Reserve Mining Company and its parent companies, Armco and Republic Steel Corporations.

Supporting information to this subpart is contained in Appendices B and D.

EXISTING FINANCIAL CONDITIONS

The existing Reserve facilities were constructed in three phases. The initial phase was completed in 1956 at a cost of $153,000,000, and had an annual pellet capacity of 3.5 million long tons. By 1961, the initial facility had been expanded, and annual pellet capacity was increased to 6 million long tons. The capital cost of this expansion was $33,000,000. The last expansion was completed in 1967 at a capital cost of $128,000,000. This expansion increased annual pellet capacity to 10.7 million long tons, which is the current Reserve capacity. Since the initial phase, Reserve also has made additional smaller capital expenditures for minor modifications and equipment replacement. The December 31, 1974 balance sheet for Reserve shows:

1. Total assets of $196,713,835 as listed below.
   a. Current assets of $45,198,685, including $24,472,243 due from Armco and Republic.
   b. Investments of $8,423,486.
   c. Non-current receivables due from Armco and Republic of $20,495,979.
   d. Miscellaneous receivables and deposits of $912,237.
   e. Property, plant and equipment of $121,197,786 (initial cost of $327,910,351).
   f. Deferred charges of $485,662.

2. Total liabilities and owners' equity of $196,713,835 as listed below.
   a. Current liabilities of $37,210,863 (including $8,355,000 of installments on long term debts).
   b. Long-term debt of $102,088,167 including 4¼% Series A Bonds due June 1, 1980 of $51,600,000 (plus $3,440,000 classified as current) and 5-3/4% Series B Bonds due December 1, 1989 of $58,844,000 (plus $4,916,000 classified as current).
   c. Operating and other reserves of $1,356,590.
   d. Funds furnished by Armco Steel Corporation and Republic Steel Corporation of $56,058,215.

Capital expenditures for 1975 are scheduled for mine and miscellaneous equipment, and are estimated to cost $2,518,000.

The total operating cost incurred for Reserve's existing mining and processing facilities from 1971 to 1973 are shown in Table 9 . The direct operating cost ranged from about $8.05 to $8.80 per long ton of pellets produced. The total operating cost incurred, including state taxes, royalties, interest, depreciation, and other adjustments, ranged from about $12.20 to $12.60 per long ton of pellets produced. During this period, the price of Reserve's pellets FOB Silver Bay, based on the Lake Erie price*, ranged from about $15.00 to $15.50 per long ton. The income before depletion and Federal income taxes to Armco and Republic ranged from about $2.35 to $2.90 per long ton of pellets.

*Lake Erie price is the price of pellets accepted by the U.S. Internal Revenue Service and State of Minnesota for tax purposes.

TABLE 9
TOTAL OPERATING COST INCURRED FOR RESERVE'S EXISTING MINING AND PROCESSING FACILITIES DURING 1971 to 1973

	$/Long Ton Pellets 1971	1972	1973
Pellet Price, FOB Silver Bay	14.982	14.939	15.496
Mining	Upon Reserve Mining Company's claim that publication of the individual components of its direct operating costs would adversely affect its competitive position the state has agreed not to publish these figures in the Draft EIS.		
Mine Stripping			
Coarse Crushing			
Rail Haulage			
Fine Crushing			
Concentrating			
Pelletizing			
Works General Expense			
Townsites			
Administration			
Research and Development			
Direct Operating Cost	8.056	8.349	8.794
Royalties	1.330	1.377	1.364
State Taxes	.616	.612	.683
Depreciation	1.371	1.338	1.238
Interest	.734	.679	.612
Other Costs and Adjustments	.080	.250	-.112
Total Operating Cost Incurred	12.187	12.605	12.579
Net Income Before Depletion and Federal Income Taxes	2.795	2.334	2.917
Depletion	1.398	1.167	1.459
Federal Taxable Net Income	1.397	1.167	1.458
Federal Income Tax	.671	.560	.700
Net Income After Depletion and Federal Income Taxes	.726	.607	.759
Depreciation	1.371	1.338	1.238
Depletion	1.398	1.167	1.459
Cash Flow Before Loan Repayment	3.495	3.112	3.456
Loan Repayment	1.139	.948	.828
Cash Flow After Loan Repayment	2.356	2.164	2.628

During 1974 and 1975, the Lake Erie price for pellets increased substantially. Since January 1974, the Lake Erie price has increased from 29.4 cents to the current price of 47.2 cents per long ton unit of natural iron, resulting in a 60% increase in pellet prices.

In mid-1975, Reserve's direct operating costs were $12.13 per long ton of pellets , and the total operating cost incurred was $17.67 per long ton of pellets, as shown in Table 10 . Based on the Lake Erie price, the price of Reserve's pellets FOB Silver Bay is $24.48 per long ton, resulting in income before depletion and Federal income taxes to Armco and Republic of $6.81 per long ton of pellets. Based on pellet production of 10.4 million long tons of pellets, this current income is $70,855,000 per year. Thus, income before depletion and Federal income taxes to Armco and Republic has increased from an average of about $25,000,000 per year for the 1971 to 1973 period to an estimated $70,855,000 for 1975.

Of major importance to Armco and Republic is the amount of cash or cash flow generated by Reserve and available to the parent companies for other uses. Since Reserve is a cost company, Armco and Republic reimburse Reserve only for the actual cost incurred by Reserve in producing the pellets. If Armco and Republic were to purchase Reserve pellets at the Lake Erie price, the cost to Armco and Republic would be substantially greater than the amount paid to Reserve. Thus, the cash flow generated by owning Reserve and thus available to Armco and Republic is determined by using the Lake Erie price for Reserve's pellets rather than the actual cost incurred by Reserve. Based on Reserve's mid-1975 costs and the current Lake Erie prices, the amount of cash generated by Reserve after existing loan repayments and available to Armco and Republic for other uses is estimated to be $58,300,000 in 1975. This is based on a cash flow, after loan repayment, of $5.603 per long ton of pellets as arrived at in Table 10

PROJECTED FINANCIAL CONDITIONS

Mile Post 7

The proposed Mile Post 7 plan requires an estimated new investment in facilities and land of $221,106,000, as shown in Table 11. These new facilities could possibly be fully operational 30 to 36 months after permits are granted, and would produce 9.5 million long tons of pellets per year. All financial analyses assume that the proposed Mile Post 7 proposal would be operational on January 1, 1979. The capital cost for the proposed Mile Post 7 plan could be financed by either of the two methods listed below:

TABLE 10
ESTIMATED TOTAL OPERATING COST INCURRED FOR RESERVE'S EXISTING MINING AND PROCESSING FACILITIES FOR 1975*

	$/Long Ton Pellets
Pellet Price, FOB Silver Bay	24.478
Mining	Upon Reserve Mining Company's claim that publication of the individual components of its direct operating costs would adversely affect its competitive position the state has agreed not to publish these figures in the Draft EIS.
Mine Stripping	
Coarse Crushing	
Rail Haulage	
Fine Crushing	
Concentrating	
Pelletizing	
Works General Expense	
Townsites	
Administration	
Research and Development	
Direct Operating Cost	12.134
Royalties	1.904
State Taxes	1.764
Depreciation	1.228
Interest	0.537
Other Costs and Adjustments	0.098
Total Operating Cost Incurred	17.665
Net Income Before Depletion and Federal Income Taxes	6.813
Depletion	3.407
Federal Taxable Net Income	3.406
Federal Income Tax	1.635
Net Income After Depletion and Federal Income Tax	1.771
Depreciation	1.228
Depletion	3.407
Cash Flow Before Loan Repayment	6.406
Loan Repayment	.803
Cash Flow After Loan Repayment	5.603

*Average for May through August 1975

TABLE 11
ESTIMATED CAPITAL COSTS OF FACILITIES AND LAND FOR RESERVE'S PROPOSED MILE POST 7 PLAN (81)

	COST
Dry Cobbing	$ 12,765,000
Concentrator Modifications	26,198,000
Concentrate Filtering	13,125,000
Centralized Process Control	6,802,000
General Plant Substation, Radio, Gas	844,000
Stores and Repair - Shop Extension	470,000
Truck Repair Shop	2,851,000
Tailings Filtering	4,542,000
Delta Stabilization	1,564,000
Delta Plant	14,730,000
Coarse Tailings Conveyors	4,685,000
Rail Loading Facilities	2,140,000
Additional Rolling Stock	4,762,000
Silver Bay Railroad Yard	534,000
Mobile Equipment Dam Site	2,336,000
Tailings Pipeline	16,134,000
Recirculating Water System in Plant	2,307,000
Dam Site Railroads	9,371,000
Truck Haul Roads at Dam Site	1,437,000
Initial Dams and River Diversions	17,200,000
Return Water Pipeline	3,214,000
Floc-Soda Ash-Reagent Supply Facilities	2,546,000
Air Quality	24,114,000
Sub Total	$174,671,000
Land	500,000
Spare Parts	2,144,000
Contingency	8,993,000
Escalation	34,798,000
TOTAL	$221,106,000

1. Bonds guaranteed by Armco Steel Corporation and Republic Steel Corporation plus all or a portion of the amount of after tax cash or cash flow generated by Reserve's existing operations during the construction period.

2. Bonds guaranteed by Armco Steel Corporation and Republic Steel Corporation.

If all the estimated cash flow generated by Reserve for the three years ending December 31, 1978 were made available for the proposed Mile Post 7 plan, it would be necessary for the parent companies to borrow an estimated $35,584,000 by January 1, 1979. After combining Reserve's existing facilities and the new facilities for the proposed Mile Post 7 plan, Reserve's pro forma balance sheet on January 1, 1979 would show:

1. Total assets of $307,194,000 as listed below:
   a. Net current assets and investments of $24,292,000.
   b. Property, plant and equipment with an estimated tax basis of $282,902,000, consisting of existing facilities of $61,796,000 and new facilities and land of $221,106,000.

2. Total liabilities and owners' equity of $307,194,000 as listed below:
   a. Long-term liabilities of $112,604,000, including $39,180,000 of 4¼% Series A Bonds due June 1, 1980, $37,840,000 of 5-3/4% Series B Bonds due December 1, 1989, and $35,584,000 of new bonds.
   b. Funds from cash flow generated by Reserve or equity of $194,590,000.

If none of the estimated cash flow generated by Reserve were made available for the proposed Mile Post 7 plan, it would be necessary for the parent companies to borrow an estimated $252,676,000 by January 1, 1979. For this method of financing, the estimated tax basis of property, plant and equipment is higher, because for this method of financing interest incurred during construction has been capitalized. After combining Reserve's existing facilities and the new facilities for the proposed Mile Post 7 plan, Reserve's pro forma balance sheet on January 1, 1979 would show:

1. Total assets of $338,764,000 as listed below:
   a. Net current assets and investments of $24,292,000
   b. Property, plant and equipment with estimated tax basis of $314,472,000, consisting of existing facilities of $61,796,000 and new facilities and land of $252,676,000.

2. Total liabilities and owners' equity of $338,764,000 as listed below:
   a. Long-term liabilities of $329,698,000, including $39,180,000 of 4¼% Series A Bonds due June 1, 1980, $37,840,000 of 5-3/4% Series B Bonds due December 1, 1989, and $252,676,000 of new bonds.
   b. Funds furnished by parent companies as equity of $9,068,000.

If Armco and Republic financed the proposed Mile Post 7 plan entirely with new bonds, the parent companies would have approximately $185,500,000 available for other use from the cash flow generated by Reserve during the construction period.

The estimated total operating costs incurred for Reserve's proposed Mile Post 7 plan during 1981 to 1983 are shown for minimum new loan ($35,584,000) financing in Table 12 and for maximum new loan ($252,676,000) financing in Table 13. These estimated costs are based on mid-1975 operating costs and a 10% interest rate for new bonds. The direct operating cost would be $13.75 per long ton of pellets produced. The total operating costs incurred, including state taxes, royalties, interest, depreciation (straight line), and other adjustments are estimated to be approximately $19.17 per long ton of pellets for the minimum loan ($35,584,000) and $21.37 per long ton of pellets for the maximum loan ($252,676,000). The price of Reserve's pellets FOB Silver Bay based on the current Lake Erie price would be $26.18 per long ton of pellets. Thus, the income before depletion and Federal income taxes to Armco and Republic would be about $7.01 per long ton of pellets for the minimum loan and about $4.81 per long ton of pellets for the maximum loan.

The rates of return for the proposed Mile Post 7 plan have been determined for both minimum ($35,584,000) and maximum ($252,676,000) new loan financing. The various rates of return determined for the proposed Mile Post 7 plan using a 10% interest rate for new bonding are shown in Table 14 . These rates of return are adequate for an investment of this type.

The cash flow generated by the proposed Mile Post 7 plan is of major interest to Armco and Republic. Assuming a discount rate of 10%, which would be the same as the bond interest rate, the present value of the accumulated net cash flow after loan repayment over the 40 year life discounted to January 1, 1976 is $414,837,000 for the minimum loan and $303,839,000 for the maximum loan.

A significant advantage to Armco and Republic of Reserve's proposed Mile Post 7 plan over the existing operation is the increased iron and decreased silica content of the pellets. The proposed Mile Post 7 plan will produce a pellet containing 5.0% silica as compared with 8.5% silica for Reserve's current pellet. Based on a silica premium of $0.77 per unit,[78] this 3.5% reduction in silica content has an economic benefit to Armco and Republic of $2.70 for every long ton of Reserve's pellets consumed. This benefit is primarily derived from savings in the making of iron at the blast furnace. This represents a savings of $25,600,000 annually to Armco and Republic because of improved pellets produced by implementing the proposed Mile Post 7 plan. However, since the Lake Erie price does not include a premium nor a penalty for the silica content of pellets, the foregoing analyses based on Lake Erie prices does not include a separately calculated premium or penalty based on the silica content of Reserve's pellets.

Entire debt financing by bonds should be possible for the proposed Mile Post 7 plan, providing Armco and Republic were to jointly and severally guarantee the debt issue by Reserve and market conditions are favorable. Armco has stated that financing their Mile Post 7 proposal would not have a material adverse impact on Armco's capital spending programs, earnings, or competitive position.(82) Based on current market conditions, it is anticipated that the interest rate would be approximately 10.0% on bonds with 20 year maturity.

Embarrass

The industrial economic analysis was made of the Embarrass site because it was felt to be representative of the Babbitt sites.

The Embarrass tailings basin alternative site, with the construction of new rail haulage, car dumping, fine crushing, dry cobbing, concentrating, concentrate filtering, concentrate loading, and tailings disposal facilities at the Embarrass site and new car dumping and concentrate handling facilities at Silver Bay requires an estimated new investment in facilities and land of $390,818,000, as shown in Table 15 . These new facilities possibly could be fully operational in 48 to 52 months after permits are granted, and produce 10.7 million long tons of pellets per year. All financial analyses assume that the Embarrass alternative would be operational on January 1, 1980. The capital cost for the Embarrass alternative could be financed by either of the two methods listed below:

1. Bonds guaranteed by Armco Steel Corporation and Republic Steel Corporation plus all or a portion of the amount of after tax cash or cash flow generated by Reserve's existing operations during the construction period.

2. Bonds guaranteed by Armco Steel Corporation and Republic Steel Corporation.

If all the estimated cash flow generated by Reserve for the four years ending December 31, 1979 were made available for the Embarrass alternative, it would be necessary for the parent companies to borrow an estimated $151,655,000 by January 1, 1980. After combining Reserve's existing facilities and the new facilities, Reserve's pro forma balance sheet on January 1, 1980 would show:

1. Total assets of $464,705,000 as listed below:
   a. New current assets and investments of $24,043,000.
   b. Property, plant and equipment with an estimated tax basis of $440,662,000, consisting of existing facilities of $49,844,000 and new facilities and land of $390,818,000.

2. Total liabilities and owners' equity of $464,705,000 as listed below:
   a. Long-term liabilities of $220,319,000 including $34,264,000 of 4¼% Series A Bonds due June 1, 1980, $34,400,000 of 5-3/4% Series B Bonds due December 1, 1989, and $151,655,000 of new bonds.
   b. Funds from cash flow generated by Reserve or equity of $244,386,000.

If none of the estimated cash flow generated by Reserve were made available for the Embarrass alternative, it would be necessary for the parent companies to borrow an estimated $468,410,000 (This figure includes capital costs of $390,818,000 plus financing interest.) by January 1, 1980. The estimated tax basis of property, plan, and equipment is higher for this method of financing, because interest incurred during construction has been capitalized. After combining Reserve's existing facilities and the new facilities for the Embarrass alternative, Reserve's pro forma balance sheet on January 1, 1980, would show:

1. Total assets of $542,297,000 as listed below:
   a. Net current assets and investments of $24,043,000.
   b. Property, plant and equipment with an estimated tax basis of $518,254,000, consisting of existing facilities of $49,844,000 and new facilities and land of $468,410,000.

2. Total liabilities and owners' equity of $542,297,000 as listed below:
   a. Long-term liabilities of $537,074,000 including $34,264,000 of 4¼% Series A Bonds due June 1, 1980, $34,400,000 of 5-3/4% Series B Bonds due December 1, 1989, and $468,410,000 of new bonds.
   b. Funds furnished by parent companies as equity of $9,068,000.

The estimated total operating costs incurred for the Embarrass alternative during 1981 to 1983 are presented for minimum new loan ($151,655,000) financing in Table 16 and for maximum new loan ($468,410,000) financing in Table 17. These estimated costs are based on mid-1975 operating costs and a 10% interest rate for new bonds. The direct operating cost would be $12.68 per long ton of pellets produced. The total operating costs incurred, including state taxes, royalties, interest, depreciation (straight line), and other adjustments are estimated to be about $19.55 per long ton of pellets for the minimum loan ($151,655,000) and $22.57 per long ton for the maximum loan ($468,410,000). Based on the current Lake Erie price, Reserve's pellets would have a price of $26.32 per long

TABLE 12
ESTIMATED TOTAL OPERATING COST INCURRED FOR RESERVE'S PROPOSED MILE POST 7 PLAN DURING 1981 TO 1983 USING MINIMUM NEW LOAN FINANCING OF $35,584,000

	$/Long Ton Pellets		
	1981	1982	1983
Pellet Price, FOB, Silver Bay	26.177	26.177	26.177
Mining			
Mine Stripping	Upon Reserve Mining Company's claim that publication of the individual components of its direct operating costs would adversely affect its competitive position the state has agreed not to publish these figures in the Draft EIS.		
Coarse Crushing			
Rail Haulage			
Fine Crushing			
Concentrating			
Pelletizing			
Works General Expense			
Townsites			
Administration			
Research and Development			
Direct Operating Cost	13.749	13.749	13.749
Royalties	1.909	1.912	1.915
State Taxes	1.294	1.339	1.373
Depreciation (Straight Line)	1.574	1.627	1.680
Interest	.565	.541	.514
Total Operating Cost Incurred	19.091	19.168	19.231
Net Income Before Depletion and Federal Income Tax	7.086	7.009	6.946
Depletion	3.543	3.505	3.473
Federal Taxable Net Income	3.543	3.504	3.473
Federal Income Tax	1.701	1.682	1.667
Net Income After Depletion and Federal Income Tax	1.842	1.822	1.806
Depreciation (Straight Line)	1.574	1.627	1.680
Depletion	3.543	3.505	3.473
Cash Flow Before Loan Repayment	6.959	6.954	6.959
Loan Repayment	.373	.398	.424
Cash Flow After Loan Repayment	6.586	6.556	6.535

TABLE 13
ESTIMATED TOTAL OPERATING COST INCURRED FOR RESERVE'S PROPOSED MILE POST 7 PLAN DURING 1981 TO 1983 USING MAXIMUM NEW LOAN FINANCING OF $252,676,000

	$/Long Ton Pellets		
	1981	1982	1983
Pellet Price, FOB, Silver Bay	26.177	26.177	26.177
Mining			
Mine Stripping	Upon Reserve Mining Company's claim that publication of the individual components of its direct operating costs would adversely affect its competitive position the state has agreed not to publish these figures in the Draft EIS.		
Coarse Crushing			
Rail Haulage			
Fine Crushing			
Concentrating			
Pelletizing			
Works General Expense			
Townsites			
Administration			
Research and Development			
Direct Operating Cost	13.749	13.749	13.749
Royalties	1.909	1.912	1.915
State Taxes	1.116	1.170	1.213
Depreciation (Straight Line)	1.739	1.792	1.845
Interest	2.810	2.742	2.668
Total Operating Cost Incurred	21.323	21.365	21.390
Net Income Before Depletion and Federal Income Tax	4.854	4.812	4.787
Depletion	2.427	2.406	2.394
Federal Taxable Net Income	2.427	2.406	2.393
Federal Income Tax	1.165	1.155	1.149
Net Income After Depletion and Federal Income Tax	1.262	1.251	1.244
Depreciation (Straight Line)	1.739	1.792	1.845
Depletion	2.427	2.406	2.394
Cash Flow Before Loan Repayment	5.428	5.499	5.483
Loan Repayment	.812	.881	.955
Cash Flow After Loan Repayment	4.616	4.568	4.528

TABLE 14
RATES OF RETURN FOR PROPOSED MILE POST 7 PLAN USING A 10% INTEREST RATE FOR NEW BONDING

Rate of Return on:	Minimum New Loan ($35,584,000)	Maximum New Loan ($252,676,000)
Investment before Interest and After Federal Income Taxes with Accelerated Depreciation*	22.8%	22.3%
Investment before Interest and Federal Income Taxes with Accelerated Depreciation*	27.6%	25.2%
Investment before Interest and Federal Income Taxes with Straight Line Depreciation**	-----	23.0%
Equity*	28.9%	-----

* Based on a 40 year life.
** Based on first years of life.

TABLE 15
ESTIMATED CAPITAL COST OF FACILITIES AND LAND FOR THE EMBARRASS ALTERNATIVE

	COST
Car Unloading	$ 14,446,100
Crushing Building	23,298,000
Concentrator Building	97,791,800
Concentrator Filter	11,089,200
Concentrate Loading	6,025,800
Tailings Clarification	8,886,800
Tailings Filter	3,228,600
Tailings Stockpiling and Loading	1,586,000
Coal Unloading and Boiler	11,412,400
Power Main Substation	13,175,300
Sewage Treatment System	374,500
Office and Change Space	1,328,100
Reagent Building	1,151,500
Plant Water Distribution System	3,626,500
Plant Water Supply System	3,717,600
Process Water Reclaim	3,124,600
Utility Tunnel	3,792,000
Concentrate Unloading and Handling	9,568,000
Site Preparation and Railroad Trackage	41,952,500
General	22,849,000
Rail Power Units	3,000,000
Haul Trucks	3,250,000
Rail Car Insulaiton	4,770,000
Sub Total	$ 293,444,300
Spare Parts	5,000,000
Engineering	5,950,000
Contractors' Fee	4,153,000
Contingency	35,214,000
Escalation	52,820,000
TOTAL For 12,840,000 Long Tons of Pellets Per Year	$ 396,581,300
Total Adjusted for 10.7 Million Long Ton of Pellets Per Year	347,009,000
Initial Dams	11,494,000
Air Quality	31,565,000
Land	750,000
TOTAL	$ 390,818,000

TABLE 16
ESTIMATED TOTAL OPERATING COST INCURRED FOR THE EMBARRASS ALTERNATIVE DURING 1981 to 1983 USING MINIMUM NEW LOAN FINANCING OF $151,655,000

	$/Long Ton Pellets 1981	1982	1983
Pellet Price, FOB Silver Bay	26.323	26.323	26.323
Mining			
Mine Stripping			
Coarse Crushing			
Rail Haulage			
Fine Crushing			
Concentrating			
Pelletizing			
Works General Expense			
Townsites			
Administration			
Research and Development			
Direct Operating Cost	12.681	12.681	12.681
Royalties	1.910	1.914	1.918
State Taxes	1.315	1.335	1.354
Depreciation (Straight Line)	2.022	2.069	2.116
Interest	1.588	1.548	1.505
Total Operating Cost Incurred	19.516	19.547	19.574
Net Income Before Depletion and Federal Income Tax	6.807	6.776	6.749
Depletion	3.404	3.388	3.375
Federal Taxible Net Income	3.403	3.388	3.374
Federal Income Tax	1.634	1.626	1.620
Net Income After Depletion and Federal Income Tax	1.769	1.762	1.754
Depreciation (Straight Line)	2.022	2.069	2.116
Depletion	3.404	3.388	3.375
Cash Flow Before Loan Repayment	7.195	7.219	7.245
Loan Repayment	.508	.548	.591
Cash Flow After Loan Repayment	6.687	6.671	6.654

Upon Reserve Mining Company's claim that publications of the individual components of its direct operating costs would adversely affect its competitive position the state has agreed not to publish these figures in the Draft EIS.

TABLE 17
ESTIMATED TOTAL OPERATING COST INCURRED FOR THE EMBARRASS ALTERNATIVE DURING 1981 to 1983 USING MAXIMUM NEW LOAN FINANCING OF $468.410.000

	$/Long Ton Pellets 1981	1982	1983
Pellet Price FOB Silver Bay	26.323	26.323	26.323
Mining			
Mine Stripping			
Coarse Crushing			
Rail Haulage			
Fine Crushing			
Concentrating			
Pelletizing			
Works General Expense			
Townsites			
Administration			
Research and Development			
Direct Operation Cost	12.681	12.681	12.681
Royalties	1.910	1.914	1.918
State Taxes	1.077	1.105	1.131
Depreciation (Straight Line)	2.370	2.417	2.464
Interest	4.548	4.457	4.357
Total Operation Cost Incurred	22.586	22.574	22.551
Net Income Before Depletion and Federal Income Tax	3.737	3.749	3.772
Depletion	1.869	1.875	1.886
Federal Taxable Net Income	1.868	1.874	1.905
Federal Income Tax	.897	.974	.886
Net Income After Depletion and Federal Income Tax	.971	.974	.981
Depreciation (Straight Line)	2.370	2.417	2.464
Depletion	1.868	1.874	1.886
Cash Flow Before Loan Repayment	5.209	5.265	5.331
Loan Repayment	1.025	1.117	1.217
Cash Flow After Loan Repayment	4.184	4.148	4.114

Upon Reserve Mining Company's claim that publications of the individual components of its direct operating costs would adversely affect its competitive position the state has agreed not to publish these figures in the Draft EIS.

ton of pellets. Thus, the income before depletion and Federal income taxes to Armco and Republic would be approximately $6.78 per long ton of pellets for the minimum loan and about $3.75 per long ton of pellets for the maximum loan.

The rates of return for the Embarrass alternative have been determined for both minimum ($151,655,000) and maximum ($468,410,000) new loan financing. The various rates of return determined for the Embarrass alternative using a 10% interest rate for new bonding are presented in Table 18. These rates of return appear adequate.

The cash flow generated by the Embarrass alternative is of major importance. Assuming both a bond interest rate and discount rate of 10%, the present value of the accumulated net cash flow after loan repayment over the 39 years discounted to January 1, 1977 is $441,551,000 for the minimum loan financing and $292,531,000 for the maximum loan financing.

The Embarrass alternative has the same advantage regarding improved pellet quality as Reserve's proposed Mile Post 7 plan. This economic benefit to Armco and Republic is estimated at $28,800,000 because the silica content of the improved pellet is 3.5 percent lower than the silica content of Reserve's current pellet. This benefit is higher for the Embarrass alternative than for Reserve's proposed Mile Post 7 plan because of the additional 1.2 million long tons of annual pellet capacity. However, since the Lake Erie price does not include a premium nor a penalty for the silica content of pellets, the foregoing analyses based on Lake Erie prices do not include a separately calculated premium or penalty based on the silica content of Reserve's pellets.

The Embarrass alternative might be financed entirely by bonds jointly and severally guaranteed by Armco and Republic, but only with very favorable market conditions. However, the Embarrass alternative probably would require financing by using a combination of debt and equity. This financing could have an adverse impact on Armco and Republic future capital expenditure programs in other areas, to the extent that the money is spent at the Embarrass site rather than elsewhere.

FINANCIAL IMPACTS

The analysis to determine the financial impacts establishes that Reserve's proposed Mile Post 7 plan is financially more prudent for Reserve than any of the alternatives considered. However, the Embarrass alternative, and presumably the Colvin and Snowshoe alternatives, also are viable and profitable alternatives.

Reserve's proposed Mile Post 7 plan requires substantially less capital funding than the Embarrass alternative. However, the Embarrass alternative has a lower direct operating cost per ton of pellets and a higher pellet production capability than Reserve's proposed Mile Post 7 plan.

The new investment required for Reserve's proposed Mile Post 7 plan is $169,712,000 less than required for the Embarrass alternative. However, when allowances are made for timing of expenditures and cash flow during operations in 1979, this difference is reduced to a present value of January 1, 1976 of $125,000,000 using a discount rate of 10%. Since the Embarrass alternative has additional annual pellet capacity of 1.2 million long tons, the new investment can be reduced an additional $60,000,000 based on an incremental capital cost of $50 per annual long ton of pellet capacity. Thus, the present value of the new investment required for Reserve's proposed Mile Post 7 plan is $65,000,000 less than required for the Embarrass alternative.

The bonding required for Reserve's proposed Mile Post 7 plan is estimated to range from $35,584,000 to $252,676,000, depending on how much of Reserve's cash flow during the construction period that Armco and Republic make available for Reserve. Bonding required for the Embarrass alternative is estimated to range from $151,655,000 to $468,410,000, again depending on the method of funding by Armco and Republic. The method of funding determined by Armco and Republic will depend on many factors, such as steel demand, earnings and market conditions. However, if Armco and Republic obtain maximum bonding for Reserve, the cash flow from Reserve during the construction period will be available to Armco and Republic for other uses.

Armco and Republic have the ability to finance Reserve's proposed Mile Post 7 plan entirely by bonds, given favorable market conditions. It is less likely, although not impossible, that the Embarrass alternative can be financed entirely by bonds. It is assumed that bonds with a 20 year maturity would demand an interest rate of about 10%.

The estimated direct operating cost for Reserve's proposed Mile Post 7 plan is $13.75 per long ton of pellets, or $1.07 per long ton of pellets more than for the Embarrass alternative, which has an estimated direct operating cost of $12.68 per long ton of pellets. Depending on the funding method, the estimated total operating cost incurred ranges from $19.17 to $21.37 per long ton of pellets for Reserve's proposed Mile Post 7 plan and from $19.55 to $22.57 per long ton of pellets for the Embarrass alternative. Thus, the estimated total operating cost per long ton of pellets incurred is lower for Reserve's proposed Mile Post 7 plan. The income before depletion and Federal income taxes to Armco and Republic also is greater with Reserve's proposed Mile Post 7 plan, with this income ranging from $4.81 to $7.01 per long ton of pellets for Reserve's proposed Mile Post 7 plan and $3.75 to $6.78 per long ton of pellets from the Embarrass alternative. It should be noted that in either case, the income to Armco and Republic is substantially higher than the income of $2.35 to $2.90 per long ton of pellets from Reserve in 1971 to 1973.

The rates of return for both Reserve's proposed Mile Post 7 plan and the Embarrass alternative appear adequate. Rates of return on the investment determined by different methods ranged from a low of 17.3% to a high of 27.6%. Under each method presented, the rate of return for Reserve's proposed Mile Post 7 plan was higher than the rate of return for the Embarrass alternative. A comparison of Reserve's proposed Mile Post 7 plan and the Embarrass alternative using maximum borrowing results in an 8.6% rate of return before interest and taxes with straight line depreciation on the incremental investment of $203,533,000 required for the Embarrass alternative.

Assuming a bond interest rate and a discount rate of 10%, the present value of the accumulated net cash flow after loan repayment over the next 43 years, discounted to January 1, 1976, from Reserve's proposed Mile Post 7 plan and from the Embarrass alternative are $414,837,000 and $441,551,000, respectively. These present values are for financing with minimum bonding, and, therefore assumed cash flow generated by Reserve during the construction period would be used for the project. Based on these present values, the present value of the accumulated net cash flow after loan repayment per annual long ton of pellet capacity for Reserve's proposed Mile Post 7 plan and the Embarrass alternative are $43.67 and $41.26, respectively. Using these present value amounts per annual long ton of pellet capacity, the present value over the next 43 years of the economic advantage of Reserve's proposed Mile Post 7 plan is (($43.67 - $41.26) x 9,500,000) $22,895,000 when compared with the Embarrass alternative. This economic advantage considers both the increased capital and total operating costs and increased pellet production.

It should be kept in mind that all the financial analyses are based on capital cost estimates that include contingencies of $8,993,000 for Reserve's proposed Mile Post 7 plan and of $30,812,000 for the Embarrass alternative. If these contingency funds are not required, or if the funds are required for Reserve's proposed Mile Post 7 plan and not for the Embarrass alternative, the economic advantage of Reserve's proposed Mile Post 7 plan would be diminished when compared with the Embarrass alternative.

Both Reserve's proposed Mile Post 7 plan and the Embarrass alternative will produce a pellet with higher iron and lower silica content than produced by Reserve's existing operation. This will result in an estimated annual economic benefit over present operations of $25,600,000 or $28,800,000 to Armco and Republic, depending on whether Reserve's proposed Mile Post 7 plan or the Embarrass alternative is implemented.

TERMINATION OF RESERVE MINING COMPANY OPERATIONS

The financial impact of shutdown or closure of Reserve would be severe to both Armco and Republic. It was estimated by Armco on September 19, 1974, that closure would result in a one-time loss of $41,000,000 after taxes and $17,100,000 additional annual operating cost to buy ore in the open market. It is assumed that similar expenses would occur to Republic. In view of these penalties and in view of the foregoing analysis of alternatives, shutdown or closure of Reserve does not appear to be a feasible or prudent economic alternative.

TABLE 18
RATES OF RETURN FOR EMBARRASS ALTERNATIVE USING A 10% INTEREST RATE FOR NEW BONDING

Rate of Return on:	Minimum New Loan ($151,655,000)	Maximum New Loan (468,410,000)
Investment before Interest and After Federal Income Taxes with Accelerated Depreciation*	19.3%	17.9%
Investment before Interest and Federal Income Taxes with Accelerated Depreciation *	23.3%	20.2%
Investment before Interest and Federal Income Taxes with Straight Line Depreciation **	---	17.3%
Equity*	27.0%	----

* Based on 39 year mine life
** Based on first 10 years of life

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ENVIRONMENTAL SETTING OF PROPOSED ACTION AND ALTERNATIVE CONCEPTS

PART III

INTRODUCTION

The description of the environmental setting contained in this part of the Draft EIS focuses on the components of the environment that may be affected by on-land tailings disposal. Thus, a detailed description of the total environment of northeastern Minnesota is not what follows. Rather, this part contains an environmental framework which forms a basis for understanding the probable impacts of the proposed action and alternatives presented in Part IV.

This part of the Draft EIS as well as Part IV is organized by major components of the environment. The organization of Parts III and IV considers the interrelationships between environmental components. In addition, in each subpart the major interrelationships between other subparts are delineated. In general, the organization of the part is constructed so as to build a picture of the character of the environmental setting.

The organization of Parts III and IV offers two approaches for review. Part III may be reviewed in its entirety prior to proceeding to to the probable impacts in Part IV or a particular subpart of Part III may be reviewed and then proceding directly to the corresponding subpart in Part IV.

CLIMATOLOGY

The climatic setting is presented to serve as a basis for a general understanding of the character of climatic conditions of northeastern Minnesota and to provide general information required to draw conclusions relative to the construction and operating characteristics of going to on-land disposal of tailings.

OVERVIEW

The primary factors affecting the climate of northeastern Minnesota are the movements of polar air from the north and west during the mid-fall to mid-spring periods and the breeze from Lake Superior in the later spring and summer months. These conditions tend to produce cold winters with prolonged periods of freezing temperatures and generally mild summers along the north shore.

Frequent and marked changes in the weather are brought about by the passage of a succession of high and low pressure systems that continually move across the country from west to east. The passage of low pressure cells with trailing cold fronts signals rapid temperature drops, brisk shifting winds and frequent precipitation. High pressure cells bring clear skies, light winds, and temperature inversions (stable thermal conditions).

The air pollution in the vicinity of a proposed or alternate tailings disposal site is related to the localized capacity of the atmosphere to transport and disperse pollutants. The primary meteorological parameters which determine this capacity are wind speed and atmospheric stability. Atmospheric stability near ground level is affected by surface roughness and solar heating. The optimum condition for dispersion of emissions from a ground-level source such as a tailings basin consists of a high degree of ventilation combined with a relatively unstable atmosphere. Conversely, atmospheric mixing is minimal in the presence of a ground-based temperature inversion. Temperature and precipitation are needed to determine average soil moisture content which affects the potential for air pollution emissions.

Climatic information such as precipitation and temperature is necessary for use in describing hydrology.

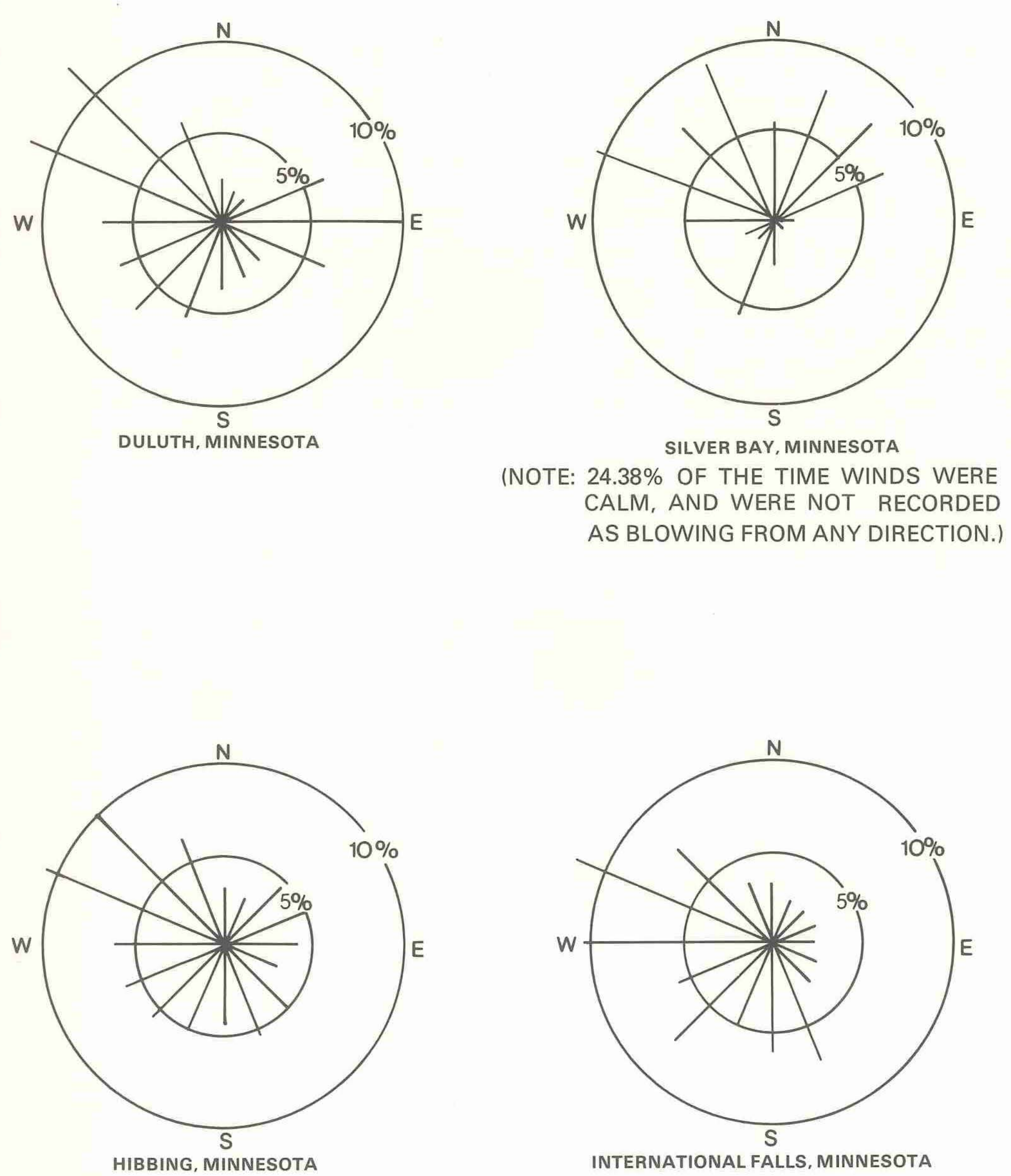
METEOROLOGICAL STATIONS

Little climatic data is available for the immediate vicinity of the proposed tailings disposal sites. In 1971, a meteorological station was established in Silver Bay. The Hibbing airport also records wind, temperature, and precipitation data. The nearest first-order stations (i.e., stations operated by National Weather Service personnel) are in Duluth and International Falls. Duluth is located on Lake Superior about 50 to 75 miles SSW of the sites and International Falls about 100 to 125 miles NNW of the sites.

The climatic data used in the Draft EIS is primarily from meteorological stations mentioned above. Time constraints prevented the inclusion of detailed Hibbing wind data, which were not readily available from the National Climatic Center.

WIND SPEED AND DIRECTION

Because the land in the three county region has, for the most part, the character of a slightly rolling plateau, the movement of air masses across the region is relatively unimpeded by physiographic influences. In the absence of cyclonic storms and associated frontal systems, atmospheric ventilation patterns follow gently curving streamlines. However, the hills that rise abruptly from the shores of Lake Superior have a strong influence on local wind patterns.



47 ANNUAL WIND ROSES

LEGEND

NOTE: PERCENTAGE OF TIME THE WIND IS BLOWING FROM EACH DIRECTION

SOURCE: SPEECH DELIVERED TO KANSAS CITY SECTION OF AICHE BY DR. JOHN MCKETTA, CHAIRMAN OF THE ADVISORY COMMITTEE ON ENERGY TO SECRETARY OF THE INTERIOR, 1972.

BARTON-ASCHMAN ASSOCIATES, INC.
MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

Table 19 gives the monthly mean wind speeds and prevailing wind directions for Duluth and International Falls. As indicated, prevailing winds exhibit an easterly character from late spring through summer. For the rest of the year, winds tend to blow from the west and northwest. Annual wind roses for Duluth, Silver Bay, Hibbing, and International Falls are shown in Figure 47.

TABLE 19
MONTHLY WIND DATA(1,2)

Month	Mean Speed (mph) Duluth	Mean Speed (mph) International Falls	Prevailing Direction Duluth	Prevailing Direction International Falls
January	12.0	9.3	NW	W
February	11.9	9.2	NW	W
March	12.0	9.5	WNW	W
April	13.2	10.6	NW	NW
May	12.4	10.2	E	NW
June	10.8	8.7	E	SE
July	9.9	8.0	WNW	W
August	9.8	7.7	E	SE
September	10.7	8.9	WNW	SE
October	11.5	9.7	WNW	SE
November	12.2	10.0	WNW	W
December	11.5	9.2	NW	W
ANNUAL	11.5	9.2	WNW	W

Table 20 gives normal daily temperature extremes and means by month for Duluth, Hibbing and International Falls. Average annual temperatures range from 36.5°F to 38.6°F. During periods of easterly winds, lake breezes may cause a strong temperature gradient between the lake shore and points which are a few miles inland.

TABLE 20
MONTHLY TEMPERATURE DATA(1, 2, 3)

Month	Mean Daily Maximum (°F) Duluth	Hibbing	International Falls	Mean Daily Minimum (°F) Duluth	Hibbing	International Falls	Monthly Mean (°F) Duluth	Hibbing	International Falls
January	17.6	17.6	12.8	-0.6	-6.4	-9.1	8.5	5.6	1.9
February	22.1	20.8	19.4	2.0	0.0	-5.5	12.1	10.4	7.0
March	32.6	32.0	32.3	14.4	13.6	8.9	23.5	22.8	20.6
April	47.8	52.0	49.1	29.3	30.4	27.3	38.6	41.2	38.2
May	60.0	63.0	62.5	38.3	40.0	37.7	49.4	51.5	50.1
June	69.7	72.8	72.4	48.3	51.8	48.3	59.0	62.3	60.4
July	76.4	77.4	78.2	54.7	56.0	53.4	65.6	66.7	65.8
August	74.4	76.0	75.5	53.7	54.9	50.9	64.1	65.5	63.2
September	64.0	64.0	64.2	44.8	42.6	41.7	54.4	53.3	53.0
October	54.3	54.4	54.0	36.2	32.8	32.9	45.3	43.6	43.5
November	35.3	36.3	32.5	21.4	16.5	17.3	28.4	26.4	24.9
December	22.5	23.2	18.1	6.3	4.2	-0.8	14.4	13.7	8.7
ANNUAL	48.1	49.1	47.6	29.1	28.0	25.3	38.6	38.6	36.5

PRECIPITATION

As indicated in Table 21, precipitation in the study region is well distributed throughout the year and is adequate for vegetation. The heaviest rainfall occurs during the warm summer months, falling from showers and thunderstorms. The area is also subject to heavy snowfall, with the most frequent snow occurring between December and March. The snow cover does not melt until about April.

ATMOSPHERIC STABILITY AND MIXING

The annual frequency distributions of stability classes for Minneapolis and Duluth are given in Table 22. Neutral stability, the most common class, occurs under cloudy conditions.

Low level (< 150 meters) temperature inversions are very common during nighttime hours in the study region, occurring 50 to 60 percent of the time. During warm weather, the heat sink created by Lake Superior substantially increases the frequency of temperature inversions along the lake shore.

TABLE 21
MONTHLY PRECIPITATION DATA(1, 2, 3, 7)

Month	Measurable Precipitation (Days) Duluth	International Falls	Mean Precipitation (Equivalent Inches of Water) Duluth	Hibbing	International Falls	Mean Snowfall (Inches) Duluth	Hibbing	International Falls
January	10	12	1.16	0.67	0.87	13.6	9.6	10.5
February	9	10	0.85	0.58	0.65	10.4	8.2	8.5
March	10	10	1.76	1.17	0.99	13.5	8.2	10.3
April	9	10	2.55	1.90	2.11	6.0	3.9	5.7
May	12	12	3.41	3.08	3.17	0.8	0.4	1.4
June	13	13	4.44	3.83	4.64	0.0	0.0	0
July	11	12	3.73	3.67	1.06	0.0	0.0	0.0
August	11	12	3.79	3.62	6.38	0.0	0.0	0.0
September	11	12	3.06	3.33	0.86	0.0	0.0	0.0
October	10	9	2.30	1.80	1.61	1.2	1.6	1.5
November	10	12	1.73	1.29	1.12	8.2	6.6	9.2
December	10	12	1.40	0.68	0.79	12.4	8.6	9.6
ANNUAL	126	135	30.18	25.62	24.25	66.1	47.1	56.7

TABLE 22
PERCENTAGE OCCURRENCE OF STABILITY CLASSES(5,6)

Stability Class	Minneapolis 1960-64	Duluth 1970
Extremely Unstable	0.29	0.14
Unstable	3.55	1.64
Slightly Unstable	9.29	8.11
Neutral Day	29.57	68.74*
Neutral Night	28.61	
Slightly Stable	11.83	21.37**
Stable to Extremely Stable	16.86	

*Combined Day and Night
**Combined Slightly and Extremely Stable.

Typically during afternoon hours and otherwise in the absence of a low-level temperature inversion, vertical mixing in the atmosphere is confined to a ground-base "mixing layer." Limited mixing (i.e., the persistence of shallow mixing layers), occurs with the passage of anticyclones through the region.

Table 23 shows the distribution of mean morning and afternoon mixing height for the reporting meteorological stations nearest the proposed disposal sites. The associated mean wind speeds averaged through the mixing layers are also given in the table.

TABLE 23
MEAN SEASONAL AND ANNUAL MORNING AND AFTERNOON MIXING HEIGHTS AND WIND SPEEDS(8)

	Time Period	International Falls	St. Cloud
Mean Morning Mixing Height (meters)	Winter	347	393
	Spring	411	469
	Summer	337	351
	Autumn	513	429
	ANNUAL	402	411
Mean Afternoon Mixing Height (meters)	Winter	656	607
	Spring	1,646	1,432
	Summer	1,747	1,646
	Autumn	1,146	1,006
	ANNUAL	1,299	1,173
Mean Morning Wind Speed (m/sec)	Winter	5.6	6.1
	Spring	5.6	6.3
	Summer	4.1	4.2
	Autumn	6.0	5.5
	ANNUAL	5.3	5.5
Mean Afternoon Wind Speed (m/sec)	Winter	7.0	7.3
	Spring	7.5	8.0
	Summer	6.9	6.9
	Autumn	7.4	7.7
	ANNUAL	7.2	7.5

BEDROCK GEOLOGY(9)

Bedrock is the underlying structure upon which surficial features are developed. Bedrock formations played a decisive role during periods of glaciation and continues to do so in defining topographic features and delineation of surface and ground water retention areas. Bedrock structural characteristics also relate to tailings basin design.

OVERVIEW

The bedrock formations of northeast Minnesota are composed of very old rocks. These will be described from the oldest to the youngest formations. Geographically, this means describing them from northwest to southeast (see Figure 48).

Those rocks north of the Mesabi Iron Range are the oldest rock formations in northeastern Minnesota. They are primarily composed of meta-volcanic and meta-sediments. These were intruded (broken into) by the Granites which probably resulted in the metamorphism of the volcanics and sediments.

The iron formation occurs as a narrow unit (see the center of Figure 48) and was formed next in succession. It contains most of the taconite and natural iron ore being mined in Minnesota today.

In the far northeast portion of the study area and the southern and southwest portion of St. Louis County are two metamorphic formations composed primarily of graywacke and slate. To the south is a broad crescent shape group of formations which extends from Duluth to the tip of northeast Minnesota. In this area, the oldest formation is the North Shore Volcanics. These rocks were later intruded by several molten rock formations. The intrusion generally flowed from the center of the crescent easterly and resulted in the formation of the Duluth Complex and a sub-group, the Beaver Bay Complex, and other smaller north shore intrusive rocks.

The significance of these rock formations is that they contain mineral resources (for example, iron and copper-nickel). Mineral potential in these formations is dealt with in the following section. Because they have been stable for 600 million years, they generally serve as a good base for foundations, except where localized structural weakness, such as joints or faulting, dictate otherwise. When such weaknesses have been located, they must be evaluated during the design phase to assure that stable structures can be constructed.

Generally, these formations have a low potential as sources of water, except where faults and weaknesses exist which form entrapment areas.

During later periods of geologic time, these formations were extensively glaciated and the rock formations had a pronounced affect on the movement of glaciers through this area. The control exerted by the bedrock often dictated the types of glacial soils that were deposited in a specific area. The bedrock formations also served as source materials for the glaciers to grind up and redeposit as soils.

BEDROCK GEOLOGY COMMON TO SITES

It can be expected that bedrock formations are generally competent to support overlying tailings basins and other heavy structures except for possible localized jointing and faulting. Additionally, there is potential for a thin weathered zone at the top of the bedrock, which may require special consideration when developing a tailings basin.

Due to the more complete or detailed exploration which has occurred at Mile Post 7, the existence of joints, faults and a weathered zone have been identified. These characteristics are being evaluated as part of the hearing process. The weathered zone, where it occurs, will be an active part of the ground water system.

SITE SPECIFIC BEDROCK GEOLOGY

Mile Post 7

The bedrock in the valley floor under the fine tailings portion of the proposed tailings basin is composed of North Shore Volcanics. The Beaver Bay Complex intruded the volcanics forming the east valley wall and is a more durable rock (more resistant to weathering) than the volcanics of the valley floor. The east ridge, which is part of the Beaver Bay Complex, is characterized by a thin soil layer and frequent rock outcroppings. The west ridge area has few outcrops, but in general, it is believed to be underlain by North Shore Volcanics and minor intrusives.

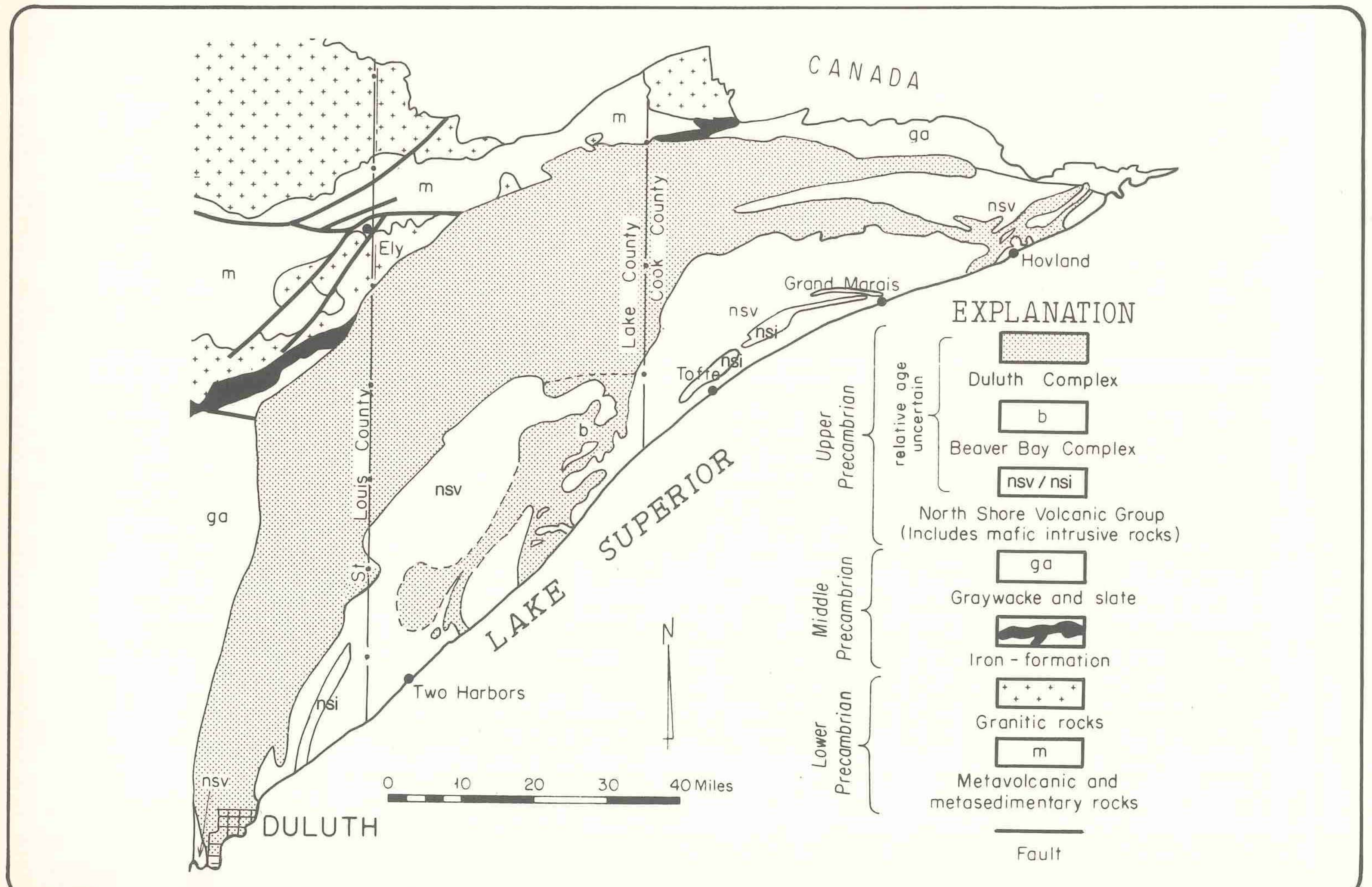
ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

48 GEOLOGIC MAP OF THREE COUNTY AREA



Embarrass

The bedrock at the Embarrass site is granite intrusives. The south ridge, which borders the tailings basin site, is the Giants Range Granite with flatter lying granite in the valley floor.

The granite ridge formed by the Giants Range deflected the flow of several ice lobes through this area. This resulted in the deposition of granular soils, gravel and bouldery and sandy till on the site.

If the Embarrass site were selected, the concentrator would be located on the Giants Range Ridge. The underlying granite would thus provide a foundation for the concentrator.

Colvin

The Colvin site is underlain by the Duluth Gabbro Complex. There seems to be some rise in bedrock from the northwest to southeast. This results in bedrock control contributing to the formation of the low ridge on the southeast side of the site. The concentrator site would be at the north end of the site where bedrock meets the surface. The presence of bedrock is verified by its presence in rock cuts along the railroad grade.

Snowshoe

This site is underlain by the Duluth Gabbro Complex. There is no known or identified bedrock control which may have contributed to the surficial formations present on the site or which may be utilized as a portion of the tailings basin.

Bedrock on this site is estimated at a maximum depth of 40-50 feet below the surface. Sandy glacial till overlays the bedrock, and serves as a base for the extensive bog areas present on the site.

MINERAL POTENTIAL (9, 10, 11, 12, 13)

Northeastern Minnesota contains vast deposits of a variety of minerals. Actions taken in this area influence the availability of these minerals. The placement of a tailings disposal basin commits a piece of land to long-term use and potentially forecloses its use for another purpose. Because of this, it is essential that mineral potential be identified.

OVERVIEW

Many of the geologic formations in northeastern Minnesota contain known or potential mineral resources. Referring to the geologic map in the preceding bedrock geology section (see Figure 48), existing or potential types of resources can be described.

Granitic Rocks: There are no known mineral resources in these formations and the potential for discovery is low.

Metavolcanic and Metasedimentary Rocks: This formation has been a valuable source of iron ores and has yielded a small amount of gold. The Vermillion iron ore district is located within this unit in the Ely - Tower Soudan area. More recently, these formations, particularly the metavolcanics are being explored for base or precious metal sulfides. Although no deposits have been discovered in Minnesota, many occur in similar formations in Canada. If located, they could potentially contain one or more of the following metals: copper, nickel, zinc, lead, gold and silver.

Iron Formation: The Biwabik Iron Formation is a narrow belt, 1/4 to 3 miles wide extending across northeastern Minnesota for approximately 120 miles. Since iron ore was first discovered in 1890, this formation has supplied the majority of the iron ore mined in Minnesota. Reserve's mine is located within the eastern end of this formation.

Graywacke and Slate: There are no known mineral resources in these formations and the potential for discovery is low.

Duluth Complex, Beaver Complex and other North Shore Intrusives: This group of intrusive formations contains three types of known mineral resources; titaniferous magnetites--a potential source of titanium; anorthosite--a potential source of aluminum; and copper-nickel sulfides--a potential source of copper, nickel and precious metals. Of these three groups, there are no known titaniferous magnetites near any of the tailings sites.

North Shore Volcanics: This formation has the potential of containing copper deposits due to its similarities with the Northern Michigan copper containing volcanics. However, no economically profitable mineral deposits have ever been discovered. Only a few mineralized outcrops have been located.

SITE SPECIFIC MINERAL POTENTIAL

Mile Post 7

A geologic map of the area indicates that the site is underlain partly by mafic intrusive rocks (Beaver Bay Complex) and partly by intrusive and extrusive igneous rocks which are probably part of the North Shore Volcanic group. The intrusives of the latter group may have some general potential for copper, but no mineralization has been reported from the site. Non-commercial copper sulfide minerals have been reported some 12 miles to the northeast and a native copper occurrence 10 miles easterly of the site. No commercial ore bodies have ever been discovered in this area. The copper resource potential of the site must be considered low.

The intrusive mafic rocks of this region contain occasional larger blocks of anorthosite. Such blocks might have long term potential for aluminum. However, very large masses of anorthosite occur elsewhere in Minnesota where they would be more easily mined. The operating and capital cost estimate for aluminum production from anorthosite is nearly double the costs for aluminum from bauxide. (14) The cost to produce aluminum from clay is nearly as high as from anorthosite. Many billions of tons of anorthosite and suitable clays are available in the U.S. No large blocks of anorthosite are known to occur at the site and if any do occur they are covered by the glacial till and lake clays.

Embarrass

The rocks which underlie the Embarrass alternative site do not contain any known minerals of value. The rocks are lower Precambrian in age and are part of the Giants Range Granite. The site is situated to the north of the Biwabik Iron Formation. Placing of tailings on this site would have no adverse impact on mineral resource values. The site has been classified by DNR as an area of remote mineral potential.

Colvin and Snowshoe

The Colvin site is underlain by igneous rocks of the Duluth Complex. It covers about 11 square miles and is centered about 5 miles southeast of the exposed basal contact of the Complex. The surface is about 8,000 to 10,000 feet vertically above the projected basal contact. The Snowshoe site, which also overlies Duluth Complex rocks, is centered 8 miles southeast of the basal contact of the Complex. Its surface is about 15,000 feet vertically above the projected position of the basal zone.

The potential mineral resource of significance that may occur is copper-nickel ore with some by-product platinum group metals and cobalt.

The principal copper-nickel deposits of the Duluth Complex are located along its basal (northwestern) margin from the South Kawishiwi River south and southwesterly past Babbitt and Hoyt Lakes. The mineralization is known to extend for some 40 miles along the basal margin and may extend much farther. It occurs as extensive lenses in a zone one to two miles wide.

The major mineralization occurs in troctolite, gabbro and ultramafic host rocks. These favorable rocks are late phases of the Complex and were intruded along and near its base.

The contact of the favorable basal phases of the Duluth Complex with older underlying rocks, dips to the southeast at 20^o and 30^o at the surface exposures of the basal contact. It has been reported that farther north there is some flattening of the dip angle at depth.

Some mineralized troctolitic phases do occur well above the basal zone near the Kawishiwi River. Thus, there is a possibility that lenses of shallower mineralization may occur in the area of the sites but none are known. The possibility must, therefore, be considered remote.

The Colvin site is some 5 miles south of a proposed 1,700 foot deep exploration shaft. Good mineralization occurs there. The Snowshoe site is about 6 miles from it.

Four exploratory drill holes are located 5 miles northwest of the southern part of the Colvin site. Assays and locations of these holes have been provided by the Department of Natural Resources. They confirm that the gabbro is mineralized. For example, the hole in NE-NW of Sec. 16, T 59N, R13W shows two zones, one 30 feet thick, another 50 feet that exceed o.5 percent combined copper-nickel. This particular hole is about 5 miles northwest of the Colvin site and 6-1/2 miles southwest of the proposed exploratory shaft.

Recent figures (1974) reported for the copper-nickel potential of the 40 mile long Gabbro Complex are:

> 5.8 billion tons of 0.84 percent combined copper-nickel over 33.2 square miles.
>
> 2.24 billion tons of 0.82 percent over 15.3 square miles.[15]

It is clear that a favorable environment for major ore-type copper-nickel mineralization occurs in the near-basal rocks beneath both the Colvin and Snowshoe sites.

To rate the mineral potential according to one classification used by the DNR, these sites would be rated between High Potential and Good Potential.

The major part of this potential resource must, on present knowledge, be assigned to the basal zone some thousands of feet below the surface.

A positive rating for resource potential, makes it necessary to consider whether disposal of surface tailings would affect any future use of this resource.

Open pit mining could not be employed at such depths. Hence, consideration of any mining in the basal zone is restricted to underground methods that might be adversely affected by tailings at the surface. Also, one must consider additional costs of exploratory and development drilling, and any additional development work that might be required.

Additional Drill Costs

These costs would be the added cost of drilling through the tailings. For example, if a 100 foot thickness of tailings existed, it would be necessary to drill an additional 100 feet. This would need to be cased. If drilling were carried out on a base of one deep hole per 40 acres, a 1,320 foot spacing, this would mean sixteen holes per square mile. For say, 5 square miles of the site this would add 5 x 16 x 100 = 8,000 feet of cased holes. At $15 per foot, this added cost would be $120,000. This would be a cost increase of perhaps 1 percent. A benefit would, of course, be the greater ease and speed of moving drills on such a flat surface, but such savings would be only a fraction of the added drilling costs.

Effect on Underground Mining

Assuming that large copper-nickel ore bodies do occur beneath a site, one added cost could be the additional 100 feet of shaft depth. However, a shaft site and surface shops, office and storage areas could now be placed on level ground whose characteristics would presumably be well known. Site leveling would be minor. Therefore, there is no great net cost advantage or disadvantage involved insofar as shaft costs are concerned.

The only mining systems that could conceivably be affected by tailings at the surface would be blockcaving or sub-level caving. Even here the only adverse effect would be in caving effects or if fractures extended several thousand feet to surface and tapped the overlying tailings. In the highly unlikely event that some fracturing extended upward to the tailings, the fine tails would act as a plug in any such fractures and would not run into a mine below. Similarly, no water seepage problems of any consequence should be expected.

Development During Operating Life of Tailings Site

The above comments are based on copper-nickel exploration and/or mining after the tailings area has ceased to be used for tailings disposal. This would be 40 years or so in the future.

If exploration drilling, shaft sinking and mining are to be conducted during the operating life of the tailings site, the problems of doing so are greater.

Moving of drills to 16 or more spots in a live tailings area would create major problems of transport of drills and men. Also, logical drill sites may well be located beneath pool areas. This could require use of special vehicles. Special drill-support problems such as shallow barges in the pool areas would add substantial costs. Helicopter servicing of such drill sites might be necessary.

For mining to take place, shafts must be sunk to the ore zones. These shafts need to be close to the ore bodies to keep haulage costs reasonably low. Shaft foundation problems would exist, buildings and storage areas would be needed and surface transport lines established. This would interfer with any tailings disposal facilities and plans and would involve additional costs.

An alternative would be to establish shaft and surface facilities off the edge of the tailings site and drive tunnels under the tailings pond body to the ore. Assuming that the ores are 1/2 mile from the edge, some idea of the magnitude of added costs can be calculated. Two large haulage and ventilation tunnels alone at $200 per foot each, would cost in excess of $1,000,000. Costs of this sort for a deep, medium to low-grade mine would seriously inhibit development.

In summary, lacking evidence of near-surface mineralization, there seems little chance that surface tailings could have serious impact on future underground copper-nickel mining after the tailings site has reached the end of its life. Tailings could have an effect on drilling and mining during the active life of a tailings pond.

It should also be noted that the depth at the Colvin site is greater than for any mine in the U.S. At the Snowshoe site, the projected depth is greater than any mine in the world. Shallower deposits would undoubtedly be mined first.

GLACIAL HISTORY AND SOILS[16]

Soils were deposited in northeastern Minnesota as a result of a series of glacial actions. This complex process resulted in soils of varying origin, form, depth, type, and productivity. The physical character of the soils deposited also varies widely. Of concern are its physical characteristics including bearing capacity, permeability, moisture content, and erodability.

An understanding of the qualities and characteristics of the soils is essential for the assessment of a number of other parameters.

Each of the actions requires substantial site clearance in order to prepare the site for construction. Erosion resulting from the site clearance directly relates to water quality; the composition of the soil relates to permeability, and, therefore, to hydrology, and the productivity of the soils directly relates to the nature of the terrestrial environment.

OVERVIEW

During the last Great Ice Age, the region was subjected to several periods of glaciation involving a succession of glacial lobes that entered the area from at least three directions (17) (Figure 49):

1. The Superior Lobe advanced into the area from the southeast out of the Superior basin following a course almost at right angles to the Lake Superior shoreline. It terminated in the Highland moraine at a position approximately 12-15 miles inland and parallel to the present shoreline. This area is described as the North Shore Highland in the landform section.

2. The Rainy Lobe advanced through the entire region from the north on several occasions. It followed a southwest course parallel to the Lake Superior coastline and probably parallel to the position of the Superior Lobe which was co-existent at the time. The Rainy Lobe is largely responsible for the Vermillion moraine, the creation of the Border Lakes and the Toimi Drumlin landform units.

3. The St. Louis Sub-Lobe diverged and advanced into this region from the northwest, was deflected to a path south of the Giant's Range and extended as far east as Aurora, which is located west of all sites being considered in this study.[18]

The advance and retreat of these glaciers resulted in the deposition of a complex mantle of sorted glacial soils and unsorted debris (till). Each glacier can be identified by these remaining soils according to their structure, composition, color, and other physical characteristics.

This soil material was eroded and derived from the parent country rock found along the path of the glacier and generally assumed the physical properties of the parent rock. Tills originating from hard, durable, igneous rocks are gravelly and permeable in nature, whereas those derived from softer rocks, such as limestone, sandstone and shale, are more impervious and less durable.

GLACIAL DRIFT TYPES (SOILS)[19]

Since this was an area of scour and erosion rather than one of deposition, the region has a relatively thin cover of glacial drift in comparison to other areas in the state.

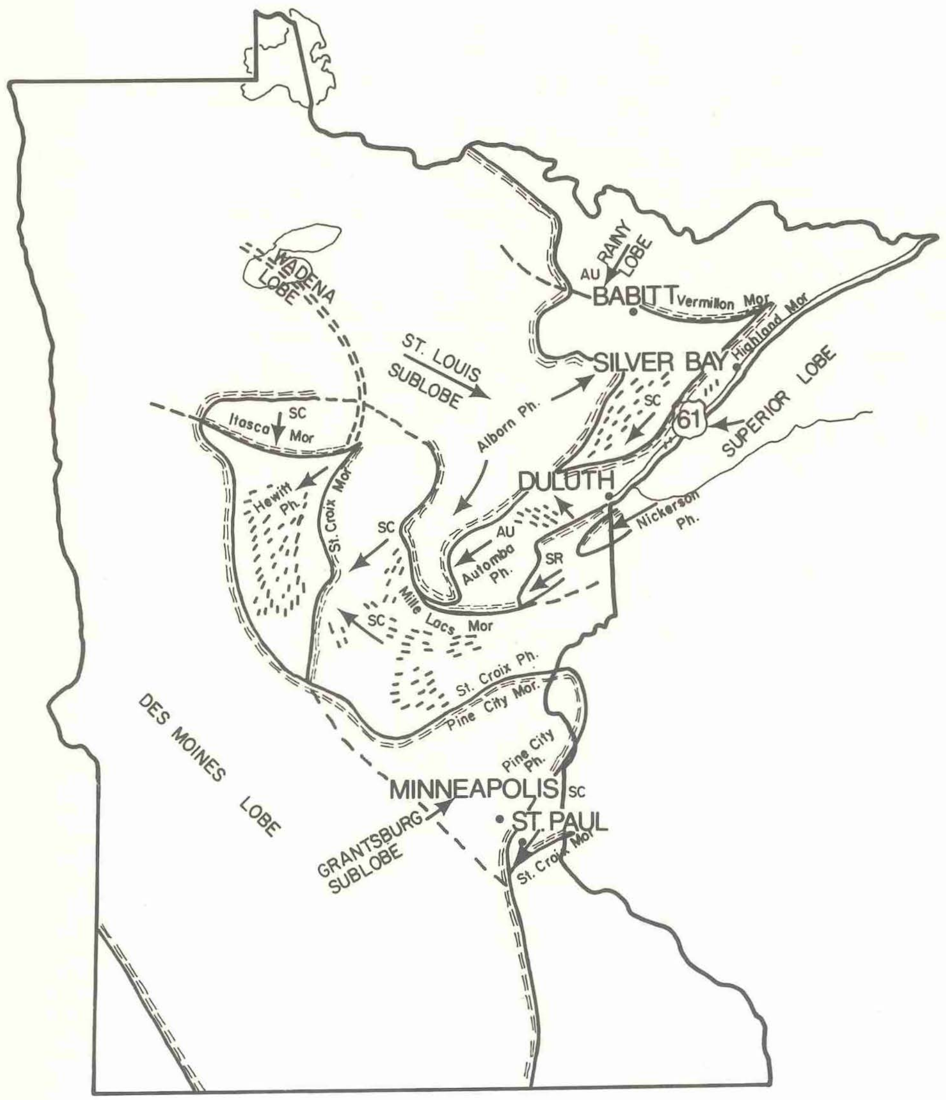
Five major types of glacial soils are present on one or several of the sites. Of the five major types, two are granular sediments resulting from hydraulic sorting by glacial melt water, two are non-sorted sediments of till and one represents quiet water deposition (lacustrine or lake deposit).

Characteristics and the probable origin of the five types of glacial soils are as follows:

1. Ice contacts deposts - water sorted sediments deposited when in direct contact with glacial ice. Examples of these are eskers and kames composed of sand and gravel (SG) or sand gravel and boulders (SGB).

2. Outwash - water sorted sediments deposited downstream or in front of the terminus of the glacier, composed of sand (S) or sand and gravel (SG).

3. Bouldery Sandy Till (ST) - represents a non-sorted deposit of ice incorporated debris. It is characterized by low clay contents (3 percent to 10 percent) and numerous large boulders, many being greater than two feet in diameter.



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

49 PHASES OF WISCONSIN GLACIATION IN MINNESOTA

LEGEND

PHASES OF ICE-LOBE MOVEMENT

N, AL	Nickerson, Alborn
SR, PC	Split Rock, Pine City
AU	Automba
SC	St. Croix
H	Hewitt
----	Drumlin Fields

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4. Clay Till (T) - also represents a non-sorted deposit of ice incorporated debris. It is characterized by clay contents of 10 percent to 40 percent and contains fewer boulders than the bouldery till.

5. Varved Lake Deposits - a sediment deposited in quiet water characterized by alternating layers of horizontally bedded clays and silts. This sediment is found only at the proposed Mile Post 7 site in a former embayment of Glacial Lake Duluth (see Figure 50).

The above listed soil types are hereafter referred to by order of listing (1through 5). Distribution of the soils and geomorphic features of the sites are depicted in Figures 50 through 53.

STRENGTH CHARACTERISTICS

The preliminary soils tests indicate that none of the site plans have any severe limitations due to soils that would preclude the construction of dams for a tailings basin.

Each of the alternate sites contain granular soils deposited by the Rainy Lobe consisting of well sorted sand and gravel associated with outwash or ice contact deposits. Each of the alternate sites also contains poorly sorted sandy-bouldery till. The Embarrass alternative generally has a larger amount of permeable sand and gravel than the other sites.

Lake sediments of varved clay and silt were found only at the Mile Post 7 site. Preliminary tests indicate they have adequate strength for dam foundations if proper engineering design and construction techniques are used.

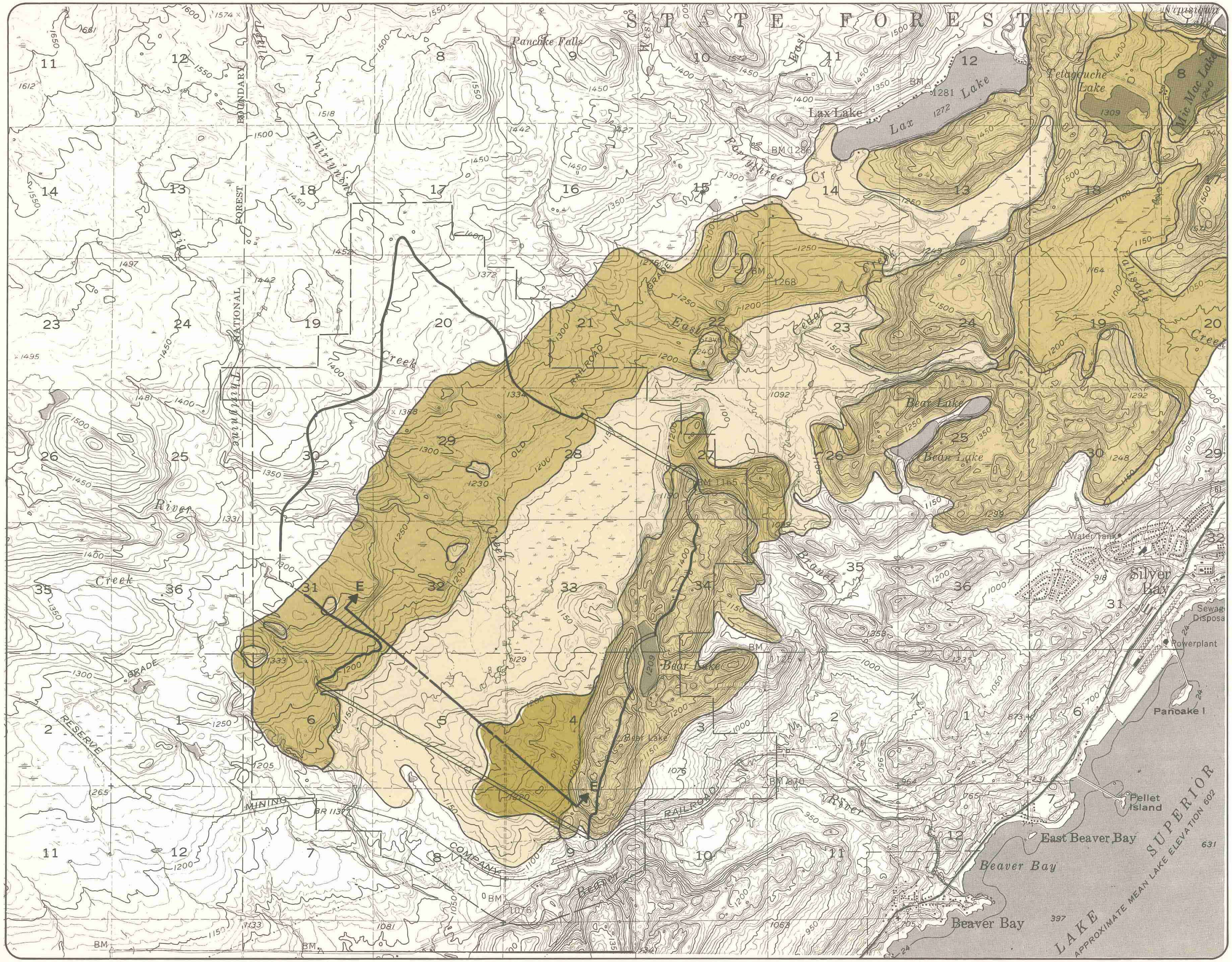
DEPTH TO BEDROCK

Depth to bedrock is displayed in Figure 54, generalized geologic cross-sections. It is readily seen that the Colvin and Snowshoe sites have relatively shallow drift covers as compared to the Mile Post 7 and Embarrass sites.

SELECTED PHYSICAL CHARACTERISTICS

Moisture content, permeability, erodability, and filtering capability are inter-related physical characteristics of a soil.

The moisture content of a soil is the percent of water in the soil as determined by the weight of water in relation to the weight of solids for a given volume. Moisture content is largely determined by original environment of deposition and permeability. Permeability, erodability, and filtering capability are related to grain size distribution. In general terms, permeability decreases with decreasing grain size and is lower for a non-sorted sediment than for a sorted sediment. Sorting results in soil masses with soil particles of similar size, which provide an abundance of uniform void space between the grains to transmit water. In unsorted soils, smaller particles may fill voids between larger particles, thereby, lowering the uniformity of void space and inhibiting flow of water.



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

50 SURFICIAL GEOLOGY - MILE POST 7

LEGEND

- GLACIAL TILL
- SHALLOW SEDIMENTS OVER ROCK
- ROCK OUTCROP
- SHALLOW SEDIMENTS

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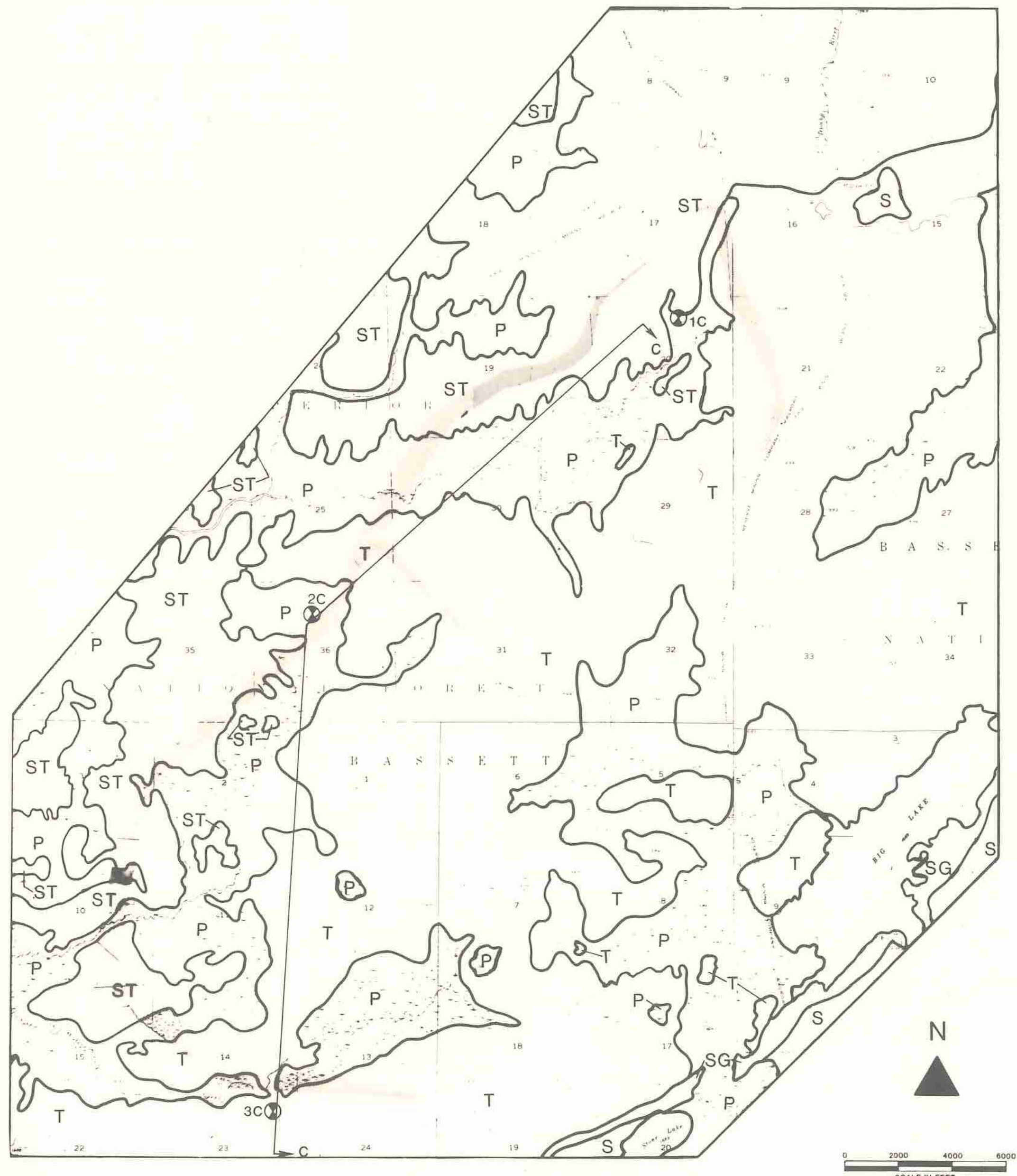
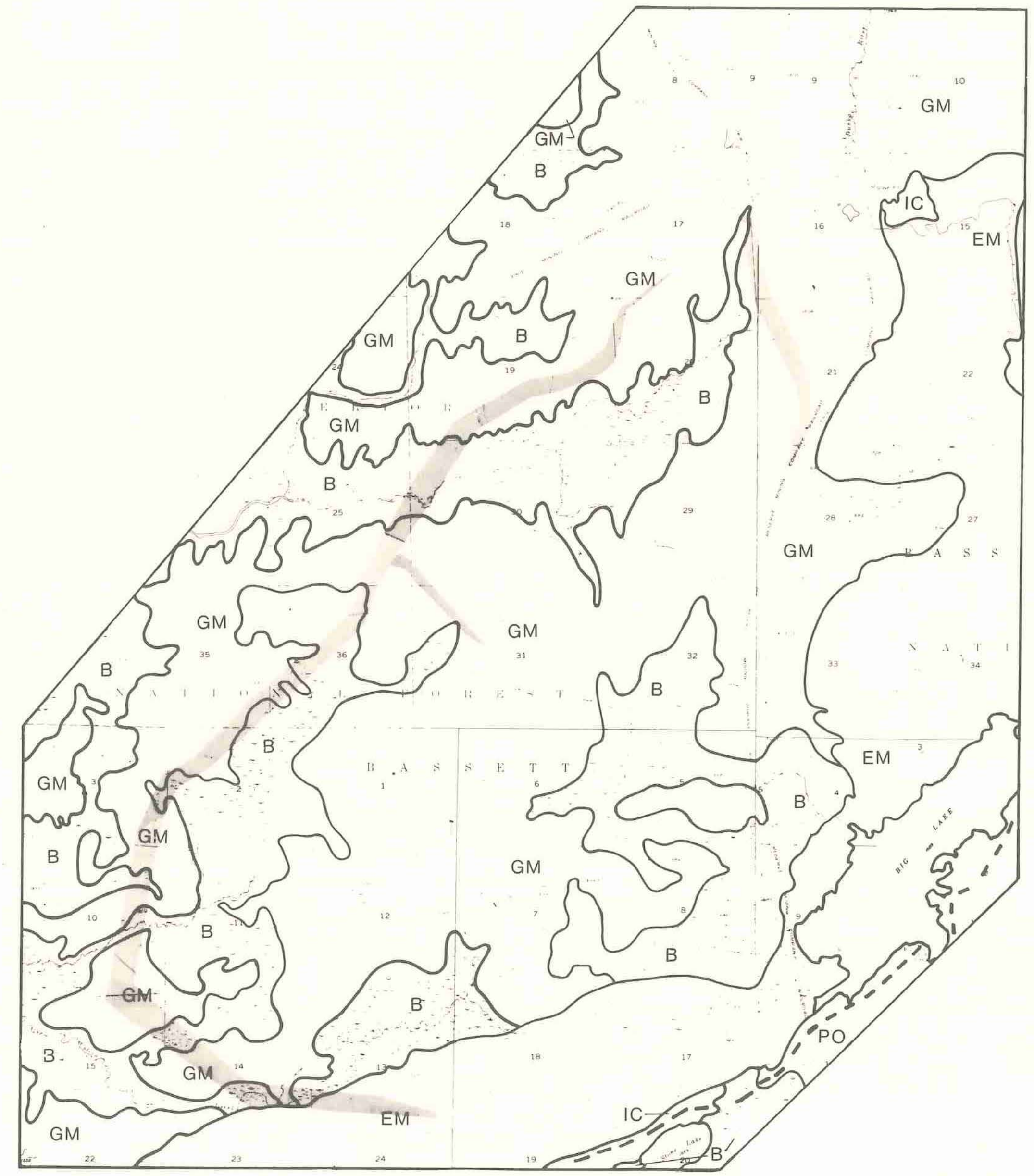
ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

51 SURFICIAL GEOLOGY - COLVIN



SURFICIAL GEOLOGY



GEOMORPHIC FEATURES

LEGEND

SURFICIAL

P PEAT	ST SANDY TILL
R RUBBLE VERY THIN DRIFT OVER BEDROCK	T BOULDERY TILL
S SAND	BOREHOLE
SG SAND AND GRAVEL	HAND AUGER PROBE
SGB SAND, GRAVEL & BOULDERS	DAM LOCATION
a a GEOLOGIC CROSS-SECTION	

GEOMORPHIC

B GLACIAL LAKE OR BACKWATER AREA	O OUTWASH
EM END MORAINE	PO PITTED OUTWASH
GM GROUND MORAINE	ESKER OR CREVASSE FILLING
IC ICE CONTACT DEPOSIT	DAM LOCATION

NOTE: See Figure 54 for Geologic Cross-Section

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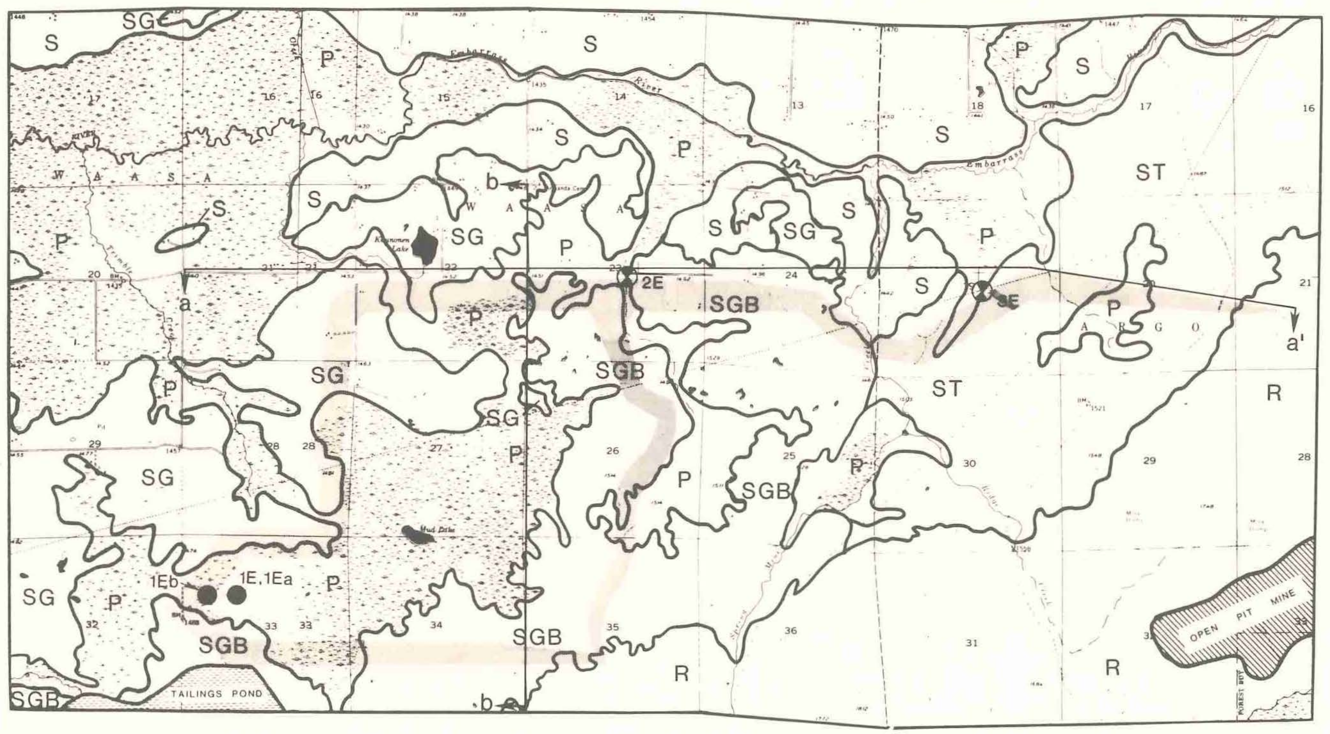
RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

52 SURFICIAL GEOLOGY - EMBARRASS

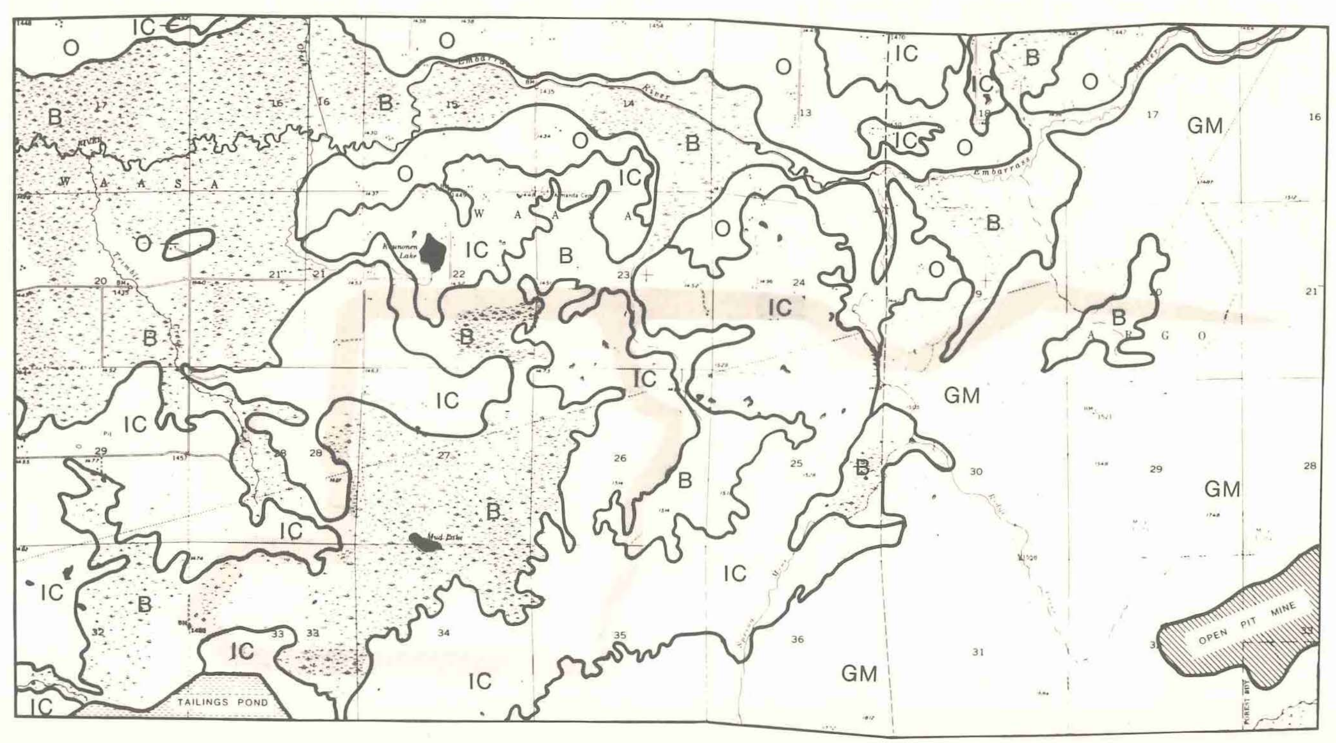


SURFICIAL

NOTE: See Figure 54 for Geologic Cross-Section

N

0 2000 4000 6000
SCALE IN FEET



GEOMORPHIC

LEGEND

SURFICIAL

- P — PEAT
- ST — SANDY TILL
- R — RUBBLE, VERY THIN DRIFT OVER BEDROCK
- T — BOULDERY TILL
- S — SAND
- BOREHOLE
- SG — SAND AND GRAVEL
- HAND AUGER PROBE
- SGB — SAND, GRAVEL & BOULDERS
- DAM LOCATION
- a — a' GEOLOGIC CROSS-SECTION

GEOMORPHIC

- B — GLACIAL LAKE OR BACKWATER AREA
- O — OUTWASH
- EM — END MORAINE
- PO — PITTED OUTWASH
- GM — GROUND MORAINE
- ESKER OR CREVASSE FILLING
- IC — ICE CONTACT DEPOSIT
- DAM LOCATION

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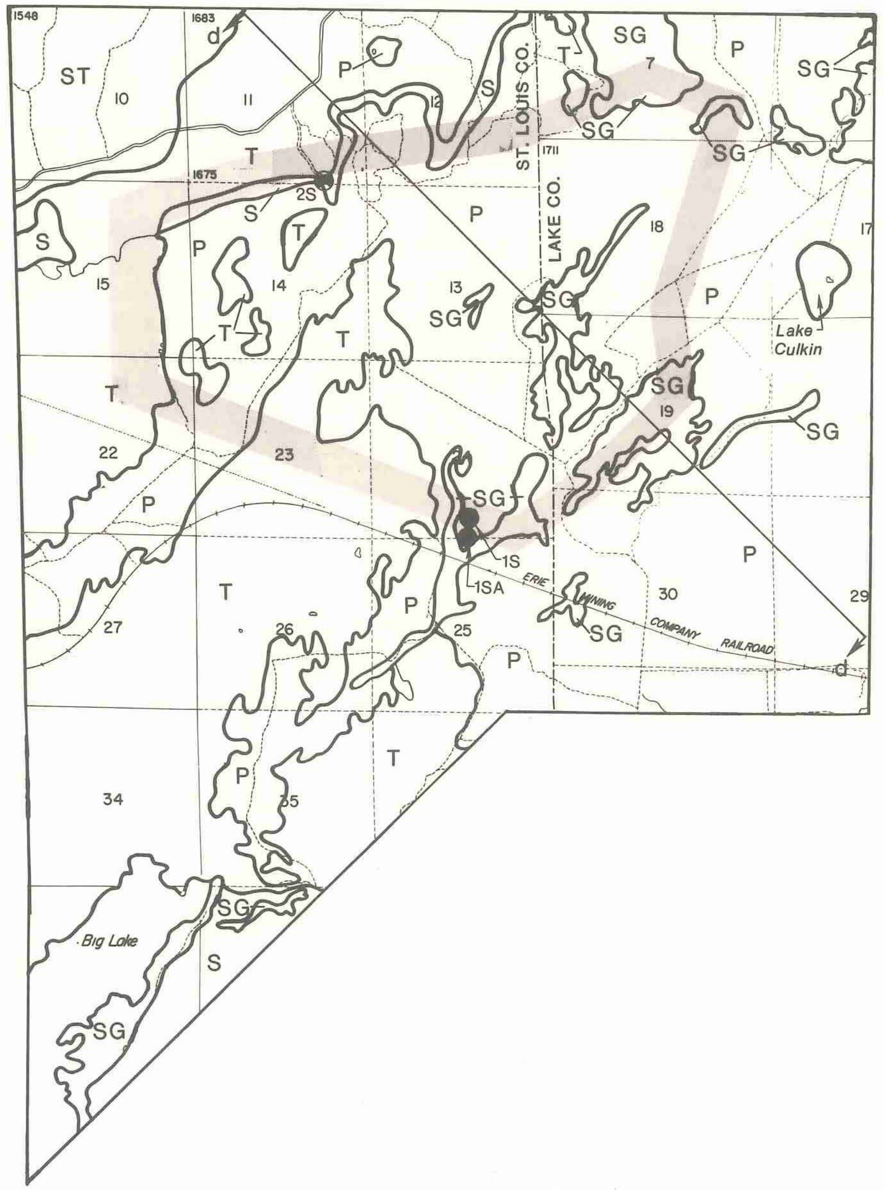
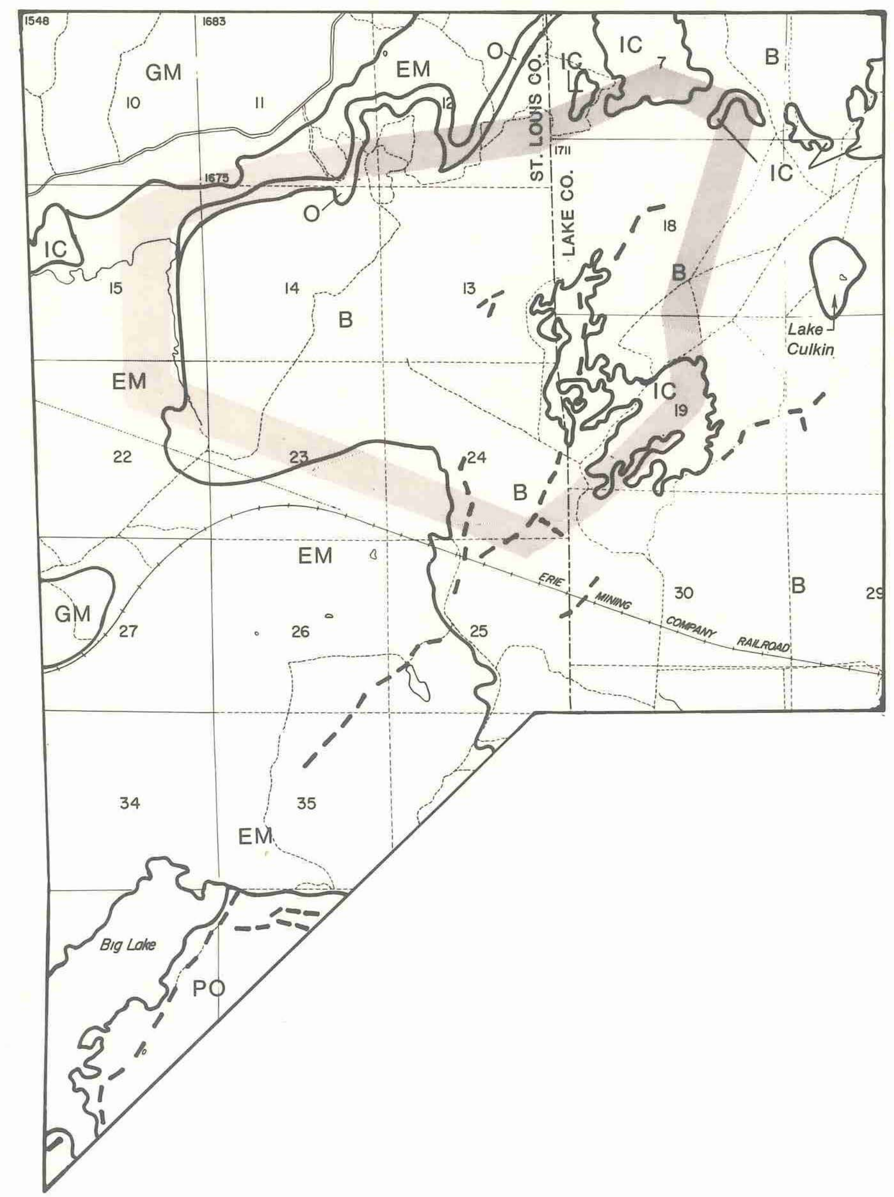
ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

53 SURFICIAL GEOLOGY - SNOWSHOE



SURFICIAL GEOLOGY



GEOMORPHIC FEATURES

N

NOTE: See Figure 54 for Geologic Cross-Section

0 2000 4000 6000 SCALE IN FEET

LEGEND

SURFICIAL

- P — PEAT
- ST — SANDY TILL
- R — RUBBLE VERY THIN DRIFT OVER BEDROCK
- T — BOULDERY TILL
- S — SAND
- BOREHOLE
- SG — SAND AND GRAVEL
- HAND AUGER PROBE
- SGB — SAND, GRAVEL & BOULDERS
- DAM LOCATION
- a a′ GEOLOGIC CROSS-SECTION

GEOMORPHIC

- B — GLACIAL LAKE OR BACKWATER AREA
- O — OUTWASH
- EM — END MORAINE
- PO — PITTED OUTWASH
- GM — GROUND MORAINE
- ESKER OR CREVASSE FILLING
- IC — ICE CONTACT DEPOSIT
- DAM LOCATION

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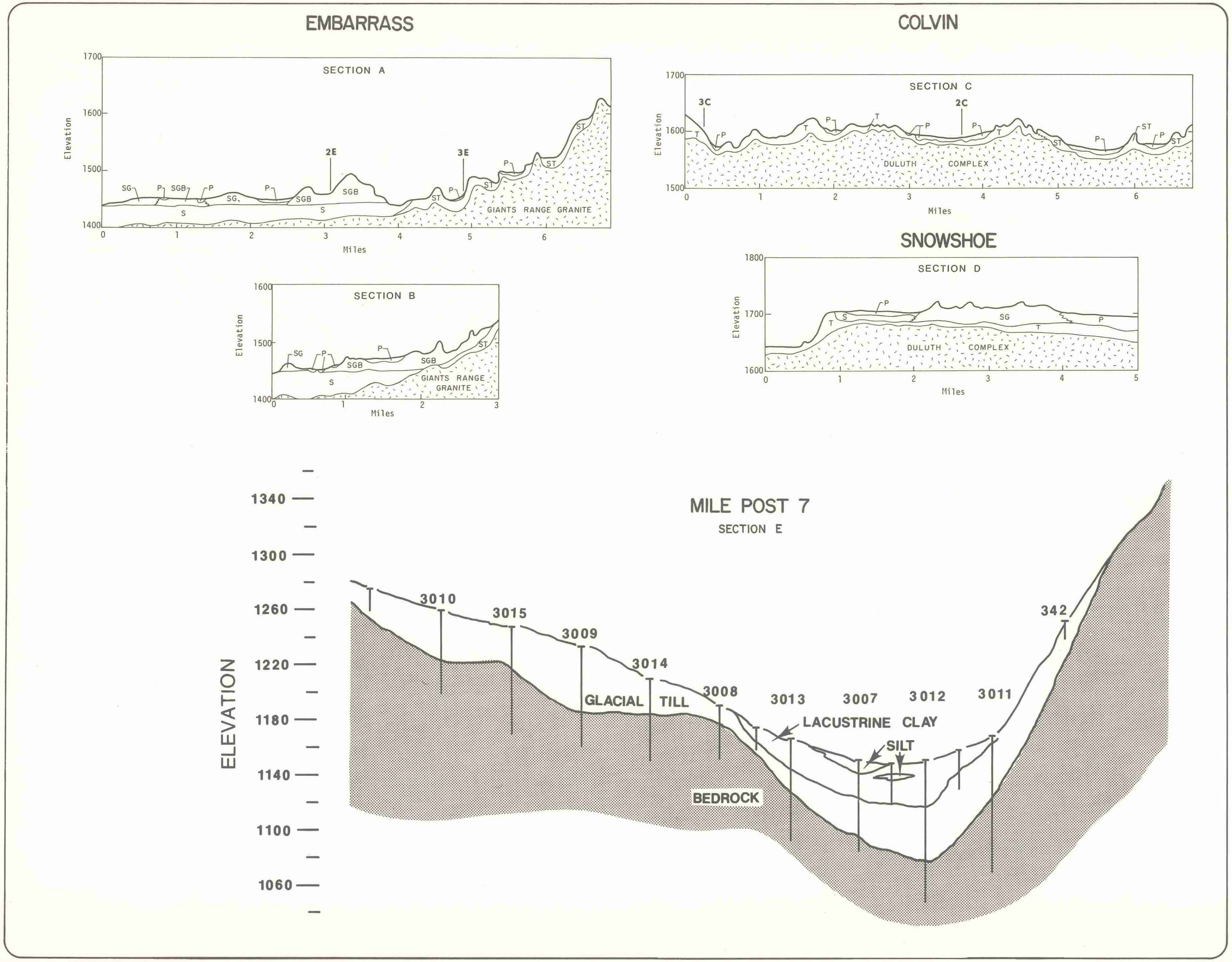

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

54 GEOLOGIC CROSS-SECTION - MILE POST 7, COLVIN, EMBARRASS, SNOWSHOE

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Table 24 gives typical ranges of permeability and moisture content for the five soil categories described above.

In relation to erodability, fine uniform soil types with a minimum of cohesion, are most subject to erosion. Particularly susceptible are uniform (well sorted) fine sands and silts. If a soil is well graded (high range in particle size) from sand and gravel to silt, a self-stabilizing mechanism may result during the erosion process. Initial erosion would remove the finer material from the till, but coarser fractions would remain in-place forming a protective cover and filter over the more susceptible soil particles below (an armouring effect). However, stabilization of this type would normally require a period of many years to develop, so erosion would be of definite concern during construction phases.

In relation to filtering capacity, it is likely that effectiveness in filtering will be inversely related to permeability. Low permeability will likely result in higher filtering capacity. However, unsorted sediments such as till do not always follow this relationship because of the lack of uniformity of void spaces.

VEGETATIVE PRODUCTIVITY

Covering the natural organic soils with tailings will destroy the vegetative productivity in the area. The finished surface of the tailings basin will have to be reclaimed by using special measures and soils conditioners if an adequate growth of vegetation is to be established.

TABLE 24
GENERALIZED HYDROGEOLOGIC DATA

Soil Type	Permeability (cm/sec)	Range (ft./mo.)	Moisture Content Range (%)
1	$10 - 10^{-3}$	862200 - 86	0 - 15
2	$1 - 10^{-2}$	8622 - 862	0 - 15
3	$10^{-3} - 10^{-5}$	86 - .86	5 - 20
4	$10^{-5} - 10^{-8}$	.86 - .001	5 - 25
5	$10^{-7} - 10^{-9}$	.01 - .0001	30 - 40

PEAT DEPOSITS

Northern Minnesota as a whole is characterized by an abundance of peat. It has been roughly estimated to account for 30 percent of the surficial area of the region.

The 7.5 million acres of peat deposits in Minnesota are now being seriously considered as a supplementary source of energy because of the world wide shortage of fuels. Certain types of peat also have potential for agricultural uses.

The Snowshoe site covers about 6 square miles of peat land along the west margin of a large peat bog referred to as the "One Hundred Mile Swamp" covering approximately 40 square miles in St. Louis and Lake counties. This bog has potential as a commercial peat development. Preliminary soils tests indicate it ranges up to 20 feet in depth and is composed primarily of humic peat which has potential as an energy source with related petrochemical by-products.

A report submitted to the Upper Great Lakes Regional Commission entitled "Peat Program" indicates that a 100 megawatt generating plant would require 20,000 acres of peat 6 feet deep, in order to operate the plant for 66 years. Improved techniques could double or triple the generating capacity for the same acreage.[20]

As a minimum a commercial gasification plant could operate for 10 years on 2,300 acres of peat 6 feet deep using 500-1,000 tons per day. Based on the above figures, it is concluded that approximately 6 square miles of peat will be permanently lost. Construction of the tailings site will not significantly alter the commercial potential of the peat resources in the "One Hundred Mile Swamp" as a fuel source.

The uses of peat for agriculture is inconsequential in that area since it is not an agricultural area. Other uses such as soil conditioning and filtering are of minor consequence compared to the large supply of peat available in the region and state.

LANDFORMS[21]

Landforms influence an area in a variety of ways. In northeastern Minnesota, landform is a primary consideration in aesthetics and recreational use of this area. In addition, landform influences the flow of the air currents and streams. Therefore, landform relates to air quality and hydrology. Landforms are also useful in tailings basin design when they can be utilized as part of the containment structure.

OVERVIEW

The landforms of northeastern Minnesota have been grouped by physiographic areas (see Figure 55). Those of particular interest to this study include: Border Lakes Area (contains the BWCA and a portion of Voyageurs National Park), North Shore Highland (contains numerous recreation areas and the proposed Mile Post 7 site), Toimi Drumlin Area (contains the Snowshoe alternative while the Colvin alternative is in a transition area between the Toimi Drumlin Area and the Giants Ridge), Giants Ridge and Chisholm-Embarrass Area (contains Embarrass alternative site).

Border Lakes Area

This area of lakes formed in bedrock depressions occupies a large area bordering Canada. Glacial soils are very thin and numerous bedrock outcrops exist. Glacial activity produced the complex patterns of chains of lakes and ridges in this area by differential erosion of the soft bedrock and the structural weaknesses. The Boundary Waters Canoe Area and Voyageurs National Park cover a significant portion of the region and are a recreational resource of national importance.

North Shore Highland

This area is underlain mostly by north shore volcanic rocks and overlooks Lake Superior from a height of 900-1,500 feet. Short streams, 10-15 miles long, drain eastward from the highland directly to the lake. Most of them have waterfalls and rapids in their lower reaches. The major landforms in the region are composed of large masses of intrusive rock, that often rise several hundred feet above the local terrain. Numerous recreation areas focus on these scenic natural features along the north shore. The proposed Mile Post 7 plan is located within this highland.

Toimi Drumlin Area

Northwest of the North Shore Highland is a triangular area marked by northeast-southwest trending drumlins drained by a linear stream pattern. A drumlin is a glacial landform which is in the shape of an elongated oval that reflects the direction of glacial flow. The drumlins in this area are about one to two miles long, one-fourth mile broad and approximately 30 to 50 feet high. A few of the interdrumlin swales that were not affected by through-flowing outwash streams are filled with lakes, but most of them form long stringer shaped bogs. Some of the bogs have a pond in the middle, indicating the progression of lateral infilling of a lake by bog growth after the lake becomes shallow by bottom filling. The alternative Snowshoe site is within this region and occupies a lake basin filled with peat. The alternative Colvin site is within a moraine area which seems to be a transition zone between the Toimi Drumlin area and the Giants Range.

Giants Range

The Giants Range is a highland of granite flanking the Mesabi range on the north from Hibbing to Babbitt and rising 200-400 feet above the plains to the north and the south. The alternative Embarrass site utilizes this ridge as a southern topographic barrier. Man-made landforms resulting from mining have long been an accepted and common part of the terrain in this region.

Chisholm-Embarrass Area

North of the Giants Range is a wedge-shaped area of shallow glacial deposits containing low moraines and outwash plains called the Chisholm-Embarrass area. The alternative Embarrass site is located partially over outwash plain in this area.

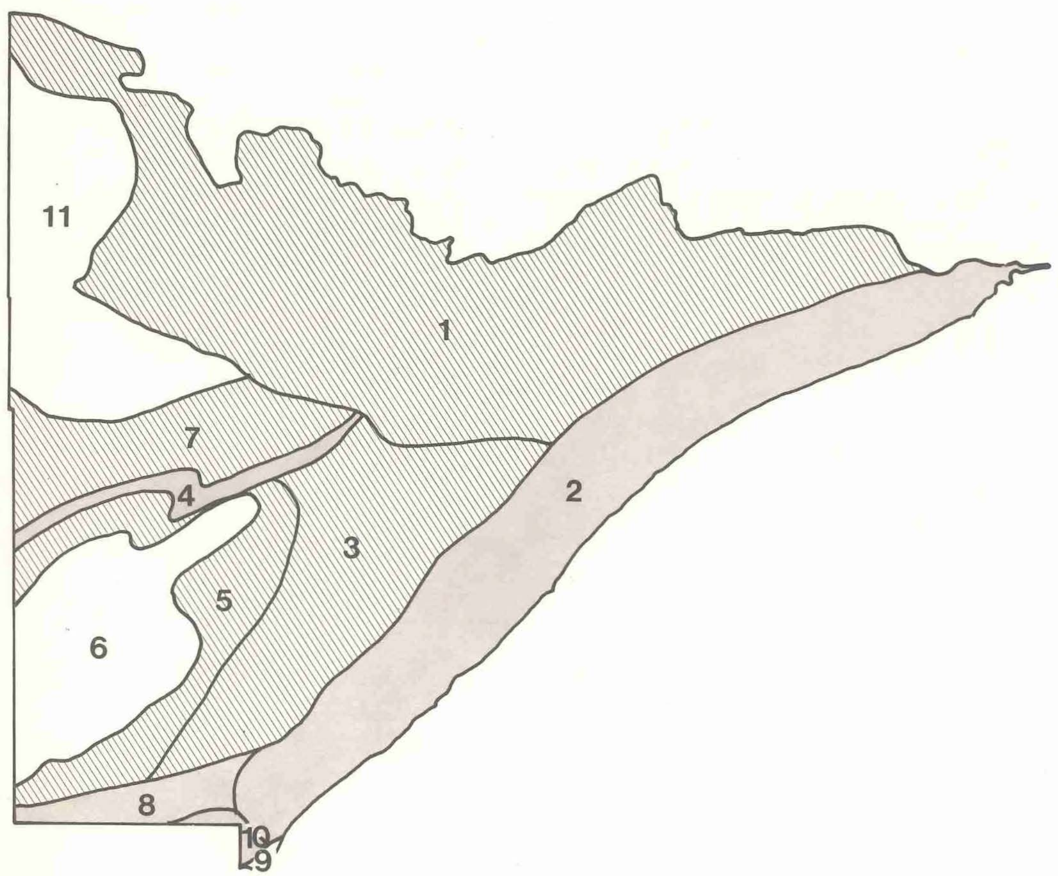
LANDFORMS AND THE ALTERNATIVES

With the exception of the Snowshoe alternative, specific landforms are utilized for basic layout and design of each site. The landforms and other natural features in the general locale of each site have been delineated in Figure 56. Their significance as surveyed by the 1970 Project 80 inventory has been noted.[22] Project 80 is the name given to a study of the environment conducted by various state agencies.

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

55 PHYSIOGRAPHIC AREAS OF NORTHEASTERN MINNESOTA



1. Border lakes area
2. North Shore Highland
3. Toimi drumlin area
4. Giants range
5. Aurora-Alborn clay-till area
6. Glacial Lakes Upham and Aitkin
7. Chisholm-Embarrass area
8. Sugar Hills-Mille Lacs area
9. Glacial Lake Duluth area
10. Brainerd-Automba drumlin area
11. Beltrami arm of Lake Agassiz

LEGEND

- Moraines and bed rock highlands
- Till plains and drumlin areas
- Sand plains, lake plains, and large valleys

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Proposed Mile Post 7 Plan

The proposed action is located within the North Shore Highlands physiographic region. Landforms in the area rise more than 870 feet above the 602 foot elevation of Lake Superior within a few miles from the lake. These landforms are the result of the intrusion of a large geologic formation previously described as the Beaver Bay Complex. They form large irregularly shaped ridges trending in numerous directions and are unlike many of the other intrusive landforms on the north shore which generally trend parallel to the Lake Superior shoreline.

The Beaver River and its tributaries which flow around and through the site are rapidly flowing streams and are characterized by numerous stretches of rapids and at least three waterfalls.

The 1970 Project 80 inventory has delineated several landforms including the east ridge of the proposed Mile Post 7 plan as significant. It also identifies a lengthy stretch of rapids, one waterfall and a beach deposit in the lower Beaver River area.

Embarrass Alternative

The Embarrass alternative is located within the Chisholm-Embarrass physiographic region and abuts the Giants Range for 4-1/2 miles. The landform resulting from this ridge of granite provides up to 400 feet of local relief. The present Erie Mining Company tailings basin abuts the Giants Range and is directly west of the Embarrass alternative. With time these two basins would eventually connect.

The 1970 Project 80 inventory has delineated the Giants Range as a significant landform.

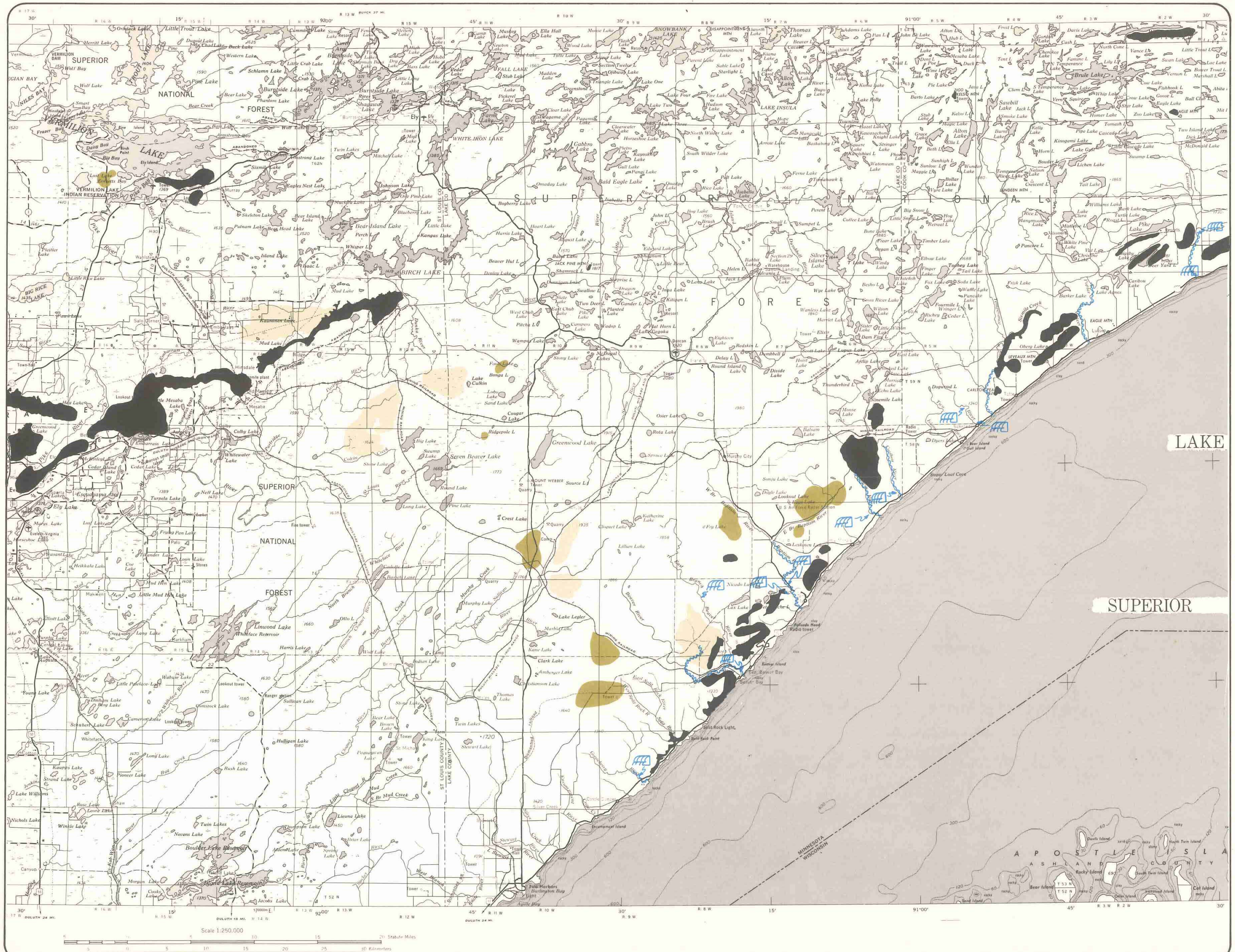
Colvin Alternative

This alternative is located within the transition zone between the Toimi Drumlin physiographic region and the Giants Range. The topography is undulating and covered by a shallow ground moraine which is controlled by bedrock. Three bedrock knobs are located along the east side of the site and the topographic relief is approximately 150 feet.

The other landform in the immediate area is an end moraine which arcs around the south and east side of the site which abruptly truncates the Toimi Drumlin area. It has generally less than 50 feet of topographic relief.

Snowshoe Alternative

The Snowshoe alternative is located immediately east of the Colvin site in the Toimi Drumlin area and is separated by the end moraine previously discussed. Topographic relief varies by less than 50 feet. The east half is a level peat bog representing a former lake bed.



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

56 LANDFORMS AND RELATED NATURAL FEATURES

LEGEND

- TAILINGS BASIN
- RAPIDS, WHITE WATER AREA
- SECNIC TIMBER
- LAND FORMS
- FALLS

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HYDROLOGY

OVERVIEW

The three county area is drained by a portion of three major river basins. These are the Rainy River basin, the Mississippi River basin and the Lake Superior basin. However, none of the sites lie in the Mississippi River basin, so there will be no impact on the hydrology in this basin. Impact of tailings basin construction, therefore, would be limited to small portions of the Rainy River and Lake Superior Basins.

Subbasins affected include the St. Louis River subbasin, the Kawishiwi (Vermillion) River subbasin and the direct Lake Superior subbasin. Within these subbasins, effects of tailings basin construction will be primarily limited to the Embarrass River, Partridge River (located within the St. Louis subbasin), Dunka River (located within the Kawishiwi subbasin) and Beaver River watersheds (located within the direct Lake Superior subbasin). The Embarrass, Colvin, Snowshow, and Mile Post 7 sites are located in the Embarrass, Partridge, Dunka, and Beaver River watersheds, respectively (see Figure 57).

Northeastern Minnesota has generally similar hydrological conditions and is an area where average precipitation minus evaporation is a positive value for both open water surfaces and upland surfaces. Therefore, the entire watershed will produce an excess of water during average years. For additional information on Hydrology, see Appendix A.

LOCAL HYDROLOGY

Annual precipitation, which averages from about 27 to 30 inches in the region, results in the surplus of water over evaporation and transpiration. Based upon an estimated average annual precipitation of about 30 inches, runoff (excess water within a watershed) at Mile Post 7 would be approximately 16 inches per year. At the alternate sites, average annual precipitation is about 27 inches. Annual runoff averages about 4 inches at Snowshoe, and from 8 to 9 inches at the Embarrass and Colvin sites. The considerably lower amount at Snowshoe results from greater evaporation caused by extensive marsh at the site.

Monthly distribution of runoff for each of the sites appears to be quite similar. Figure 58 shows the variation based on observed stream flow records for the Baptism, Embarrass, Partridge, and Dunka Rivers. The Baptism River has been used to estimate runoff conditions in the Beaver River. Lowest flows commonly occur during the months of January and February. Maximum flow rates are shown during April and May, resulting from the release of runoff stored during the winter months as snow and ice. Low flow during January and February is primarily supplied by ground water to the streams. The slight increase in stream flow during September is likely caused by increased ground water flow caused by a build up in ground water supply during the summer months.

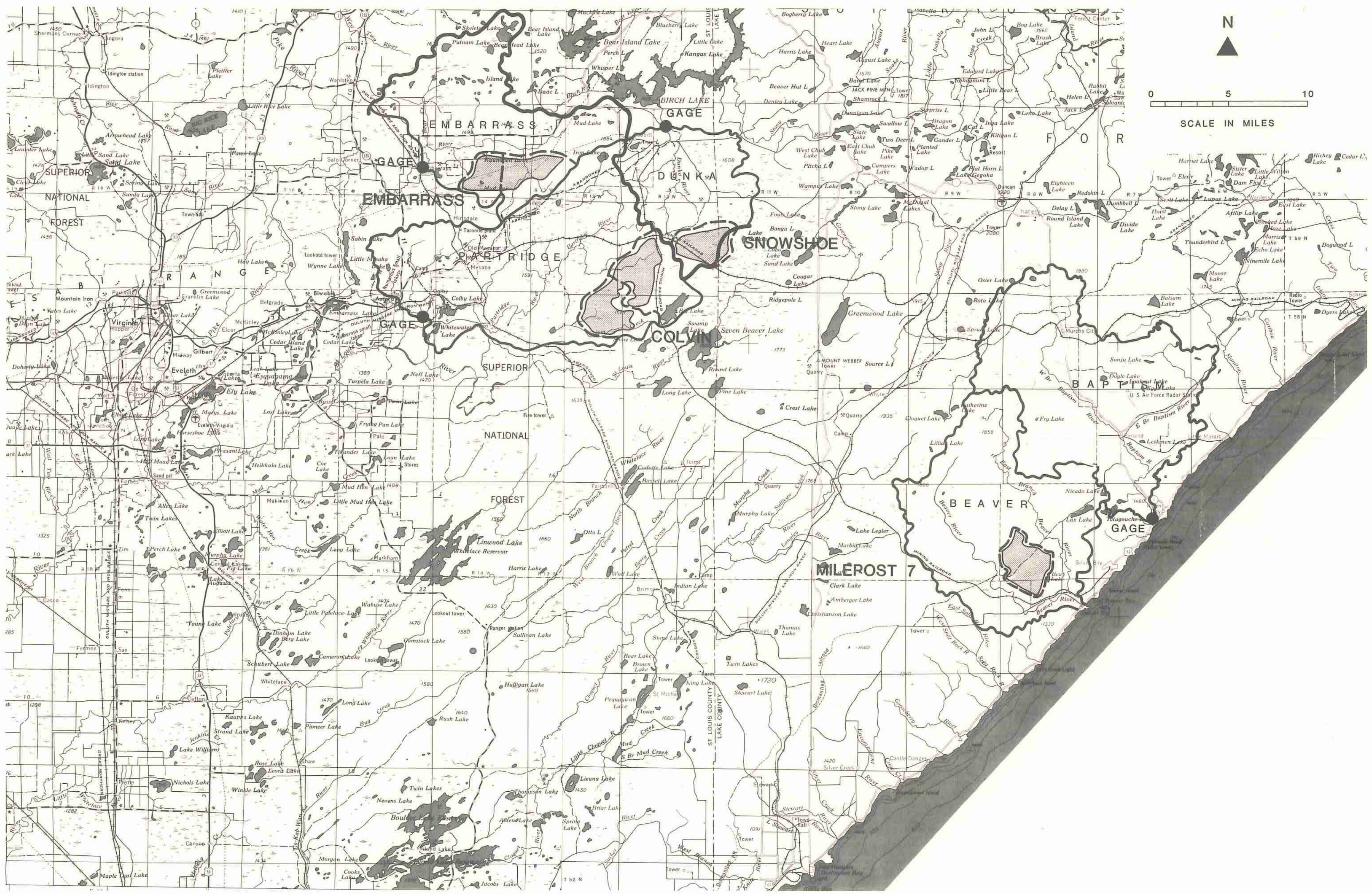
The Mile Post 7 site lies in the Beaver River watershed which is directly tributary to Lake Superior. Two of the alternative tailings basin sites also lie within watersheds which are eventually tributary to Lake Superior. The Embarrass site lies within the Embarrass River watershed which flows into the St. Louis River. The Colvin site lies within the Partridge River watershed which is also tributary to the St. Louis River. The St. Louis River flows into Lake Superior, becoming the boundary between Minnesota and Wisconsin along the southwest tip of Lake Superior. The Snowshoe alternative lies principally within the Dunka River watershed which is tributary to Birch Lake. A minor portion of the site lies in the North River watershed. Birch Lake is ultimately tributary to the Rainy River which flows north into Canada. Figure 57 shows the approximate watershed boundary of the Embarrass, Partridge, and Dunka Rivers. The approximate limits of the alternative basin sites are also shown. The watersheds shown represent only the portions of the Embarrass, Partridge, and Dunka watersheds which are tributary to gaging stations. Following is a brief description of watershed and streamflow characteristics for each of the basins.

Mile Post 7 (Beaver River Watershed)

The Beaver River watershed tributary to Lake Superior has a total area of approximately 131 square miles. The area isolated from the watershed during basin operations would consist of about 9.1 square miles as shown on Figure 57.

ENVIRONMENTAL IMPACT STATEMENT
RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

57 MAJOR DRAINAGE BASINS



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The watershed appears to be typical of many of the short streams directly tributary to Lake Superior along the north shore. Terrain can be described as rugged with relatively steep gradients which produce rapid runoff in response to heavy rainfall. Storage areas such as marshes for slowing the rate of runoff within the watershed are limited, probably within a range from 10 to 20 percent of the total area. A comparison of the watershed with the Baptism River watershed adjacent to it shows a definite similarity between the basins. A review of available topographic maps indicates that the upper portion of the Baptism watershed may contain slightly more storage than is found within the Beaver watershed. The stream network within the Beaver watershed consists of a rather complex array of small channels and tributaries to the Beaver River, and the West and East Branches of the Beaver River.

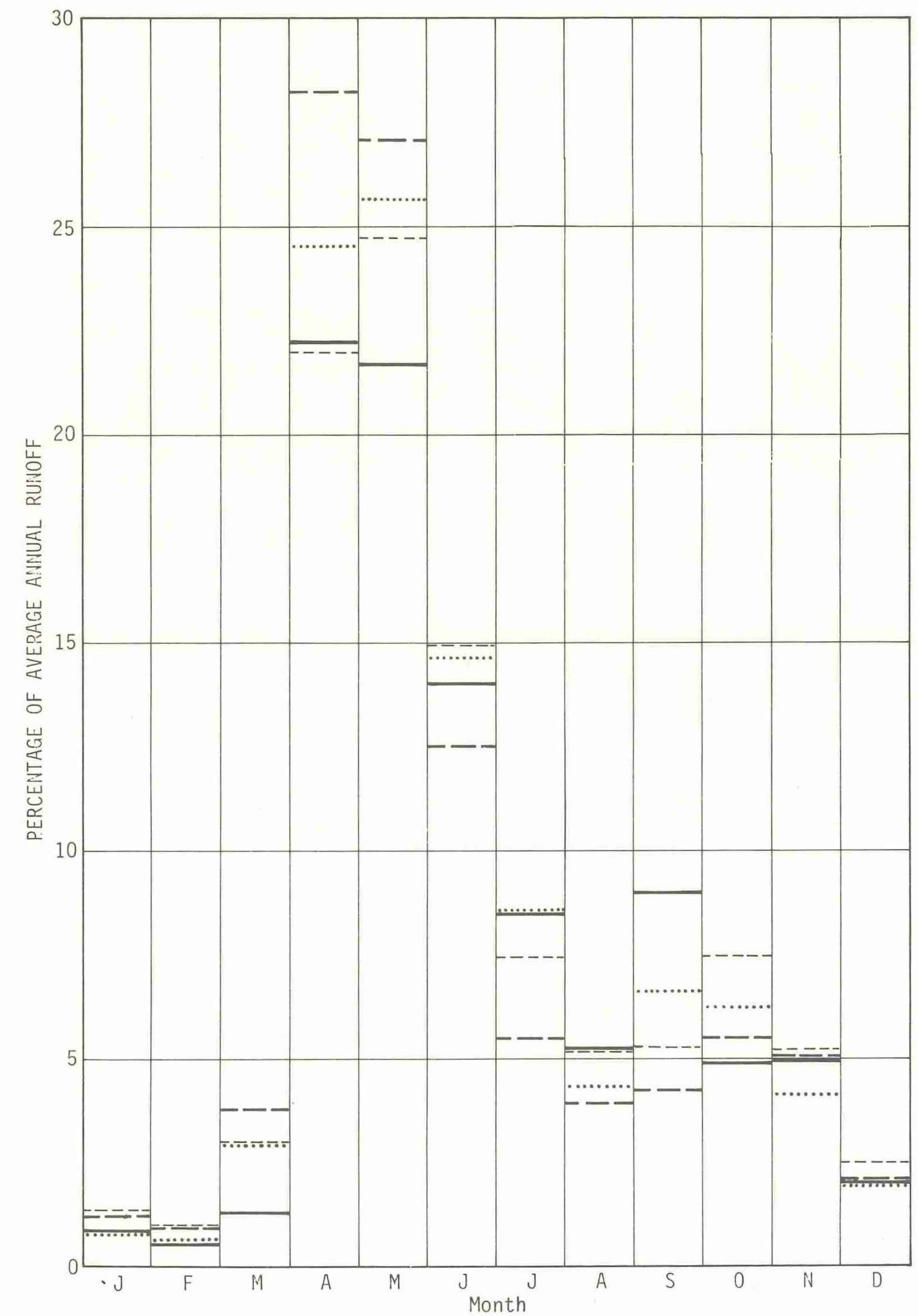
Embarrass Site (Embarrass River Watershed)

The Embarrass River watershed, as shown in Figure 57, has a total area of about 94 square miles. The maximum area isolated from the watershed during tailings basin operation is about 19.3 square miles.

The Embarrass River watershed shows extensive swamp and wetland lying along the Embarrass River, including a major portion of the area proposed for the West tailings basin. Considerable storage capacity exists in the northerly portion of the watershed tributary to Bear Creek which flows into the Embarrass River. The southern and eastern portions of the watershed are rather steep and rocky. However, runoff from this area flows into the extensive swampland along the Embarrass. The stream network is not as complex as found in the Beaver watershed. The Embarrass River has a number of small tributaries from the south, originating in the steep slopes forming the southern watershed boundary. The northern portion of the watershed which is generally flatter and marshy, contributes runoff to the Embarrass primarily through Bear Creek and Camp Eight Creek. Generally, the watershed can be described as gently rolling to hilly land with extensive storage in the form of marshes. Wetlands appear to occupy from 30 to 40 percent of the total area.

Colvin Site (Partridge River Watershed)

The Partridge River watershed, shown on Figure 57, has a total area of about 156 square miles. The approximate limits of the Colvin tailings basin site and tributary area affected by tailings basin operation are also shown. The maximum area isolated from the watershed will be about 30.5 square miles.



58 MONTHLY DISTRIBUTION OF ANNUAL RUNOFF

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The Partridge River watershed can be described as rolling to hilly timberland with rather extensive swamps and lakes throughout the basin. A large area near the north limits of the watershed is occupied by open pit mines. These mining areas are dewatered by pumping on a continuous basis, thereby returning precipitation and runoff collected within them to the watershed. The effect of the mining areas on runoff is similar to the effect of lakes and marshes in temporarily storing runoff within the watershed. The Whitewater Reservoir, adjacent to Hoyt Lakes, and Colby Lake serve as reservoirs operated by Erie Mining Company to provide water supply for the Erie taconite operation. Operation of this reservoir and the open pit mines has a moderating effect on streamflow in the Partridge River.

The stream network within the watershed is similar to that for the Embarrass River. Smaller tributaries form in the steeper slopes along the perimeter of the basin and drain to the Partridge which flows through an extensive swamp or marsh along the middle portion of the watershed. A major tributary to the Partridge River is Colvin Creek which originates in the southeast portion of the watershed. The Colvin alternate site is so named because a portion of the proposed tailings basin is located on this tributary stream. Big Lake, located in the southeast portion of the watershed, is also tributary to the Partridge through an unnamed stream entering about 2 miles upstream of Colvin Creek. This stream also traverses the proposed Colvin tailings basin site. Other tributaries to the Partridge include Second Creek, Wyman Creek, Longnose Creek and Wetlegs Creek which are all tributary from the north.

Snowshoe (Dunka River Watershed)

Figure 57 shows the approximate limits of the Dunka River watershed with an area of about 53 square miles. The approximate limits of the Snowshoe tailings basin and tributary area are also shown. The area isolated from the watershed during operations would be about 10.2 square miles.

The Dunka watershed can be described as gently rolling to hilly land with extensive storage in the form of swamps. As with the Partridge watershed, a portion of the Dunka basin is occupied by the Reserve open pit mine. The mining area is dewatered on a continuous basis with discharge to the Dunka River. The effect of the open pit mine again is similar to the effect of storage in the swamps.

The central portion of the watershed is relatively steep, sloping generally to the north and northwest toward the Dunka River. Extensive marsh occupies the portion of the watershed above and below this sloping area.

The stream network in the Dunka watershed is similar to the Partridge basin. The Dunka River serves as the main waterway originating in the marshy upper portion of the watershed near the proposed Snowshoe site. The Dunka flows in a northerly direction meandering through extensive marshland. Several similar unnamed tributaries originate in the steeper areas to the east of the Dunka. A major tributary called Langley Creek originates in the marsh which also drains to the Partridge River in the westerly portion of the basin.

Of significance relative to the Dunka watershed is the fact that it lies to the north of the Laurentian Divide, which separates streams which flow to the north to Hudson Bay from streams tributary to the St. Lawrence Seaway. Portions of the Dunka watershed divide are a part of the Laurentian Divide. Because the divide crosses extensive marshland, precise determination of its location is difficult. The proposed Snowshoe site lies in the extreme southern portion of the Dunka watershed approximately along the divide. A small portion of the site may be tributary to the North River.

Existing Ground Water Conditions

Existing ground water conditions on each site were evaluated using the following:

1. Observation of surface water elevations.

2. Utilization of available information on ground water levels in the vicinity of the sites.

3. Estimated information such as geometrical configurations and water-bearing properties of geologic units on each site.

The possibility of multi-level ground water tables was considered and not found to exist based on preliminary review of the sites. Preliminary piezometric maps for the Colvin, Embarrass and Snowshoe sites are shown in Appendix A. Piezometric data for the Mile Post 7 site is available in the Feasibility Report prepared by Klohn-Leonoff Consultants for Reserve Mining Company.

Mile Post 7 Site

The limits of the existing local ground water basin at the Mile Post 7 site are roughly defined by the local surface watershed boundary. The lake clays and glacial till found in the basin area have permeabilities on the order of 10^{-7} to 10^{-9} centimeters per second (.01 to .0001 feet per month). Permeabilities on the order of 10 to 100 times higher may exist in the 1 to 3-foot thick zone at the top of the existing bedrock surface which is highly fractured. As a result of these low permeabilities, ground water movement toward local sinks, such as streams, is extremely slow. Ground water levels in portions of the basin which have lake clays are difficult to determine because of the extremely low permeability. It is probable, however, that the lake clays are generally saturated to within 5 feet of the surface. In areas where bedrock is close to the surface, ground water levels are near the surface due to the impermeable nature of the bedrock.

Embarrass Site

The primary outlet for ground water in the Embarrass site is the Embarrass River. The prominent ridge on the southern edge of the basin area has bedrock at or near the surface which results in ground water at or near the surface. Steep bedrock gradients result in steep ground water gradients. These steep gradients, in turn, result in bog areas being created at the base on the ridge due to ground water flowing over the surface. The piezometric map at this site indicates that the general ground water flow is from south to north toward the Embarrass River. The area is generally underlain by sands and gravels with relatively high permeabilities on the order of 10^{-3} to 10^{-2} centimeters per second (86 to 862 feet per month).

Colvin Site

The Colvin site is generally characterized by bedrock at or near the surface. As a result, ground water levels are also at or near the surface being controlled by the impermeable bedrock. As on the Embarrass site, steep bedrock gradients result in steep ground water gradients which produce bog areas at their base. The permeability of the soil from the Colvin site generally ranges from 10^{-6} to 10^{-4} centimeters per second (.09 to 9 feet per month). The piezometric map for the Colvin site indicates that ground water levels closely follow surface topography. Ground water levels are generally 5 to 20 feet below the existing ground surface. Local outlets for the ground water are the several streams that flow through the area.

Snowshoe Site

A large portion of the Snowshoe site is bog area. This indicates the ground water levels are at the surface. The ground water and surface divide run near the southeast limits of the proposed basin, with the result that half of the existing ground water flows in a northwesterly direction and roughly half flows in a southeasterly direction. The permeabilities of the peat which ranges in thickness from 10 to 20 feet over the site is 10^{-6} to 10^{-4} centimeters per second (.09 to 9 feet per month). Peat, in turn, is underlain by a thin layer of sand and till which is underlain by bedrock which presents an impermeable surface to the ground water. As a result, the bedrock topography roughly controls the direction of ground water flow.

WATER QUALITY

OVERVIEW

Water has many uses as recognized in the water quality standards adopted by the State of Minnesota. Potential uses include domestic and industrial consumption, recreation, fishing, agriculture, wildlife, navigation, waste disposal, and others. These uses require a specified minimum quality as defined by various water quality parameters.

Water quality is evaluated by its physical-chemical characteristics such as temperature, color, turbidity, dissolved oxygen, biochemical oxygen demand (BOD), pH, alklinity and concentrations of dissolved salts. The water quality of surface waters depends upon the physical, chemical, and biological processes to which it has been exposed.

Alkalinity and pH are related factors. Alkalinity is a function of carbon dioxide, bicarbonate, and carbonate concentrations in the water and is a measure of a stream's or lake's buffering capacity while pH is related to hydrogen ion concentration. Both variables are important to aquatic organisms. The pH of water influences the availability of dissolved substances and alkalinity functions as a carbon dioxide reservoir for photosynthetic organisms.

Total dissolved solids indicate the presence of dissolved materials in the water. These materials are usually derived from the weathering of rocks, and consist largely of only a few salts: the carbonates, sulphates, and chlorides of calcium, magnesium, sodium, potassium, nitric acid, and small amounts of nitrogen and phosphorus compounds. In addition, compounds of iron, manganese and dissolved organic substances may be present. Dissolved solids function as nutrients, but in high concentrations, can cause osmotic stress and toxicity.

Macronutrients (particularly phosphates and nitrates) are the major nutrients for aquatic plant growth. These substances are derived from the weathering of rock and from man-made products.

Oils are organic compounds which, in sufficient quantity, create a biochemical oxygen demand and are toxic to aquatic plants and animals.

Heavy metals are substances that are generally derived from the geologic formations and are potentially toxic to aquatic plants and animals. Some metals in low concentrations are necessary for living organisms, whereas in higher concentrations can be toxic. The toxicity of some metals can be affected by pH, dissolved oxygen, temperature, turbidity, carbon dioxide, magnesium salts, phosphates, and stream organics.

Like many activities, the on-land disposal of tailings can affect existing water quality. To protect water quality for its designated uses it is important to consider the potential for water quality changes inherent in the on-land disposal of tailings.

GENERAL WATER QUALITY DESCRIPTION

The Minnesota Pollution Control Agency has classified all intrastate and interstate waters of Minnesota on the basis of their usage by the public (MPCA Regulations WPC 24 and 25). Each classification has associated standards for water quality (MPCA Regulations WPC 14 and 15). The classification of the waters in the proposed site and alternatives is given in Table 25. According to these classifications, the water quality of the streams at Mile Post 7 and alternative sites is relatively high. Study area streams in the north shore locations have more stringent water quality classifications than streams in the inland portion of the study area. This more stringent classification reflects the present usage of the north shore streams for trout fishing and the intrinsic water quality in the area.

The tailings basin sites can be separated into two general categories, north shore (Mile Post 7) and inland (Colvin, Embarrass, and Snowshoe), based on their water quality characteristics. For comparison, data from the upstream portion of the Dunka River are used to represent the inland rivers and data from the Beaver River are used to represent the north shore rivers (Table 26). Locations of the sampling stations are shown in Figure 59. In general, Dunka River water has higher color values, chlorides, ammonia, iron and manganese concentrations and lower pH values and dissolved oxygen concentrations.

TABLE 25
SUMMARY OF REGIONAL AND LOCAL WATER QUALITY SETTING

Site		Mile Post 7	Colvin	Snowshoe	Embarrass
Major Watershed		Lake Superior	St. Louis	Rainy St. Louis	St. Louis
Sub Watershed		Beaver	Partridge	Dunka St. Louis	Embarrass
Classification	Beaver River	1B, 2A, 3B	Partridge River 2B St. Louis River 2B, 3B	Dunka River 2B St. Louis 2B, 3B	Embarrass River 2B
	Portion of Beaver River (T.57, R.8W, 9W)	2B			
	Beaver River North Branch East Branch	 1B, 2A, 3B 1B, 2A, 3B			
	Big Thirty Nine Creek	1B, 2A, 3B			
	Cedar Creek	1B, 2A, 3B			
Limit or Range of Classification Parameter					
Turbidity		5 (JTU)	25 (JTU)	25 (JTU)	25 (JTU)
D.O.		6-7 (mg/l) [1]	5-6 (mg/l) [2]	5-6 (mg/l) [2]	5-6 (mg/l) [2]
Temperature		no material increase	5° above natural in streams [3]	5° above natural in streams [3]	5° above natural in streams [3]
NH_3		0.20 (mg/l)	1.0 (mg/l)	1.0 (mg/l)	1.0 (mg/l)
pH		6.5 - 8.5	6.5 - 9.0	6.5 - 9.0	6.5 - 9.0
Chlorides		50 (mg/l)	--	--	--
Chromium		0.02 (mg/l)	0.05 (mg/l)	0.05 (mg/l)	0.05 (mg/l)
Watershed Land Use		Recreation	Recreation, Mining Timber	Mining, Timber	Mining Timber
Water Appropriation		Yes	Yes	Yes	Yes
Discharges		No	Yes	Yes	Yes

(1) Not less than 7 mg/l between Oct 1 and May 31 and not less than 6 mg/l at other times.
(2) Not less than 6 mg/l between Oct and May 31 and not less than 5 mg/l at other times.
(3) Based on monthly average of the maximum daily temperature, except in no case shall it exceed the daily average temperatures of 90°F.

The discharges and water uses existing in the immediate area of the tailings basin sites are shown in Table 27 and Figure 59. Water quality data (Table 26) from the Dunka River above and below the outfall of mine water discharges show increased conductivity and chloride concentrations and presumably reflect the impact of these discharges. Data from upstream and downstream areas of the Beaver River (Table 26) indicate a change in turbidity.

Since water quality data is limited on many of the streams, water quality studies were conducted. The results of these studies are shown in Appendix E. Infrequent spot sampling will not provide information on either daily or seasonal variations in water quality. The collected data therefore describe the general water quality of the selected sample sites.

Analyses for asbestiform fiber content were conducted at three stations on the Beaver River. Results are shown in Appendix E. No fibers where present in the samples collected and analyzed.

TABLE 26
WATER QUALITY IN THE STUDY AREA

	Dunka River(1)	Beaver River(2)	East Beaver River(2)
Parameter(3, 4)/Station	Upstream Sampling Station A-6	Upstream Sampling Station RMC-4	Upstream Sampling Station RMC-1
Chloride*	3.2 (mg/l)[4]	0.9	1.0
Ammonia-N*	0.39	0.055	0.033
Nitrate-N*	0.095	0.24	0.37
pH* (units)	6.94	7.42	7.37
Conductivity (UMHO/CM)	113	94	88
Iron, total*	2.28	1.27	0.68
Manganese, total*	0.082	0.033	0.010
Turbidity* (JTU)	7.2	2.9	2.2
Dissolved Oxygen*	6.4	12.6	12.7
Color* (units)	170	45	70
	Dunka River(1)	Partridge River(1)	Beaver River(2)
Parameter(3,4)/Station	Downstream Sampling Station A-7	Downstream Sampling Station A-1	Downstream Sampling Station RMC-7
Chloride*	26.7	33.8	1.8
Ammonia*	0.490	0.52	0.015
Nitrate*	0.047	3.35	0.240
pH* (units)	7.05	7.36	7.68
Conductivity (UMHO/CM)	242	403	116
Iron, total*	1.53	0.770	0.89
Manganese, total*	0.220	0.180	0.009
Turbidity (JTU)*	5.4	4.0	6.7
Dissolved Oxygen*	6.7	9.0	13.3
Color* (units)	120	60	50

(1) Data collected by Barr Engineering for Amax Exploration, September 3, 1974 to April 11, 1975.
(2) Data collected by Reserve Mining Company, September 16, 1974 to April 2, 1975.
(3) Several criteria were used for the selection of parameters used in this comparison. Starred (*) parameters represent those from PCA standards. In addition, in order to make meaningful comparisons, the sample must be collected over the same time period at comparable frequencies. This type of data was not available for all parameters.
(4) All values in mg/l unless otherwise noted. All data are averages.

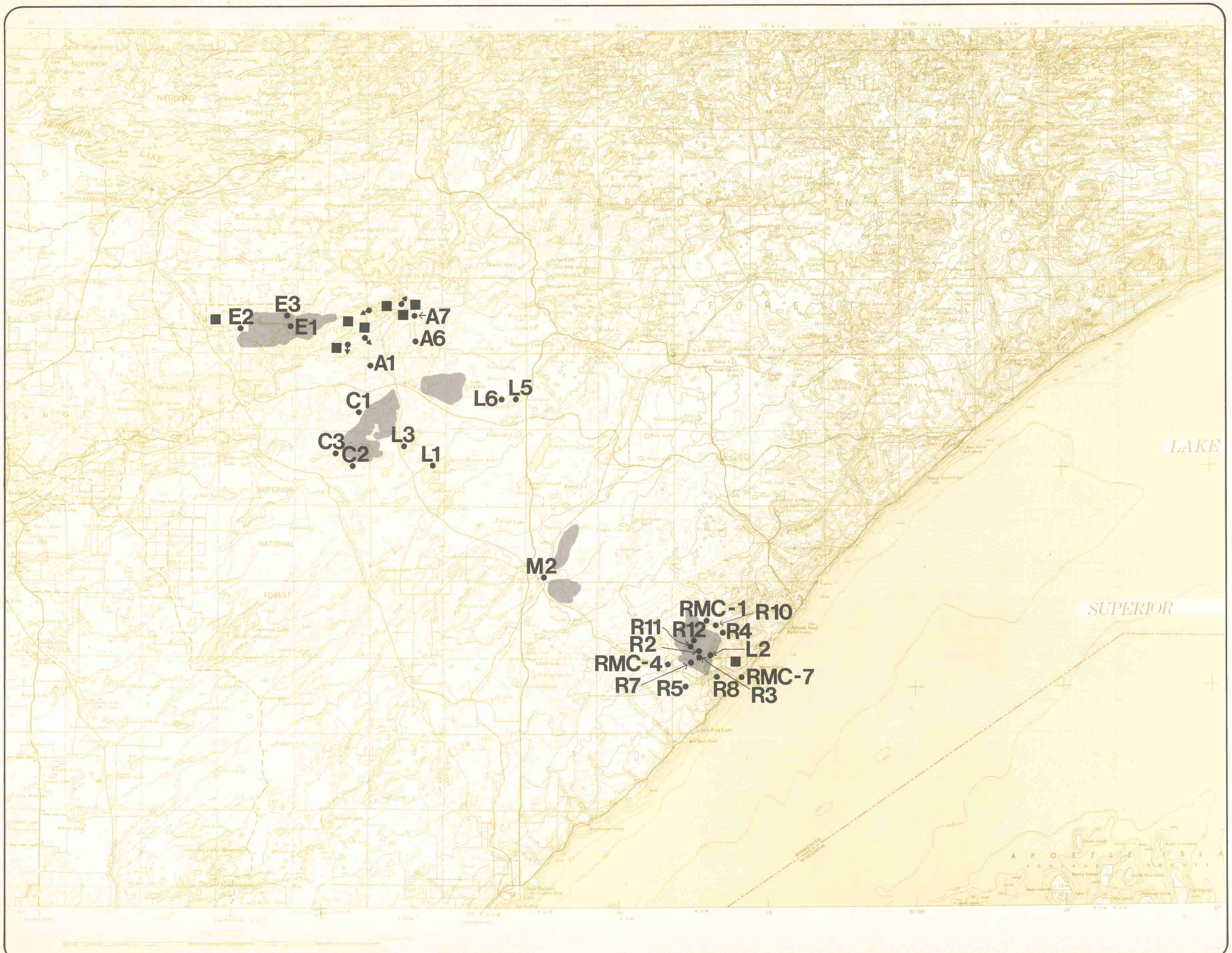
UNIQUE SITE SPECIFIC WATER QUALITY CHARACTER

Two sites (Mile Post 7 and Snowshoe) have lakes bordering the tailings disposal area. Bear Lake (Figure 24) is located on the eastern border of the Mile Post 7 disposal site and will ultimately be separated from the tailings basin by Dam #5. The natural drainage from Bear Lake into the tailings basin will be diverted after ten years of operation. Limited data prevents a detailed description of the water quality in Bear Lake but the existing data (Appendix E) suggest the lake contains soft water of low alkalinity and generally high quality. The second lake, Lake Culkin, borders the Snowshoe site. No data are available to describe its water quality.

One site, Embarrass, contains a lake (Mud Lake) of 7 acres within the disposal area. No water quality data is available for this lake.

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN



59 WATER QUALITY SAMPLING STATIONS

LEGEND

COLLECTED BY MIDWEST RESEARCH

E - EMBARRASS SAMPLING SITES

C - COLVIN SAMPLING SITES

M - MIDWAY SAMPLING SITES

R - MILE POST 7 SAMPLING SITES

L - LAKE SAMPLING LOCATIONS

COLLECTED BY RESERVE MINING COMPANY

RMC RESERVE MINING CO. SAMPLING SITES

AMAX EXPLORATION SAMPLES

- EXISTING DISCHARGE

■ - EXISTING APPROPRIATION

A - SAMPLING SITE

TAILINGS BASIN

BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

TABLE 27
STUDY AREA DISCHARGES AND WATER USE(1)

Watershed(2)	Appropriators & Discharge	Appropriated From	Average Pumping Rate (million gallons per day)	Use	Discharged To	Discharge Rate (million gallons/day)
Partridge River above Allen	Reserve Mining	Ground Water	8.9	D	Partridge River	8.9
Partridge River above Allen	Reserve Mining	Iron Lake	0.2	I		
Dunka River	Reserve Mining	Ground Water	2.9	D	Dunka River	2.9
Dunka River	Reserve Mining	Ground Water	2.2	D	Langley Creek-Dunka River	2.2
Dunka River	Reserve Mining	Dunka River	0.375	I		
Dunka River	Union Carbide	Ground Water	3003	I		
Embarrass River above Highway 135	Babbitt	Ground Water	975 3	M	Embarrass River	0.345
Embarrass River above Highway 135	Robert Mackie	Ground Water	5.5 4	G	None	
Beaver River	Silver Bay Country Club	East Branch Beaver River	0.35	G	None	

(1) Data obtained from DNR and PCA permits
(2) In general, only those portions of the watershed that were in the immediate vicinity of the disposal site were considered. The Dunka watershed was considered in its entirety due to its small size. Numerous discharges and appropriations occur downstream on the St. Louis, Embarrass and Partridge River.
(3) GPM average pumping rate
(4) allowable limit million gallons/year
(5) allowable limit MGD

Use Key D=Dewatering
I=Industrial
M=Municipal
G=Irrigation

AQUATIC HABITAT AND BIOTA

OVERVIEW

The first major study describing aquatic flora and fauna of northeastern Minnesota was published by Smith and Moyle in 1944. (23) The Minnesota Department of Natural Resources, Division of Fish and Wildlife, has completed numerous other stream and lake surveys adding significantly to the aquatic inventory of the area. The majority of these surveys are concerned primarily with the capture of fish, represent a single collection (no seasonal change) and are dated (species composition may differ from today). They are, however, invaluable, for they represent an historical picture of the lakes and streams and allow comparison with conditions that exist today. Field collections and environmental inventories were made specifically for this study. Although each sample is quantitative in itself, the data as a whole is used qualitatively, for relatively few samples were collected and seasonal sampling (essential for determining biomass or productivity) was not possible. Additionally, it is necessary to sample each bottom and habitat type to establish an accurate profile of diversity. This was not accomplished due to the time limitation.

There are three major drainage basins within the Arrowhead Region of Minnesota that provide two distinct stream habitats. Extending for approximately 135 miles along the north shore of Lake Superior, and inland for a distance varying from 15 to 30 miles, is a natural hydrologic drainage area known as the Lake Superior basin.

The numerous streams that drain this area flow from the northwest and descend with frequent cascades from a maximum elevation of 2,000 feet to 600 feet above sea-level into Lake Superior. Most of this drop occurs within 5 to 10 miles from the lake shore. Because of the steep gradient and relatively cool climatological conditions of the area, the north shore streams are typically cold, fast water, trout (and lately salmon) streams. Along the north shore there are relatively few lakes most of which are deep bedrock basins in the highland area. In contrast to the steep, rapidly falling streams of the north shore area, inland streams flow slowly across the plateau of the basin to the west of the north shore highland area with an average gradient of 8 to 10 feet per mile. Streams and rivers in this area have more consistent flow rates throughout the year because of the more extensive predominance of surface water and ground water basins in this drainage area. Thus, there is more contribution to stream flow from various water reservoirs. These slower and warmer streams support a perch, northern pike and walleye fishery. Some also contain bass and their prey. Lakes of this area in general support the same type of fishery.

AQUATIC HABITAT AND BIOTA DESCRIPTION

Aquatic habitats in the vicinity of and within the proposed Mile Post 7 site and alternative sites were sampled specifically for this report to permit qualitative comparisons of the potential productivity of these sites for aquatic species. Specific actions associated with the construction and operation of a tailings basin at any site are concerned with hydrological modifications to permit control of the water entering and leaving the basin. These actions discussed in Part II, Description of the Proposed Action and Alternative Concepts, may also have consequences for aquatic habitat and biological components in areas in the vicinity of the tailings disposal sites. Therefore, efforts were made to sample these adjacent water bodies.

Mile Post 7 Site

The aquatic habitats at the proposed Mile Post 7 site are listed in Table 28 and the locations at which samples of macroinvertebrate and fish populations were taken are shown on Figure 60. This data has been tabulated and is presented in Appendix E. It supports the general findings that the Mile Post 7 area is free from pollution, that it is capable of supporting trout populations of unknown size and that it does in fact support such populations at the present time in the specific streams sampled. Further, based on surveys conducted by the Department of Natural Resources, most streams in the Mile Post 7 area (including some not sampled for this EIS) have been designated trout streams. The state conservation lands in the proposed tailings disposal area at Mile Post 7 have been acquired for the special purpose of trout propagation and management.

TABLE 28
AQUATIC HABITATS

	Classification	Species of Major Importance	Major Substrates	Benthic Organisms
MILE POST 7				
Beaver River	Trout-Minnow Cold Water	Rainbow Trout Brown Trout Brook Trout Minnow-Sp.	Gravel Boulder Rubble	Clean Water Indicators
Big Thirty-Nine	Trout-Minnow Cold Water	Brook Trout Creek Chub Minnow-Sp.	Sand Detritus Gravel	Clean Water Indicators
Cedar Creek	Trout-Minnow Cold Water	N.S.	N.S.	N.S.
Bear Lake	Clear-Cold* Deep Water	Smallmouth Bass Yellow Perch White Sucker	Sand Gravel-Rubble Muck	Clean Water Indicators
COLVIN				
Colvin Creek	Warm Water Feeder Stream	Northern Pike Walleye Yellow Perch	Boulder-Rubble Gravel-Sand Muck-Detritus	Clean Water Indicators
South Branch Partridge River	Warm Water* Feeder Stream	Northern Pike Walleye White Sucker	Boulder-Rubble Muck-Detritus Sand-Gravel	Clean Water Indicators
Cranberry Creek	Warm Water Feeder Stream	N.S.	Muck Detritus	N.S.
Big Lake	Soft Water* Game Fish	Rock Bass Northern Pike Yellow Perch White Sucker	Boulder-Rock Sand-Gravel Detritus-Muck	Wide range organisms
Seven Beaver	Soft Water Walleye	Northern Pike Walleye Yellow Perch White Sucker	Rubble-Boulder Muck-Detritus	Wide range organisms
Round Lake	Soft Water Walleye	Northern Pike Walleye Yellow Perch White Sucker	Rubble-Boulder Muck-Detritus	N.S.
SNOWSHOE				
Sand Lake	Soft Water Walleye	Northern Pike Walleye Yellow Perch White Sucker	Sand Muck-Detritus	N.S.
Lobo Lake	Minnow Northern Pike	N.S.	N.S.	N.S.
Birch Lake	Soft Water Walleye	Walleye Northern Pike Yellow Perch Black Crappie Rock Bass	N.S.	N.S.
EMBARRASS				
Embarrass River	Warm Water Feeder Stream*	N.C.	Sand Detritus	Clean Water Indicators
Spring Mine	Warm Water Feeder Stream*	N.S.	Detritus-Sand Muck	Clean Water Indicators
Trimble	Warm Water Feeder Stream*	N.S.	Detritus-Sand Muck	Clean Water Indicators

* MRI classification
N.S. Not Sampled - no data available
N.C. Sampled - none collected

Area Streams

Fishing pressure on streams varies directly with accessibility. The lower sections of Beaver River have convenient access and therefore are heavily fished. Access to the upper reaches of most streams is extremely difficult. A few trails and old railroad grades allow only limited access to some of these upper reaches.

Beaver River at Avon Falls was sampled using the backpack shocker and angling methods. Fish taken in this survey include bluegill, brown trout and a number of minnows. This area of the Beaver River is easily accessible and the fishing pressure is extremely high. The East Branch of the Beaver River contained a variety of fish. Approximately 1/4 mile of stream was surveyed with the shocker in which 10 brook trout were taken. A number of trout escaped the electric field and were not captured or counted in the survey. Additional fish taken include the creek chub, blacknose dace, longnose dace, mottled sculpin and shiner.

Based on this survey, the Beaver River basin provides a variety of habitats capable of supporting a population of fish including brook and brown trout. The requirements necessary for a suitable trout habitat are readily available including adequate food production (terrestrial and aquatic insects, minnows), suitable substrate (sand, gravel and rubble), clean moving water and low water temperatures.

Approximately 7 miles of Big Thirtynine Creek, 2.7 miles of Little Thirtynine Creek (its major tributary) and a few small feeder streams fall within the boundary of the proposed tailings basin. Big Thirtynine Creek is a designated trout stream but is only lightly fished due to poor access. Typical bottom types within these creeks include sections of gravel, boulder, rubble and silt over clay, the latter predominating in the lower sections. Fish collected from this area include brook trout, white sucker and a number of minnows.

Area Lakes

Bear Lake is privately owned and lies adjacent to the eastern edge of the proposed Mile Post 7 tailings basin. It occupies 39 acres and is just over 1/2 mile long and under 1/4 mile wide. It is a clean, clear, soft-water lake and reported to be as much as 60 feet deep. Almost the entire shoreline is comprised of rock, gravel and sand. Because of this, the number of aquatic macrophytes is very low.

Rock and gravel form the characteristic bottom substrate to a depth of approximately 20 feet (varying with slope) with mud and detritus found at greater depths. Dredge samples taken in the mud and detritus show a considerable diversity of benthic organisms. If the sand and gravel bottom were sampled it would certainly yield a considerable number of additional species.

Fish were collected from Bear Lake using a gill net for 7 hours. Three species of fish were collected, with smallmouth bass comprising 50 percent of the catch. Yellow perch and white sucker accounted for 19 and 31 percent, respectively. A number of minnow species were observed; however, none were collected. Bear Lake is an unusually clear lake, offering a quality habitat for its resident fishes and would be capable of supporting a number of other fish species including trout.

The characteristics of the aquatic habitat discussed above for lakes and streams within the area immediately adjacent to the Mile Post 7 disposal area are summarized in Table 28.

Colvin Site

Aquatic habitats in the Colvin area are also listed in Table 28. Sampling locations for benthic organisms and fish are shown on Figure 60. The assembled data is presented in Appendix E.

Area Streams

Three streams, Colvin Creek, Cranberry Creek, and the South Branch of the Partridge River flow within the Colvin site. The approximate length of streams within the basin boundaries are as follows: Cranberry 1.7 miles, Colvin 4.4 miles, South Branch of Partridge River 4.9 miles, North tributary of the South Branch of Partridge River 2.3 miles, and the South tributary 0.8 mile.

Data for Colvin Creek, the South Branch of the Partridge River and Big Lake in particular support the general findings that these water bodies are relatively free from pollution and capable of supporting an excellent fishery. However, the species of fish and benthic organisms found in these waters differ from those that characterize the Mile Post 7 area.

Fish collecitons of Colvin Creek and the South Branch of the Partridge River, were conducted using a backpack shocker, experimental gill net and angling. Yellow perch, walleye, and northern pike were caught. Minnows were not sampled. A previous survey by the Minnesota DNR Division of Game and Fish in 1967 reported northern pike and mottled sculpin.

Colvin Creek is a warm-water feeder stream with a swamp and forest drainage, and is the largest stream within the Colvin tailings basin boundary. The bottom is composed of approximately 70 percent gravel, rock or sand with the remaining 30 percent muck, detritus, or clay.

Fishermen were observed at both sampling stations on Colvin Creek. They reported fishing for northern pike was fair to good.

The south branch of the Partridge River was surveyed where it crosses Forest Route 116 (Station C-1). The stream bed upstream consisted of numerous boulders and rubble with swift current and deep water. Boulders made walking difficult, and only a single white sucker was taken. For approximately 300 yards downstream, the creek consisted of rapids with large rocks and fallen trees. Beyond these rapids, the river widened (to approximately 150 to 175 feet) and meandered downstream for approximately 1 mile where a large boulder area was noted and a beaver dam was under construction.

A gill net set in the wide area revealed the presence of northern pike as did angling. Walleye were present in this area and were also taken by angling. Burbot were taken with the backpack shocker near the beaver dam.

Cranberry Creek was surveyed by the Minnesota DNR Division of Game and Fish in 1967. However, no fish or benthic samples were taken. This creek is described as a warm-water feeder stream with drainage characteristics like those of Colvin Creek and south branch of the Partridge River.

Area Lakes

Big Lake is 793 acres and lies approximately 1-1/2 miles southeast from the Colvin alternative. The lake is approximately 2-1/2 miles long and 1/2 to 3/4 miles wide.

Big Lake is unique, for unlike many of the lakes and rivers in this area it does not have the typical bog-stained deep brown color. The lake is not surrounded by bog or swamp communities, for the topography is somewhat higher and bog drainage into the lake is reduced. Another characteristic of the lake is the very sandy bottom. Silt and detritus were evident only in the confined coves or small bays. Otherwise, the bottom was relatively clean sand, gravel and rocks. The lake has an extremely large number of boulders, particularly along the shoreline.

In talking with a number of long time local residents and fishermen of the area, the lake was described as an extremely good fishing lake. Fishing pressure on the lake is very low primarily due to poor access. Apparently, fishing pressure is higher during the winter, for snowmobiles provide easier access. The depth of the lake is not knwon. However, local fishermen say that there are areas in excess of 60 feet deep. The only previous survey made on Big Lake was in 1937, with only walleye collected. Survey work on Big Lake for the Draft EIS included benthic, fish and plankton collections.

The benthic substrate consisted of sand and gravel in the shallower areas and sand mixed with fine detritus in the deeper portions. Cognizant of the limitations placed on the data, the species diversity and production are high.

Gill nets were set in Big Lake for a period of 20 hours in which 82 fish were taken. Catch percentage is as follows: 29 percent rock bass, 21 percent white sucker, 20 percent yellow perch, 17 percent northern pike, and 13 percent sunfish. This survey indicates that Big Lake supports an excellent fishery and offers a wide variety of sport fishing. This clean natural lake provides its native fish with biological success. This lake, relatively undisturbed by man, has maintained itself and has arrived at an apparent predator prey relationship which will certainly continue if left free from major disturbance.

Seven Beaver and Round Lakes are located approximately 4 miles southeast of the Colvin site. These lakes are noteworthy in that they are the headwater source of the St. Louis River. Seven Beaver Lake is the larger of the two, with an area of 1,410 acres compared to 311 acres for Round Lake. Both are relatively shallow lakes. They are classified as soft-water lakes and are managed for walleye by the Minnesota Department of Natural Resources. The lakes are completely surrounded by a mature upland forest, spruce swamp and peat bog communities which restrict accessibility.

Round Lake has only one inlet and its single outlet flows directly into Seven Beaver Lake. Seven Beaver Lake has two additional inlets, the East River and North River, and one outlet, the St. Louis River. The channel connecting Seven Beaver and Round Lakes is quite wide and only 1/4 mile long.

Lake shoals as well as the outlets of Seven Beaver Lake were composed of nearly equal parts of muck-detritus and rubble, while at the inlets, the bottom was entirely muck and detritus. At Round Lake, substrate at the inflow is primarily muck with some rubble and at the outlet, it is entirely muck and detritus.

Even though bottom habitat diversity appears to be low, benthic invertebrate production and species diversity both appear to be high.

Fish collections made at each lake by the Minnesota Department of Natural Resources indicate that the four major species present are walleye, yellow perch, northern pike and white sucker. Fish production in the lakes appears to be good and in fact exceeds state-wide median levels. Available food supplies and habitat are both adequate, and spawning areas for game species are described as "fair."[24] Northern pike spawning areas are usually concentrated in slow moving, muck bottomed areas near rivers or upstream. Walleye spawning is confined to rubble and gravel areas in rivers and near lake shoals.

Despite the remote location and limited accessibility of the lakes, fishing pressure is reportedly very heavy. Fishing success is good although very few large sport fish have been taken. Most of the walleye collected by the Department of Natural Resources were less than 15 inches in length, while most northern pike were under 20.[24,25] The average weight of sport fish collected from gill nets was 0.86 pound for walleye and 1.2 pounds for northern pike in Seven Beaver Lake, and 1.16 pounds for walleye and 2.3 pounds for nothern pike in Round Lake. According to local fishermen, 3 pounds was the approximate size of the larger fish at that time.

Embarrass Site

Aquatic habitats in the Embarrass area are also listed in Table 28. Sampling locations for benthic organisms and fish are shown on Figure 60. The assembled data is presented in Appendix E. These data support the general findings that the waters of the area are relatively clean and free from pollution. However, in terms of potential fishing opportunity, the Embarrass area as a whole has little aquatic habitat, and that which exists is relatively unproductive. This latter finding is further supported by reports from local officials and fishermen.

The Embarrass site is located in the Embarrass River Watershed. Approximately 3.4 miles of Spring Mine Creek, and 1.27 miles of Ridge Creek are within the Embarrass basin boundary. Each flows into the Embarrass River which is itself not within the proposed site. Trimble and Spring Mine Creek are very small and drain similar areas. The bottom substrate at Trimble Creek (E-2) consisted of sand over clay and necessitated the use of a ponar dredge. Spring Mine Creek (E-1) was sampled with an Elman dredge for the substrate was largely detritus. No effort was made to survey further up either creek due to their small size.

A gill net was placed completely across the Embarrass River (at Station E-5) for 9 hours. No fish were taken.

Snowshoe Site

The Snowshoe site is located at the western portion of a very large senescent peat bog which is the headwaters for the Dunka River and North River. The Dunka River flows into the Kawishiwi River system and the North River flows into Severn Beaver Lake which is headwaters of the St. Louis River. There are a series of bog lakes ranging in distance between 1/2 mile to 5 miles in an easterly direction. The major lake is Sand Lake, 4 miles east. Lake Culkin is approximately 1/2 mile east of the site. To avoid covering Lakes Culkin, Continental, Lobo, and Bonga, the boundary of the Snowshoe site has been modified.

A survey of the aquatic biota and habitat of the Snowshoe area was not carried out.

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

60 SAMPLING STATIONS AQUATIC HABITAT AND BIOTA

LEGEND

- PROPOSED TAILINGS BASIN
- R - MILE POST 7 SAMPLING SITES
- M - MIDWAY SAMPLING SITE
- C - COLVIN SAMPLING SITES
- E - EMBARRASS SAMPLING SITES
- L - LAKE SAMPLING LOCATIONS

BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

TERRESTRIAL HABITAT AND BIOTA

REGIONAL OVERVIEW

Fauna

The study area lies in northeastern Minnesota, in St. Louis, Lake and Cook Counites. This area may be categorized as forest land and is classified as the northern boreal forest. However, due to fire and disruption by man, major habitat types represented are early to mid-successional mixed conifer/hardwood communities.

Northeastern Minnesota has few amphibians and reptiles with only twelve species and five species represented respectively (see Appendix E).[26, 27, 28, 29] Four species of salamanders, eight species of frogs and toads, three snake species, and two turtle species have geographic ranges which include the study area. Among the more familiar species are the green frog, wood frog, American toad, western painted turtle, snapping turtle, and western garter snake. This group has very little direct economic importance. However, they are important in the food web, both as consumers of insects and rodents and as prey species for some predators.

Within the study area a variety of landscapes consisting of lakes, streams, bogs, swamps, conifer and hardwood forests, and rocky outcrops are found. These areas provide habitat for a large number of birds. Approximately 229 species of birds (Appendix E) are found in the area during some seasons of the year.[30, 31, 32, 33, 34] There are 30 species which are year-round residents and 143 other species breeding in the area. The remainder are either winter residents or migrants. There are 38 species which are considered game birds and are hunted in some part of their range. Included in this number are 24 species of waterfowl, woodcocks, and snipe.

The mammalian component of the biota is composed of 51 species (Appendix E).[35,36,37] Seven of these are considered game animals and 15 are furbearers. The other mammalian species present are primarily small rodents, shrews and bats. Many of the rodents are a primary food source for some of the furbearers, game species and raptorial birds.

There are two animal species in upper Minnesota which are classified as nationally endangered: the peregrine falcon and the timber wolf. The peregrine falcon passes through this area on its spring and fall migration while the timber wolf is a permanent resident.[38]

Probably the most controversial, and certainly the largest furbearer and carnivore presently inhabiting the area is the eastern timber wolf.[39-44] It is on the federal endangered species list, but is considered a "species of changing or uncertain status" by the State of Minnesota.[45,46] All of the tailings disposal sites are within the major wolf range in Minnesota.

The wolf population remained fairly stable from 1966-1971, but started a decrease in 1972. The latest estimate for the spring of 1973 indicates a population level of one wolf per 14.7 to 16.4 square miles.[40] The successional trend toward forests of increasing age is detrimental to deer populations, the primary food source of the wolf. This in turn places stress on the wolf population which may necessitate use of alternate or supplemental food sources.

Minnesota lists 64 species of animals which merit special consideration. There are 21 species, excluding fish, which may be found in northeastern Minnesota and are listed below along with their status.[47]

Endangered Species
- Peregrine Falcon

Threatened Species
- Pine Martin
- Bobwhite
- Greater Sandhill Crane

Species with Changing or Uncertain Status
- Fisher
- Eastern Timber Wolf (nationally designated as endangered species)
- Canada Lynx
- Northern Bald Eagle
- Osprey
- Marsh Hawk
- Cooper's Hawk
- Double-Crested Cormorant
- Franklins's Gull
- Common Tern

Species of Special Interest
- Bobcat
- Common Loon
- Great Blue Heron
- Pileated Woodpecker
- Snapping Turtle
- Redback Salamander
- Central Newt

In addition to the state and federal listing, the National Audubon Society maintains a Blue List for birds which is intended to give early warning of apparently non-cyclical population declines.[48] Eighteen of these species have ranges which include northeastern Minnesota (see Table 29).

Common game species of this area include: ruffed grouse, spruce grouse, snowshoe hare, black bear, moose and white-tailed deer.

The ruffed grouse is a very important game bird in Minnesota, and is considered by some as the most important game bird in the state.[49]

The habitat preferred by ruffed grouse is probably a mixture of aspen and hardwoods. The area under consideration is prime grouse range in this regard.

The ruffed grouse has a geographical range which closely approximates the range of aspen.[50,51] Aspen is one of the primary foods of the species, particularly in winter. Other foods which are important include hazel and birch catkins and buds, clover, wild cherry and blueberry.[51,53] In this area, ruffed grouse populations fluctuate widely as do snowshoe hare populations.

In general, the value of the habitat in this area is probably declining due to the increasing age of forest communities. Ruffed grouse respond well to early successional stages and decline after mid-successional stages are reached.

The spruce grouse is one of the lesser utilized important game species of Minnesota. Currently, the population numbers are moderate,[49] although it may increase in the future. During the late 1800's, the spruce grouse was abundant in this area. After most of the merchantable coniferous timber was logged and vast areas burned, the habitat was no longer favorable for this species.

As jackpin stands matured after the large fires and spruce became more abundant, the spruce grouse began to increase from an extremely low population level.[49] With the continued increase in the abundance of coniferous vegetation in this region, there will probably be a corresponding increase in spruce grouse populations.

The snowshoe hare is most numerous in areas of mixed coniferous-deciduous vegetation, especially where there is abundant, low, cover. The snowshoe hare is one of a number of species whose population exhibits cyclic irruptions and declines. Minnesota populations have been as high as 500 per square mile in 1933, and as low as 32 per square mile in 1938. At the present time, they seem to be increasing.[49]

Prime habitats for the black bear are upland areas such as relatively young aspen stands with high berry production or areas of high acorn production. Increased fire protection in both the Superior National Forest and state forests have reduced the berry crop and thus affected

TALBE 29
BLUE-LISTED SPECIES HAVING RANGES WHICH INCLUDE NORTHEASTERN MINNESOTA[48]

Red-necked grebe	Kestrel
Double-crested cormorant	Piping plover
Black-crowned night heron	Upland sandpiper
Canvasback	Yellow-billed cuckoo
Cooper's hawk	Common nighthawk
Sharp-shinned hawk	Hairy woodpecker
Marsh hawk	Purple martin
Osprey	Yellow warbler
Merlin	Grasshopper sparrow

the black bear. The population near Isabella, approximately 20 miles north of Mile Post 7, is estimated at one bear per 2 square miles.[35,49]

The moose is the largest game animal in Minnesota. They feed on various types of browse most of the year, but in the late spring and summer, aquatic plants form a large part of their diet.[35,49,54,55] Other major foods include willow, aspen, white birch, balsam fir, maple and mountain ash. All of the proposed tailings disposal sites are within the major moose range in the state.[56,57] The area around Isabella probably has the greatest density of moose in the state, 0.7 to 1.7 moose per square mile. The net productivity of the moose approximates 15 percent, which is just enough to offset mortality and dispersal indicating a stable moose population. Some decrease in the population is expected in the coming years due to the natural maturing of the forests.

Deer in forest areas are often considered successional species. That is, they find forest habitat in the early to mid-successional stages of greater advantage than later stages. Deer generally prefer brushy openings in and along forest edges to other sites due to the relative proximity of food to cover.[35,59,60,61,62,63,64]

In northeastern Minnesota some of the better deer foods are choke cherry, service berry, white cedar and maple during winter periods.[53] In summer, deer feed on a wide variety of plants, including grasses and shrubs which are abundant.

In Minnesota, deer probably reached their greatest abundance in the 1930's to 1940's.[49] This was the result of prior logging. Presently, the age class of most forest communities is past the prime for maximum deer production.

The general reduction in the amount of available food resulting from advancing forest succession combined with severe winter conditions, which are typical of this northern latitude, lead to declines in deer populations. This situation leads to both low populations and natality rates. Under conditions such as these, a substantial increase in population can only be achieved through habitat manipulation.

Plant Communities

When white man first inhabited this area, the vegetation in several respects was different than at present.

The forests along the periphery of Lake Superior were composed of an overstory, largely of eastern white pine and red pine. Further north along the coast, aspen was the predominant tree species.[58] Inland, there was a more heterogeneous tree overstory, including large areas of "jackpine barrens" and bogs with coniferous overstories composed of black spruce, tamarack and white cedar.[58]

At present, plant communities are similar. For instance, aspen is the predominant tree species of the whole area, however, sugar maple is more common in the area where weather is influenced by Lake Superior. Plant communities vary more in quantitative aspects than in species composition among the sites.

The variations in soil characteristics, micro-climate, the availability of seed or root crowns, in the case of plants which propagate vegetatively, all helped influence the heterogeneity of present plant communities. The overstory components of the vegetative communities consist of the following tree species either singularly or in combination: red pine, jackpine, eastern white pine, eastern white cedar, white spruce, black spruce, balsam fir, tamarack, quaking aspen, paper birch, yellow birch, sugar maple and balsam poplar. By far the most common overstory component of this area is quaking aspen-paper birch, in combination.

Fire has largely been the causative factor in the ecological rejuvenation of forests areas. Fire may modify areas characterized by late seral or climax vegetation and change them to early secondary successional stages. In more recent years--late 1900's to present--however, man has played an increasing role in setting back succession through timber harvest. Also, man is often the cause of forest fires, adding to those caused naturally by lightning. Recent fire suppression practices have reduced the area burned by fires, thus resulting in stable community age classes in this region.

At the present time, most stands of trees and the understory vegetation are the result of earlier logging operations and fire. Therefore, most stands in this area are about 60 years old. The vast expanses of eastern white pine overstory which once existed in this area are no longer present. Not only logging, but also white pine blister rust has resulted in the reduction of this species.

Interspersed in the study area are peat bogs. Peat ecosystems have an accumulation rate which exceeds the rate of biodegradation. The overall result is an accumulation of a portion of the plant detritus producing material known as peat. The partially decomposed plant materials are an integral part of the suspended solids found in waters which drain the bog areas.

COMMON CHARACTERISTICS

Fauna

The fauna at Mile Post 7, Colvin, and Embarrass sites are similar. The Snowshoe site is not included in the discussion in this section. Yet, differences do occur, although primarily quantitatively rather than qualitatively. For instance, white-tailed deer occur on all these sites but population densities differ.

The number of species of amphibians and reptiles found in this area are much lower than at more southern latitudes. However, populations of several of the species which occur here are relatively high. It is probable that all the species with a geographical range which includes this vicinity occur on all three sites. It is also probable that the Colvin site has higher populations of most of these species because of the greater surface area of wet land, necessary for their life cycles.

The bird species at all three sites are extremely varied during the summer months. The number of year-round residents is low in comparison to the number of summer residents. Northeastern Minnesota is an important nesting area for certain migratory birds. This area within northeastern Minnesota is extremely important for the mourning and connecticut warblers which have a relatively restricted breeding range in comparison with many other birds. The elimination of habitat here would be more detrimental to these two species and to others like them than to many others.

Since there are many bird species which inhabit all three sites, the relative value of one site in relation to another is very difficult to assess. If the grouse species which are the major upland game birds are considered, it is probable that the Mile Post 7 site is presently better suited for spruce grouse than the other two sites. This is due to the relatively higher abundance of coniferous trees on that site. The Colvin site is probably the best site for ruffed grouse due to a greater heterogeneity of age classes in the aspen type.

As with birds, most of the mammal species found in the area will be found in the other areas. The difference then, is chiefly one of habitat conditions which are more favorable for a particular species. Using this criteria, the Colvin site is probably more favorable for semi-aquatic species such as the beaver. Next, the Mile Post 7 site and lastly the Embarrass site would offer suitable habitat in that order.

The best site for white-tailed deer is undoubtedly the Colvin site due to a greater diversity of age classes in aspen. However, white-tailed deer occur on all sites.

Mile Post 7 is the site which sustains the highest populations of moose. On this site population densities are considered to be about one moose per square mile.[65,66] On the Colvin and Embarrass sites moose populations are somewhat less.

Flora

The vegetation of Mile Post 7, Colvin and Embarrass sites have similarities, yet in many respects differ widely. All the sites were probably logged and/or burned about 65 to 70 years ago. Aspen-birch type is the most abundant forest type on all three areas. Sugar maple occurs in quantity only on the Mile Post 7 site. The following forest types occur on the various areas as follows:

	Mile Post 7	Colvin	Embarrass
Aspen-Birch	X	X	X
Balsam Poplar	X		
Black Ash	X		X
Sugar Maple	X		
Black Spruce	X	X	X
Jackpine		X	X
Cedar-Tamarack	X		
Balsam Fir	X		
Bog		X	X
Meadow	X		
Lowland Brush	X	X	
Total	9	5	6

It is evident that there is more forest type diversity at Mile Post 7 than at either the Colvin or the Embarrass sites. Balsam poplar, sugar maple, cedar-tamarack, and balsam fir forest types are only represented on the Mile Post 7 site. Each of these forest types, as individual species, may be found on the Colvin and Embarrass sites, however, not in sufficient quantity to constitute delineating them as forest types.

Species diversity in sampled forest types is shown in Table 30. Not all stands of each forest type on the three areas were examined.

There were no areas found on the Mile Post 7 or the Embarrass sites in which logging operations had occurred in the last 7 to 8 years as it had on the Colvin site. On the recently logged site (see Table

30), which appeared to have been predominately jackpine-aspen, there were 50 species present as compared to 43 species found in the aspen reproduction and 48 species in the mature aspen community.

TABLE 30
NUMBER OF SAMPLED PLANT SPECIES BY FOREST TYPE ON THREE DISPOSAL SITES

	Number of Species		
	Milepost 7	Colvin	Embarrass
Mature Aspen-Birch	41	48	44
Aspen Reproduction		43	
Recently Logged (Jack Pine-Aspen)		50	
Balsam Poplar	39		
Black Ash	27		42
Sugar Maple	40		
Jackpine		36	42
Black Spruce		20	13
Lowland Brush	29	40	
Meadow	11		

However, since no more than one community of each type was sampled on a site, these numbers are not statistically valid. Yet, the sample is indicative of differences (see Appendix E for scope of field studies undertaken).

Aspen and birch are the predominant trees at all three sites and samples were taken in this type on all three areas. This type community, therefore, illustrates the similarities and differences which may be found in the various areas.

Beaked hazel is present on all three sites. However, the ground cover percentage varies considerably. Beaked hazel is shade tolerant and grows best on moist sites.

The only other outstanding difference is the amount of mountain maple present at the Embarrass site in relation to the other sites. At the Embarrass site, indications are that mountain maple was substantially more abundant than at either the Mile Post 7 or Colvin sites.

All other shrub species which occurred in the aspen-birch forest type were relatively scarce (sampling error due to the small number of samples taken could account for this difference). There is stand to stand variation in species diversity and abundance in the shrub layer of the aspen-birch forest types.

There are indications of site to site differences in the species composition and abundance in a single forest type. These differences determine the relative value of the sites in relation to timber and, related products used by man and for wildlife. No one forest type provides optimum habitat for all species. Therefore, changes in one forest type will alter conditions for a particular set of animal species more than a similar change in another forest type.

As an example of the impact of plant species change on wildlife, it was cited earlier that the best site for white-tailed deer is undoubtedly the Colvin site due to a greater diversity of age classes in aspen. This does not mean that the Colvin site is potentially the better site or that it has qualities which are absent at the other sites, rather, a large segment of the aspen stands has been recently harvested on the Colvin area and provides more favorable habitat. Given equal conditions (i.e., an equal proportion of the timber, particularly aspen, harvested on each site), then the quality of each would be about equal. The differences which effect the micro-character of the site, however, are soil, snow depths, temperature and rainfall. These influence succession and therefore, the quality of habitat produced at each site. (A listing of the plants found in the various communities of the three sites is included in Appendix E.)

SOCIOECONOMICS

The socioeconomic environment consists of a number of human, cultural, and economic factors, which include employment, education, housing, public services, taxes, demographics, and economic base. The economics, as they apply to Reserve Mining Company and its parent companies, (Armco Steel Corporation and Republic Steel Corporation) are discussed in the industrial economics section of this report.

Implementation of the Mile Post 7 plan or any of the alternatives will create changes in the existing socioeconomic environment. The extent of these changes will vary considerably, depending on whether the proposed action or one of the alternative sites is chosen.

For the purposes of this part of the report, the study area will be defined in the initial text of each sub-heading.

DEMOGRAPHIC CHARACTERISTICS

For the demographic characteristics, the study area is considered to be the three county area comprising of St. Louis, Lake, and Cook Counties.

Existing population in the three county study area is 239,710. Between 1960 and 1970, the study area experienced a 4.5 percent decline in population.(67) During this period, most of the cities in the study area declined in population with the exception of Babbitt and Proctor, which were the only two communities with populations over 2,500 which showed population increase. Recent 1974 population estimates for selected cities and villages in the study area indicate that the trend of the decline in population experienced in the 1960 to 1970 decade may have reversed. Since 1970, the population in the study area has increased by nearly 1 percent over a three year period, (Table 31) which suggests that a stable period may be underway.

Table 31 also gives population projections for cities with populations over 1,500 in the three-county study area. The five cities in the immediate area of the Reserve facilities (Babbitt, Ely, Beaver Bay, Silver Bay, and Two Harbors) are expected to gain in population from 1970 to 1980, with the exception of Ely, which is expected to decline by approximately 6.2 percent. Considerable growth is expected

TABLE 31
POPULATION PROJECTIONS OF COUNTIES AND SELECTED CITIES IN THE STUDY AREA(67,68,69)

	1970	1975	1980	1985	1990
St. Louis County	220,693	223,230	226,880	229,590	234,250
Aurora	2,531	2,950	3,170	3,390	3,610
Babbitt	3,076	3,740	4,310	4,880	5,440
Chisholm	5,913	5,900	5,900	5,900	5,900
Duluth	100,578	100,150	99,730	99,300	98,880
Ely	4,904	4,750	4,600	4,460	4,310
Eveleth	4,721	4,410	4,100	3,790	3,480
Gilbert	2,287	2,780	3,030	3,410	3,770
Hibbing	16,104	16,360	16,620	16,880	17,140
Hoyt Lakes	3,634	4,380	5,120	5,870	6,610
Mountain Iron	1,698	1,970	2,240	2,520	2,790
Proctor	3,123	3,260	3,370	3,490	3,600
Virginia	12,450	12,730	13,000	13,270	13,540
Other Citites	6,633	6,810	6,760	6,690	6,620
Balance of County	53,041	53,140	54,930	55,740	58,560
Lake County	13,351	13,150	12,950	12,750	12,550
Beaver Bay	362	370	370	370	380
Silver Bay	3,504	3,540	3,580	3,600	3,610
Two Harbors	4,437	4,480	4,530	4,560	4,580
Balance of County	5,048	4,760	4,470	4,220	3,980
Cook County	3,423	3,330	3,220	3,120	3,020
Grand Marais	1,301	1,450	1,520	1,600	1,680
Balance of County	2,122	1,880	1,700	1,520	1,340
Study Area	237,467	239,710	243,050	245,460	249,820
Study Area excluding Duluth	136,889	139,560	143,320	146,160	150,940

in Babbitt where Reserve Mining Company's mine is located. Population in Babbitt will possibly increase from 3,076 to 4,310 persons (a 40.1 percent growth) by 1980. By 1990, over 5,000 persons are expected to reside in Babbitt. Beaver Bay, Silver Bay, and Two Harbors are expected to show only slight gains in population during the period from 1970 to 1990. As a whole, the study area is expected to gain 5,583 persons by 1980 and another 6,770 persons by 1990. Excluding Duluth, the study area shows an even greater rate of gain in population--6,431 persons (a 4.7 percent increase) from 1970 to 1980, and an additional 7,620 persons from 1980 to 1990.

Additional demographic profiles were developed to identify unique population characteristics existing within the study area. The factors of age, sex composition, migration patterns, and educational characteristics were considered in this further analysis. This information will provide a basis for assessing some of the potential sociological and economic impacts resulting from the proposed and alternative actions.

Age Characteristics

The distribution of the population by age is presented in Table 32. The median age of persons in the study area is considerably higher than the state figure of 26.9 years, with the exception of Lake County where the median age is 26.1 years. The percentage of persons in the under five age bracket is lower in the study area (7.6 percent) than in both the state (8.7 percent) and the U.S. (8.4 percent). All of the counties, as well as the state, had a lower percentage of persons in the bracket 18 to 64 years than the U.S. figure of 65.6 percent.

TABLE 32
POPULATION BY AGE, 1970(70)

	Percentage of Population				Median
	Under 5	5-17	18-64	65 and Over	Age
St. Louis County	7.6	27.2	53.3	11.9	29.6
Duluth	7.6	24.6	54.4	13.4	29.8
St. Louis County excluding Duluth	7.6	29.4	52.4	10.6	NA
Lake County	8.1	32.3	51.2	8.4	26.1
Cook County	7.4	26.2	53.2	12.2	32.7
Study Area	7.6	27.5	53.2	11.7	NA
Study Area excluding Duluth	7.6	29.6	52.4	10.4	NA
Minnesota	8.7	27.8	52.7	10.8	26.9
U.S.	8.4	16.1	65.6	9.9	28.3

Race and Sex Composition

The percentage of the total population classified as minority is relatively low in the study area (1.3 percent) when compared with the U.S. rate of 12.4 percent (see Table 33). Cook County had the highest percentage of minority population in the area of 3.4 percent. Lake County had the lowest percentage of minority population, only 0.8 percent.

In the study area, males account for 49.1 percent of the population. When Duluth is excluded, however, there is a higher percentage of males than females in St. Louis County.

TABLE 33
POPULATION BY SEX AND RACE, 1970(70, 71)

		Sex		Race		
	Total	Male	Female	White	Indian	Other Nonwhite
St. Louis County	220,693	108,140	112,553	217,767	1,531	1,395
Duluth	100,578	47,976	52,602	98,851	615	1,112
St. Louis County excluding Duluth	120,115	60,164	59,951	118,916	916	283
Lake County	13,351	6,782	6,569	13,249	55	47
Cook County	3,423	1,783	1,640	3,288	117	18
Study Area	237,467	116,705	120,762	234,304	1,703	1,460
Study Area excluding Duluth	136,889	68,729	68,160	135,453	1,088	348
Minnesota	3,804,971	1,864,436	1,940,535	3,738,997	23,128	42,846
U.S.	203,212,877	98,964,671	104,248,206	178,107,190	792,730	24,312,957

The corresponding percentages for the State of Minnesota and the U.S. as a whole are 49.0 percent male and 48.7 percent male, respectively.

Net Migration Rates

The net migration rate represents the difference between the number of persons moving into an area and the number moving away from the area. Net migration is estimated by subtracting the natural increase (births minus deaths) from the net population change. As shown in Table 34, all of the counties except Lake County had negative net migration rates during the period from 1950 to 1970, indicating an out-migration from the area. Lake County had a positive net migration rate from 1950 to 1960; none of the counties in the study area had a positive rate from 1960 to 1970.

TABLE 34
NET MIGRATION RATES(70,72)

	1950-1960	1960-1970	1970-1973
St. Louis County	-2.3	-11.9	-1.8
Lake County	45.1	-16.9	-1.1
Cook County	-3.2	-8.5	3.4
Minnesota	-3.2	-0.7	0.1

Population estimates for 1973 were used in determining the 1970 to 1973 rate. During this three year period, two counties, Lake and St. Louis, lost population. However, the large decline rate noted during the 1960 to 1970 period appears to have been stabilized.

Education Levels

The median number of school years completed by persons 25 years old and over are presented in Table 35. All of the counties in the study area compared favorably with the educational achievements of persons in both the State of Minnesota and the U.S. as a whole.

Table 35 also shows the percentage of persons 3 to 34 years old enrolled in schools. Cook County, with a rate of 51.9 percent, is the only county in the area with a lower percentage enrolled than the 54.3 percent norm for the U.S. This is indicative of the higher median age in Cook County.

TABLE 35
EDUCATIONAL CHARACTERISTICS, 1970(4, 67, 68, 70)

	Median School Years Completed			Percent Enrolled,
	Total	Male	Female	3 to 34 Years Old
St. Louis County	12.2	12.1	12.3	59.5
Duluth	12.3	12.2	12.3	58.2
Lake County	12.2	12.1	12.3	60.8
Cook County	12.2	12.1	12.2	52.9
Minnesota	12.2	12.2	12.2	52.9
U.S.	12.1	12.1	12.1	54.3

LABOR FORCE

The study area for labor force includes St. Louis, Lake, and Cook Counties. The labor force in these three counties represents the major Reserve Mining Company labor resource.

During the 1950-1970 period, the three-county study area labor force expanded slightly, from approximately 88,000 to 89,000 individuals, (Table 36) about a 1.1 percent increase. If Duluth is excluded from the study area, the labor force in the remaining portion of the study area increased nearly 11 percent, from 44,246 to 49,058. Major changes which occurred in the study area labor force during this 20-year period included a decline in Duluth's labor force, while Cook, Lake, and the remainder of St. Louis County have had an expansion of their labor force. During the 1970-1974 period, the study area labor force increased from 89,114 to 90,467, a 1.5 percent increase. The 1974 labor force is higher than the 1970 labor force with the exception of St. Louis County excluding Duluth.

TABLE 36
LABOR FORCE*(67, 68, 73)

	Labor Force				Percent Change	
	1950	1960	1970	1974	1950-1960	1960-1970
St. Louis County	83,943	83,370	82,898	83,482	-0.7	-0.6
Duluth	43,902	40,616	40,046	42,029	-7.5	-1.4
St. Louis County excluding Duluth	40,041	42,754	42,852	41,453	6.8	0.2
Lake County	3,051	4,865	4,800	5,179	59.5	-1.3
Cook County	1,154	1,315	1,416	1,806	14.0	7.7
Study Area	88,148	89,550	89,114	90,467	1.6	-0.5
Study Area excluding Duluth	44,246	48,934	49,058	48,438	10.6	0.3
Minnesota	1,185,767	1,298,965	1,555,429	1,783,000	9.5	19.8

*Indicates persons 14 years old and over for 1950, 1960, and 1970, but only persons 16 years old and over for 1974.

Employment

Employment in the study area totaled 81,811 according to the 1970 census. Of that total, 44 percent were residents of Duluth, and 56 percent lived elsewhere within the three counties. The number employed increased 4 percent by 1974 to 85,206.

Unemployment

The unemployment rate in the study area has generally been greater than the unemployment rate in the state (Table 37). However, between 1970 and 1974, the unemployment rate declined appreciably to a level of 5.8 percent in the study area; if Duluth is excluded, the rate is even lower, 4.0 percent, compared with the State rate of 4.3 percent. In 1974, Duluth had the highest unemployment rate in the entire region at 7.8 percent. Lake and Cook Counties experienced the lowest rate with only 3.6 percent of the labor force unemployed.

TABLE 37
UNEMPLOYMENT RATE*(67,68,73)

	1950	1960	1970	1974
St. Louis County	5.5	9.7	7.1	6.0
Duluth	5.5	8.5	6.2	7.8
St. Louis County excluding Duluth	5.5	10.8	8.0	4.2
Lake County	4.4	9.1	8.4	3.6
Cook County	12.2	14.1	5.9	3.6
Study Area	5.6	9.7	7.1	5.8
Study Area excluding Duluth	5.6	10.8	8.0	4.0
Minnesota	3.5	5.0	4.3	4.3

* Includes persons 14 years old and over for 1950, 1960 and 1970, but only persons 16 years old and over for 1974.

New Job Opportunities

For the new job opportunities discussion, the study area has been established as the entire Seven County Arrowhead Regional Development Area. The iron range has been defined by the ARDC as an area requiring special planning considerations because of the economic growth that is expected to occur over the next five years.(74) The iron range extends as far west as Grand Rapids which is in Itasca County.

Expansion of the taconite industry and the construction of new taconite plants is expected to create a demand for 4,000 new employees through 1980. Development of the copper-nickel mining industry in the Ely/Hoyt Lakes vicinity is expected to contribute to the area's economic growth in the more long-term future, probably beyond 1980. Planned projects in other industries and the induced employment effects in the nonbasic service economy are also expected to contribute to this expansion of the iron range industrial base, creating a total of 7,450 new jobs by 1980 (Table 38), and 9,200 jobs as copper-nickel developments possibly occur over the longer term.(74)

TABLE 38
PROJECTED ECONOMIC DEVELOPMENT 1974 TO 1980(74) IRON RANGE AREA

Projects	Project Status	Location	Cost in Millions	Permanent Required Labor
Taconite Plants				
Hibbing Taconite Co. (Bethlehem & PM)	Construction	Bibbing	$ 150	1,000
Eveleth Taconite Co. (Ogleby-Norton)	Engineering	Eveleth	110	400
Minorca Tac. Plant (Inland Steel)	Engineering	Virginia	90	500
Minntac Expansion (U.S. Steel)	Engineering	Mt. Iron	200	750
Natl. Steel P. Plant (Hanna Mining Co.)	Construction	Keewatin	150	400
Butler-Cooley Expan. (Hanna Mining Co.)	Planning	Cooley	100*	350
Mckinley Tac. Plant (Jones & Laughlin)	Planning	Biwabik	150*	600
Subtotal			950	4,000
Copper Nickel (Mining & Metal Extraction)				
International Nickel Co. (INCO)	Planning	Ely	250	800
American Metal Climax	unknown	Babbit	150*	500*
American Shield Corporation	unknown	Hoyt Lakes	120*	450*
Subtotal			520	1,750
Other Major Products				
Mining Support Industries (Blasting etc.)	Planning	Iron Range	20*	420*
New Housing Developments (3,800 units)	Planning	Iron Range	76*	50*
Virginia Municipal Hospital Addition	Engineering	Virginia	3.5	20*
Subtotal			99.5	490
Multiplier Factor in Other Sectors (.47)[1]				
Manufacturing and Wholesale	not available	Iron Range	110*	940*
Commercial Retail and Service Industries	not available	Iron Range	150*	1,380*
Finance, Transportation, Utilities & Covt.	not available	Iron Range	80*	640*
Subtotal			340	2,960
Total			2,005.5	9,200

* Estimated dollars, tonnages, or labor force.
1 The multiplier of .47 to every one employee in a base industry is applied to the total of preceeding employment numbers in other sectors.

An August, 1975 survey of all Minnesota mining companies except Reserve Mining and two small companies revealed an estimated need for new hires to fill turnover and retirement openings and new jobs created by plant expansion as follows:

	Yearly New Hires	Cumulative Hires
1976	2,282	2,282
1977	2,789	5,071
1978	2,350	7,421
1979	1,640	9,061
1980	1,615	10,676

It appears there will be ample job opportunities on the iron range over the next five years and probably beyond that time. However, these jobs will be filled partially by natural ore mining employees as production continues to decrease and also by women in the labor force who are now being hired for the full spectrum of mining jobs. There are about 200 women presently employed in mining and ore processing jobs on the iron range.

Commuting Patterns

The employment pattern in the three county study area results in a number of employees working outside of their county of residence (Table 39). This information provides some indication of commuting patterns and distances involved in the job market of this area. The work force follows the jobs. Lake County residents have the highest percentage employed outside the county.

As company closures have occurred in Duluth, for example, daily or weekly commuting to the iron range by Duluth residents has become a necessary and accepted practice.

Although Reserve employees tend to live close to their jobs as indicated in Table 40, it is also evident that about one of every four employees at both locations commutes more than 20 miles to their job. Public transit is used by Babbitt area employees to the extent of supporting two viable bus companies, one each in Ely and Babbitt.

These commuting patterns reflect observations that long commuting distances are not unusual for the northeastern Minnesota labor force. Further discussion of commuting patterns is presented in the transportation subpart.

Income Levels

Per capita personal income for the study area was $4,384 in 1973. By comparison, the per capita figure for the state was $5,144 or 17 percent greater than that for the study area. Of the three counties, Cook had the lowest per capita personal income of $3,434, followed by Lake with $3,551, and St. Louis County at $4,447.(73) Computing the average household income from these figures yields the following results:

Study Area -	$12,600
St. Louis County -	$12,700
Lake County -	$11,650
Cook County -	$ 9,300
State of Minn. -	$15,750

These are averages of the household income rather than the more typical median, which is the reason for the higher numbers than might be expected.

TABLE 39
PLACE OF WORK, 1970(67)

	All Workers	Working in County of Residence	Working Outside County of Residence	Not Reporting Place of Work
St. Louis County	76,107	90.3	4.7	5.0
Duluth	37,157	89.0	4.6	6.4
St. Louis County excluding Duluth	38,950	91.6	4.8	3.6
Lake County	4,380	83.2	12.1	4.7
Cook County	1,324	87.2	3.9	8.9
Study Area	81,811	89.9	5.1	5.0
Study Area excluding Duluth	45,978	88.0	5.4	3.6

TABLE 40
COMMUTING PATTERN OF RESERVE MINING EMPLOYEES(75)

Residence	Number and Percent Working at Babbitt Site: Number	Babbitt Site: Percent	Silver Bay Plant: Number	Silver Bay Plant: Percent
Silver Bay	16	1.0	892	62.3
Beaver Bay	4	<1.0	77	5.4
Finland/Little Marais	1	<1.0	103	7.2
Two Harbors	30	1.8	267	18.6
Cook County	0	0	11	<1.0
Duluth/Superior	5	<1.0	75	5.2
Babbitt	703	42.9	0	0
Ely	548	33.4	0	0
Iron Range	332	20.2	4	<1.0
Other	1	<1.0	3	<1.0
TOTAL	1,640	100.0	1,432	100.0

The effective buying income (EBI) is wages, salaries, interest, dividends, profits and property income minus federal, state and local taxes. The EBI was used as another measure for comparing income levels within the study area. The 1973 median household EBI in each county was below both the state and U.S. values of $9,755 and $9,544, respectively (see Table 41).

Except for the mine and coarse crushers, the Reserve taconite plant is located in Lake County. This county has the lowest percentage of poverty level households and the highest median EBI in the study area.

An examination of the percentage of EBI by income bracket reveals that the area has a significant number of households in the "less than $3,000" range. Only Lake County has a lower percentage of households (10.1) in this income bracket than the state and national counterparts of 12.2 percent and 12.8 percent, respectively. None of the counties compared favorably to either the state or U.S. percentages of households in the highest income bracket. Lake County had a greater percentage in the "$10,000-$14,999" income bracket than the U.S. However, the area lags behind both the State of Minnesota and the U.S. in terms of median income.

ECONOMIC BASE

Employment

The economic base of the three-county study area (St. Louis, Lake, and Cook) is presented in terms of employment by industry. Other descriptive measures of the important industries are also presented.

Professional and related services employ more people than any other industry in Cook County with 21.9 percent and St. Louis County with 24.1 percent of the labor force. Lake County and St. Louis County, excluding Duluth, have the highest percentage of employment in mining, with 31.3 and 22.4 percent, respectively (Table 42). In the study area, excluding Duluth, mining professional and related services and retail trade are the three largest employers, in that order. Government and manufacturing are the only others employing more than 10 percent in this same area.

Retail trade is the second largest employer in the study area; however, two-thirds of the regional total is found in three cities--Duluth - 52 percent, Hibbing - 8 percent, and Virginia - 6 percent.

In the following sections, the mining, timber, construction, manufacturing, retail trade and service industries are examined in greater detail as the basic employers of the study area.

TABLE 41
EFFECTIVE BUYING INCOME, 1973[76]

	Percent of Households With EBI						
	Less Than $3,000	$3,000-4,999	$5,000-7,999	$8,000-9,999	$10,000-14,999	$15,000 and Over	Median Household EBI ($)
St. Louis County	13.7	9.4	22.4	16.0	20.9	17.6	8,516
Duluth	14.3	8.8	19.8	15.9	22.2	19.0	8.887
Lake County	10.1	6.5	23.2	18.5	23.5	18.2	9,130
Cook County	17.8	9.6	26.3	14.1	21.1	11.1	7,620
Minnesota	12.2	8.6	16.8	14.0	24.9	23.5	9,755
U.S.	12.8	9.1	17.7	13.4	23.1	23.9	9,544

TABLE 42
EMPLOYMENT BY INDUSTRY FOR SELECTED AVAILABLE CITIES IN THE STUDY AREA--1970[77]

	Agriculture Forestry Fisheries	Mining	Construction	Manufacturing	Transportation Communication Utilities	Wholesale Trade	Retail Trade	Finance Insurance Real Estate	Professional Related Services	Government	Total Employed 16 Years Old and Over
St. Louis County	854	8,945	4,247	10,656	6,537	3,046	13,203	2,629	16,592	9,221	75,930
Chisholm	5	509	76	232	137	64	337	35	403	262	2,060
Duluth	186	241	1,768	6,037	3,620	1,858	6,850	1,748	9,862	4,871	37,077
Ely	21	528	76	78	45	6	399	30	223	128	1,534
Eveleth	0	431	78	203	75	28	254	36	297	203	1,605
Hibbing	14	950	317	480	330	270	1,017	216	1,399	563	5,556
Hoyt Lakes	3	744	9	64	49	0	123	13	68	113	1,186
Proctor	0	5	53	203	228	35	145	66	196	110	1,041
Virginia	15	759	205	456	384	127	886	109	977	652	4,500
Lake County	68	1,355	191	353	457	101	608	103	556	531	4,323
Silver Bay	0	697	20	9	40	13	114	9	63	113	1,078
Two Harbors	25	169	51	119	258	48	289	74	288	216	1,537
Study Area*	990	10,384	4,565	11,104	7,086	3,153	14,077	2,747	17,460	9,981	81,549
Study Area Excluding Duluth	804	10,143	2,797	5,031	3,466	1,297	7,227	999	7,598	5,110	44,472
Minnesota	111,030	14,008	82,759	309,222	96,004	70,525	274,925	45,106	309,870	150,824	1,464,273
U.S.A.	2,840,488	630,788	4,572,235	19,837,208	5,186,101	3,133,382	12,239,498	3,838,387	15,750,836	8,524,676	76,553,599
	Percent of Total Employed										
St. Louis County	1.1	11.8	5.6	14.0	8.6	4.0	17.4	3.5	21.9	12.1	100.0
Chisholm	0.2	24.7	3.7	11.3	6.6	3.1	16.4	1.7	19.6	12.7	100.0
Duluth	0.5	0.6	4.8	16.4	9.8	5.0	18.5	4.7	26.6	13.1	100.0
Ely	1.4	34.4	5.0	5.1	2.9	0.4	26.0	2.0	14.5	8.3	100.0
Eveleth	0.0	26.9	4.9	12.6	4.7	1.7	15.8	2.2	18.5	12.7	100.0
Hibbing	0.3	17.1	5.7	8.6	5.9	4.9	18.3	3.9	25.2	10.1	100.0
Hoyt Lakes	0.3	62.7	0.8	5.4	4.1	0.0	10.4	1.1	5.7	9.5	100.0
Proctor	0.0	0.5	5.1	19.5	21.9	3.4	13.9	6.3	18.8	10.6	100.0
Virginia	0.3	16.6	4.5	10.0	8.4	2.8	19.4	2.4	21.4	14.3	100.0
Lake County	1.5	31.3	4.4	8.2	10.6	2.3	14.1	2.4	12.9	12.3	100.0
Silver Bay	0.0	64.7	1.9	0.8	3.7	1.2	10.6	0.8	5.8	10.5	100.0
Two Harbors	1.6	11.0	3.3	7.7	16.8	3.1	18.8	4.8	18.8	14.1	100.0
Study Area*	1.2	12.7	5.6	13.6	8.7	3.9	17.3	3.4	21.4	12.2	
Study Area Excluding Duluth	1.8	22.8	6.3	11.3	7.8	2.9	16.3	2.2	17.1	11.5	
Minnesota	7.5	1.0	5.6	21.1	6.6	4.8	18.8	3.1	21.2	10.3	
U.S.A.	3.7	0.8	6.0	25.9	6.8	4.1	16.0	5.0	20.6	11.1	

*Study area includes St. Louis, Cook and Lake counties.

Study Area	1.2	12.7	5.6	13.6	8.7	3.9	17.3	3.4	21.4	12.2
Study Area Excluding Duluth	1.8	22.8	6.3	11.3	7.8	2.9	17.3	2.2	17.1	11.5
Minnesota	7.9	1.0	9.6	21.1	6.6	4.8	18.8	3.1	21.2	10.3
U.S.A.	3.7	0.8	6.0	25.9	6.8	4.1	16.0	5.0	20.6	11.1

Major Industries

Manufacturing

Between 1967 and 1972, Minnesota experienced a 5.4 percent growth in the total number of manufacturing establishments, as shown in Table 43. The number of establishments in the study area, however, declined by 6.8 percent.

The three county study area, including Duluth, experienced a 15 percent increase in value added by manufacturing from 1967 to 1972, which was less than the 35.4 percent increase experienced by the state as a whole. However, the study area, excluding Duluth, experienced a growth of 45.7 percent from 1967 to 1972. The number of establishments in Lake County did not change from 1967 to 1972, but value added increased from $2 million to $4.5 million. St. Louis County, excluding Duluth, experienced a value added growth of $9.5 million or 39.7 percent during this period.

Lumber and wood products had the most severe decrease in number of establishments dropping from 140 to 104 in the study area - a 26 percent drop as indicated in Table 44. The largest percentage increase in the study area occurred in the machinery, except electrical, group and other unnamed manufacturing industries.

Timber Industry

The timber industry is the third largest industry in Minnesota, and is expanding because of increasing demand and cost control based on advanced technology and sophistication of tree-harvesting and wood-handling equipment. The 1973 estimate of Minnesota's forest products amounted to about $483 million; pulpwood products alone accounted for $425 million (see Table 45).

The major expansion has been in the pulpwood industry, specifically, pulp and paper manufacturing. Between 1963 and 1973, Minnesota paper mills invested nearly $166 million and employed 9,000 people with a payroll of approximately $123 million.(79)

Total employment in the timber industry is relatively low, accounting for only 1.8 percent in the study area, excluding Duluth, assuming that agriculture, fisheries, and forestry employment is primarily the latter in this area. The study area accounts for 29.5 percent of the state's commercial timber acreage. The dollar value of this acreage is approximately $142 million.(79)

Mining Industry

U.S. iron ore demands are met largely from the iron mines in Minnesota. Taconite accounts for the largest share of iron ore production in the state. The economy of the study area rises and falls with the mining industry. In fact, within the study area, excluding Duluth, the mining industry is the largest employer, with nearly 23 percent of total employment (return to Table 42).

The development of the taconite industry as the major segment of the iron mining industry in Minnesota started in the mid-1950's, reached about 35 percent of total ore shipments from Minnesota by the mid-1960's, and 70 percent by 1972. Pellet production capacity in place and under construction totals 65 million tons per year as of early 1975.(81) The extent of taconite reserves, the integration of the steel and taconite industries, and the foreign location of alternative iron sources presumably ensures a stable and substantial economic base for Minnesota, especially the northeastern region of the state.

TABLE 43
MANUFACTURING(78)

	Number of Establishments			Value Added (million $)		
	1967	1972	Percent Change	1967	1972	Percent Change
St. Louis County	303	280	- 7.6	114.0	128.8	13.0
Duluth	123	118	- 4.1	90.1	95.4	5.9
St. Louis County excluding Duluth	180	162	-10.0	23.9	33.4	39.7
Lake County	13	13	--	2.0	4.5	125.0
Cook County	24	24	--	1.0	1.3	30.0
Study Area	340	317	- 6.8	117.0	134.6	15.0
Study Area excluding Duluth	217	199	- 8.3	26.9	39.2	45.7
Minnesota	5,409	5,699	5.4	4,080.2	5,523.8	35.4

TABLE 44
DISTRIBUTION OF MAJOR MANUFACTURING INDUSTRY GROUPS BY NUMBER OF ESTABLISHMENTS: 1967 AND 1972(78)

	Food and Kindred Products			Lumber and Wood Products			Printing and Publishing			Stone, Clay and Glass Products		
	1967	1972	Number Change	1967	1972	Number Change	1967	1972	Number Change	1967	1972	Number Change
St. Louis County	35	30	-5	108	75	-33	53	47	-6	19	22	3
Lake County	-	-	-	9	8	-1	1	1	-	-	-	-
Cook County	-	1	1	23	21	-2	1	1	-	-	-	-
Study Area	35	31	-4	140	104	-36	55	49	-6	19	22	3
Minnesota	947	728	-219	618	557	-61	835	895	60	349	356	7

	Fabricated Metal Products			Machinery Except Electrical			All Other			Total Establishments		
St. Louis County	15	14	-1	17	20	3	56	72	16	303	280	-23
Lake County	1	10	-	1	2	1	1	1	-	13	13	-
Cook County	-	-	-	-	1	1	-	-	-	24	24	-
Study Area	16	15	-1	18	23	5	57	73	16	340	317	-23
Minnesota	414	476	62	736	877	141	1,510	1,680	170	5,409	5,569	160

TABLE 45
MINNESOTA PRODUCTION AND ESTIMATED VALUE OF TIMBER PRODUCTS - 1973[79]

	Value ($)	Production	
Pulpwood	424,924,240	1,376,920	Cords
Lumber, Ties Logs and Bolts	25,952,400	195,000,000 151,200	Board Feet Railroad Ties
Christmas Trees	8,085,000	4,200,000	Trees
Matchwood, Veneer Logs and Cooperage	8,498,000	700,000	Cords
Posts, Poles and Piling	5,115,500	4,455,000 192,510 155,550	Fence Posts Poles Pilings
Fuelwood	5,032,000	296,000	Cords
Shavings, Sawdust, Novelities, Slats, Etc.	2,900,000		
By-Products and Mill Residue	2,490,710		
TOTAL	482,977,850		

Employment in iron mining in Minnesota from 1962 through 1972 has remained close to 12,300, as indicated in Table 46. Current expansion plans at seven different sites are expected to add 3,000-4,000 jobs throughout the iron range by the late 1970's.[83]

Minnesota's share of the U.S. iron ore market remained consistently close to 62 percent from 1961 to 1971; its share of the world market has declined from a high of about 25 percent to 6.5 percent in 1971. This reduction has occurred because of new developments of iron ore deposits in Australia, Canada, South America, and Africa.[81]

Construction Industry

In 1974, 21 new or expanding industries provided nearly 2,000 new permanent jobs primarily in the study area; the investment in the area by these industries was over $470 million. Of this amount, $350 million was invested by National Steel and Eveleth Taconite in two separate taconite plants.[83]

In 1973, there were 37 industrial construction projects, again primarily in the study area, with a total investment of over $130 million.[83] The percentage of the labor force in construction is about 6 percent in the study area, in Minnesota, and in the U.S. The development and expansion of taconite plants has provided an impetus to the construction industry. Continued industrial growth, diversification in the economic base, and the need for housing are factors favoring continued construction employment demand over the next 5 to 10 years.

TABLE 46
IRON MINING EMPLOYMENT IN MINNESOTA (THOUSANDS)[80]

Year	Total	Non-Taconite	Taconite	% of Non Taconite	% Taconite
1962	12.9	8.0	4.9	62.0	38.0
1963	11.5	6.6	4.9	57.4	42.6
1964	11.3	6.0	5.3	53.1	46.9
1965	13.0	7.4	5.6	56.9	43.1
1966	13.3	6.8	6.4	51.1	48.1
1967	12.8	5.4	7.3	42.2	57.0
1968	13.3	4.1	9.3	30.8	69.9
1969	13.1	3.7	9.4	28.2	71.8
1970	13.3	3.4	9.9	25.6	74.4
1971	12.6	3.0	9.6	23.8	76.2
1972	11.8	2.7	9.1	22.9	77.1

Retail Trade

Retail sales and receipts of service industries are indicators of trade or service centers. Total retail sales in the study area increased by 38.7 percent between 1967 and 1972 (see Table 47). The number of retail establishments increased by 212, an increase of 9.7 percent during this same time period. Cook County had the largest increase in retail sales, 68.2 percent from 1967 to 1972. The remaining counties tended toward a 40 percent increase in retail sales, which is similar to the statewide increase. Duluth, the study area hub for retail sales, had approximately $275 million in sales during 1972, about 54 percent of the study area. This is an increase of 31.5 percent over 1967 sales.

Retail sales in Hibbing increased the most among the large towns in the area--approximately 54 percent from 1967 to 1972. In dollar volume, Hibbing was just behind Virginia, the second largest retail trade center in the study area. Duluth, Virgina, and Hibbing accounted for 62 percent of retail employment in the study area. In Lake County, Two Harbors had more establishments and a sales volume substantially greater per capita than in Silver Bay, perhaps indicative of a lagging retail sector in Silver Bay. In fact, only Hoyt Lakes and Proctor were below Silver Bay in number of establishments and total sales.

TABLE 47
RETAIL TRADE - STUDY AREA

	Number of Establishments			Sales (in $000)		
	1967	1972	Percent Change	1967	1972	Percent Change
St. Louis County	1,993	2,168	8.8	349,650	481,736	37.8
Chisholm	83	81	-2.4	7,837	9,580	22.2
Duluth	920	973	5.8	209,280	275,151	31.5
Ely	83	89	7.2	11,298	16,080	42.3
Eveleth	69	73	5.8	9,323	13,395	43.7
Hibbing	174	206	18.4	31,174	47,932	53.8
Hoyt Lakes	13	19	46.2	1,871	2,601	39.0
Proctor	24	24	--	2,899	4,236	46.1
Virginia	196	217	10.7	35,283	51,248	45.2
Lake County	124	147	18.5	15,525	23,159	49.2
Silver Bay	20	26	30.0	2,781	4,253	42.9
Two Harbors	71	83	16.9	11,258	16,438	46.0
Cook County	59	73	23.7	5,275	8,873	68.2
Study Area	2,176	2,388	9.7	370,450	512,768	38.7
Study Area excluding Duluth	1,256	1,415	12.7	161,170	238,617	48.1
Minnesota	32,886	36,176	10.0	5,980,481	8,352,397	39.7

Selected Services

The selected services industries are hotels, motels, tourist camps, repair services, personal services, amusement services, or any other establishments that primarily engage in deliveries of a variety of services to individuals and other business establishments. Receipts of these establishments are somewhat related to tourist expenditures, especially in Cook County.

Total receipts of selected services establishments more than doubled in the study area from 1967 to 1972 (see Table 48). Lake County had the lowest level of receipts at $2 million in 1972, and experienced a growth of about half that of the study area. Duluth, as might be expected, had the largest dollar volume of receipts at $47.7 million.

In the study area, excluding Duluth, Hibbing had the most receipts (8.4 million) in 1972; Hoyt Lakes had the fewest ($147,000). In Lake County, Silver Bay had the lowest level of receipts in 1972 ($392,000); however, this was more than double its receipts in 1967.

TABLE 48
SELECTED SERVICES - STUDY AREA(87)

	Number of Establishments			Receipts (in $000)		
	1967	1972	Percent Change	1967	1972	Percent Change
St. Louis County	1,220	1,469	20.4	32,078	74,222	131.4
Chisholm	35	31	-11.4	381	571	49.9
Duluth	597	734	22.9	20,049	47,659	317.7
Ely	72	90	25.0	1,175	2,139	82.0
Eveleth	24	41	70.8	485	1,705	251.5
Hibbing	108	140	29.6	3,408	8,393	146.3
Hoyt Lakes	10	11	10.0	97	147	51.5
Proctor	12	14	16.7	72	226	213.9
Virginia	84	115	36.9	2,798	5,886	110.4
Lake County	123	113	-8.1	1,186	1,961	65.3
Silver Bay	12	26	116.7	182	394	116.5
Two Harbors	59	53	-10.6	454	662	45.8
Cook County	108	90	-16.7	3,448	3,270	119.1
Study Area	1,451	1,672	15.2	34,711	79,353	128.6
Study Area excluding Duluth	854	938	9.8	14,662	31,694	116.2
Minnesota	19,442	29,184	50.1	676,494	1,734,051	156.3

RESERVE MINING COMPANY

Reserve Mining Company employs approximately 3,000 people, which accounts for about 24 percent of the total Minnesota employment in iron mining. Reserve's employment costs ($46.8 million in 1974) relative to the total mining industry are about the same percentage as employment.(85) Reserve also accounts for over 90 percent of the mining in Lake County.

Mining and processing taconite to produce iron-rich pellets requires the purchase and consumption of substantial quantities of materials, supplies, and services. Many of Reserve's supplies are located in Minnesota. Reserve reports spending $50.66 million on such purchases during 1974. Of this total, $36.8 million--about 73 percent--was spent in Minnesota. Purchases in excess of $5,000 were made by Reserve in 1974 from Minnesota vendors in the following locations:(86)

	No. of Vendors	Amount
Duluth	47	$ 12,900,640
Minneapolis-St. Paul	50	5,439,891
Iron Range	60	15,173,575
Other Minnesota	15	3,257,296
Totals	172	$ 36,771,402

These purchases plus those of Reserve employees support employment in other sectors or industries of the economy, especially at the local and regional level. The taxes paid by Reserve and its employees also support employment in the public sector of the economy. The generation of this additional employment by the economic activities of Reserve and its employees is analyzed and estimated by the determination of the employment "multiplier"--an estimate of "indirect" and "induced" jobs in the total economy that can be economically linked to direct economic inputs and activity. A study of the regional economy concluded that approximately one job is generated for every mining job in the region.(88) Thus, Reserve Mining operations could be generating up to 3,000 additional jobs in other sectors of the economy, with the associated income, spending, and taxes from such employment.

In addition to the usual economic effect attributable to any operating company, Reserve Mining has participated in other affairs of local, regional, state or national concern and interest. Corporate donations totaling about $41,000 in 1974 were primarily directed to local and regional community affairs. One-third of the total was used for scholarships. Reserve spent $109,600 on membership dues in 1974.(89)

HOUSING AND PUBLIC SERVICES

Housing

Recent studies by the ARDC have found that there are several significant factors which have contributed to an existing and an anticipated near-term shortage of housing. This housing shortage is evident in various growth centers on the iron range, and is primarily the result of the following factors: (90)

- Average iron range family income limitations.
- Tight money market--shortage of mortgage credit at private as well as public levels.
- Temporary influx of construction workers as a result of expansion of the taconite mining industry.
- Lack of the proper impetus to attract well qualified medium- and large-scale developers to the area.
- Lack of adequate financial programs and other housing programs at the state and federal level for dealing with these particular types of problems.
- High construction cost.

The result of these factors has generally been a shortage of adequate housing to accommodate construction workers and expanding taconite labor needs. In turn, this has generated pressures to use mobile homes.

In order to meet the increased demand for housing generated primarily by the expanding taconite industry, the ARDC has projected a need for approximately 3,800 additional housing units by 1979 (see Table 49). However, these projections do not include consideration of Reserve's future status.

Table 49 indicates current occupancy levels in four distinct growth areas in the iron range, future projected housing needs by 1979 and existing vacant habitable housing.

In the cities which are projected to expand significantly as a result of the growth in the taconite mining industry, there were only 168 habitable vacant housing units in 1974. This amounts to just slightly more than 1/2 of one percent of the total habitable units. Updated figures from the ARDC show that there are few or no housing units available for present or near-term future occupancy.

Costs of typical new homes constructed on the iron range in 1974 to 1975 varied from $33,000 to $44,000 per unit, while typical rents for newly constructed rental units are:(90,91)

1 bedroom units -- $150-$275/month
2 bedroom units -- $245-$283/month
3 bedroom units -- $290-$350/month

Since the north shore is not currently a growth area, little data on housing characteristics for that part of the state exists. However, it is probable that a very high occupancy level of homes, and that few multi-family dwellings exist.

Education

Table 50 indicates enrollments and excess capacity of schools in the study area for grades K-12. In almost all cases, an excess capacity exists in the schools of the study area.

Electric Power

Electric power is produced and supplied by a number of private, cooperative, municipal, and industrial sources. The principal generation

TABLE 49
SELECTED HOUSING OCCUPANCY DATA[90]

Minor Civil Div. (Growth Centers)	Occupied Housing 1974 Est.	Projected* Future Need Housing	Vacant Habitable Housing
Ely	1,897	110	0
Babbitt	735	90	37
Hoyt Lakes	902	150	0
Aurora	927	90	21
Biwabik	462	80	9
SUB TOTALS	4,923	520	67
Gilbert	737	210	3
Virginia	1,657	640	12
Eveleth	1,732	110	7
Fayal Township	1,173	320	8
Mt. Iron	1,006	340	5
SUB TOTALS	9,305	1,620	35
Buhl	402	20	12
Chisholm	2,046	270	2
Hibbing	6,339	360	16
Stuntz Township	1,585	670	7
SUB TOTAL	10,373	1,320	37
Keewatin	487	110	4
Hashwauk	672	80	6
Coleraine	369	60	5
Grand Rapids	3,172	110	14
SUB TOTALS	4,700	360	29
TOTALS	29,301	3,820	168

* The projected distribution of this housing demand is based on the growth capacity of various communities, including such factors as available land in proximity to utilities, highways, compatible zoning, employment centers, public service facilities, etc. May 1974 projections here are currently being revised, but the grand total remains valid.

methods of these plants are hydroelectric generation and steam generation. The primary fuel is western low sulphur coal. Therefore, to a degree, the future of elctric power in the study area is dependent upon the future uses and mining of these coal resources. Present electrical generating capacities are adequate for existing demands in the area. See the utilities section of the EIS for a further discussion of electrical power in the study area.

Health Care

The crucial or key elements of health care provisions in the study area consist of the health manpower categories of primary and secondary care physicians, dentists and health care facilities, in the form of hospital beds, nursing homes, and boarding care homes. Tables 51 and 52 include data on the existing supply of health manpower and facilities in the study area.

TABLE 50
ENROLLMENT AND EXCESS CAPACITY OF SCHOOLS IN STUDY AREA[92]

	1973-1974 Enrollment	Additional Students Facilities Can Accommodate (Excess Capacity)	% Excess Capacity Over Present Enrollment
Lake County			
Ind. 381 Two Harbors	3,778	0	0
Int. 381 *Silver Bay	1,610	NA	NA
St. Louis County			
Incd. 691 Aurora	2,709	1,200-1,500	44.3-55.4%
Ind. 692 Babbitt	1,867	200-300	10.7-16.1%
Ind. 693 Biwabik	850	275-325	32.4-38.2%
Ind. 694 Buhl	543	450	82.9%
Ind. 695 Chisholm	1,579	300	19.0%
Ind. 696 Ely	1,707	300	17.6%
Ind. 697 Eveleth	1,884	20	1.1%
Ind. 698 Floodwood	566	50	8.8%
Ind. 699 Gilbert	875	300	22.9%
Ind. 700 Hermantown	2,065	0	0.0%
Ind. 701 Hibbing	5,360	225-300	4.2-5.6%
Ind. 703 Mountain Iron	927	300	32.4%
Ind. 704 Proctor	2,849	50-60	1.8-2.1%
Ind. 706 Virginia	3,000	1,500-2,500	50-83.3%
Ind. 707 Nett Lake	92	0	0.0%
Ind. 708 Tower Soudan	600	120	20.0%
Ind. 709 Duluth	22,601	5,209	23.0%
Ind. 710 St. Louis County (Unorganized)			

*Includes the three schools in Silver Bay and the Finland School. Data provided by Independent School District #351, Two Harbors, Minnesota October 2, 1975.

In all cases, the supply of health manpower and facilities in Lake County is less than the state average. In all cases except nursing home beds and boarding care home beds, St. Louis County exceeds the state averages for health manpower and facilities supply, due primarily to the concentration of medical personnel and facilities in Duluth. If Duluth is excluded, the St. Louis County figures drop significantly, in half the cases, below the state averages.

TABLE 51
SUPPLY OF HEALTH MANPOWER IN THE STUDY AREA (93)

	Primary Care Physicians*	Secondary Care Physicians	Dentists
Lake - 13,251**			
Silver Bay	3	0	2
Two Harbors	2	1	3
TOTAL and	5	1	5
NO. PER 100,000	(37.5)	(7.5)	(37.5)
St. Louis - 220,693			
Aurora***	3	0	3
Babbitt	1		2
Buhl	1	0	1
Chisholm***	1	1	2
Cook	0	0	1
Duluth***	56	94	80
Ely***	4	0	2
Eveleth***	3	0	3
Floodwood	0	0	1
Gilbert	1	0	1
Hibbing***	9	14	16
Hoyt Lakes	0	1	1
Mountain Iron	0	2	0
Parkville	0	1	0
Proctor	0	0	2
Virginia***	16	22	19
TOTAL and	95	135	134
NO. PER 100,000	(42.8)	(60.8)	(60.7)
State Average per 100,000	41.5	22.6	44.5

* Primary Care Physicians include M.D., D.D., P.D., I.M. Secondary Physicians include all other declared specialists.

** 1970 Population.

*** Indicates the location of a hospital or hospitals in the municipality.

Sewer and Water

See the utility subpart.

TAX CHARACTERISTICS

For purposes of this section, the study area is generally considered to be within the counties of St. Louis and Lake. In addition, there is a certain amount of reference to the entire State of Minnesota or comparable size counties. Cook County was not considered within the study area, primarily due to the fact that it is not a direct recipient

TABLE 52
SUPPLY OF HEALTH FACILITIES IN THE STUDY AREA(93)

	Number and Type of Facility*	Type and Number of Beds HOSP	NH	BCH	OTHER	Average Annual Hospital Occupancy Rate
Lake - 13,351						
Two Harbors	1 HOSP	37	50	0	0	85.1%
	1 BCH	0	40			
TOTAL	1 HOSP	37	90	0	0	85.1%
NO. OF BEDS PER 1,000	1 BCH	(2.8)	(6.8)			
St. Louis - 220,693**						
Aurora	1 HOSP	30	29	26	0	66.2%
Buhl	1 NH	0	31	0	0	
Chisholm	1 HOSP	54	0	0	0	56.0%
	1 NH	0	42	0	0	
Cook	1 NH	0	51	0	0	
Duluth	3 HOSP	1,137	0	0	138	74.9%
	6 NH		893	68		
Ely	1 BCH	0	0	64	0	
Eveleth	1 HOSP	45	70	0	0	78.3%
	1 HOSP	26	24			48.0%
Hibbing	1 NH	0	64	0	0	72.1%
	1 HOSP	182	0	0	0	
Nopeming	2 NH	0	276	0	0	
Virginia	1 NH	0	203	0	0	
	1 HOSP	173	122			76.6%
	1 NH	0	110	0	0	
TOTAL	9 HOSP	1,647	1,915	158	138	67.4%
BEDS PER 1000 STATE	14 NH	(7.4)	(8.6)	(.7)	(.6)	
AVERAGE: NO. OF BEDS PER 1000		5.0	10.6	2.7		

* Facility abbreviations are the following: HOSP = General Hospital, NH = Nursing Home, and BCH = Boarding Care Home
** 1970 Population

of substantial tax revenue from the taconite industry, as there are no taconite mining operations in Cook County.

The purpose of this section is to review existing expenditures for local governmental agencies on a county level and once this level has been reviewed, to analyze the relationship of Reserve Mining Company's taxes as it applies to the taxing entities to which they are responsible.

Selected items of public finance for St. Louis and Lake Counties are shown in Table 53. This Table shows the per capita amount of general revenues and expenditures as well as totals. Per capita amounts are also shown for all Minnesota counties in the two population size categories into which Lake and St. Louis Counties fall.

Per capita general tax revenues and public expenditures in St. Louis County during 1972 were $719.16 and $773.67 respectively. These are considerably higher than the equivalent figures for other Minnesota counties within the same population size range. By contrast, Lake County, in which the Reserve beneficiation plant is located, has a slightly lower level of revenues and expenditures per capita than the average of other Minnesota counties of the same comparable size range.

TABLE 53
SELECTED ITEMS OF PUBLIC FINANCE FOR COUNTY AREAS--1971 to 1972

	Amounts ($000's)		Per Capita Amounts			
	St. Louis County	Lake County	St. Louis County	Minnesota Counties with Populations 100,000-249,999	Lake County	Minnesota Counties with Population 10,000-24,999
General Revenue	158,713	7,440	719.16	662.55	557.24	582.47
State Sources	70,282	5,279	318.46	294.32	395.39	298.88
Local Sources	84,455	2,019	382.68	357.39	151.25	273.56
Property Taxes	55,821	1,467	252.93	236.94	109.84	185.72
Other Taxes	2,824	16	12.80	8.77	1.19	2.67
Direct General Expenditures	161,917	7,249	773.67	683.81	542.94	589.03
Education	66,208	4,019	300.00	341.00	301.05	290.39
Highways	12,226	1,309	55.40	48.55	98.06	78.23
Public Welfare	32,048	511	145.21	88.58	38.29	83.04
Hospitals	10,528	0	47.71	20.45	0.00	26.35
Health	840	58	3.81	2.52	4.36	2.70
Police Protection	3,509	252	15.90	17.00	18.89	10.78
Fire Protection	2,559	25	11.60	8.30	1.91	1.82
Sanitation	795	31	3.60	2.64	2.33	1.47

Per capita figures for the counties are based on 1970 population; Minnesota county per capita figures are based on the total 1972 population.

Revenue per capita from state sources is considerably higher in Lake County than in St. Louis County. However, both counties are receiving more state funds than the average of other similar size Minnesota counties. This illustrates, among other things, the revenue sharing policies of the State of Minnesota in general and the redistribution of taconite and iron ore taxes.

In general, per capita expenditures in St. Louis County on selective items of public finance are greater than the average of comparable size counties in Minnesota. The two exceptions to this are in education and police protection. In Lake County, public welfare and hospital cost are less per capita than in similar size counties throughout the state. Public welfare expenditure in Lake County is less than half the average per capita expenditure for all similar size Minnesota counties. This reflects the stable and self-sufficient nature of Lake County.

Current Relationship of Reserve to Various Tax Bases

Minnesota state and local taxes attributable to Reserve Mining include property taxes, special taxes, (related to the taconite industry) ad valorem taxes and employers Minnesota excise tax. Reserve Mining pays state and local taxes as set forth by state law for taconite companies. However, Reserve Mining pays no federal income tax directly because it is a cost company with no profit resulting from its operations. However, Reserve's parent companies (Armco Steel Corporation and Republic Steel Corporation) are subject to federal income tax on profits which they derive from products incorporating taconite pellets from Reserve Mining Company.

Reserve Mining Company had a 1974 total state and local tax liability of $7,845,000 and a 1975 liability estimated to be $15,314,000. In addition, it is estimated that Armco and Republic paid $16,004,000 in federal taxes attributed to Reserve's operations. Due to increases in taxes on the taconite industry, the 1975 Reserve Mining Company liability is substantially greater than the 1974 liability. The largest portion of Reserve's tax contributions are in the form of various kinds of taconite taxes accruing to local and state governments. Table 54 compares Reserve's 1974 tax liability with estimates of its 1975 state and local tax liability.

Reserve's contributions of taconite and iron ore taxes are based on an elaborate system of levies, collections, and redistribution as established by the state legislature.

TABLE 54
SUMMARY OF RESERVE'S STATE AND LOCAL TAXES[95]
(1975 Estimated Liability Compared with 1974 Liability)

	1974 ($)	1975 ($)	1975 Increase ($)
Taconite Tax	2,865,000	7,614,000	4,749,000
Taconite Railroad Tax	1,335,000	1,527,000	192,000
Occupation Tax	1,729,000	3,900,000	2,171,000
Royalty Tax	976,000	1,209,000	233,000
Sales Tax	600,000	720,000	120,000
Ad Valorem Tax	269,000	265,000	(4,000)
Employer's Minnesota Excise Tax	71,000	79,000	8,000
Total Liability	7,845,000	15,314,000	7,469,000
Production - Tons (Natural Weight)	10,368,000	10,450,000	
Tax Per Ton	$0.76	$1.47	

In order to provide some perspective of the magnitude of Reserve's contribution of taconite/iron ore taxes, information on the 1974 distribution of tax dollars for which Reserve is responsible is provided in Table 55. Reserve's total taconite/iron ore tax liability in 1974 exclusive of sales tax, ad valorem tax, and employers Minnesota excise tax was approximately $6,905,000. The biggest single payment was received by the state general fund and amounted to approximately $1,051,000 in 1974. Other large receipts of taconite/iron ore money accrued to various school districts in the two counties of Lake and St. Louis. In addition, over $860,000 of these tax monies were allocated to the state school fund and state university. Total taxes for all of the receiving educational institutions amounted to over $2,239,000 in 1974.

TABLE 55
DISTRIBUTION OF RESERVE MINING COMPANY 1974 IRON ORE TAX LIABILITY(96)

	Royalty Tax ($)	Taconite Tax ($)	Taconite Railroad Tax ($)	Occupation* Tax ($)	Total Iron Ore Taxes ($)
Taconite Property Tax Relief		1,050,670			1,050,770
State - General Fund	975,690	52,285	80,118	432,231	1,540,324
St. Louis County		92,886	144,677	50,260	287,825
St. Louis County - Road and Bridge Fund		67,803			67,803
Lake County		109,063	151,996	57,798	318,857
Lake County - Road and Bridge Fund		78,498			78,498
City of Babbitt		94,832	126,088	50,260	271,180
City of Babbitt - Special					
Town of Bassett			6,000		6,000
Town of Beaver Bay			7,112		7,112
City of Silver Bay		109,063	120,824	57,798	287,685
City of Silver Bay - Special					
Town of Silver Creek			16,309		16,309
Unorganized Township No. 2 (Lake County)			2,325		2,325
School District No. 692 (St. Louis County)		222,648	326,543	100,537	649,728
School District No. 692 (Building)					
Unorganized Schools (St. Louis County)			2,444		2,444
School District No. 381 (Lake County)		256,062	345,447	115,579	717,088
School District No. 381 (Building)					
Lake County School District (Unorganized)			5,427		5,427
State School Fund				691,570	691,570
State University Fund				172,892	172,892
Iron Range Resources and Rehabilitation Commission		146,300			146,300
Taconite Municipal Aid Account		585,201			585,201
	975,690	2,865,311	1,335,310	1,728,925	6,906,236

* Distribution estimated on 1973 basis.

Taconite tax plays an important role in supplying necessary monies for municipal operations. In 1974, taconite tax receipts accounted for 57 percent of the money used in actual expenditures in the City of Babbitt, Minnesota. In addition, over 60 percent of the budget of the City of Silver Bay, Minnesota, was accounted for by taconite taxes in 1974.

In addition to the taxes paid by Reserve Mining Company as described above, employees of Reserve Mining Company also pay income, property, and sales taxes. The people linked to Reserve's operations through indirect and induced employment also pay these taxes as appropriate to their residence.

LAND USE PLANNING

PURPOSE

Land use planning provides a framework within which change can be addressed. The proposed Mile Post 7 plan is one of many actions which would bring about changes in regional land use activities as well as changes related to specific sites.

Land use planning deals with the management of resources. It addresses the relationship between different activities. Land use planning in the context of on-land tailings disposal addresses two scales:

1. The three county study area.
2. The local site related changes due to its use as a tailings disposal basin.

LAND USE PLANNING RELATIONSHIPS

Land use planning deals with managing the location of activities in relationship to limitations imposed by the natural and cultural environment. In the broadest sense, land use planning relationships with respect to on-land tailings disposal can be classified into three major areas, each having different policy implications.

1. Natural Areas and Systems - These physical features are the resource base upon which policy decisions are formulated. Natural area land use planning focuses on the opportunities and constraints presented by terrestrial and aquatic habitat, hydrological and geological features, soil and landforms. These are essentially non-manageable elements particularly with respect to location. These are discussed individually in other sections.

2. Natural Resource Oriented Uses - The major resource use categories occurring in the study area are agricultural, in extremely limited areas; forestry, the most extensive land use; recreation including active or facility oriented activities such as lodges, camping, picnicing and passive or feature oriented activities such as hiking and fishing; and mineral extraction. Being natural resource oriented, the location of these uses is also not generally manageable. However, the intensity of development and compatibility with adjacent uses and other natural resource conflicts can be managed. Other sections explore these uses.

3. Cultural Uses - The major categories of this group include residential/commercial; industrial; transportation, communication and utilities; and historical and archaeological features. Cultural uses generally can be guided and managed locationally. Compatibility with respect to minimizing conflicts between each other and the natural environment is managed largely through public policy and plans.

Land use is set in a broad context. It should serve therefore as a coalescing element, one which interrelates the elements of the EIS and establishes a framework for considering long term policy implications of on-land tailings disposal.

REGIONAL DEVELOPMENT OVERVIEW

This section describes the regional setting of the proposed action site and the alternative disposal sites. Included is a discussion of the land area occupied by natural areas, natural resource areas and cultural activity areas of the three county area. This section, however, concentrates on cultural land use areas. This material provides the basis for projecting and assessing the potential impacts of on-land tailings disposal on land use in the region, on the site and on the area immediately adjacent to the site.

LAND USE

Utilizing 1969 aerial photographs, the Minnesota Land Management Information System Study (MLMIS) classified land use in nine categories: (1) forest; (2) cultivated; (3) water; (4) marsh; (5) urban residential; (6) extractive; (7) open, or pasture; (8) urban non-residential, or mixed residential; and (9) transportation. (Due to the use of only aerial photos, typical designations such as public, industrial or commercial were not included in the breakdown). Recreational uses are intertwined with these categories and were not calculated as to land area used separately by MLMIS. These nine categories of land use can be grouped into the three previously mentioned management units for the purpose of discussing future impacts and management capability. The natural areas which are not manageable from a locational aspect are water, marsh and swamps, and open or pasture areas. The natural resource oriented uses are associated principally with forest, cultivated and extractive areas. While these areas are not manageable from a locational standpoint, the intensity of activity associated with them can be managed. The third management unit is the cultural uses of land which include urban residential, urban non-residential or mixed residential and transportation. These uses can, to a much greater extent, be managed locationally and modified based on the impact they will have on adjacent natural or cultural uses to avoid conflicts.

Table 56 records the land area in each county by the three management units and by the nine land use classifications.

TABLE 56
LAND USE IN STUDY AREA*

	COOK		LAKE		ST. LOUIS		THREE COUNTY TOTALS	
	Percent	Sq. Mi.	Percent	Sq. Mi.	Percent	Sq. Mi.	Percent	Sq. Mi.
Natural Areas and Systems								
Water	24.4	377.7	15.9	365.9	8.0	536.9	12.1	1,280.5
Marsh & Swamps	0.1	1.5	0.3	6.9	1.1	73.8	0.8	82.2
Open or Pasture	0.2	3.1	0.4	9.2	4.2	281.9	2.9	294.2
Natural Resource Oriented								
Forested	74.8	1,157.9	82.5	1,898.3	81.4	5,462.7	80.7	8,518.9
Cultivated**	--	--	0.1	2.3	1.8	120.8	1.2	125.4
Extractive	--	--	--	--	1.0	67.1****	0.6	67.1
Cultural								
Urban Residential	0.4	6.2	0.5	11.5	1.4	93.9	1.0	111.6
Urban Non-Residential or Mixed Residential	0.2	3.1	0.2	4.6	0.9	60.4	0.6	68.1
Transportation**	--	--	--	--	0.1	6.7	--	6.7
Total***	100.1	1,549.5	99.9	2,298.7	99.9	6,704.2	99.5	10,554.7

*Source: Minnesota Land Management Information System Study.
**Due to the calculating of land uses by the dominant use in each 40 acre tract, at times specific land uses were not recorded; i.e., the transportation system in Cook and Lake counties.
***Due to rounding the percentages and totals do not equal 100%.
****The calculation of this figure did not include tailings ponds, stock piles, or mine structures. See Table 57 for a more complete discussion of extractive land uses.

Natural Areas and Systems

Water/Marsh and Swamps

Water bodies have played a major role in the development and economy of the study area. The MLMIS study reported that approximately 1,280 square miles were occupied by water which accounts for over 12 percent of the area of the three counties. According to the Water Resource Coordinating Committee (Technical Bulletin #2, June, 1969), there were over 2,500 lakes of 10 acres or more in the three counties. Marsh or swamp accounts for an additional 82 square miles, or 0.8 percent, of the 10,560 square miles in the study area.

Open or Pasture

Distinguishing between naturally open land or pasture is difficult without site by site inspection. Therefore, the joint grouping was appropriate. In total, 294 square miles of the three counties are included in this classification.

Natural Resource Oriented Uses

Forest

Approximately 81 percent or 8,500 square miles of the study area is presently forest (see Table 56, Figure 61). Included within this classification are preserve areas, such as the interior zone of the BWCA (628,000 acres/965.6 square miles), Voyageurs National Park (210,000 acres/320 square miles, a segment of the park is in Koochiching County), state park land (38,250 acres/60 square miles), and commercial forest. Most of the forested land is utilized for commercial production.

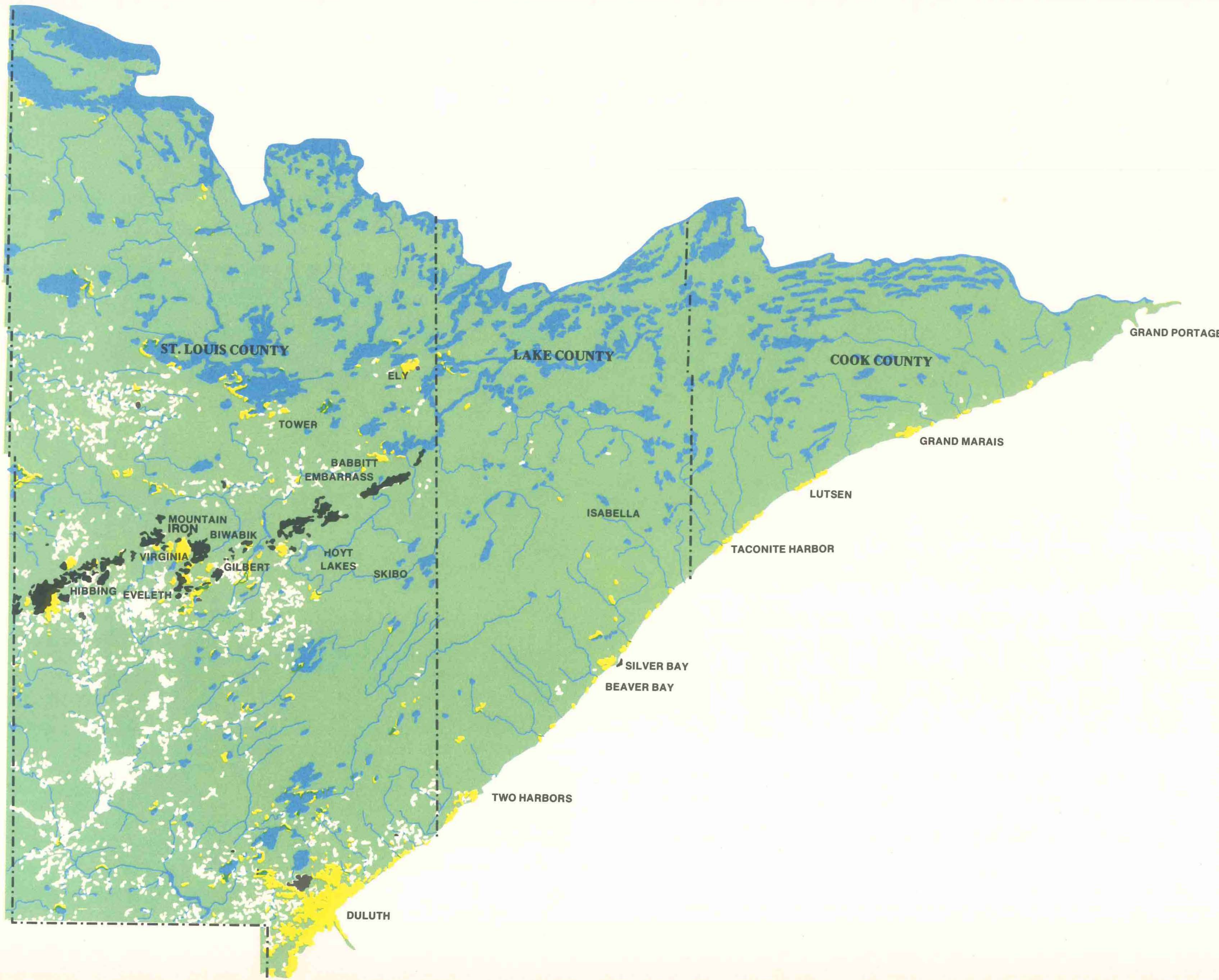
Cultivated

At present, in the three county area, 125 square miles is under cultivation.

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

61 REGIONAL SUMMARY OF EXISTING LAND USE



LEGEND

- TRANSPORTATION
- FOREST
- URBAN
- WATER
- EXTRACTIVE
- OPEN

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Extractive

The location of all mining operations in the study area is restricted to the Mesabi and Vermillion Ranges with the great majority of activity concentrated on the Mesabi, from Hibbing to Babbitt. Within the three counties the MLMIS study reported approximately 67 square miles were devoted to extractive activities. Since these data were taken from aerial photographs of the study area it does not include associated facilities such as tailings ponds, water reservoirs, or mine structures. In an attempt to more accurately identify this very important land use, Table 57 has been included. As can be seen from the 1971 figures of mine pits, underground caves and stockpiles, the total area was 74.8 square miles. This figure can be compared with the MLMIS data. The increased land use between 1969 and 1971 and the underground caves which could not be inventoried from the air, account for the difference in the two figures. When the tailings pond, water reservoirs and mine structures and facilities are included, the total land area in the three counties devoted to extractive activities approximates 126 square miles.

TABLE 57
MINE LAND INVENTORY
AREA (In Acres) UTILIZED BY MINING OPERATIONS — Date: January 1, 1971

LOCATION	MINE PITS and U.G. CAVES	SURFACE LEAN ORE and TACONITE STOCKPILES	TAILING PONDS	WATER RES.	MINE PLANTS and FACILITIES	TOTAL ACRES
St. Louis County						
Vermilion Range	480	---	---	---	280	760
Mesabi Range	22,280	25,080	12,160	3,520	15,720	78,760
Total St. Louis County	22,760	25,080	12,160	3,520	16,000	79,520
Itasca County						
Mesabi Range	6,320	9,720	9,880	2,760	4,200	32,880
Crow Wing County						
Cuyana Range	2,120	1,680	360	---	520	4,680
Lake County	---	---	280	40	680	1,000
Cook County	---	---	---	---	360	360
Total Northern Minnesota Counties	31,200	36,480	22,680	6,320	21,760	118,440 (185.1 sq.mi)
Total Study Area Acres (Square Miles)	22,760 (35.6)	25,080 (39.2)	12,440 (19.4)	3,560 (5.6)	17,040 (26.6)	80,880 (126.4)

NOTE: The above areas include only that land used (present and past) for mining and associated purposes. Areas do not include land held only for future mining and associated purposes.

Cultural

Urban Residential/Urban Non-Residential or Mixed Residential

While far from the most extensive land use, the urban areas or cities illustrate a concentration of man's effect on the area and a manageable activity. Included in these two land-use classifications are commercial and industrial uses along with residential development. In total, the two groupings accounted for approximately 180 square miles or 1.6 percent of the three county area. Residential land uses are concentrated around employment areas. The Iron Range and the metropolitan area of Duluth represent the major concentration of the urban residential and non-residential classified lands.

The residential property not located within these two areas or other communities is usually located in clusters at the intersection of two highways, along a highway or road or along the shores of lakes.

Transportation

While not a major land user, transportation must be considered a major developmental factor. The principal transportation facilities which are of importance in this study are the highway system (federal, state and county), railroads and harbors. A more complete discussion is included in the section on Transportation.

LAND USE SETTING

This section describes the cultural land use aspects of each site. While natural features, including terrestrial and aquatic habitat, hydrology and geology, make up the majority of "land use" on all the sites, these features are discussed in other sections of this study. Recreation, although not a specific use category is a major activity and is discussed fully within a separate section.

Included below are the specific cultural use activities including historic sites which are on or adjacent to the alternative disposal sites. An abbreviated discussion of historically significant features of the general area of the alternate sites can be found in Appendix E. Much of this material has been mapped for each site.

Mile Post 7

The proposed action site is presently in a natural state and exhibits few of man's facilities or activities other than those associated with testing for the proposed action. The major impact of human activities took place around the turn of the century when the site was logged and a railroad line was built. Since that time, the site has been left to natural forces to produce what presently exists on the site. A logging railroad has been abandoned. Listed in Table 58 are those facilities which exist on or near the site. There are no occupied structures on the site. Reserve has cleared access roads on the site to facilitate soil borings and other tests. These roads have been laid out in a grid pattern. The Henry Wieland homestead, and the adjoining Greenwood Trail, are the most significant of the historic sites within the Mile Post 7 study area (see Figure 62 for the location of historic sites).

Two snowmobile trails totalling 8 miles in length exist on the site. The state trail extends from 7 miles north of Duluth to 1 mile west of

Finland. This trail will be used as part of the planned North Shore Trail, which will extend from Duluth to Grand Portage. This will be a multipurpose trail used for hiking as well as snowmobiling. Other features that exist adjacent to the site include:

Off-Site

---Reserve's railroad
---Bear Lake residence
---Greenwood Trail
---Henry Wieland homestead

TABLE 58
LAND USE ON THE MILE POST 7 SITE

Snowmobiling Trail (Proposed to be one segment of the North Shore Trail)	-Use as a multipurpose trail is planned on this old railroad grade-- Township 56 North, Range 8 West, Sections 19, 21, 27, 28, 29, 31, 32.
Structures (Swanstrom Farm)	-Township 55 North, Range 8 West, Sections 3, 5.
Unimproved Dirt Road	-Township 55 North, Range 8 West, Sections 3, 4, 5, 8, 9.
Power Transmission Line	-Township 55 North, Range 8 West, Sections 8, 9.

Embarrass

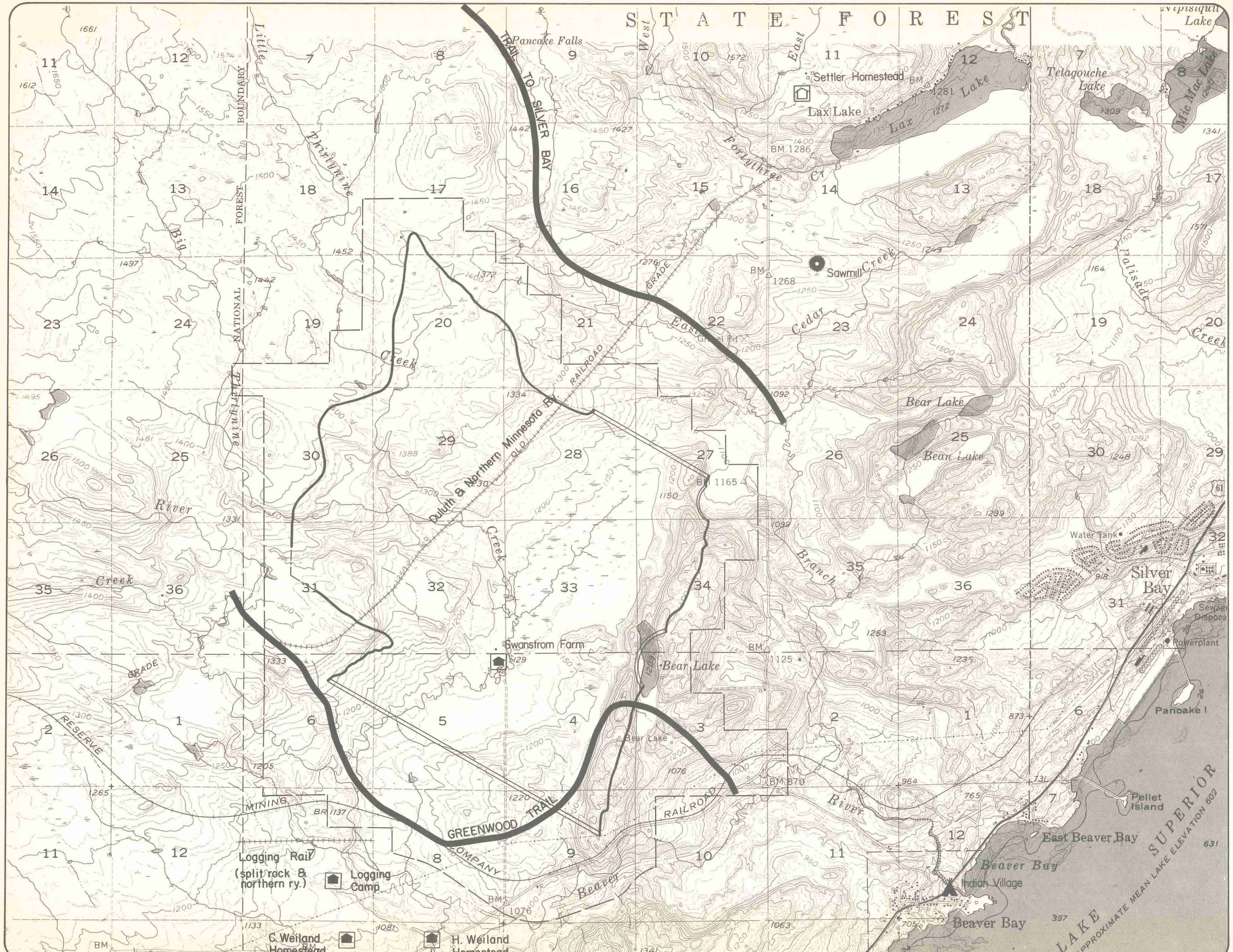
A number of facilities and activities exist on the Embarrass site. Facilities and locations are recorded in Table 59. Included are active farms, power transmission lines, roads and trails. A reserve stockpile is operated on the southern edge of the site. For the location of historic features see Figure 63.

Adjacent area uses include:

Trail Twp 60NR13W, Sec 19, 32
1874 mine shaft 4 miles northeast.
Ridge along southeastern edge of site reaches an elevation of 1,800 feet with a vertical rise of 150 feet in a horizontal distance of approximately 1,000 feet.[22]

TABLE 59
LAND USE ON THE EMBARRASS SITE

Tailings Basin	
Structures	-Township 60 North, Range 14 West, Sections 21, 22, 23, 24, 27, 33.
Power Transmission Line	-Township 60 North, Range 13 West, Sections 19, 20, 29, 30, 32; -Township 60 North, Range 14 West, Sections 24, 25, 26, 27, 28.
Improved Light Duty Road	-Township 60 North, Range 14 West, Sections 21, 23, 33.
Trails	-Township 60 North, Range 13 West, Sections 19, 30; -Township 60 North, Range 14 West, Sections 25, 26, 27.
Associated Project Area	
Structures	-Township 60 North, Range 13 West, Section 19. -Township 60 North, Range 14 West, Sections 22, 23, 24, 28.
Power Transmission Line	-Township 60 North, Range 13 West, Sections 19, 20. -Township 60 North, Range 14 West, Sections 24, 28, 36.
Improved Light Duty Roads	-Township 60 North, Range 13 West, Sections 19, 29, 31, 32, 33.
Unimproved Dirt Roads	-Township 60 North, Range 13 West, Sections 20, 31, 32. -Township 60 North, Range 14 West, Sections 32, 33.
Indian Camp Remains	
Trails	-Township 60 North, Range 13 West, Sections 19, 32.



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

62 HISTORIC FEATURES - MILE POST 7

LEGEND

——	TAILINGS BASIN
- - -	ASSUMED SITE BOUNDARY

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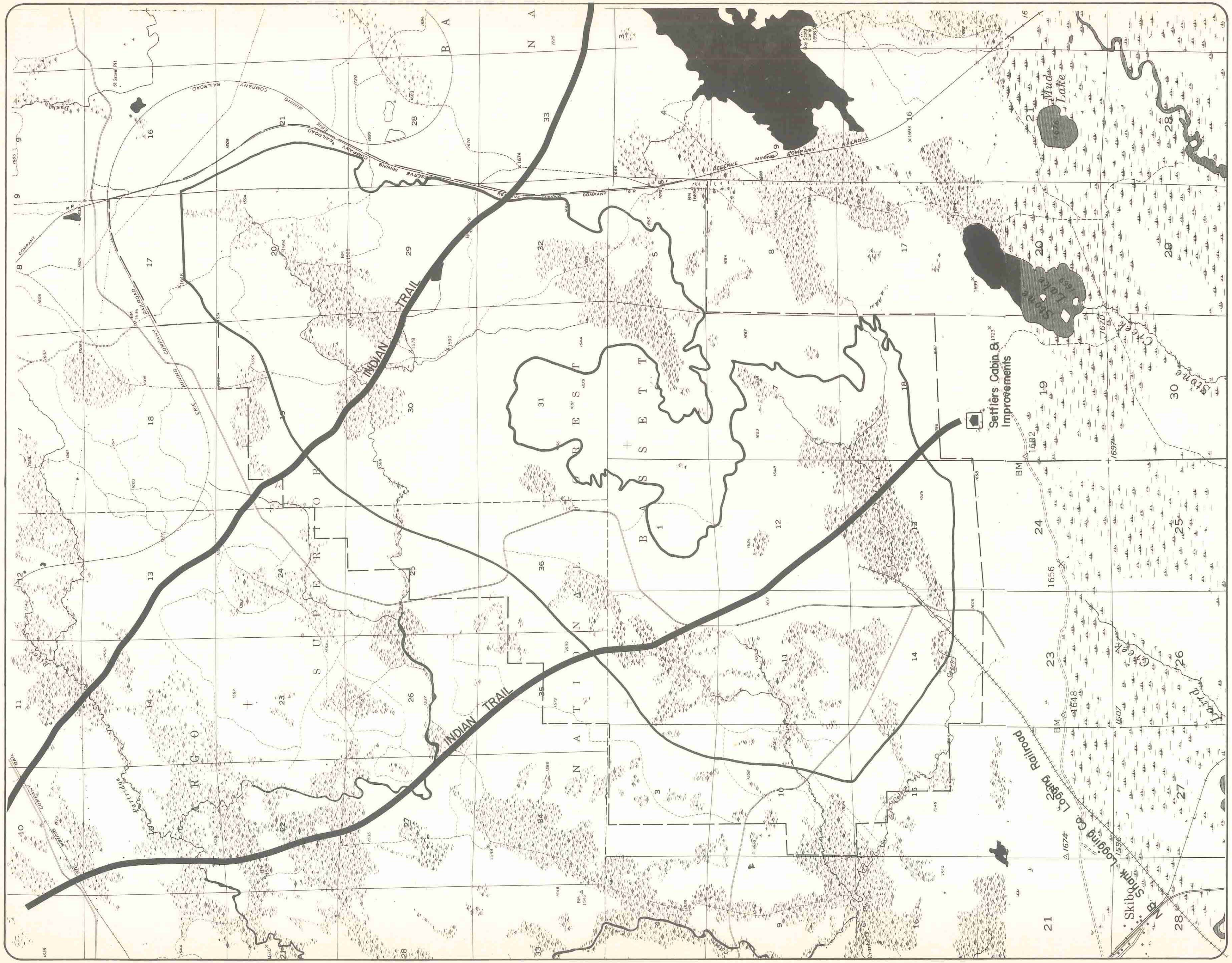
ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

63 HISTORIC FEATURES - COLVIN



LEGEND

— TAILINGS BASIN

- - - ASSUMED SITE BOUNDARY

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Colvin

The Colvin site is similar to Snowshoe in that it is within the Superior National Forest and a major portion of the site is owned by the Federal government (55 percent) and is managed under the multiple use--Sustained Yield Act (see Appendix F). Due to public ownership, the area is available for various recreational activities.

A portion of the Colvin site has been designated as a recreation area referred to as the Seven Beaver recreation area in the Aurora Ranger Districts-Multiple Use Plan approved August 31, 1972. That plan stated that "further development without a management plan could destroy the unique character of the area". The following is an excerpt from that plan.

> <u>Management Objective</u>
>
> Develop a comprehensive management plan for this area which will incorporate all facets of the Multiple Use -- Sustained Yield Act of June 12, 1960.
>
> <u>Management Decisions</u>
>
> 1. Permit no further development until an approved management plan is written.
> 2. Manage this area for as many purposes as are feasible and desirable.
> 3. Integrate management activities so that each contributes to the others for optimum efficiency and public benefit.
> 4. Give primary consideration to the aesthetics and recreational opportunities of this cahin of lakes with all other uses secondary.

The proposed Seven Beaver Recreation Area is presently accessible only by water, hiking, or snowmobile trails and would be used for primitive and wilderness camping.

The man-made facilities on the site are recorded in Table 60. The site is not inhabitated by man and no structures were found on the site. The principal facility on the site is Forest Route 114-116. Historic features are shown on Figure 64,

Snowshoe

The major influence on use of the site is its inclusion in the Superior National Forest. The Forest Service owns 72 percent of the site. This land is administered in accordance with the Multiple Use Substained Yield Act of June 12, 1960. Land ownership is also important since it influences the accessibility and use of the land by the general public. In the case of the Federal ownership, this land can be used for various forms of recreation. The privately owned areas may or may not become available to the public (see Appendix F).

TABLE 60
LAND USE ON THE COLVIN SITE

<u>Tailings Basin</u>	
Improved Light Duty Roads	-Township 58 North, Range 13 West, Sections 1, 2, 10, 11, 14. -Township 59 North, Range 13 West, Section 36.
Indian Trail Connecting to Greenwood Trail	
Trails	-Township 58 North, Range 12 West, Section 5. -Township 59 North, Range 12 West, Sections 17, 19, 20, 29, 30, 31, 32. -Township 58 North, Range 13 West, Sections 14, 15.
Abandoned N.B. Shank Logging Railroad	
<u>Associated Project Area</u>	
Improved Light Duty Roads	-Township 58 North, Range 13 West, Sections 10, 14. -Township 59 North, Range 13 West, Sections 25, 36.
Trails	-Township 58 North, Range 12 West, Section 5. -Township 58 North, Range 13 West, Sections 14, 15. -Township 59 North, Range 12 West, Sections 17, 18, 19, 28.
Power Transmission Line	-Township 59 North, Range 12 West, Section 17.
Erie Mining Company Railroad	-Township 59 North, Range 12 West, Sections 17, 18.
Other Features adjacent to the site include:	-Inactive sawmill (off site) 2.5 miles southwest near Skibo. -A state snowmobile trail about one mile west of the site and a local snowmobile trail about one mile south of the site.

The present man-made facilities on the site include two snowmobile trails (the Greenwood Trail, 2.5 miles, and the Top Township Trail, 1.0 miles), and unimproved dirt roads. Within the site area are trails, unimproved roads, a power transmission line, and the Erie Mining Railroad. The specific locations of the various features are recorded in Table 61. The location of historic features are shown on Figure 65.

DEVELOPMENT POTENTIAL IN THE STUDY AREA

The discussion below examines the components of change, which are present in the three counties with focus on those which are resource oriented uses or cultural in nature. The accuracy with which changes in land use can be projected over an extended length of time is limited. Many unpredictable factors enter into determining changes that will ultimately occur. These factors include the demand for the various minerals and forest products.

The information discussed below is drawn from a number of sources which deal with specific aspects of land use in the study area. An attempt has been made to assemble regional information to draw a composite picture of the study area in the future.

Mining

The land use changes associated with the mining industry will be the most extensive that will take place in the study area during the coming century. The expansion of the taconite industry and the initiation of copper-nickel mining will bring about numerous alterations to the existing land use. Natural iron ore (including both direct ore and gravity concentrated) is declining in the percentage of total iron ore shipped out of Minnesota. While the active and abandoned natural ore mines are an important aspect of present land use, it will not be increasing greatly in the future. Therefore, the discussion of the impact of mining on future land use will be restricted to taconite and copper-nickel operations.

Taconite

The taconite industry began in 1949. Given the demand for iron ore and the amount of taconite in Minnesota, a long life is expected.

According to figures supplied by the Division of Minerals, DNR, approximately 45 billion tons of magnetic taconite mineable by open pit methods exist in the iron range. This figure does not include non-magnetic taconite, or taconite which is recoverable by underground mining methods. Additionally, this figure does not assume changes in mining and processing technologies and metal markets. These changes will undoubtedly take place, and will allow future mining of taconite which is uneconomical by today's standards. It is clear that this 45 billion ton figure is conservative.

TABLE 61
LAND USE ON THE SNOWSHOE SITE

Tailings Basin	
Snowmobile Trails	-Township 59 North, Range 11 West, Sections 7, 18, 19. -Township 59 North, Range 12 West, Sections 11, 12, 13, 14, 23, 24.
Unimproved Dirt Road	-Township 59 North, Range 12 West, Section 11.
Associated Project Area	
Unimproved Dirt Road	-Township 59 North, Range 12 West, Section 11.
Trails	-Township 59 North, Range 11 West, Section 7, 18, 19, 30. -Township 59 North, Range 12 West, Sections 11, 12, 22, 23, 25, 26, 27.
Erie Mining Company Railroad	-Township 59 North, Range 11 West, Section 30. -Township 59 North, Range 12 West, Sections 22, 23, 24, 25.
Power Transmission Line	-Township 59 North, Range 11 West, Section 30. -Township 59 North, Range 12 West, Sections 22, 23, 24, 25.
Snowmobile Trails	-Township 59 North, Range 11 West, Sections 7, 18, 19.

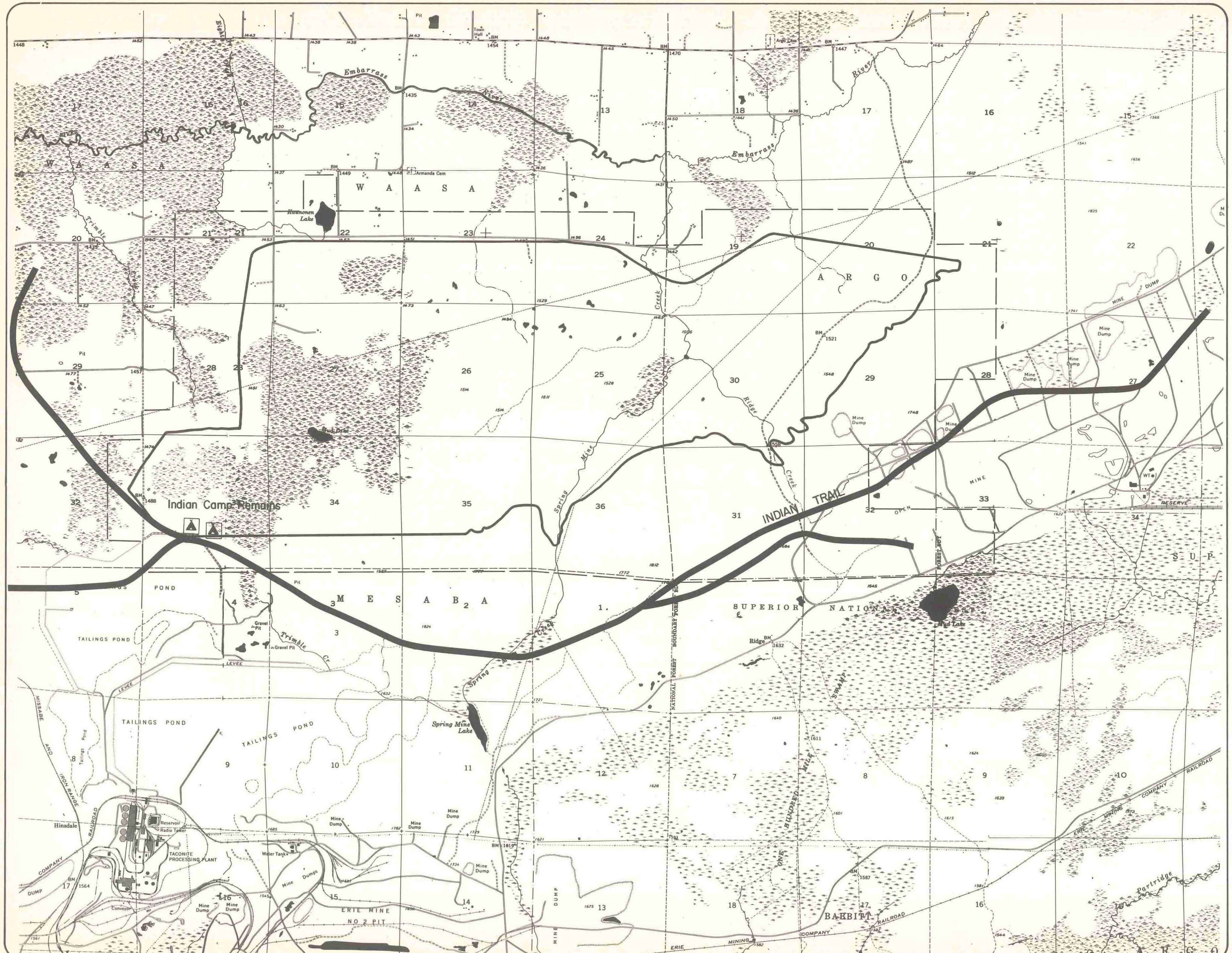
Mining of the 45 billion tons of ore will produce 15 billion tons of pellets and 20 billion tons of tailings. To date approximately 0.5 billion tons of pellets have been produced.

The existing land use associated with taconite mining and processing is approximately 40 square miles (see Table 62). The expansion of existing taconite mining operations and the three new operations which are presently under construction, being engineered or planned will require approximately 112 square miles of additional land. The total for existing and short term expansion then involves 153 square miles of land.

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

64 HISTORIC FEATURES - EMBARRASS



LEGEND

TAILINGS BASIN

ASSUMED SITE BOUNDARY

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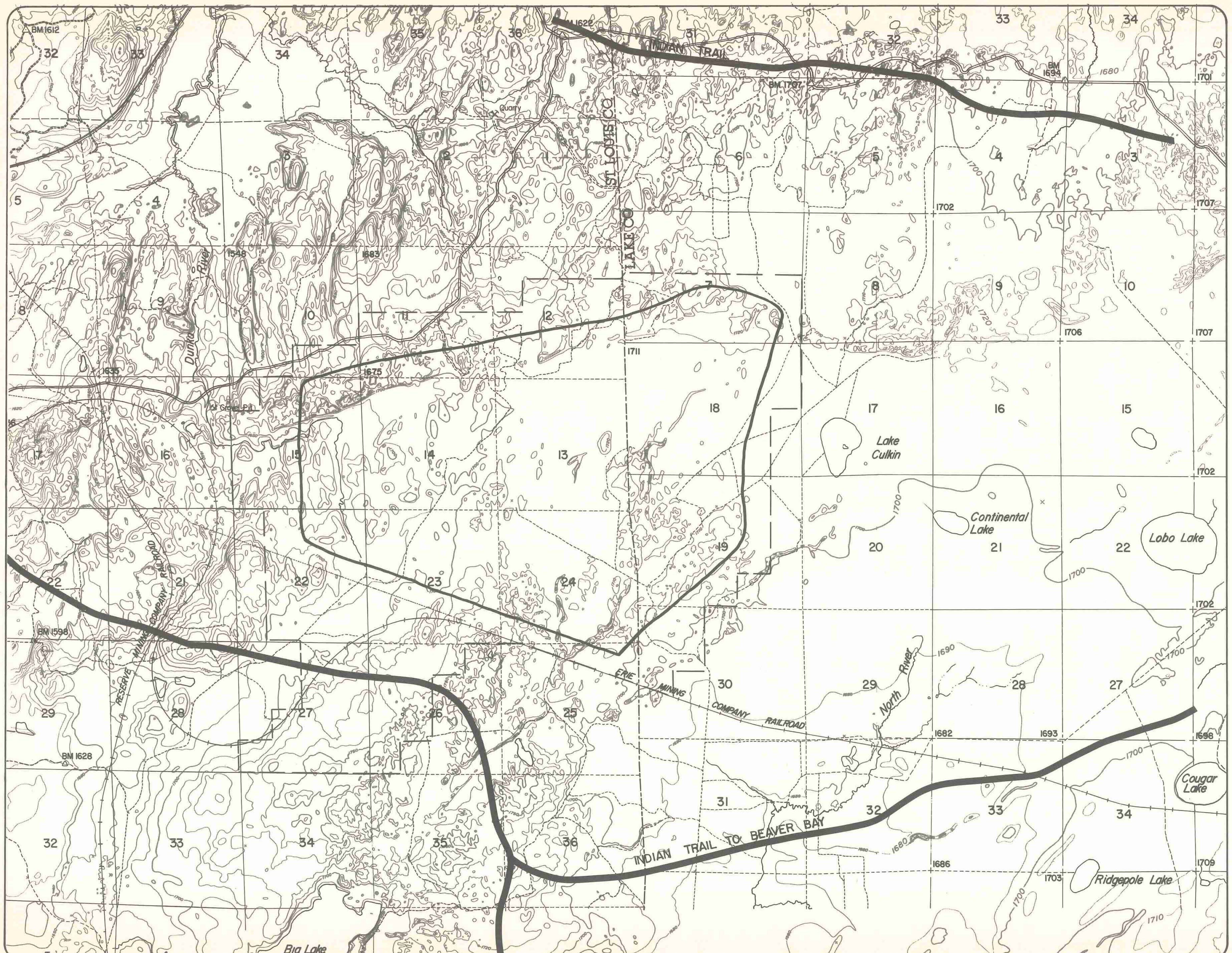
ENVIRONMENTAL IMPACT STATEMENT
RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

65 HISTORIC FEATURES - SNOWSHOE



LEGEND

- TAILINGS BASIN
- ASSUMED SITE BOUNDARY

BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

The short term expansion of the taconite industry will result in an increased production of approximately 70 percent of present taconite products (see Table 62).

From a land use standpoint, changes will occur to accommodate homes, roads, public facilities and associated industries. Thus, while the short term expansion of taconite mining and processing will require 112 square miles, those activities indirectly tied to it will require more land.

No long term projections of land use changes associated directly or indirectly with taconite mining and processing have been made. The present taconite mining operations have extracted 3% of the 45 billion tons of taconite recoverable by open pit methods. If technology finds a method of extracting iron from non-magnetic taconite the ore available for processing would increase significantly. If in time underground mining of taconite becomes economically feasible, the potential ore supply would be greatly expanded.

Copper-Nickel

While the future of the copper-nickel mining is much less definite than the expansion of the taconite industry, the potential effects on land use resulting from this new industry may also be substantial in the coming years. While a specific year cannot be predicted as to when copper-nickel mining might begin in northeastern Minnesota, it seems safe to assume that if the necessary permits can be obtained by the mining industry, that during the 1980's copper-nickel ore could be mined.

Based on existing data, it is likely that copper-nickel mines will be located somewhere in a band which extends from Hoyt Lakes to the BWCA southeast of Ely. This area is considered the prime area of copper-nickel potential. Individual sites are rated by their potential described in the Mineral Potential Subpart.

Since no copper-nickel mining operations have yet to be located in Minnesota, data on future land use associated with such mining has to be drawn from other sources. An Inter-Agency Task Force was set up in 1972 to consider the impacts of base metal mining and processing in Minnesota and to research the capacity of the state to deal with the ramifications of the entire copper-nickel mining process. Representatives of the Department of Natural Resources, Pollution Control Agency, State Planning Agency, Department of Economic Development, Department of Health, and the Department of Labor and Industry participated in the study. The final report was released in January, 1973. Information from that study has been used in the discussion below to project possible land use changes which may result from copper-nickel mining (see Table 64).

According to the Inter-Agency Task Force Report on Base Metal Mining Impacts, the typical copper-nickel mine in this area will be mining the Duluth Gabbro. The typical mine would likely be an underground operation with an individual mine life on the order of 25 to 50 years. (It should

TABLE 62
EXISTING AND PROJECTED LAND USE ASSOCIATED WITH TACONITE MINING AND PROCESSING (SQUARE MILES)

	PIT		BASIN(1)		STOCK PILE	
	Existing(1)	Planned	Existing	Planned	Existing	Planned
U.S. Steel	2.53	NA	4.37	22.0(2)	0.87(3)	NA
Erie	8.19	NA	4.19	14.1	2.92(4)	NA
Reserve	5.19	NA	--	--	1.82(5)	NA
In Land Steel(6)	--	1.18	--	4.39	--	2.38
Hibbing Taconite	--	3.59(7)	--	11.6	--	NA
Eveleth Taconite(8)	1.78	2.0	1.22	5.12	1.87	2.73
Cleveland Cliff (Jones & Laughlin)	---	2.62	--	7.2	--	NA
Hanna	0.98	NA	4.5	32.6	0.86	NA
TOTAL - Sq. Miles	18.67	9.39	14.28	97.01	8.34	5.11

(1)Department of Natural Resources, Working Map, January, 1973

(2)Pollution Control Agency Permit # WPC 5055

(3)U.S. Steel, 1975, Reclamation Map

(4)Erie Mining Company, 1975, Reclamation Map

(5)Reserve Mining Company, 1975, Reclamation Map

(6)Final Environmental Impact Statement: Proposed Inland Steel Taconite Operation, St. Louis County, Minnesota March 22, 1974

(7)Application for Permit (submitted to the Minnesota Pollution Control Agency), Hibbing Taconite Project

(8)Application for Permit (submitted to the Minnesota Pollution Control Agency), Expansion of Eveleth Taconite Project

be noted that at this time one company is considering an open pit mine and that some of the mines in the area will probably start out as an open pit operation and go to underground mining as the ore near the surface is exhausted.)

The requirements for 36 mines based on the three types of operation range from 39 square miles to 328 square miles. In comparison, taconite mining at present occupies 40 square miles of land in the three counties.

The maximum land area required for an underground operation is 294 square miles, or 2.8 percent of the study area. This would be an area approximately equal to all the urban residential, urban non-residential or mixed residential and cultivated land uses in these three counties in 1969. Included in these land use categories is the City of Duluth.

The land area required to support a population increase generated can be assumed to be in proportion to the existing land in urban and residential

TABLE 63
PROJECTED SHORT TERM (5 YEARS) EXPANSION OF THE TACONITE INDUSTRY*

	Location	Investment	Increased Production (millions of tons)	New Permanent Jobs	Construction Jobs
Hibbing Taconite	Hibbing	$ 300,000,000	8.1	1,050	2,000
Inland Steel	Virginia	100,000,000	2.6	450	1,500
U.S. Steel	Mountain Iron	200,000,000	6.0	750	1,500
National Pellet	Keewatin	200,000,000	3.4	400	1,500
Eveleth Taconite Co.	Eveleth	200,000,000	3.6	450	800
Butler	Cooley	100,000,000	3.0	350	1,000
Cleveland Cliff	Biwabik	150,000,000	4.0	600	1,300
		$1,250,000,000	30.7	4,050	9,600

*Source: "Assessment of Growth Impacts on the Iron Range," May 1974, Arrowhead Regional Development Commission.
Update: St. Paul Dispatch, August 30, 1975
Lottee Seidler, United Press International

use. At present, the area in these two categories of land use equals approximately 180 square miles. An increase of 64 percent, or approximately 115 square miles, would be required.

Forestry

Forested land accounts for approximately 81 percent of the three counties. A majority of these 8,500 square miles (5,440,000 acres) is available for timber production. The 618,000 acre interior zone of the Boundary Waters Canoe Area was the principal exception until recently. No timber harvesting is permitted in this area. In addition to the interior zone, a 412,000 acre portal zone exists around the interior zone, which acts as a buffer.

This area has been logged under the Multiple Use Sustained Yield Act of 1960 until a recent court injunction. This injunction was issued in response to an action requesting that the portal zone be managed in a

TABLE 64
LAND REQUIREMENTS FOR COPPER/NICKEL MINING

	1 Mine Minimum	1 Mine Maximum	9 Mines Minimum	9 Mines Maximum	36 Mines Minimum	36 Mines Maximum
Underground Mine-2/3 of Tailings and Waste Rock are Disposed of Underground	acres					
	695	2,410	6,255	21,690	25,020	86,760
	1.1 sq. miles	3.8 sq. miles	9.8	33.9	39.1	135.6
Underground Mine - No Underground Disposal of Tailings or Waste Rock	acres					
	1,980	5,220	17,820	46,980	71,280	187,920
	2.8 sq. miles	8.2 sq. miles	27.8	73.4	111.4	293.6
Open Pit	acres					
	2,610	5,840	23,490	52,560	93,960	210,240
	4.1 sq. miles	9.1 sq. miles	36.7	82.1	146.8	328.5

similar manner as the interior zone (i.e., no timber harvesting). An appeal to lift the injunction will be heard during the fall of 1975. If the injunction is not lifted, the net result would be to reduce the amount of land that could be harvested for forest products by 7.5 percent and increase the amount of land utilized principally for wilderness or primitive recreation.

Recreation

Recreation areas overlap the forestry areas to a large extent except as noted above. A number of public and private facilities are provided as enumerated in the recreation section. The following are plans for specifically designating and developing additional public recreation areas.

Voyageurs National Park

Voyageurs National Park was officially established in 1975 and encompasses 210,000 acres. The area will be managed as a natural area by the National Park Service and portions will be reviewed for inclusion in the National Wilderness System. The water oriented park will be utilized for a variety of activities such as camping, hiking, swimming, boating, fishing and cross-country skiing. Creation of the park recognizes the uniqueness of the area as a national resource. Its development will broaden national exposure and visitations. The area presently attracts 350,000 users a year. Upon completion of the various facilities, annual visitor days is expected to be 1 to 1.3 million.

While development of the park will create changes in the use of the 200 square miles of land involved, it will also bring about changes to the surrounding area and along access roads leading to the park.[98]

The principal changes will be associated with tourist accommodations (approximately 65 percent of all tourists will have to be housed in private facilities), and services such as restaurants, service stations, boat rental, and grocery stores. Since most of the existing commercial activities will be able to accommodate additional customers, the greatest demand will be for overnight accommodations. At maturity, the park is anticipated to require 1,100 additional lodging units during peak daily conditions.[99] No estimates have been made as to the amount of land which would be required to meet this demand for overnight facilities. There are no estimates for other land uses and facilities that will be required.

The draft report on sub-regional plan for the Voyageurs planning area establishes development goals and policies for guiding this anticipated expansion.[99] For a discussion of these plans, see Appendix F.

State Park Expansion

New and expanded state public recreation facilities are planned in the study area to accommodate increasing number of visitors. The Department of Natural Resources has identified expansion plans for a number of state parks in the three counties and the development of the new Tetagouche State Park along the north shore. The amount of land involved in these activities was estimated at 5,890 acres. (The total of present park land in the three counties is 38,250 acres.) The majority of these expansions will be along the north shore (see recreation section for detailed discussion of existing parks and proposed expansion).

Seven Beaver Recreation Area

The Federal government through the National Forest Service has proposed the Seven Beaver Recreation Area in the Superior National Forest. This area will be managed to "give primary consideration to the aesthetics and recreational opportunities of this chain of lakes with all other uses secondary." (Source: Aurora Ranger District Multiple Use Plan approved on August 31, 1972.) This area is accessible by hiking and snowmobiling trails. The designation of this area would create an additional primitive recreation area in support of those resource oriented activities.

Potential Development Sites Relating to the "National Recreational Corridor"

Working for the Minnesota State Planning Agency, the Minnesota Land Management Information System Study group investigated potential land for development of adjoining northern Minnesota's "National Recreation COrridor." This 1972 study concluded that a creational corridor exists, which extends from Isle Royale to Rainy Lake. This corridor includes two national parks, a national monument, and a major national wilderness area and extends for a distance of 200 miles along the northern Minnesota boundary. Supporting the recreation corridor is the Quetico Provincial Park.

The study concentrated on identifying land suitable for private development supporting recreation activities. The study included the area within a one-hour driving time to any access point of the two parks and the BWCA. This was defined as the impact zone. The criteria utilized to identify favored locations for private development were:

- Privately-owned land.
- Existing development.
- Transportation modes.
- Water frontage.
- Suitable soils.

Applying these criteria to the impact zone, it was found that there was:

1. Over 300,000 acres of privately-owned property within one hour's driving time to Voyageurs National Park.
2. Approximately 120,000 acres of the above area is within one hour's driving time of BWCA entrance.
3. All five criteria were met by about 500 acres.
4. 14,500 acres met all but one of the criteria.

The amount of land required by this development varies widely. Because of its accessibility orientation, the areas will be highly visible to those living in and visiting the area.

Cultural Activities

Expansion of iron mining and processing, forestry, recreation and the potential of copper-nickel mining and processing create an expanded economic base. This expanded base in turn requires expanded services and facilities. Commercial goods and service facilities will be needed. Supporting industrial uses will increase. Additional housing and community facilities will be required. More highways, transportation facilities and utilities will be needed to support the development expansion. Land needed to support these activities could range from less than 100 square miles to several hundred square miles, depending on the magnitude of the projections and the public policy which emerges with respect to locational concerns. These uses are largely not compatible with the fragile and limited natural environmental resource and create conflicts for long term utilization and enjoyment of the primitive natural resources.

SUMMARY

Recent and projected cultural and resource oriented land use changes document that significant change is and will be occurring in the three-county area. The change in status of the BWCA portal zone and the newly created Voyageurs National Park alone represent over 843 square miles of forest which have changed from wood producing to recreation in a period of a few months. Changes in the amount of land devoted to activities is occurring in resource extraction, forestry, public recreation areas, and related cultural activities. Locational and development intensity decisions taken individually are relatively insignificant. However, in the dynamics of regional development each action and particularly each policy decision sets a course of development which is significant and if improperly managed could substantially erode the natural and recreational character of the area.

STATUS OF EXISTING LAND USE PLANNING

The development potential for the three-county area described above poses many opportunities and problems. Certain types of changes can be managed through public policy and plans. Comprehensive planning offers the opportunity to relate activities to each other, minimize conflicts, and protect the natural and cultural environment. The first problem with existing land use planning is that it is spread out between numerous overlapping jurisdictions with differing geographic and functional responsibilities. Such a proliferation of responsibility creates a potential for conflicting plans. Consider some of those agencies with land use and environmental planning responsibilities in the study area:

- U.S. National Park Service
- U.S. Forest Service
- U.S. Bureau of Indian Affairs
- U.S. Border Patrol
- U.S. Fish and Wildlife Service
- Minnesota Department of Administration
- Minnesota Department of Aeronautics
- Minnesota Department of Agriculture
- Minnesota Office of State Auditor
- Minnesota Department of Economic Development
- Minnesota Department of Health
- Minnesota Department of Highways
- Minnesota Historical Society
- Minnesota Iron Range Resources and Rehabilitation Commission
- Minnesota Department of Miltary Affairs
- Minnesota Department of Natural Resources
- Minnesota Pollution Control Agency
- Minnesota Department of Public Safety
- Minnesota State Soil and Water Conservation Commission
- Minnesota Department of Taxation
- Minnesota Water Resources Board
- Arrowhead Regional Development Commission
- St. Louis County
- Cook County
- Lake County
- Several Municipalities

The second problem is with the lack of coordinated comprehensive land use plans. The three counties and selected communities have comprehensive plans in various stages of completion and have or are in the process of adopting zoning ordinances. Local and county planning efforts have difficulty in responding to factors of state and national significance such as tourist demand, and steel markets. In the absence of the broader framework these plans have, according to regional reports, led to over zoning for cultural land use activities encouraging sprawl and land use conflicts. While the Arrowhead Regional Development Commission is involved in many planning studies, adoption of a regional comprehensive plan has not yet occurred. The state does not have a comprehensive land use plan. Seventeen state agencies are involved in land use and environmental planning. Their efforts are uncoordinated and often result in conflicting policies. A recent study conducted by the State Planning Agency found that many State agencies are operating without clearly defined policies to guide their on-going programs.

The resources and markets of the three counties respond to broader forces and interests. Coordinated, consolidated, comprehensive public policy form a state and regional as well as local perspective, is needed. The authority exists but the job remains incompleted.

INDIVIDUAL GOVERNMENTAL ACTIONS CONSTITUTING PLANNING POLICY

In the absence of stated comprehensive public planning policy, it is possible to examine the policy which individual public actions imply. The difficulty of this approach is that each action or decision need not be compatible or related to others, causing confusion as to what course should be pursued for the area. On the state level, for example, most state agencies which are involved with various aspects of land use and resource management do not have comprehensive plans or policies to guide their actions in relationship to each other. However, these agencies are vested with important powers to influence land use decisions including:

1. Acquisition, Construction and Management Programs - Through legislative authority, state agencies are empowered to acquire land, build facilities, and manage the resources. Examples include highways, state parks, forests, wildlife management areas and state institutions.

2. Regulatory Programs - Certain actions regarding the use of land or a particular resource require issuance of a state permit or license. Examples are, DNR permits for dredging or filling of lakes and streams and PCA permits which regulate the location and design of feedlots or solid waste sites. In some cases such as shoreland management, enforcement and implementation is delegated to local governments.

While state agencies have a wide range of authority to manage change, they appear to have been given limited guidance as to what should be done with these tools. "... these agencies have some discretion in administering the functional programs they are responsible for. That is to say, they can determine priorities for the funding, acquisition, development and location of facilities and can, within certain constraints, allow exceptions to the terms of regulatory programs."(100)

To illustrate the problem of determining public policy through incremental, non-comprehensive actions, some of the activities which have been encouraged or sanctioned along the north shore, as an example, were examined and are listed in Table 65. Two conflicting objectives or policies for the north shore are indicated by these actions:

1. Improve and protect the natural and recreational resources of the area.

2. Foster and encourage industrial and urban development.

The same types of conflicts emerge in analyses of individual actions in other areas. In the absence of comprehensive coordinated policy, individual actions take on greater significance because their relationship to other actions and long term needs may be devastating.

TABLE 65
INDIVIDUAL GOVERNMENTAL ACTIONS CONSTITUTING PLANNING POLICY ALONG NORTH SHORE

1. Actions Supporting Improvement and Protection of Natural & Recreational Resources

   Technical Assistance Grants provided through the ARDC:
   - Mobile Tourist Information Van Demonstration
   - Recreation Tourist Development Center
   - Assistance to Small Business and Recreation

   Economic Assistance Grants:
   - Development of tourist accommodations on the Grand Portage Indian Reservation

   Development of Recreation Facilities:
   - State Parks
   - Local Parks
   - Scenic Overviews
   - Rest Areas
   - North Shore Trail
   - Identification of Historic Sites
   - Designation of a National Monument at Grand Portage

   Fish Stocking Program:
   - Streams
   - Lake Superior

   Planning and development of pleasure boat harbors at:
   - Grand Marais
   - Knife River

   Issuance of building permits for motel, recreational homes, restaurants, and commercial enterprizes.

   Creation of a Wildlife Management Area along the North Shore.

   Creation of State Forests:
   - Finland
   - Grand Portage

2. Public Actions Encouraging Industrialization and Urbanization of the North Shore

   Reserve's beneficiation plant at Silver Bay
   Silver Bay Harbor construction
   Taconite Harbor construction
   Reserve's railroad and unloading facilities
   Erie's railroad
   Construction of industrial habor facilities at Two Harbors
   Construction of the city of Silver Bay and associated facilities
   Construction of the city of Taconite Harbor and associated facilities

RECREATION

Northeastern Minnesota is a nationally recognized recreation area, largely due to its pristine nature, attractive setting, and abundant lakes. The presence of a tailings basin will displace a portion of the setting and could affect the surrounding area. This analysis will attempt to identify the effects upon the recreation area that will occur if the proposed action or one of the alternatives is implemented.

The extent to which the recreational character in and around a site would be affected by using that site for a tailings basin is dependent on a number of environmental factors, which are discussed elsewhere in the EIS. These are: air and water quality, terrestrial and aquatic habitat, landform and hydrology, aesthetics, and accessibility. Each influences the existing and potential recreational character of an area.

OVERVIEW

The recreation study area consists of Lake, Cook, and St. Louis Counties. This area and the recognized recreational units within the area, represent unique natural resources of state and national importance. Examples of recreation units within the study area are the Boundary Waters Canoe Area, the North Shore of Lake Superior, and Voyageurs National Park. Visitors are attracted to the study area for a number of reasons:

Summer:
- To enjoy the panoramic vistas of Lake Superior from U.S. Highway 61 (part of the Lake Superior Circle Route).
- To explore the scenic and historic features of the area, such as iron mining and related facilities.
- To partake in the wilderness camping, fishing, and canoeing experiences offered in the region.
- To relax and enjoy the natural features of the area and the facilities offered at various resorts and lodges.

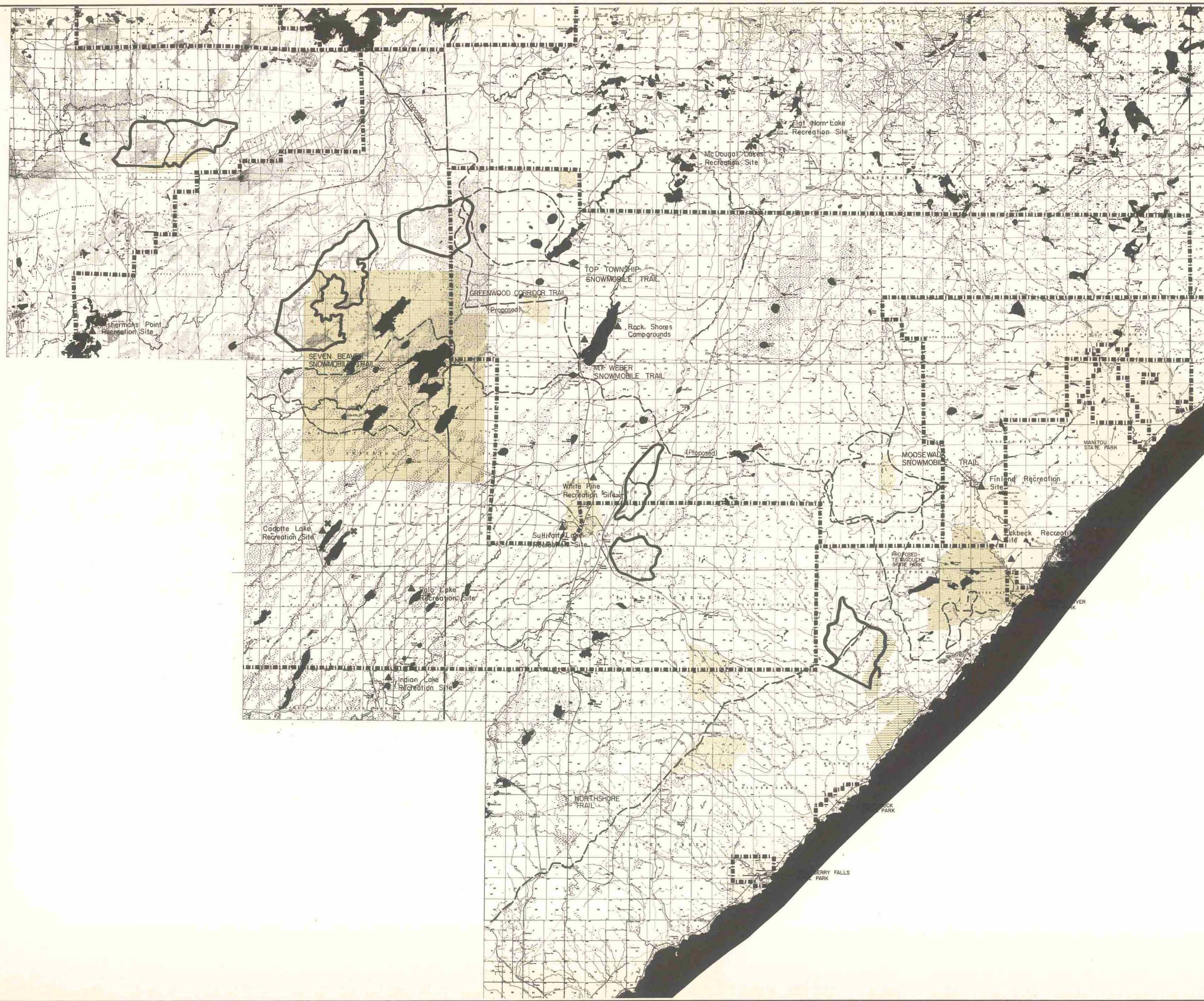
Autumn:
- To enjoy the panoramic vistas of Lake Superior and the fall change of color as seen from U.S. Highway 61 and inland roadways.
- To partake of hunting, camping, fishing, and canoeing opportunities.

Winter:
- To participate in the snow sports offered in the area: snowmobiling, downhill skiing, cross-country skiing, snow-shoeing, and, to a limited degree, ice fishing.
- To relax and enjoy the scenic remoteness of the area and the facilities offered at various lodges and resorts.

Spring:
- A time of limited opportunity, due to the weather variations experienced between winter and summer, with some fishing activity.

The study area includes a number of designated or recognized recreation facilities and system (see Figure 66). The newly-established Voyageurs National Park, located in the northwestern part of the study area, represents a water-oriented natural area. The Boundary Waters Canoe Area, which is managed by the U.S. Forest Service, is a 1 million acre wilderness area located in the northeastern portion of the study area, adjoining the Canadian border. The north shore of Lake Superior is a nationally recognized scenic and recreational corridor. The North Shore Drive (U.S. Highway 61) is part of the Lake Superior Circle Route, and provides access to several routes leading into the Boundary Waters Canoe Area. The north shore corridor contains several state parks, trails, resorts, and campgrounds and has been considered for possible designation as a Critical Area pursuant to the Minnesota Critical Areas Act of 1973[101] and is currently being considered for inclusion in the Federal Coastal Zone Management Program. At the northeastern tip of Minnesota, on the north shore, is Grand Portage National Monument, an historic fur trading post. Twenty-two miles off Grand Portage in Lake Superior is Isle Royale National Park. A boat launch provides access to Isle Royale from Grand Portage.

The Vermillion and Mesabi Iron Ranges have become recreational attractions in and of themselves, due in essence to the nature of the iron-mining industry. Many observation decks, a museum, an Iron Range Trail, and a state park have evolved as a result of interest in the iron mining industry. The remainder of the study area offers a combination of activities complimentary to the recreation components discussed above.



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

66 RECREATIONAL FACILITIES AND SYSTEM

LEGEND

- LAND FORMS
- SCENIC TIMBER
- PROBABLE FUTURE PARK EXPANSION AREAS
- PROPOSED STATE PARKS OR RECREATION AREA
- STATE RECREATION TRAILS
- RECREATION SITES
- PROPOSED TAILINGS SITES
- POINT OF INTEREST
- BOAT LAUNCH
- RECREATION SITE WITH CAMPGROUNDS
- NATIONAL/STATE FOREST BOUNDARIES AND STATE PARKS
- COUNTY BOUNDARIES

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MINNEAPOLIS, ST. PAUL, MINNESOTA 55454

Recreational User Origins

The importance of the study area as a recreation area is apparent. Thirty-eight percent of Minnesotans interviewed in 1974 planned to vacation in the area for a week or more during the coming year.[102] Estimates of annual Minnesota visitors to the study area range from 1.0 to 1.3 million visitors.

The significance of out-of-state usage is indicated in summer usage figures compiled by state and federal park officials. For visitors from out-of-state, the primary season of travel is summer, when approximately 42 percent of visitors to the Boundary Waters Canoe Area are from states other than Minnesota (see Table 66).[103]

TABLE 66
LOCATION OF BWCA ORIGINS

Origin	% of Total BWCA Visitors
Minnesota	58.4
Illinois	14.1
Wisconsin	7.0
Iowa	4.3
Indiana	3.1
Other	13.1

Projection of recreational activity demand for major cities in the Upper Midwest market is presented in Table 67. For those metropolitan areas and states projected to gain population during this period, the recreational activity demand will be the greatest (i.e., Indianapolis, Ind.; Minneapolis, Minnesota). It should be expected that this growing demand should be met in states that have developed reputations and promotional programs as major recreational destinations. Thus, Minnesota, and the study area in particular, should expect to continue to draw heavily from the 28 million people[104] residing in its market area wishing to enjoy the scenic natural resources and the nation's iron mining legacy. Likewise, the nationally prominant wilderness facilities of Boundary Waters Canoe Area, Isle Royale National Park, and Voyageurs National Park should increase the broadened appeal of the area due to its growing national public exposure. Presented in Appendix F is a summary overview of recreational activities and expenditures. The major national and area trends that will impact the future recreation demand for the study area can be summarized as follows:

1. Participation in outdoor recreation is expected to grow 1/3 faster than the market area's population, owing to increase in leisure time, disposable income, and proximity to resource areas.[105]

2. Escalation in total vacation costs (i.e., energy, accommodations, food, etc.) will result in not only greater amounts of time spent engaged in pre-planning of vacation, but will result in more destination-oriented trips to recreational regions. Rising vacation costs will result in an escalation of low-cost recreational activities (e.g., camping, fishing, canoeing).

3. The demand will emerge for a variety of overnight accommodations. Overnight accommodations can be expected to vary in response to changes in user demands.

4. Non-energy using winter-time recreational activities should continue to grow in popularity, while energy-using recreational activities should begin a relative decline. Thus, for geographical areas within well-developed snow ski areas, demand should continue to increase through a slow expansion of market.

5. Completion of the Voyageurs National Park will create a wilderness recreation corridor extending across the northern edge of Minnesota. The Boundary Waters Canoe Area, Isle Royale, Grand Portage, and

TABLE 67
PERCENT INCREASE IN OUTDOOR RECREATION ACTIVITIES DEMANDED BETWEEN 1972 AND 1978

	Camping in Developed Camp Grounds	Fishing	Riding Motor Cycles Off The Road	Nature Walks	Walking For Pleasure	Bicycling	Water Skiing	Other Boating	Outdoor Pool Swimming	Other Swimming Outdoors	Golf	Playing Other Outdoor Games Or Sports	Going To Outdoor plays Concerts, Etc.	Going To Outdoor Sports Events	Visiting Zoo, Fairs, Amusement Parks	Sightseeing	Picnicking	Percent Change in Population	Percent Change in Family Income
Indianapolis, Ind.	15	13	13	16	14	12	17	20	15	16	21	6	15	21	12	14	13	11	13
Chicago, Ill.	13	10	11	14	12	11	16	19	14	14	20	4	13	19	10	12	11	9	15
Madison, Wis.	14	13	13	16	14	11	15	20	14	15	20	6	14	19	12	13	13	11	10
Milwaukee, Wis.	12	10	11	14	11	10	14	17	13	13	19	4	12	19	9	11	11	8	15
Duluth, Minn.	8	7	7	9	8	5	9	13	8	9	13	0	8	13	6	7	7	6	10
Rochester, Minn.	11	10	10	12	11	9	11	15	12	11	16	3	11	16	9	10	10	8	10
Minneapolis, Minn.	12	11	11	14	12	10	13	17	13	13	18	4	12	18	10	12	11	9	11
Grand Forks, N.D.	-1	-2	-2	0	-1	-3	0	3	-1	0	4	-7	-1	2	-2	-2	-2	-3	9
Bismarch, N.D.	2	1	0	3	1	-2	2	6	1	2	7	-6	2	5	-1	1	0	0	9
Fargo, N.D.	4	4	3	6	4	2	5	9	5	6	9	-2	5	8	3	3	3	2	8
Aberdeen S.D.	0	-1	-1	1	0	-3	0	4	0	1	5	-7	0	4	-2	0	-1	-2	9
Sioux Falls, S.D.	3	2	1	4	2	0	2	6	2	3	8	-5	3	7	1	2	2	1	10
Rapid City, S.D.	2	1	1	3	1	0	3	6	2	3	7	-5	2	7	0	1	1	-1	11
Des Moines, Iowa	9	8	8	10	8	7	10	13	10	9	14	1	9	15	7	8	8	6	13
Omaha, Neb.	10	8	9	12	9	8	12	15	11	11	16	2	10	16	7	9	9	7	13
St. Louis, Mo.	11	9	10	13	10	9	15	18	12	13	18	3	11	17	8	10	10	8	13

Voyageurs will provide an unique attraction not duplicated in this country. It is projected that 1.3 million visitors will be attracted annually to Voyageurs alone.(106)

An adequate energy supply and the timely completion of proposed state and national park plans should serve as the catalysts to increase present tourist volumes of 1.0-1.3 million annual visitor days to a year 2000 average of approximately 1.8 to 2.0 million annual visitor days. The projected increase will not only necessitate increased public development of campground and park facilities, but will require a major commitment from the private resort/lodge sector for additional hospitality accommodation development and investment.

Facilities and Opportunities

The quality of the natural experience is a significant factor of the area selected for recreation activity. In addition to the quality of the experience, use is also related to the accessibility of the area(s), the quality and type of facilities and activities provided, and the availability of suitable accommodations.

Figure 67 depicts the major access routes to and through the study area. These provide access to the following major recreational areas:

1. The Mesabi and Vermillion Iron Ranges
2. Voyageurs National Park
3. BWCA
4. Superior National Forest
5. Grand Portage National Monument and Isle Royale National Park
6. North Shore
7. Supporting natural areas.

Existing public facilities and their useage further illustrate the recreational resource base. Recreational facilities in the study area are provided for the most part by the federal government through the U.S. Forest Service and the National Park Service, and the State of Minnesota through the Department of Natural Resources.

The following is an overview of state recreational facilities for fishing, trail-related activities, and parks.

Fishing

Minnesota contains 15,000 miles of fishable rivers and streams, of which about 1,500 miles are inhabited by various trout species. There are only two areas in Minnesota having concentrations of trout streams. They are the north shore and the southeastern tip of the state. Lake Superior streams contain primarily brook and rainbow (steelhead) trout, while the southeast streams contain primarily brown trout.(107)

Fishing pressure amounting to nearly 1,000 person-hours per acre have been recorded on the lower reaches of north shore streams where lake-run rainbow trout enter from Lake Superior in spring and brown trout in fall. This is heavy pressure, considering that the average warm water lake logs only 35 person-hours of fishing during summer and winter.(107) The three county study area contains 217 designated trout streams. There are 71 designated trout streams in Lake County.

Trails

Trails in Minnesota are provided for at least the following activities: snowmobiling, hiking, cross-country skiing, biking, and horse-back riding. The DNR Division of Parks and Recreation is coordinating an extensive and diversified trail system which will eventually link all 87 Minnesota counties.(108) There is a total of over 400 miles of federal, state, and county designated snowmobile trails in the study area.(109) Most of these trails are multipurpose and, therefore, provide for other trail activities throughout the year. There are a total of about 60 miles of multipurpose trails under state jurisdiction in Lake County.

Parks

The Minnesota Department of Natural Resources operates ten parks in the three county study area. Seven of these are located along the north shore. A complete inventory of public recreational facilities is presented in Appendix F.

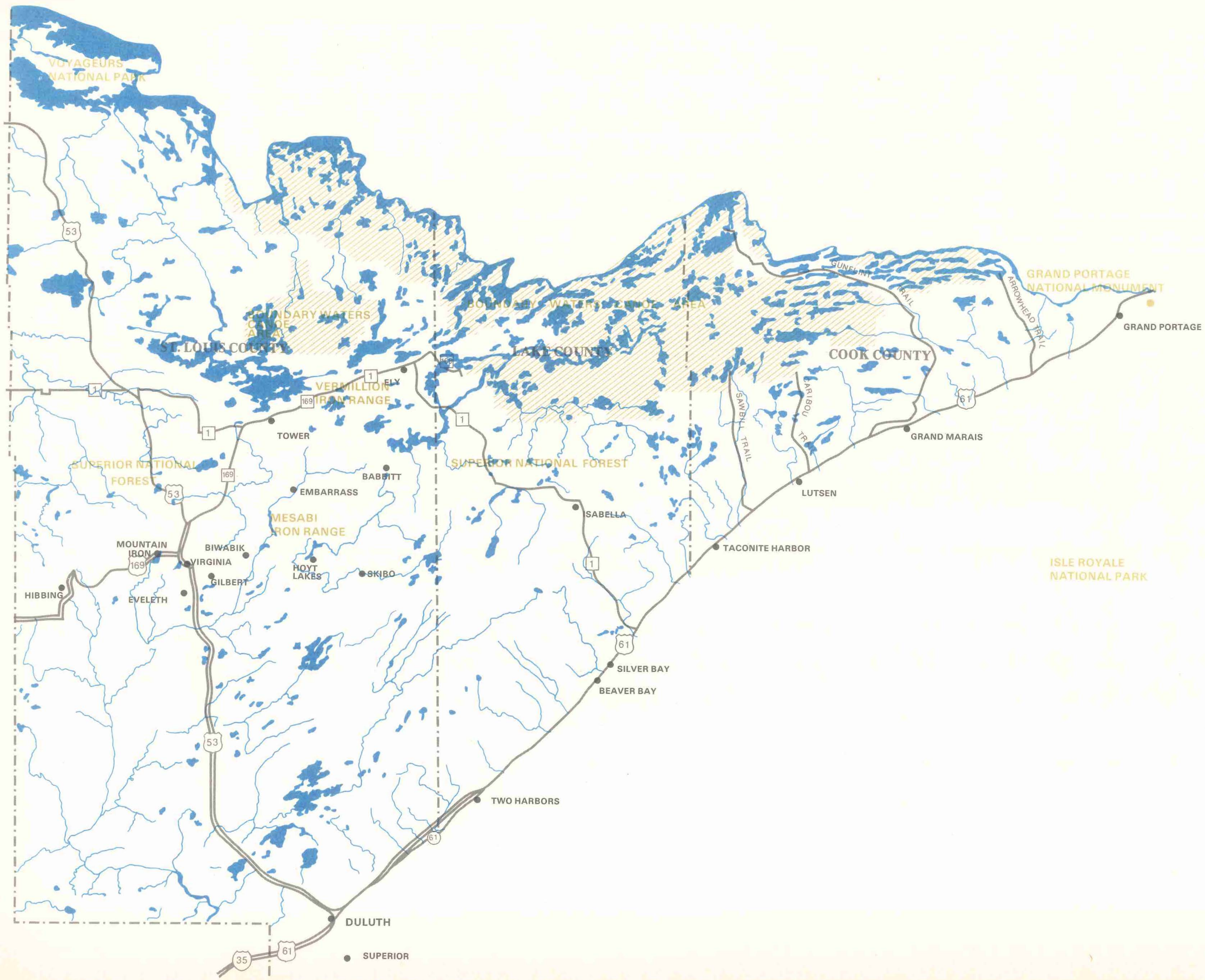
It is important to note that while there are no recorded state park statistics on park overcrowding, state park ranger interviews indicated capacity operation from mid-July through August. The state parks along U.S. Highway 61 reach capacity at various times during the day in accordance with their proximity to metropolitan areas. Thus, by mid-afternoon Gooseberry Falls has to turn away campers, and by dusk, Temperance River has to do the same. This capacity operation is achieved daily during this period, and results from no widespread public promotion of individual areas, but rather from the recreation system which exists.

Total visit figures for the Boundary Waters Canoe Area demonstrate an increasing user trend from 1970 to 1973, but show a slight decrease of 3 percent in 1974 (see Table 68). This decrease in attendance in 1974 is probably, again, a function of user attitudes toward the national energy situation.

TABLE 68
BOUNDARY WATERS CANOE AREA VISITOR ATTENDANCE

	1970	1971	1972	1973	1974	1970-74 Percent Change
Boundary Waters Canoe Area	126,100	141,500	163,100	168,542	163,429	+20

Source: Superintendent of Park



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

67 MAJOR ACCESS ROUTES

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The most popular travel zones within the BWCA are in geographical areas that generally require direct travel through the north shore and, therefore, along U.S. Highway 61. Among access points to the BWCA are State Highway 1, State Highway 169, and the Sawbill, Caribou, Arrowhead, and Gunflint Trails. All access points except State Highway 169 start on U.S. Highway 61.

An important aspect of the recreation/tourism industry is the state's promotion of an Iron Range Trail covering not only the Mesabi Iron Range and its mining towns of Hibbing, Chisholm, Virginia, etc., but also the Duluth to Silver Bay portion of the north shore. Table 69 provides mining-related attendance figures for this aspect of the regional points of interest.

The future recreational needs for the State of Minnesota have been well documented under such reports as the State Comprehensive Outdoor Recreation Plan, 1974 (SCORP)[110] and the Project 80 Report.[111] In the SCORP study, the supply of outdoor recreational facilities was inventoried for Region #3* and consisted of the following facilities (see Table 70).

The SCORP plan went on to project what future recreational demand would mean in terms of the existing supply of recreational facilities. Thus, the deficiencies indicated in Table 71A from this report presented the projected future recreational needs for the entire Region #3. What this need statement produced was a set of recreational priorities and action items for future state park expansion into this region. Thus, the future Region #3 park priorities, as outlined in SCORP, were:

1. Provide at least minimal public access on all lakes suitable for water activities, wildlife, or fish management.
2. Preserve shore areas needed for public recreation.
3. Transferring of lands needed by Voyageur National Park.
4. Provide non-motorized trails where need can be demonstrated.
5. Expand snowmobile trail mileage.
6. Provide additional campsites.
7. Provide a sufficient number of picnicking areas.
8. Community recreation facilities should be increased.

Future state park expansion and acquisitions will heavily stress the first two priorities listed above. Presently, the Department of Natural Resources is in the planning stages for a new state park facility north

*Region #3 for the State's SCORP plan covered not only the three counties of this investigation, but the counties of Aitkin, Carlton, Itasca, and Koochiching.

TABLE 69
MINING-RELATED TOURIST ACTIVITIES

Activity	Location	Attendance
Minnesota Museum of Mining	Chisholm	27,000 (1970) 33,000 (1968)
Mintac Taconite Tour	Mountain Iron	17,000 (1970)
Sherman Mine Viewpoint	Chisholm	49,591 (1970)
Viewpoint in the Sky	Virginia	73,597 (1970)
Iron Range Interpretive Center (proposed)	Hibbing/ Chisholm	75,000-100,000 (initially) 225,000 (ultimate)

Source: Aguar, Jyring, Whitman, Moser, Inc, Iron Range Interpretive Program, 1971.

TABLE 70
COUNTY INVENTORY OF OUTDOOR RECREATION FACILITIES

County	Tent Camping No. Areas	Tent Camping No. Sites	Vehicle Camping No. Areas	Vehicle Camping No. Sites	Total Camping No. Areas	Total Camping No. Sites	Picnicking No. Areas	Picnicking No. Sites	Trails - Miles Horse	Trails - Miles Snow	Trails - Miles Hiking	Trails - Miles Bike
Cook	8	52	31	724	39	776	20	34	5	58	45	1
Lake	11	82	36	779	47	861	44	343	-	52	55	1
St. Louis	44	212	50	902	94	1,114	111	825	-	327	70	-
TOTAL	63	346	117	2,405	180	2,751	175	1,202	5	437	170	2

Source: MInnesota State Compreshensive Outdoor Recreation Plan - 1974.

TABLE 71A
ACTION PROPOSED AND REQUIRED TO MEET FACILITY AND ACREAGE DEFICIENCIES: REGION 3

	Swimming Water Area (Unit = acres)	Camping (Unit = campsites)	Picknicking (Unit = tables)	Athletic Field and Playground (Unit = acres)	Trail (b) (Unit = Miles) Snow Hikes	Golf (b) (Unit = 9-hole courses)	Accesses (b) (Unit = No. Accesses)	Total Acres
A. 1980 Deficiency Units (From Chapter 5)	(a) Water Area	2,487	1,470	264	274 (a)	(a)	110	
B. Proposed State Additions to 1980 (Units)	0.2	85	180	-	60 (c)	-	8	
C. Proposed Federal Additions to 1980 (Units)	-	1,263	170	-	131 (c)	-	4	
D. TOTAL - Proposed State and Federal Additions to 1980 (Units)	0.2	1,348	350	-	191	-	12	
E. NET DEFICIENCIES TO BE MET BY 1980 (A-D) (Units)	(a)	1,139	1,120	264	83	(a)	98	
F. DEVELOPED ACRES TO Meet Net 1980 Deficiencies	(a) Beach Area	285	56	264	332	(a)	490	1,427
G. TOTAL ACRES REQUIRED INCLUDING UNDEVELOPED ACREAGE (Buffer, etc.)								7,135
H. Primary Responsibility for Meeting Deficiencies	Municipalities	Federal-P State-P&S Private-M	Munic. Counties State	Municipalities	State Federal Private (clubs)	-	State Federal	
I. Secondary Responsibility for Meeting Deficiencies	Counties Federal State	Counties P&S Munic. S&M	Federal Private	Schools	Counties	-	Counties	

(a) Supply is considered adequate to meet requirements, based on standards.
(b) Based on 1975 deficiency.
(c) All types of trails

Source: State Comprehensive OUtdoor Recreation Plan - 1974 of Silver Bay -- Tetagouche State Park. A state bill that would authorize the creation of this facility was submitted to the 1974-1975 legislature. Expansion of existing state park facilities along the north shore and, thus, preservation of the shoreline will occur primarily through the acquisition of land around existing north shore park facilities. The probable expansion areas for future purchase for these park areas is a long-term program which, according to the Project 80 Report, has low priority status at this time.(111)

The state has established five objectives to aid in the recreational site selection process:

1. The selection of those sites for a future state recreation system that will provide the highest quality environment and satisfy the outdoor recreation needs of the people of Minnesota and visitors.

2. Preservation of the most outstanding natural, scientific, and historic features regardless of location or potential for development.

3. Provision for the education of citizens through a better understanding of the natural, scientific, and historical features that make up the environment.

4. Protection of natural and cultural resources along with improved conservation of lands and waters.

5. Improvement of the local and state economy for the purposes of a higher standard of living and better quality of life.

The federal government in addition to the Voyageurs National Park plans, proposes the establishment of the Seven Beaver Recreaction Area as a part of the Superior National Forest Recreation Management Plan. The area will be primarily water oriented in activity. Intense planning activities are being carried out in the Voyageur's perimeter area and along the north shore, the latter as part of Coastal Zone Management planning effort. Transportation facility improvements are discussed elsewhere in this document.

Finally, private accommodations and trends will affect user participation in the study area. The private recreational accommodations sector, as it exists in the study area, consists of two components -- resort/lodge facilities (see Appendix F) and the secondary home market.

The future for private resort operations in the region is closely linked to many national issues (i.e., energy prices, inflation, etc.). It should be assumed that, given no drastic alteration in the national factors influencing recreational demand, the private resort market should continue to expand with new, modern resort operations and continued modernization of older resort operations.

An important part of recreational development is in secondary homes. While the number of these units and their annual rate of construction is difficult to ascertain, certain trends have emerged. Lakeshore property with access has been the primary focus. Consequently, Lake Superior has been and will continue to be a primary market area.

However, land availability and cost considerations are spreading this trend inland away from Lake Superior. Potentials continue in areas that are accessible, exhibit scenic qualities, and are associated with streams or lakes.

In summary, the study area recreational activities, usage and facilities must be viewed as a total system. Any alteration of the part will affect the whole. The system has a number of subcomponents, all related to a natural, quality experience, whether it be the more passive scenic and relaxing qualities or the more active functions of hiking, fishing, and canoeing.

COMMON AND SITE SPECIFIC RECREATIONAL ELEMENTS

The recreational analysis has encompassed land ownership as it relates to recreational use, identification of existing and potential recreational areas, and topographic, aquatic, and wildlife features as they relate to tourism and recreational use. Generally, relatively poor existing accessiblity in conjuntion with limited developed recreational facilities has resulted in low recreational use of the sites themselves.

Common Recreational Elements

Some recreational elements are common to all of the sites and site-adjacent areas. These common recreational elements include hunting and fishing. The intensity of recreational use concerning these activities on the individual sites varies due to the quality of aquatic and terrestrial habitats, quantity of fish and wildlife in the area, and the level of accessibility to the area. The recreational analysis indicates that while all sites are within the major moose and wolf range of Minnesota and contain streams and/or lakes supporting fish populations, that hunting and fishing experiences at the individual sites vary from poor to good. A summary table of the recreational conditions is presented in Table 71 B. A complete description of individual site characteristics follows.

Site Specific Recreational Elements

There are a number of recreational elements which are inherent at some sites and not common to the area. These site specific recreational elements include the amount of public land available at each site; the degree to which fishing and hunting occur on each site; the number of recreational trails for hiking, cross-country skiing, and snowmobiling; the proximity of the site to designated recreational areas; and the individual site characteristics which offer a potential for future recreational development (see Figures 68-71).

TABLE 71B
SUMMARY OF RECREATIONAL CONDITIONS - SITE SPECIFIC

Item	Mile Post 7	Snowshoe	Colvin	Embarrass
Land Ownership	Site size + 14.7 sq. mil. Public ownership = 45.3 % Private ownership = 54.7%	Site size = 11.5 sq. mi. Public ownership = 91.8% Private ownership = 8.2%	Site size = 21.1 sq. mi. Public ownership = 85.8% Private ownership = 14.2%	Site size =16.8 sq. mi. Public ownership = 14.8% Private ownership = 85.2%
Locational/Topographic Features	High landforms NE and SE of site A proposed county recreational area will be located 2 miles east of the site Split Rock State Park is 4 miles south Baptism River State Park is 8 miles east The proposed Tetagouche State Park will be about 4 miles east of the site The North Shore Trail (hiking and snowmobiling) U.S. Highway 61, a scenic drive passess 2½ miles from the site.	Site is located within Superior National Forest The northern boundary of the proposed Seven Beaver Recreation Area will be located about one mile south of the site The site contains two snowmobile trails	Site is located within the Superior National Forest The proposed Seven Beavers Recreational Area would include more than half of the site A state snowmobile trail is located about one mile south of the site	High landforms south of site
Aquatic/Fishing Features	Four lakes within 3 miles of site which contain about 30 residences A ten foot waterfall on site. Big Thirty-Nine Creek which passes through the site for about 11 miles is a DNR designated trout stream E and W Branches of the Beaver River lie adjacent to the site and are also DNR designated trout streams Fishing pressure in the upper reaches of the drainage basin is believed to be low due to limited access The lower Beaver River sustains greater fishing pressure	The site is about 60 percent peat bog	Three streams lie within the site boundaries and fishing is reported as fair, to good Fishing pressure is low due to limited access Five lakes are within 4 miles of site Banner Brook, a DNR designated trout stream, is located about one mile west of the site	No lakes in the vicinity of site Spring Mine Creek flows through site and fishing is generally poor
Terrestrial/Wildlife Features	The site lies within the major moose and wolf range of Minnesota	The site lies within the major moose and wolf range of Minnesota	The site lies within the major moose and wolf range of Minnesota	The site lies within the major moose and wolf range of Minnesota

Public Land Ownership

All sites contain a certain amount of public land. An investigation of land ownership on the sites indicates three categories of public ownership:

- State Trust Fund Lands: primarily land provided to the state by act of Congress as part of the Northwest Ordinance.

- Tax Forfeited Lands: predominantly lands held by the State in trust for local taxing districts.

- Federal Land: usually land which has always belonged to the Federal Government. In this case, federal land is the Superior National Forest.

Table 72 presents a summary of public land ownership at all sites.

Recreational Trails

The most prevalent non-hunting and fishing recreational activities which occur on the sites is associated with trails. The Minnesota Department of Natural Resources has designated trails for hiking, cross-country skiing, and snowmobiling.(108, 109, 112) Table 73 presents an inventory of state designated trails on the sites.

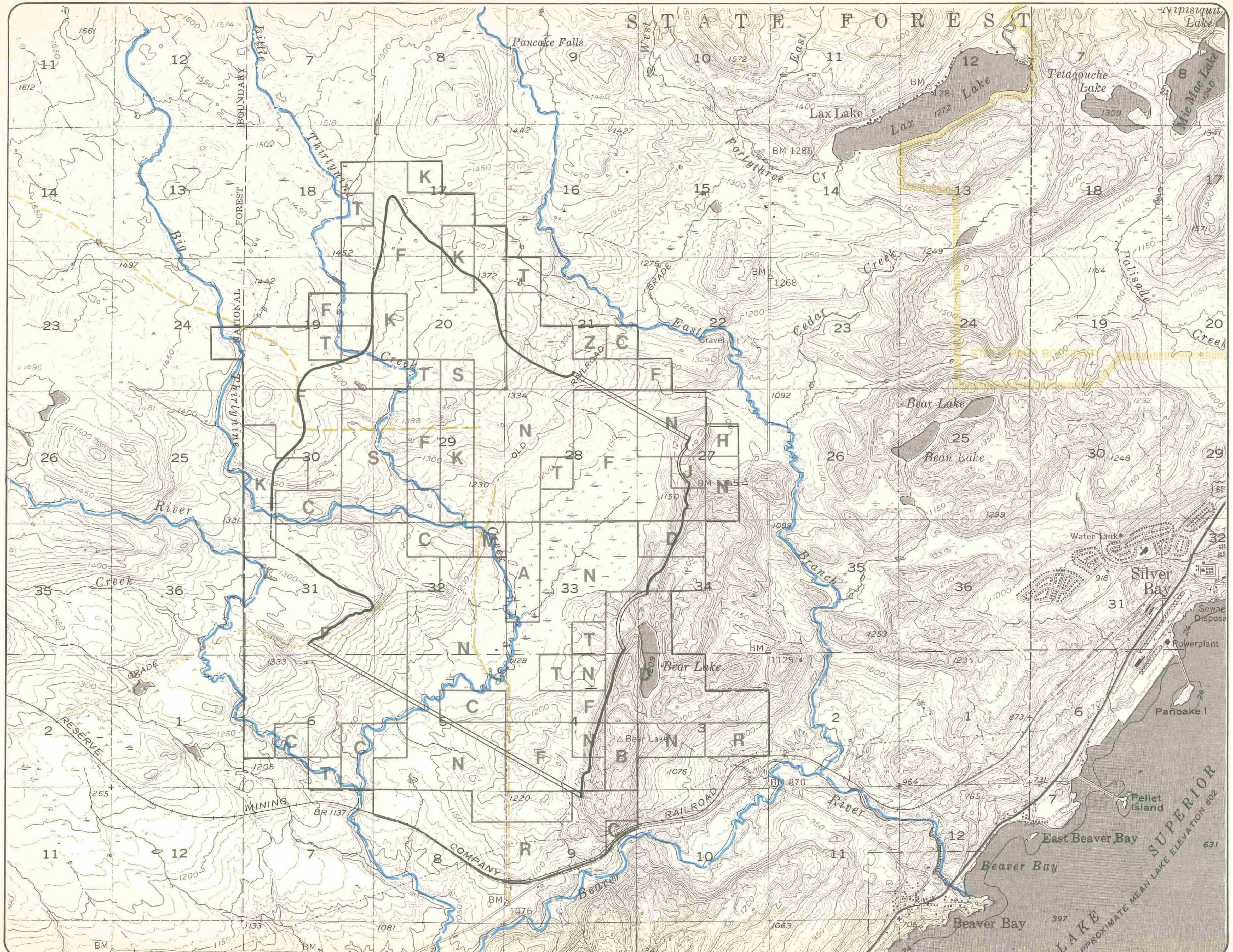
TABLE 72
PUBLIC LAND OWNERSHIP - SITE SPECIFIC(1)

Site	Total Size (2)	Percent of Site Which is Public	State Trust Fund Lands (2)	Tax Forfeited Lands (2)	Federal Lands (2)	Total Public Lands (2)
Mile Post 7	9,415	45.3	820	3,600(3)	--	4,420
Snowshoe	7,334	91.8	1,210	240	5,282	6,732
Colvin	13,540	85.8	1,845	2,311	7,468	11,624
Embarrass	10,783	14.8	520	1,080	--	1,600

(1) See Appendix F for a detailed description of site ownership.
(2) Measurement is in acres.
(3) Includes 500 acres of State Conservation Lands.

TABLE 73
INVENTORY OF STATE DESIGNATED TRAILS

Site	Trail Name	Description	Length Within Site (Miles)
Mile Post 7	North ShoreTrail	Currently Duluth to Finland/Proposed Duluth to Grand Portage	4.0
Colvin	Seven Beaver Trail	Snowmobile trail	(adjacent to site)
Snowshoe	Top Township Trail	Miltipurpose trail	1.0
	Greenwood Corridor Trail	Snowmobile trail	2.5



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

68 RECREATIONAL ACTIVITIES - MILE POST 7

LEGEND

- R - Reserve Mining Company
- N - Northern Land Company
- F - Tax Forfeited Lands
- C - State Acquired Lands
- T - State Trust Fund Lands
- K - Kimberlands
- D - Nelson (formerly Douglas estate)
- S - Kinard, Tupancy, Sperry, et al
- A - Roman Catholic Diocese
- B - Oulie
- H - Castner, Halvorson, et al
- J - Jacobson
- Z - Koeckritz
- M - MacDonald

- STATE SNOWMOBILE TRAILS
- LOCAL SNOWMOBILE TRAILS
- HIKING TRAILS
- DESIGNATED (STOCKED) TROUT STREAMS
- DESIGNATED TROUT STREAMS
- WARM WATER FEEDER STREAMS

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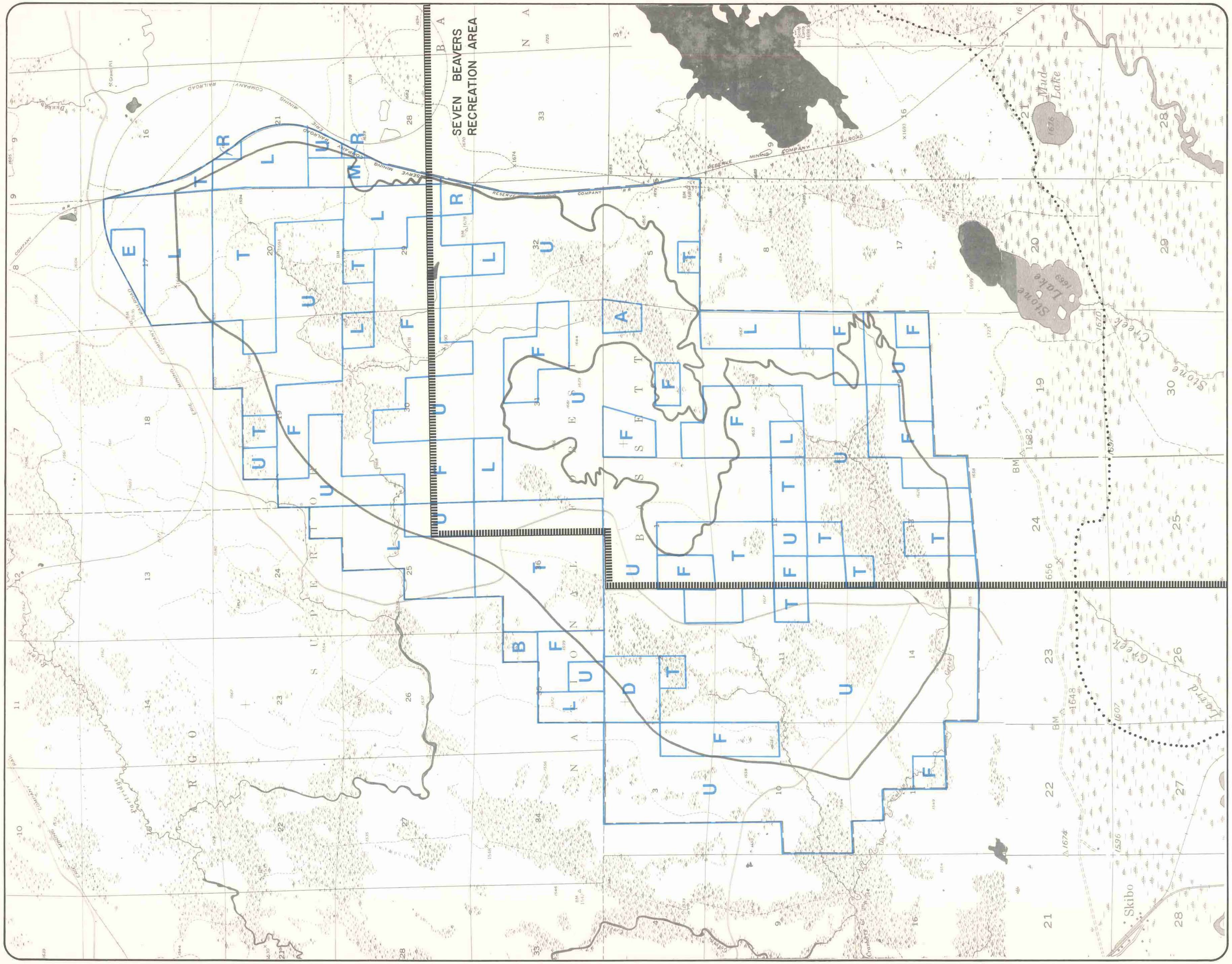

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

69 RECREATIONAL ACTIVITIES - COLVIN

LEGEND

OWNERSHIP

U	Federal Lands
T	State Trust Fund Lands
F	Tax Forfeited Lands
C	State Conservation Lands
L	Lake Forest Enterprise Inc.
R	Reserve Mining Co.
E	Erie Mining Co.
M	Myer, Karon, et al
A	Lath, et al
B	Hughes, et al
D	Tousley
▬	Tailings Basin
---	Assumed Site Boundary
	Streams
·····	State Snowmobile Trails

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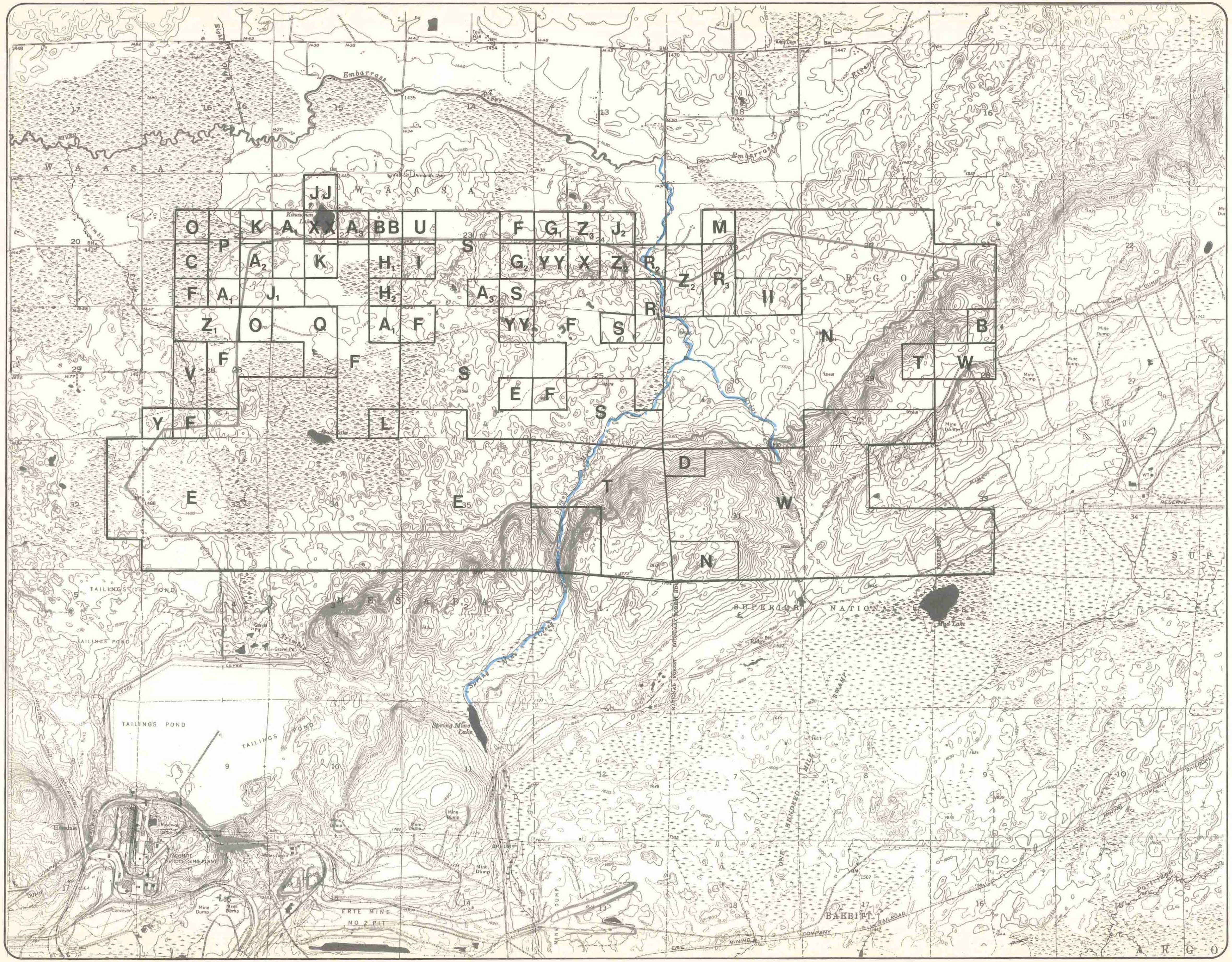

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

70 RECREATIONAL ACTIVITIES - EMBARRASS

LEGEND

OWNERSHIP MAP LEGEND

- T — STATE TRUST FUND LANDS
- F — TAX FORFEITED LANDS
- E — ERIE MINING CO.
- L — U.S. STEEL
- N — NORTHERN LAND CO.
- S — SCHUSSLER CO.
- B — N.W. NAT'L BANK
- M — MICHAELS et al
- W — WILLIAM A. TODD et al
- K — NEIL A. KAUNONEN et ux
- O — ERICK NELIMARK
- A_1 — KENNETH ALASPA et al
- A_2 — ELLEN S. ALASPA
- A_3 — RAY C. ALASPA et ux
- D — M. KAMERER
- P — SIGNE NORHA
- C — JENNIE CARSON
- J_1 — LEMPI NIEMI et al
- J_2 — JOHN NIEMI
- Z_1 — ARVO E. SALO
- Z_2 — GEORGE & HELIA SALO
- Z_3 — EINO SALO
- Y — SYLVIA KOSKELA
- V — KATHLEEN BECKMAN
- Q — RICHARD LAMPPA
- G_1 — ALBERT LASSILA et ux
- G_2 — PAUL LASSILA et ux
- I — THEODORE PATTERSON et ux
- U — WILLIAM H. TUOMALA et ux
- H_1 — JOHN HENDRICKSON
- H_2 — NIILO HENDRICKSON
- X — GARY SUNDBLAD
- II — MITCHELL et al
- R_1 — REUBEN MAKKYLA
- R_2 — HILMA MAKKYLA
- R_3 — MARTIN MAKKYLA
- YY — ROBERT A. KALLIO
- JJ — JOHNSON
- BB — BESEMAN

XX — 10 OWNERS
— E. ALASPA
— C. ECKMAN
— WM. SIPOLA
— D. BESEMAN
— G. FRVELICK
— G. ALASPA
— N. KAUNONEN
— R. ALASPA
— E. JOHNSON

WARM WATER FEEDER STREAMS

TAILINGS BASIN

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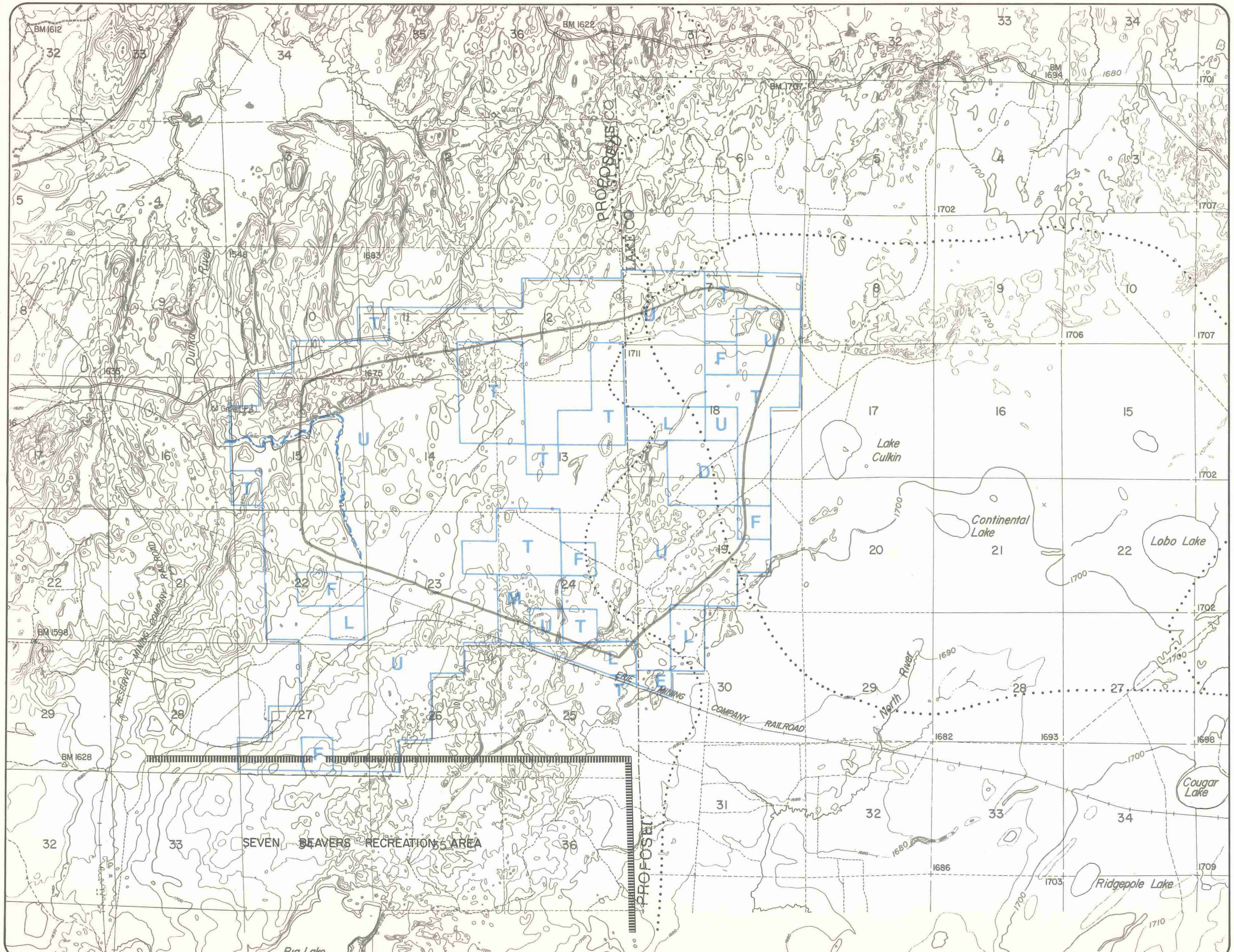
ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

71 RECREATIONAL ACTIVITIES - SNOWSHOE



LEGEND

- U Federal Lands
- T State Trust Fund Lands
- F Tax Forfeited Lands
- L Lake Forest Enterprise Inc.
- D Farm Lake Land Co.
- E Erie Mining Co.
- M John J. Mattila Jr. et al
- ······ STATE SNOWMOBILE TRAILS
- —— TAILINGS BASIN
- - - - ASSUMED SITE BOUNDARY
- -·-· WARM WATER FEEDER STREAMS

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Fishing

Mile Post 7

The proposed Mile Post 7 site is located within the Beaver River drainage basin. The Big Thirtynine Creek, a DNR designated trout stream, and the Little Thirtynine Creek flow through the proposed Mile Post 7 site.

Two other designated trout streams, the East and West branches of the Beaver River, pass within one mile to the north and south of the site respectively. These streams have been stocked with steelhead, brown, rainbow, and brook trout for many years. In 1974, both streams received over 3,000 steelhead fry.(113) A census of streams along the north shore for the years 1961-1967(114) indicated that about 20,000 anglers annually fish for steelhead along the north shore. Fifty-nine streams along the north shore attract steelhead spawning runs, providing a total of 132 miles of water accessible to fish, with more than half of that total contained in the Knife River (70 miles). The mean length of accessible water for the 15 study streams was 0.60 miles. The Beaver River provides 0.16 miles of steelhead water. The Big and Little Thirtynine Creeks which flow through the Mile Post 7 site are tributaries to the Beaver River. Two nearby streams, the Baptism and Split Rock, both received higher fishing pressure of 530 angling trips and 430 trips respectively.

Embarrass

Two streams lie within the boundaries of the Embarrass site disposal area - Spring Mine Creek (2.9 miles) and Ridge Creek (1.3 miles). These creeks have little aquatic habitat, and there is practically no fishing opportunity.

Colvin

Three streams lie within the boundaries of the Colvin site disposal area - Colvin Creek (4.4 miles), Cranberry Creek (1.7 miles), and branches of the Partridge River (8.0 miles). The Colvin Creek offers the best fishing and is capable of supporting excellent fishing. Fishing pressure is fair at the Colvin Creek. The other creeks receive less fishing pressure, due in part to very limited access.

Snowshoe

It is estimated that up to sixty percent of the Snowshoe site is peat bog and offers little fishing habitat and limited on-site access. Due to limited accessibility and poor fishing habitat, it is estimated that fishing pressure is low.

Hunting

While data is not available on the number of hunters who frequent each site, it is assumed that hunting pressure is a direct function of the wildlife habitat, quantity of wildlife on the sites, and the relative accessibility to and on the sites. All sites lie within the major moose and wolf (cannot be hunted) range of Minnesota(115,116) and have varying quantities of other fur and game animals. Presented in Table 74 is a summary of wildlife on each site. (For more detailed information, see subpart devoted to Terrestrial Habitat and Biota.)

Generally, none of the sites have unique wildlife characteristics, and all generally contain the same wildlife either on-site or adjacent to it. Therefore, other factors, such as site accessibility probably dictate the amount of hunting pressure. While specific data concerning wildlife quantities at the Snowshoe alternative are not available, its limited on-site accessibility probably results in low hunting pressure. The Embarrass alternative, on the other hand, because of its closer association to man, may receive heavier hunting pressure than the other areas.

TABLE 74
SUMMARY OF SITE SPECIFIC WILDLIFE

	Estimated Quantity at Each Site[1]			
Wildlife	Mile Post 7	Snowshoe	Colvin	Embarrass
Moose	0.7-1.7	*	0.2-0.25	Less than 0.2
Wolf	0.06-0.07	*	+	+
Deer	6.0	*	8.9	*
Black Bear	0.5	*	+	*
Beaver	+	*	+	+
Raccoon	+	*	*	+
Coyote	+	*	*	+
Snowshoe Hare	+	*	+	+
Snipe	+	*	*	*
Grouse	+	*	*	*
Woodcock	+	*	*	+
Partridge	+	*	*	*
Lynx	+	*	+	*
Fox	+	*	*	+
Cottontail Rabbit	+	*	*	+

[1]Number is density per square mile.
*Not known if wildlife occupies site.
+Wildlife occupies site but quantity is not know.

Proximity to Recreational Areas

While there are no existing public parks or recreation areas on the sites, all sites, except Embarrass, lie in areas of existing, planned, and/or proposed recreation area development.

Mile Post 7

The Baptism River State Park is located about eight miles east of the site and Split Rock State Park is located about four miles south. The 1974 attendance at the Baptism River State Park was 18,786 and at Split Rock State Park was 203,785. The Department of Natural Resources has proposed a state park, Tetagouche State Park, which will be located about four miles northeast of the site and contain about 10,000 acres. Anticipated activities include hiking, back-pack camping, snowshoeing, fishing, cross-country skiing, and picnicking.

In addition, Lake County has proposed the development of the Bean and Bear Lake area just north of Silver Bay as a future recreational area.(117) Activities proposed include camping, swimming, hiking, and canoeing. This proposed recreation area is located about two miles east of the Mile Post 7 site. In addition, an existing golf course is located in the same area. It should also be noted that Lake County has designated County Road 3 located about one-half mile south of the site, as a scenic drive.(117) Also of importance is the site's proximity to U.S. Highway 61, the North Shore Drive, which also is a designated scenic drive.(117)

Embarrass

There are no existing or proposed major recreation areas in the vicinity of the site.

Colvin

The proposed boundaries of the Seven Beaver Recreation Area (described in detail above) will include more than half of the Colvin site. There are no other existing or proposed recreation areas in the vicinity of the site.

Snowshoe

The site is located within the Superior National Forest. The northern boundary of the proposed Seven Beaver Recreation Area, which is part of the Superior National Forest Recreation Management Plan, is located approximately one mile south of the site. The Seven Beaver Recreation Area is proposed to be primarily water-oriented in activity, and has been assigned the second priority among the eight multiple use areas being proposed by the United States Forest Service for the Superior National Forest.(118) The Aurora Ranger Districts' Multiple Use Plan for the area states that the overlying management direction for this area is to "give primary consideration to the aesthetics and recreational opportunities of this chain of lakes with all other uses secondary."(118) The U.S. Forest Service is currently attempting to acquire the private land within the area on willing seller basis through exchange, donation, and direct purchase with Land and Water Conservation funds.

Potential for Future Recreational Development

The Department of Natural Resources has established a criteria list for identifying and ranking potential park areas.(111) A number of criteria apply to site characteristics:

- Quality of views and visual character
- Diversity of topography
- Unique characteristics
- Tolerance of site vegetation to site development
- Suitability of land for buffer
- Appropriateness of water for recreational activities
- Water quality

Most of the above criteria have been analyzed in other sections of the Draft EIS.

TRANSPORTATION

OVERVIEW

Adequate access is an important factor with respect to the proposed action or any of the alternatives. Two of the principal determinations of access are the adequacy of the existing thoroughfare network to absorb the traffic loads created and the degree to which displacement of existing thoroughfares presently serving the area will occur.

Transportation systems are very closely interrelated with development activities. Reserve maintains a utility/transportation corridor which will affect ultimate transportation decisions. In addition, the United States Forest Service proposes to construct Forest Route 11 for which a corridor has been selected. This is in response to present demand, but is viewed as a significant element in the total transportation element if one of the alternatives to Mile Post 7 is selected.

Information needed for the preparation of this section was obtained from federal, state and county agencies having jurisdiction for roadways in the area. While this information is essential for assessing transportation considerations, it will also be utilized in assessing aesthetics, land use, recreation, noise and air quality.

Regional Roadways

The majority of the regional roadways in the northeast portion of Minnesota radiate from Duluth, which serves as the hub of the area. Most of the roadways which serve an arterial function are under the jurisdiction of the State of Minnesota. These roadways range in design from freeways to two-lane highways. Figure 72 illustrates the regional highway network in northeastern Minnesota.

Interstate 35 is the only interstate highway in the area. This high capacity roadway provides a connection between the Minneapolis/St. Paul Metropolitan area and Duluth.

North of Duluth, State Highways 53 and 61 provide service through the area and to Canada. Highway 53 is an expressway from Duluth to just north of Virginia. From that point to International Falls, it is a two-lane highway. Highway 61 extends from Duluth to Canada along Lake Superior. Commonly referred to as the North Shore Drive, this route is used as a principal tourist route as well as providing a roadway for the movement of goods to and from Canada. It also serves the region and north shore communities. Between Duluth and Two Harbors, it is a four-lane, divided expressway. North of Two Harbors, it is a two-lane roadway.

North of Duluth, the only roadway in an east-west direction is State Highway 1. This winding, two-lane highway connects Illgen City with Ely. In Ely, Highway 1 connects with Highway 169. Within the Duluth Metropolitan area, Highway 2 proceeds westerly and extends across the entire State of Minnesota.

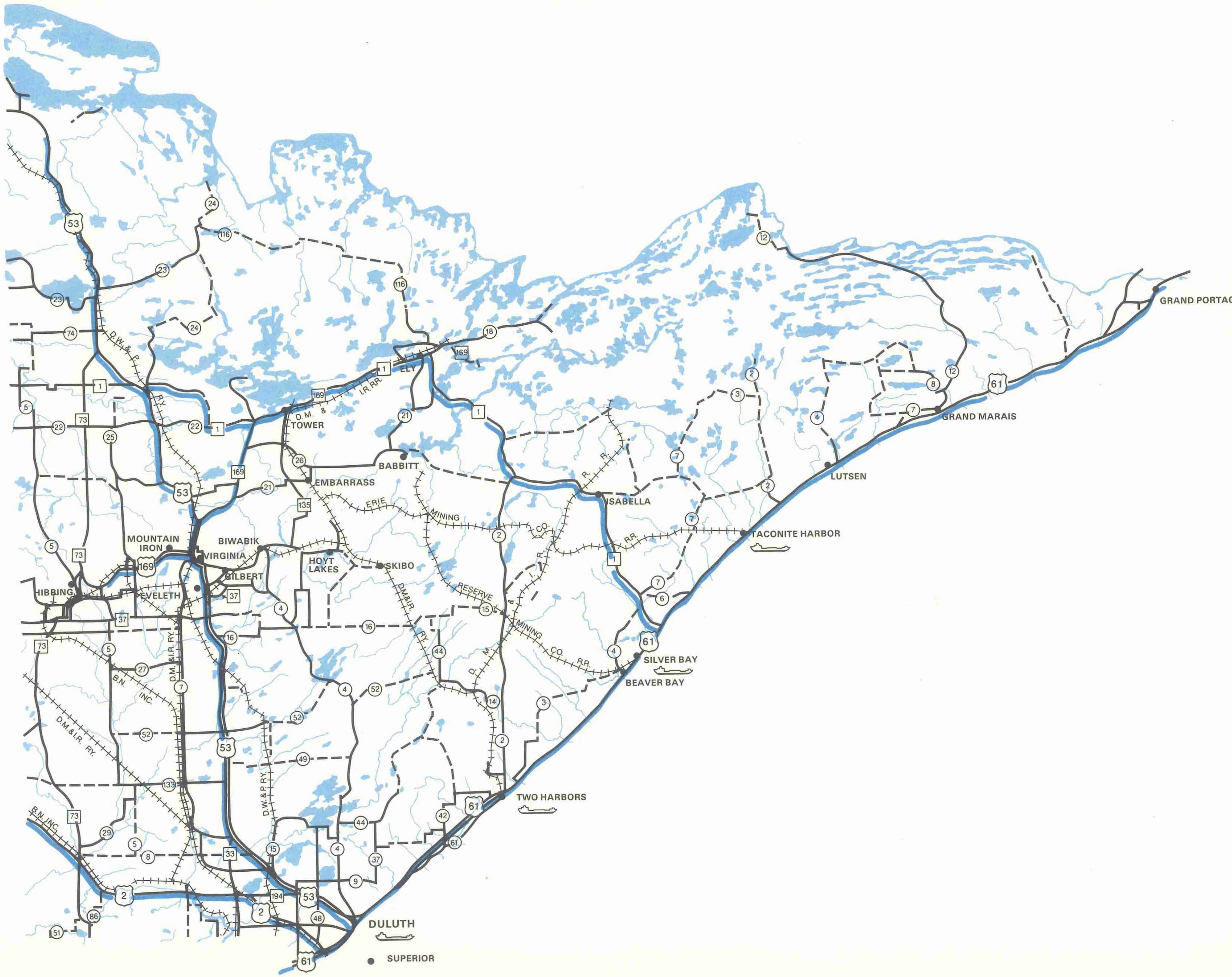
County Roadways

The major county roadways within St. Louis and Lake Counties are shown in Figure 73. The roadways carrying the highest volume of traffic in Lake County are County Road 61 from Duluth to Two Harbors and County Road 2 from Two Harbors to its junction with State Highway 1. County Road 61, even though paralleled by State Highway 61, accommodates tourist traffic due to its proximity to Lake Superior and motels, resorts and camping areas. Other Lake County roadways are 3, 4, 5 and 7. Within St. Louis County, County Road 4 extends from Duluth to the Gilbert-Aurora area. County Road 16 provides an east-west connection from State Highway 169 to Ely. With the exception of St. Louis County Road 21, and County Road 61 in both counties, none of the county routes have nine-ton load classifications. Although most are paved, they are unable to satisfactorily accommodate excessive loads.

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

72 REGIONAL HIGHWAY NETWORK



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Rail Transportation

Within the northeastern portion of Minnesota, the following railroads provide for transportation of general commodities:

1. The Duluth, Mesabi and Iron Range Railroad (D.M. and I.R.R.R.).
2. The Duluth, Winnipeg and Pacific Railroad.
3. The Burlington-Northern Railroad.
4. The Soo Line Railroad.
5. The Chicago, Milwaukee, St. Paul and Pacific Railroad.
6. The Chicago and Northwestern Railroad.

Duluth is the rail center for these lines.

Reserve and Erie Mining Companies operate their own railroads from their mines to Lake Superior. Reserve terminates their line at the Silver Bay plant, from which point boats are used to transport the taconite pellets. Erie Mining Company transports their taconite pellets to Taconite Harbor where boats are then utilized. The D.M. and I.R.R.R. transport taconite pellets from various mining locations to the harbor facilities at both Duluth and Two Harbors.

The only connection with commercial rail facilities for the Reserve Mining Company railroad occurs at Reserve's Mile Post 20. At this location, Reserve is served by the D.M. and I.R.R.R. trackage. The existing rail facilities are shown on Figure 74.

Proposed Regional Facilities

There are two roadways being proposed or upgraded which would improve regional transportation. A corridor for proposed Forest Route 11 has been established. This proposed corridor is shown in Figure 75. The roadway would connect Silver Bay to Hoyt Lakes and provide an east-west travel corridor from the Mesabi Iron Range communities to the north shore. This corridor has been established by Lake and St. Louis Counties as well as the United States Forest Service. If constructed, this could serve the tailings disposal sites as well as recreational/tourist type travel. According to the St. Louis County Highway Department, this roadway has a 1990 projected average daily traffic volume of less than 1,000 vehicles and will be a two-lane, nine-ton roadway. This type of construction has a capacity of about 5,000 vehicles per day. Presently, the roadway does not have a high priority rating although approximately $1,000,000 has been appropriated by Congress for its construction. St. Louis County is presently involved in the preparation of an environmental impact statement for the roadway.

The Minnesota Highway Department is in the process of assessing the upgrading of State Highway 61 between Two Harbors and Illgen City. This assessment could also consider relocation of existing Highway 61 as an alternative. If this roadway were to be upgraded, the primary effect on transportation would be a decrease in travel time along the corridor served. If constructed to expressway standards, safety aspects would also be increased greatly.

SITE SPECIFIC TRANSPORTATION

Mile Post 7

Access to the Mile Post 7 site will be via County Road 4 from the City of Beaver Bay. In addition, County Road 3 is located near the south edge of the area, but due to topography access to the site would be difficult to provide. County Road 4 traverses near the eastern edge of the proposed Mile Post 7 site. No public roadways will be affected by implementation of the proposed Mile Post 7 plan.

Embarrass

The primary access to the Embarrass site will be through the existing Mine Pit and private roads. However, there is direct access into the site on County Road 104 which is of minimal standards. Approximately 9 miles of this road will be covered if the Embarrass site is implemented. However, access will still be provided for all those who currently receive access off of 104 to the north of the site via County Road 21, which is an all weather paved highway. In addition to County Road 104, there are two local roads of approximately 1-1/2 miles in length which connect County Road 104 with County Road 21. Should the Embarrass site be developed as a tailings basin, these roads would also be partially covered by the proposed tailings basin.

Colvin

Access to the Colvin site is via Forest Route 113 off Forest Route 120 through the City of Hoyt Lakes. Forest Route 113 is of minimal standards and turns into a primitive road mid-way through the site and proceeds on to the north of the Colvin site and eventually connects with Forest Route 116 near the Snowshoe site. Portions of Forest Route 113 will be covered due to implementation of the Colvin alternative. However, inasmuch as this roadway only provides access into the area to be covered by the Colvin site, there should be no need to replace it. No other public roadways are affected by this alternative.

Snowshoe

The Snowshoe alternative is served by Forest Route 114 off of Forest Route 112 from the City of Babbitt. Forest Route 114 terminates at the north edge of the Snowshoe site when it connects with Forest Route 116, which goes on to the west to connect with Forest Route 113. Forest Route 116 is a primitive road. A small portion of Forest Route 114 may be covered due to placement of tailings at this site. However, inasmuch as Forest Route 114 only provides access to the area to be covered, there should be no need to replace that portion of the route that is covered. It may be desirable to reconnect Route 114 to Route 116 via a minimal standard roadway. No other public roadways are affected by this alternative.

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

73 MAJOR COUNTY ROADS

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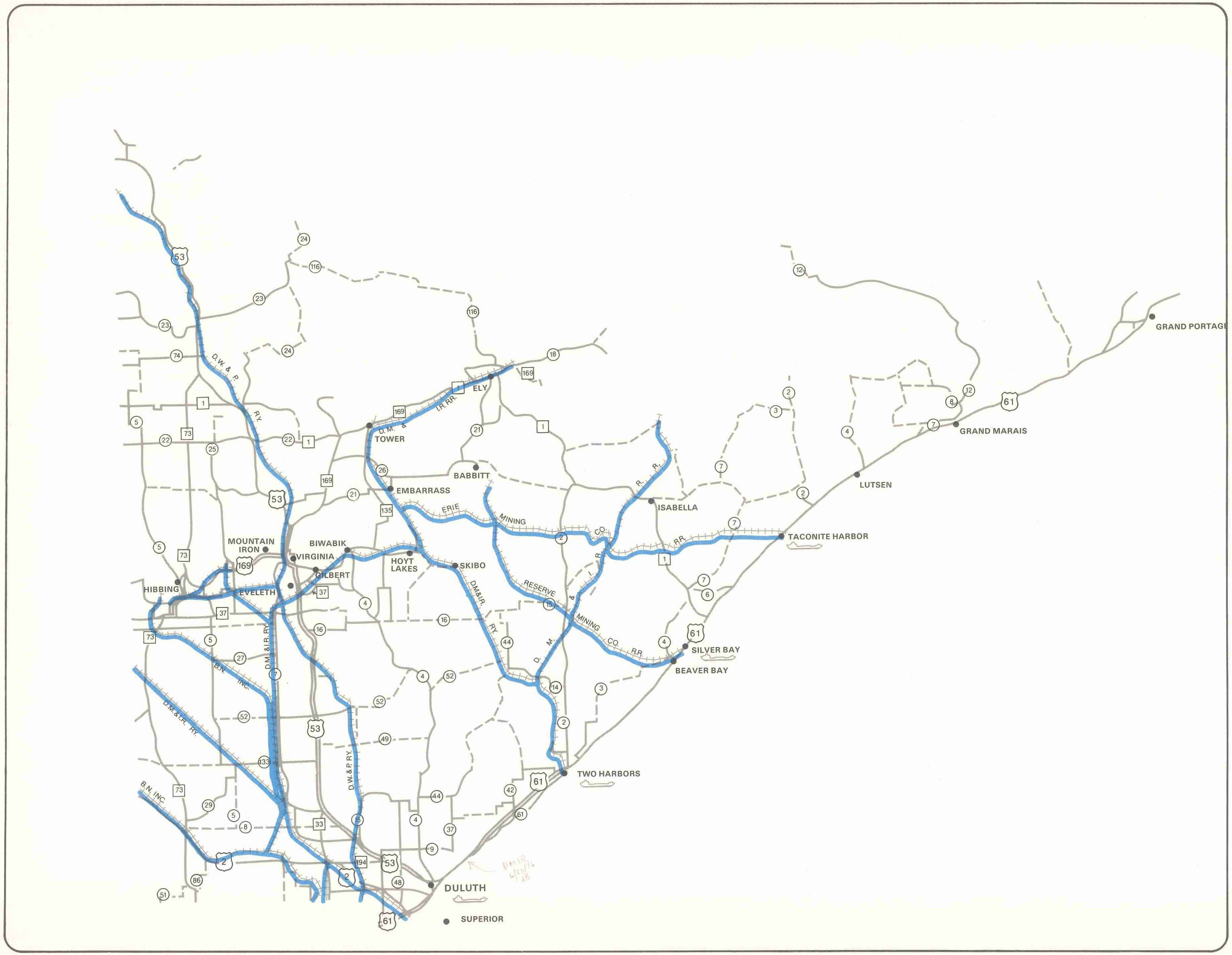
ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

74 EXISTING RAILROAD NETWORK



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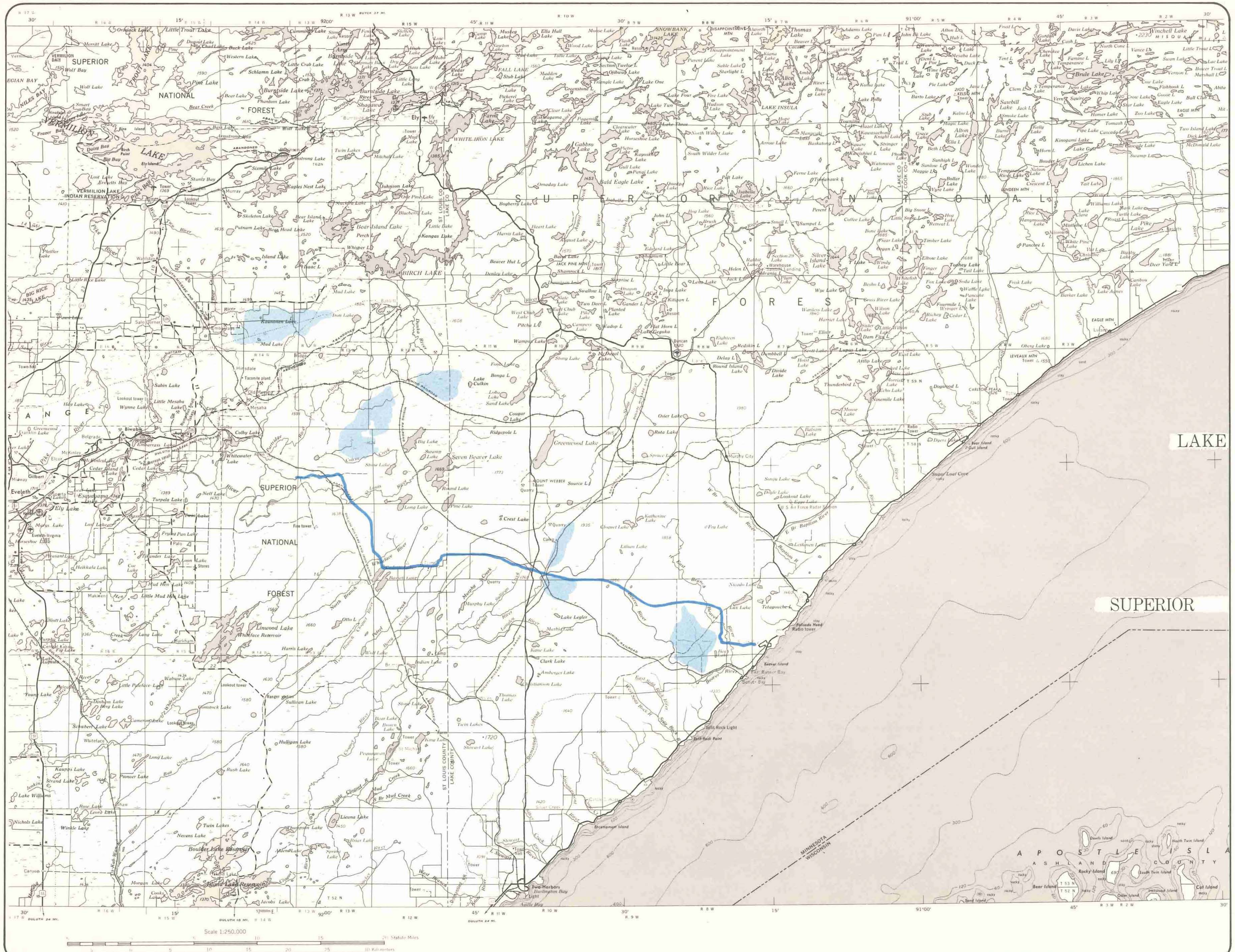

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

75 PROPOSE FOREST ROUTE 11 CORRIDOR

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UTILITIES

OVERVIEW

The utilities study area (Lake and St. Louis Counties) is serviced by utilities which are supplied by a combination of public, semi-public, and private providers. Each of the cities potentially affected through the selection of any of the alternatives provides sewer and water services. Electric power in the study area is supplied by the Minnesota Power and Light Company (MP&L) as well as Reserve Mining, through an exchange agreement with MP&L. Reserve, the largest single consumer of electrical energy in the area, generates its own power.

UTILITIES COMMON TO ALTERNATIVES

Electric Power

The major utility consideration common to each of the sites is the supply of electric power. Reserve Mining Company generates its own power at a generation plant in Silver Bay with a 136 megawatt capacity. This power plant is linked into the Minnesota Power and Light grid. Reserve and MP&L, through cooperative agreements, exchange energy in emergency situations. Reserve presently uses 133 megawatts in their taconite processing.

At present, the Minnesota Power and Light Company supplies 2 megawatts to the City of Silver Bay. Increased demand would be readily supplied by the new line requirements for any of the tailings basin sites. The situation would be similar at the City of Babbitt.

Telephone Lines

There is presently a telephone line which runs the length of the Reserve Mining Company railroad line. This line could be tapped and service brought to Mile Post 7, Embarrass, Colvin, or Snowshoe along the spur line track alignment. At the Embarrass site, a line could be brought from the mine pit switchboard to the tailings basin site.

Fuels and Fuel Lines

Since the largest use of natural gas by Reserve Mining Company is for the power plant and pelletizer, both of which will remain at Silver Bay under all alternatives and since the gas companies are no longer guaranteeing long-term commitments to industry, it is unlikely that Reserve will run natural gas lines to a new site. The needs for natural gas at a new site can be filled by alternate fuels such as oil or coal.

Water Requirements

Potable water for any of the sites could be obtained from wells (see Appendix A). If necessary, potable water could be provided by tanker, either by rail or truck.

Water for fire protection and other non-potable uses could be available at each site from seal water supplies.

The City of Silver Bay has adequate capacity in their water supply system to handle growth in residential use induced by any of the tailings basin plans. Presently the City of Silver Bay has one 750,000 gallon water storage tank which is not in service because it is not needed. The Reserve Mining Company owns the water treatment facility which supplies water to the City of Silver Bay. The additional demand for potable water in Silver Bay would require additions to the water main grid.

The City of Babbitt also has adequate capacity in their water supply system to handle growth in residential use from a population increase as a result of any of the tailings basin plans. At present, the city pumps from two wells 300,000 gallons per day and has a maximum capacity to pump 2,000,000 gallons per day. Officials of Babbitt believe they could accommodate double their present population of 3,000 with the current water capacity.

Sewage Treatment

The sewage requirements at each site would be minimal, and as such could be handled by prefabricated sanitary disposal systems.

The City of Silver Bay presently has a problem with infiltration in its sanitary sewage collection system. This infiltration problem is most acute during spring runoff, at which time the city processes near its capacity of 830,000 gallons per day. The average amount of sewage process per day by the Silver Bay facility is 500,000 gallons. The infiltration problem is recognized by the city and studies and recommendations are being made which could relieve the problem within two or three years. Officials of the city believe they could presently handle a population increase of 500 to 1,000 people.

The City of Babbitt's sanitary sewer system presently processes 300,000 gallons per day. The treatment facility has a capacity of 550,000 gallons per day. This remaining capacity could easily handle a population increase of 500 to 1,000 people. There would be, by necessity, a requirement to construct additional sanitary sewer lines to handle additional growth.

Surface Drainage

The site runoff would be controlled predominantly by means of overland drainage. Use of storm sewers and culverts would be limited.

AESTHETICS

OVERVIEW

Aesthetics is what is attractive or pleasing to people and is expressed as one's perception of the surrounding landscape. It is a combination of all of the components of the environment. The development of a tailings basin would affect the perception of the surrounding environment by altering the existing setting through the creation of a new landform of a different character than what naturally occurs in northeastern Minnesota. In addition, the landscape would be altered with the addition of roads and haul roads, rail spurs and other ancillary facilities.

In order to describe aesthetics, it is necessary to have an understanding of the character of the landscape. The landscape of northeastern Minnesota has been greatly glaciated. Occasionally, there are hills which demonstrate typical ice-scoured forms rising above the general level of the plain. Some small moraines, remnants of short-term advances and retreats of glaciers are evident. The inland landscape is somewhat hummocky, interspersed with numerous lakes, bogs and slow meandering streams. In contrast, the landscape of the north shore of Lake Superior is characterized by rock-outcroppings, steep rugged slopes, waterfalls, a rocky shoreline and fast moving clear streams. The north shore streams are considered the only streams in Minnesota which remain in their natural state and have the highest priority for protection.[(119)] Northeastern Minnesota is heavily forested with a mixture of deciduous and coniferous woodlands.

While the general character of the landscape provides a basis for understanding the aesthetic qualities of northeastern Minnesota, each of the alternative disposal sites has characteristics that need be described.

Mile Post 7

The proposed Mile Post 7 site is situated in a broad north-south trending valley and has aesthetic features which are characteristic of the landscape of the north shore of Lake Superior. The landforms at Mile Post 7 rise more than 870 feet above the Lake Superior elevation. Topographic relief varies at this site from 1,130 feet to over 1,470 feet. This range of over 340 feet is greater than at any other site.

The Mile Post 7 site contains a mixture of deciduous and coniferous woodlands common to the study area.

The streams in and near the Mile Post 7 site are typical of north shore streams. Two creeks, Big Thirtynine, which is a designated trout stream, and Little Thirtynine, flow through the site. In addition, waterfall (ten foot vertical drop) is situated on Big Thirtynine Creek. Two Lakes, Bear and Lax, lie 1/4 mile east and 2 miles northeast of the Mile Post 7 site respectively. One cabin exists on Bear Lake, while several cabins are on the north end of Lax Lake.

Public access in the vicinity of the Mile Post 7 site is provided by U.S. Highway 61 (North Shore Drive), which passes within 2.5 miles of the site to the southeast and County Roads 3 and 4, located about 1 mile on the south and east sides of the site respectively.

Embarrass

Topographic relief on the site ranges from approximately 1,450 feet to approximately 1,600 feet. The east ridge is part of the Giants Range which has been designated as a significant natural feature.

Forest cover in the Embarrass site consists of aspen, birch, and lowland and upland conifers.

Forest Route 104 lies on the northern edge of the Embarrass site. St. Louis County Road 21, which connects the towns of Embarrass and Babbitt, lies approximately 1.5 miles north of the site.

Colvin

The Colvin site is of rolling topography. The site perimeter contains three bluffs, all of which are greater than 1,720 feet in elevation. The topographic relief on the site itself ranges from approximately 1,550 feet to over 1,660 feet.

The Colvin site contains a mixture of deciduous and coniferous tree species, including birch and aspen, spruce, fir and pine. The headwaters of Colvin Creek are located within the site, including portions of Colvin Creek, a branch of the Partridge River, and Cranberry Creek. Big Lake lies 1.5 miles to the southeast, and Cranberry lake is 2.5 miles to the southwest. Seven Beaver Lake lies approximately 4 miles southeast of the Colvin site.

Forest Route 113 runs through the Colvin site, as well as a portion of Forest Route 420. Forest Route 120 runs approximately 1/2 mile to the south of the site.

Snowshoe

The Snowshoe site lies in a basically flat area. Topographic relief on the site ranges from less than 1,660 feet to over 1,730 feet in elevation.

Swamp areas and bogs are found on the Snowshoe site, with a bog covering a large portion of the site. Forest cover on the site consists mainly of birch, aspen, and lowland coniferous tree species.

Two shallow lakes, Culkin and Continental, lie 1/2 mile and 1.5 miles east of the Snowshoe site respectively. Forest Route 116-114 is located approximately 1/4 mile northwest of the site.

AIR QUALITY

This section describes the existing ambient air quality in the vicinity of the proposed Mile Post 7 site and alternatives for on-land disposal of taconite tailings. The discussion focuses on the pollutants which reflect the primary atmospheric impact of the construction and operational phases of on-land tailings disposal. The pollutants are total suspended particulates (TSP) and asbestiform fibers.

Air quality standards for TSP are given in Table 75. Primary air quality standards denote the concentration limits which protect public health. Secondary standards are designed to protect public welfare. No air quality standards establishing safe concentrations exist for ambient asbestiform fibers.

AMBIENT AIR QUALITY MONITORING NETWORK

Two ambient air quality monitoring networks have been operated in Lake and St. Louis Counties. St. Louis County, in cooperation with the State of Minnesota, has maintained a group of stations that sample TSP once every 4 days and trace metals once per month. Since 1972, Reserve Mining Company has operated a network of TSP stations in and around Silver Bay (Lake County). Particulates are sampled on a daily basis.

Figure 76 shows the locations of air quality monitoring stations in relation to the proposed disposal sites [122, 123]. The letters M and R designate stations operated by the State of Minnesota and by Reserve Mining Company, respectively.

Although no permanent monitoring network for asbestiform fibers has been established, several short-term sampling studies have been conducted, as listed in Table 76. The only extended monitoring program for asbestos was conducted by EPA Region V from November, 1973 through January, 1974, as part of the Lake Superior Asbestos Study.

MEASURED AMBIENT AIR QUALITY

Total Suspended Particulates

Table 77 gives annual geometric mean TSP concentrations and the maximum 24-hour observations for the stations shown in Figure 76 for the years 1971 to 1974. All of the reported mean concentrations are well below

TABLE 75
AMBIENT AIR QUALITY STANDARDS FOR TSP [120, 121]

Type	Averaging Time	Concentration Limit (u/m^3) µg/m^3	Comments
Primary	Year	75	Geometric Mean
Secondary	Year	60	Geometric Mean
Primary	24 hr.	260	Not more than once per year
Secondary	24 hr.	150	Not more than once per year

Note: Minnesota standards are identical to federal standards.

TABLE 76
AMBIENT ASBESTOS STUDIS

Investigating Organization	Sample Period	Sampling Location	Number Sites	Number Samples Taken	Number Samples Analyzed	Analytical Laboratories	Meteorological Data
EPA - Region V [124]	June 1973	Northeastern Minnesota	21	137	--	--	Wind speed and direction at each site
MPCA [125]	June-July 1973	Silver Bay	8	62	23	Bureau of Mines Mt. Sinai University of Minnesota	Duluth weather station
District Court [126]	October-November 1973	Silver Bay	6	176	24	A. D. Little McCrone Mt. Sinai	Wind speed and direction at each site
EPA - Region V [127]	November 1973 September 1974	Northeastern Minnesota	11	1 every 6th day	98	Ontario Research Foundation Battelle McCrone	Duluth weather station

TABLE 77
MEASURED 24-HOUR CONCENTRATIONS OF TSP(123,128)

Station Number	Annual Geometric Mean ($\mu g/m^3$) 1971	1972	1973	1974	Average	Maximum Observation ($\mu g/m^3$) 1971	1972	1973	1974	Average
M 1 Virginia	50	44	42	47	46	296	184	228	160	217
M 2 Ely	--	--	38	38	38	---	---	201	337	269
M 3 Mt. Iron	40	44	43	41	42	126	208	160	190	171
M 4 Hoyt Lakes	47	45	39	30	40	242	230	174	189	209
M 5 Hibbing	40	47	43	35	41	151	178	133	120	146
R 1 Silver Bay	--	18	22	26	22	---	NR	145	211	178
R 2 Silver Bay	--	40	34	45	40	---	NR	205	274	240
R 3 Silver Bay	--	19	25	27	24	---	NR	99	195	147
R 4 Silver Bay	--	30	43	43	39	---	NR	522	410	466
R 5 Silver Bay	--	20	30	28	26	---	NR	130	214	172
R 6 Silver Bay	--	35	48	38	40	---	NE	223	500	362
R 7 Silver Bay	--	--	19	22	21	---	NR	69	143	106

NOTE: NR indicates Not Reported.

the primary standard (75 $\mu g/m^3$) and the secondary standard (60 $\mu g/m^3$). However, some of the stations recorded concentrations exceeding the maximum 24-hour concentration prescribed by the primary standard (260 $\mu g/m^3$). Since this value can be exceeded once per year, these stations are not necessarily in non-compliance with the standard.

Asbestiform Fibers

The results of the Lake Superior Asbestos Study are shown in Table 78. Only the first ten sets of samples spanning the period 15 November, 1973 to 11 January, 1974 were analyzed. Because of the short duration of the study, it is not possible to determine long-term asbestos concentrations based on these data.

In addition, the interpretation of measured asbestiform fiber concentrations is complicated by several factors which result in large quantitative variations:

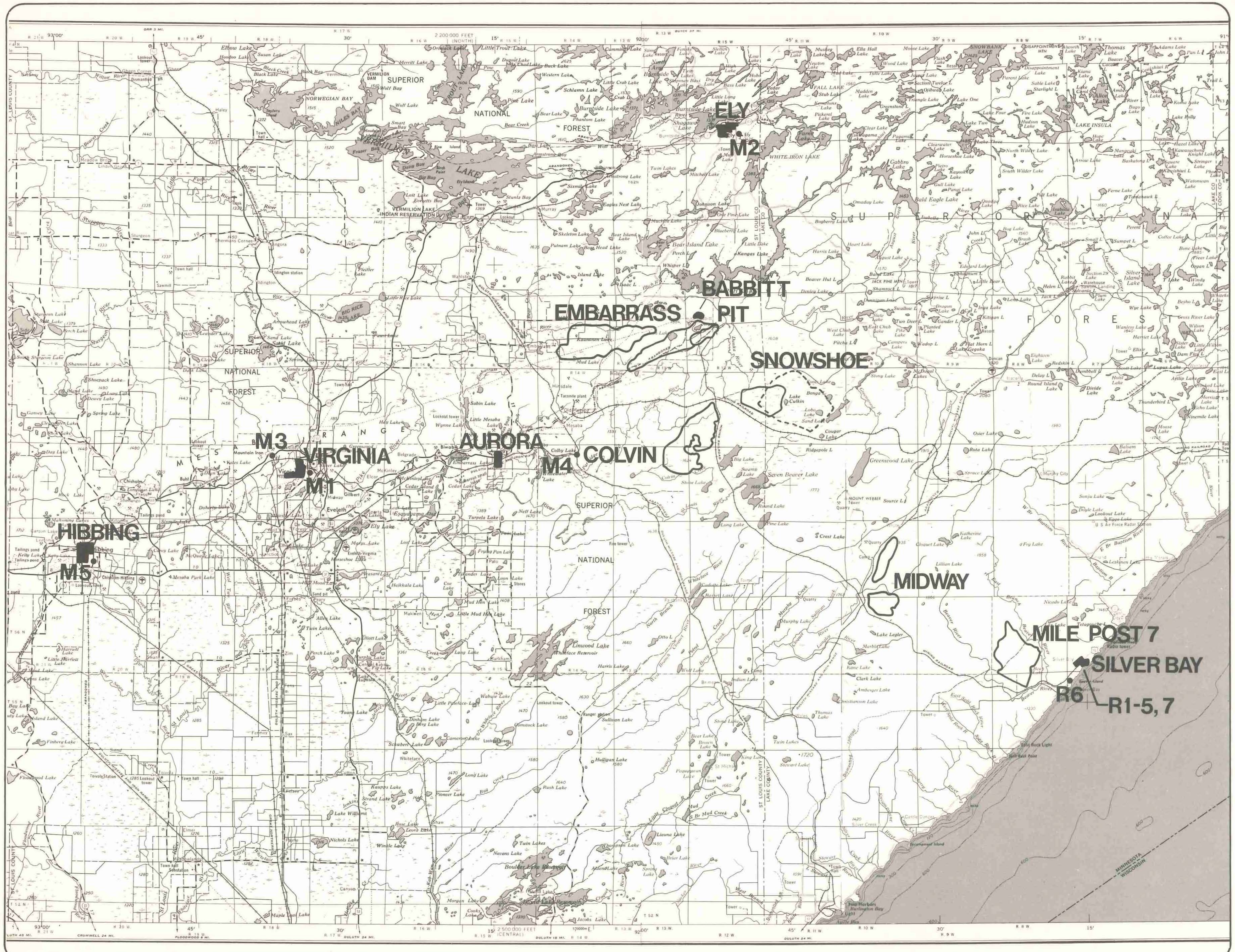
1. Disagreement regarding physical and chemical definition of an asbestiform fiber.

2. Lack of accepted standard procedures for sampling, transferring, identifying and enumerating asbestiform fibers.

3. Strong dependence of analysis results on laboratory procedures and subjective judgments of laboratory personnel.[128]

TABLE 78
LAKE SUPERIOR ASBESTOS STUDY (127)

Station Location	Asbestos Concentration (10^3 fibers/m^3) Maximum	Minimum	Average
Beaver Bay	30	0	11
Babbitt	82	0	13
Hoyt Lakes	31	0	12
Hibbing	19	0	5.6
Virginia	12	0	4.2
Mountain Iron	45	0	8.9



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

76 AIR QUALITY MONITORING STATIONS

BARTON-ASCHMAN ASSOCIATES, INC.

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NOISE

The construction and operation of an on-land tailings basin and ancillary facilities would increase noise levels and could affect surrounding land use and activities. Thus, it is necessary to relate noise effects to the activities and uses of the land in the vicinity of the proposed Mile Post 7 and alternative sites. The land in the immediate vicinity of the alternate sites and the proposed Mile Post 7 site is, for the most part, uninhabited forest and open space or areas with scattered residences.

Table 79 shows the noise level criteria for uninhabited forest areas suitable for hunting, fishing and/or camping and for residential land uses. The criteria are expressed as units of sound level in decibels (dB) weighted according to the (A) scale as specified by the American National Standards Institute (dB(A)). The L_{10} and L_{50} are the noise level criteria in dB(A) which should not be exceeded for 10 and 50 percent of a given time period respectively. L_{eq} is the energy average noise level in dB(A).

Monitoring of existing noise levels was performed to determine ambient (background) noise levels in the vicinity of each of the sites. A description of the monitoring equipment and procedures is in Appendix F.

The measured ambient (existing) noise levels at the Mile Post 7, Midway, Colvin, Snowshoe, and Embarrass sites are shown in Table 80. These observed noise levels are all typical of uninhabited forested areas under low wind (0-10 mph) conditions. On completely calm days or nights, the anticipated background levels would be lower by 5dB(A) or more. The major noise sources in the vicinity of the sites are the wind and the wildlife. The vehicular and train activity is currently perceptible over only small portions of the sites because the forest significantly increases the attenuation of noise and because of the relative infrequent and short duration of these activities.

As a result of the monitoring study, background L_{50} and L_{10} noise levels of 35 and 42 dB(A) were assumed as being representative for all the sites. This represents a quiet background noise environment suitable for outdoor activities requiring serenity.

TABLE 79
NOISE LEVEL CRITERIA

Land-use Type	Noise Level Criteria dB(A) L_{10}	L_{50}	L_{eq}
Uninhabited forest areas suitable for camping and/or hunting	42	35	38
Residential	55	50	52

TABLE 80
MEASURED AMBIENT NOISE LEVELS

Site	Ambient Noise Levels L_{10}	L_{50}	L_{90}	L_{eq}	Comments
Mile Post 7 Site	45-48	38-41	33-38	41-44	Wind speeds 0-5 mph. Leaves rustling/occasional construction equipment and railroad noise off in a distance. Train noise was observed for 14 minutes.
Colvin-Snowshoe Sites	51	42	37	48	Wind speeds 5-10 mph. Leaves rustling/occasional logging or recreational vehicles. Two vehicles were observed to be passing through the area. Noise from rail lines would not be distinguished.
Embarrass Site	47	41	38	43	Wind speeds 0-5 mph. Leaves rustling/occasional vehicles on roadway north of site boundary.

Note: L_{10}, L_{50}, and L_{90} are the noise levels in dB(A) exceeded for 10 percent, 50 percent, and 90 percent of the observed time period, respectively.

L_{eq} is the energy average noise level in dB(A) for the observed time period.

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PROBABLE IMPACTS OF THE PROPOSED ACTION AND ALTERNATIVES ON THE ENVIRONMENT

PART IV

INTRODUCTION

As in Part III, this part--the Probable Impacts of the Proposed Action and Alternatives--is organized by major environmental components. Part III provided the framework for describing the probable impacts expected to result from the actions described in Part II. It is important to have an understanding of the actions and the environmental setting prior to reviewing this part of the Draft EIS.

The summary matrix of the probable impacts discussed in Part IV is contained in the Executive Summary. A more thorough understanding of the impacts presented in the Executive Summary can be gained through review of Part IV.

Part II contains a subpart on Industrial Economic considerations which includes financial impacts.

MINERAL POTENTIAL

SITE SPECIFIC IMPACTS

Mile Post 7

The potential for mineral deposits at this site is low or remote. Thus, the impact of the development of a tailings basin on the mineral potential is insignificant.

Embarass

The potential for mineral deposits at the site is remote. Thus, the impact of the development of a tailings basin on the mineral potential of the site is insignificant (see Appendix C).

Colvin and Snowshoe

Both the Colvin and Snowshoe alternatives have good to high mineral potential. Thus, the presence of a tailings basin would have an effect on the exploration and mining of minerals, if discovered. Since the minerals which may be found at this site would be extracted by means of deep underground mining, the tailings are seen as a minor impact.

If either the Colvin or Snowshoe alternative were to become a tailings basin, conflicts could occur. The tailings would make access to the minerals more difficult and increase the costs of exploration during the active life of the tailings basin (see Appendix C).

Because mines at both sites would be deep mines, there is little likelihood that conflicts would occur with the tailings disposal operation.

SOILS

COMMON IMPACTS

The soils at each site, except for those excavated for the dam construction, will be covered with tailings. The productivity of the soils thus covered will be destroyed.

The disposal of fine tailings will create a basin area that will probably not be able to sustain heavy loadings for a long period of time.

SITE SPECIFIC IMPACTS

Snowshoe

The Snowshoe site lies in a peat resource area. The placement of the tialings basin at this site represents the loss of approximately 6 square miles of this resource. However, it would not significantly alter the commercial potential of the remaining peat resource adjacent to the site.

The placement of the tailings basin at this site could potentially load and thus compress the peat. Such loading and compression could result in a simi-impermeable layer thus reducing soil permeability and therefore seepage from the tailings basin.

LANDFORMS

COMMON IMPACTS

At each of the sites, there will be an early impact upon the landform. The first is the earth grading needed to gain access and construct roads into the site.

The most obvious impact is the introduction into the landscape of a significant man-made landform.

SITE SPECIFIC IMPACTS

Mile Post 7

Impacts unique to Mile Post 7 will first occur during the implementation phase of the action. A stream diversion will be needed at this site. This diversion will result in the creation of a new landform - an artificial stream bed to accomodate the diverted stream. Subsequent to the stream diversion, the abandoned stream bed and a waterfall will be eliminated.

As the tailings basin develops, continued disturbance and modification of the east ridge landform, a significant landform, will occur.

Embarrass

The major site specific impact anticipated in the Embarrass alternative is the utilization of the Giants Ridge, a significant landform, as a portion of the tailings basin. This will result in the reshaping and disturbance of 4.5 miles of the Giants Ridge landform.

HYDROLOGY

INTERRELATIONSHIPS

Hydrologic impacts interrelate with the study areas of soils, water quality, aquatic biota and habitat, landforms, bedrock geology, land use, recreation and aesthetics. For additional information on hydrology see Appendix A.

COMMON IMPACTS

Impacts to hydrology resulting from tailings basin construction and operation at all of the sites can be grouped into four general categories.

Alteration of Runoff Due to Changes in Watershed Area

The effect of hydrologically removing the tailings basin and the tributary drainage area from its watershed occurs during the operation period of the basin. Following completion of the basin, runoff from the area would again be returned to the watershed. The effect of modifying watershed character relates to the relative amount of runoff produced within the basin drainage area during operation and to the amount of runoff supplied to the watershed following operations.

The tailings basins have been designed to operate as nearly as possible to closed hydrologic systems. Therefore, during operation, runoff from these areas will be contained within the basin limits. This has the effect of hydrologically removing the basin area from its present watershed. In addition to the tailings basin itself, other area is also removed hydrologically from the watershed. Drainage areas which contribute runoff to the tailings basins are also removed, since this runoff is also captured within the basins. The design also anticipates collection of seepage passing through the tailing dams used to create the tailings basins. Because the seepage collection system is normally located a short distance outside of the tailing dams, a small additional amount of surface runoff will also be collected along the outside basin perimeter. The total area hydrologically removed from a watershed includes the basin area, its tributary drainage area, and the small area tributary to the seepage collection system outside the tailing dams.

It should be recognized that seepage from the tailings basin areas into the underlying aquifers cannot be totally collected, and some amount of seepage will continue to leave the tailings basin area during operations. Figure 77 illustrates the components of seepage. This uncollected seepage represents water not removed hydrologically from the watershed. Release of uncollected seepage is common to all of the sites, even though the rate varies.

As discussed above, the primary impact on watershed runoff resulting from basin operation relates to surface runoff. Uncollected seepage at each of the sites will either maintain or slightly increase ground water flows which maintain low flows in the streams during January and February. Modifications to stream flows are based upon a linear reduction in runoff for the months of March through December based on watershed area removed. The reduction in watershed area for the alternative sites and their tributary area are summarized in Table 81. For the Mile Post 7, Colvin, and Snowshoe sites, no change in January or February flow rates are anticipated. At the Embarrass site, a slight increase in low flow is anticipated due to an estimated increase in seepage resulting from basin operation. Table 82 summarizes seepage flow rates for the various sites.

The effect of a reduction in runoff within the various watersheds during basin operation appears to be minor with the exception of the Colvin site. Erie Mining Company uses the Partridge River as its water supply, and more detailed analysis is required to quantify this impact. (See Appendix A).

Following completion of basin operations, it is likely that a settling pond will be required on each site for water quality purposes. These storage sites will also control the rate of release of surface overflow for severe precipitation events. As a result, some proportion of the tailings basin area will ultimately remain as wetland and the remainder as upland. The relative proportion, as compared to pre-operational conditions, will affect the amount of runoff produced from the basin area. Because of the relatively small area involved in the change by comparison with the overall watershed area at the gaging station, this effect will be minor at those locations.

Table 82 also summarizes the estimated post-operational seepage rate from the alternate sites.

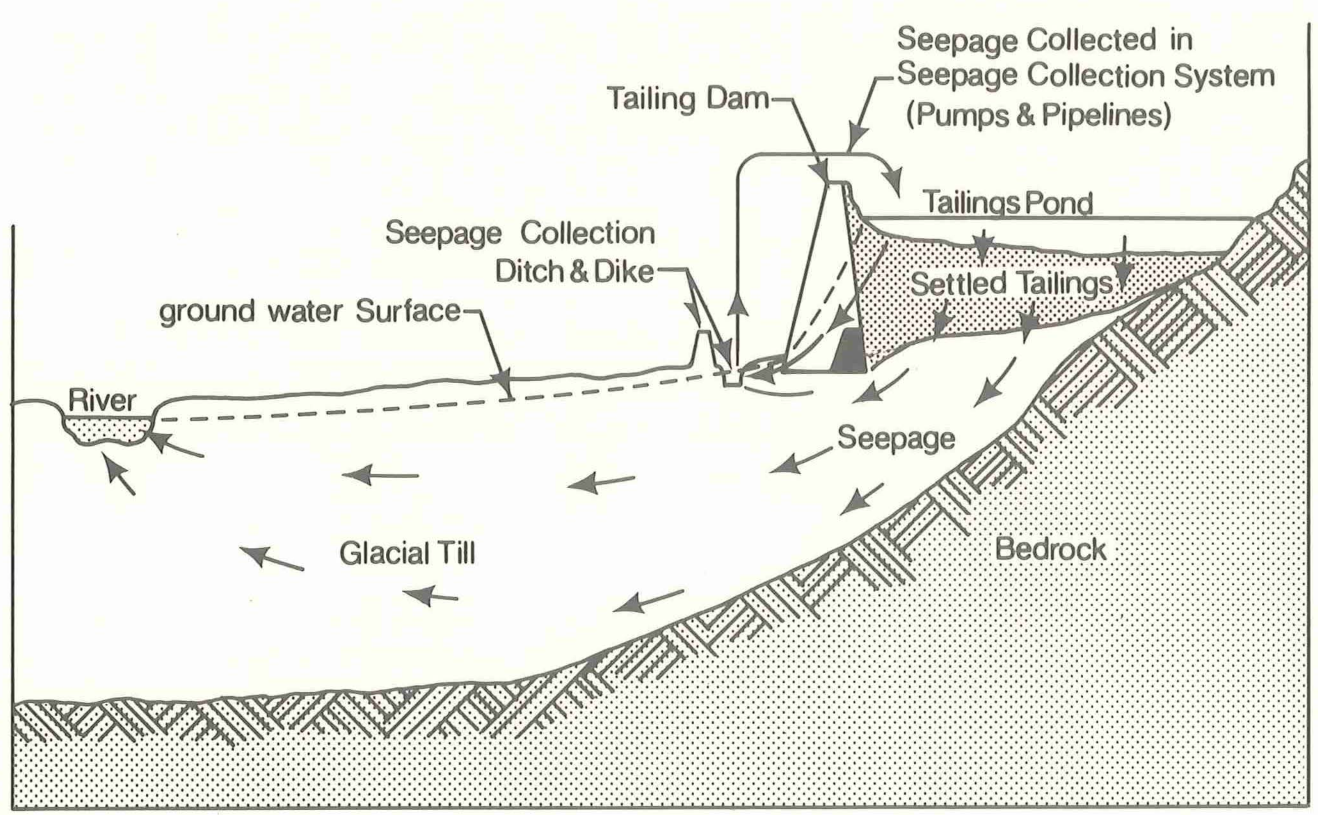
ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

77 COMPONENTS OF SEEPAGE



Effect on Runoff Outside of the Basin Due to Makeup Water Requirements

Each of the tailings basins has a different size and tributary drainage area. Also, each has its own watershed character of percent upland and wetland. Therefore, each basin has its probable water supply in the form of runoff within the basin and tributary area. However, at each of the sites, an outside source of water supply will be required to assure adequate water for start-up and operation. Therefore, since the available interior runoff varies from site to site, the required makeup water will also vary between sites.

Each of the alternative sites require an outside source of makeup water to assure adequate water for startup and continuation of plant operation during periods of drought. The impact on hydrology of this makeup water requirement is a reduction in available runoff downstream of the makeup water source. The assumed source of makeup water for the Embarrass, Colvin, and Snowshoe sites is Birch Lake. However, excess water available from mine pits should be considered as a source. Table 83 summarizes the estimated makeup water requirements for the Colvin, Embarrass, and Snowshoe sites and for Mile Post 7 for a dry cycle of five years. The maximum demand is approximately 4,000 gallons per minute which amounts to approximately 9 cubic feet per second. Bowers' study of Birch Lake[1] indicates that such a demand rate can likely be met with only minor effect on Birch Lake. The use of water from Birch Lake does not appear to be barred by international treaty; and state and federal statutes, should they apply to appropriation from Birch Lake do not appear to impose insurmountable obstacles to the use of the water. The impact on other water users resulting from this appropriation has not been determined. However, based on Bowers' study, considering the driest twelve months of record, appropriation would amount to only slightly less than 3 percent of the inflow to the lake. Makeup water for the proposed Mile Post 7 site would be obtained from Lake Superior at Silver Bay.

Makeup water requirements would have no impact following completion of basin operations.

Changes in Runoff Due to Changes in Wetland and Upland Area Within the Basins

Another modification to the hydrology relates to the change in surface character of the tailings basin areas. Due to a significant difference in evaporation losses from lakes and marshes compared with upland areas, the presence of ponds and marshes affects the quantity of runoff produced by precipitation. Construction of a tailing pond in an area previously of upland character will have the effect of reducing runoff from this area due to increased evaporation. Conversely, filling or covering areas with tailings which are presently occupied by wetlands or open water will decrease evaporation losses and increase runoff. Some degree of modification to watershed character will result at all of the sites. However, the degree of modification varies from site to site. Figure 78 illustrates the components of the generalized hydrologic cycle.

TABLE 81
SUMMARY OF WATERSHED AND TAILINGS BASIN DRAINAGE AREAS

	Tailings Basin Drainage Area	Watershed Area	Percent Removed From Watershed
North Colvin	18.1 sq. mi.		11
South Colvin	12.4 sq. mi.	156 sq. mi.	8
TOTAL	30.5 sq. mi.		19*
East Embarrass	11.9 sq. mi.		13
West Embarrass	7.4 sq. mi.	93.8 sq. mi.	8
TOTAL	19.3 sq. mi.		21*
Snowshoe	10.2 sq. mi.	53.0 sq. mi.	19
Mile Post 7	9.1 sq. mi.	131 sq. mi.	6.9

*Greastest impact results during period when both stages of basin are operated simultaneously.

TABLE 82
SEEPAGE (rates in gpm)

Site	Collected Start of Operations	Collected End of Operations	Uncollected During Operations	Post Operations
East Embarrass	1,200	2,400	500	1,600
West Embarrass	1,260	2,500	500	1,700
North Colvin	400	2,000	100	580
South Colvin	440	2,200	100	720
Snowshoe	525	3,000	75	2,030
Mile Post 7	1	1,300	180	500*

*Calculations for Mile Post 7 included in this table were performed by Barr Engineering based upon data from Reserve Mining Company Report - Mile Post 7; On-Land Tailings Disposal and Air Quality Plan; May 26, 1975.

TABLE 83
ESTIMATED MAKEUP WATER REQUIREMENTS FOR THE PROPOSED ACTION AND ALTERNATE SITES (Dry Cycle)

East Embarrass	2,593 gpm
West Embarrass	4,943 gpm
North Colvin	2,218 gpm
South Colvin	2,993 gpm
Snowshoe	3,693 gpm
Mile Post 7	950 gpm*

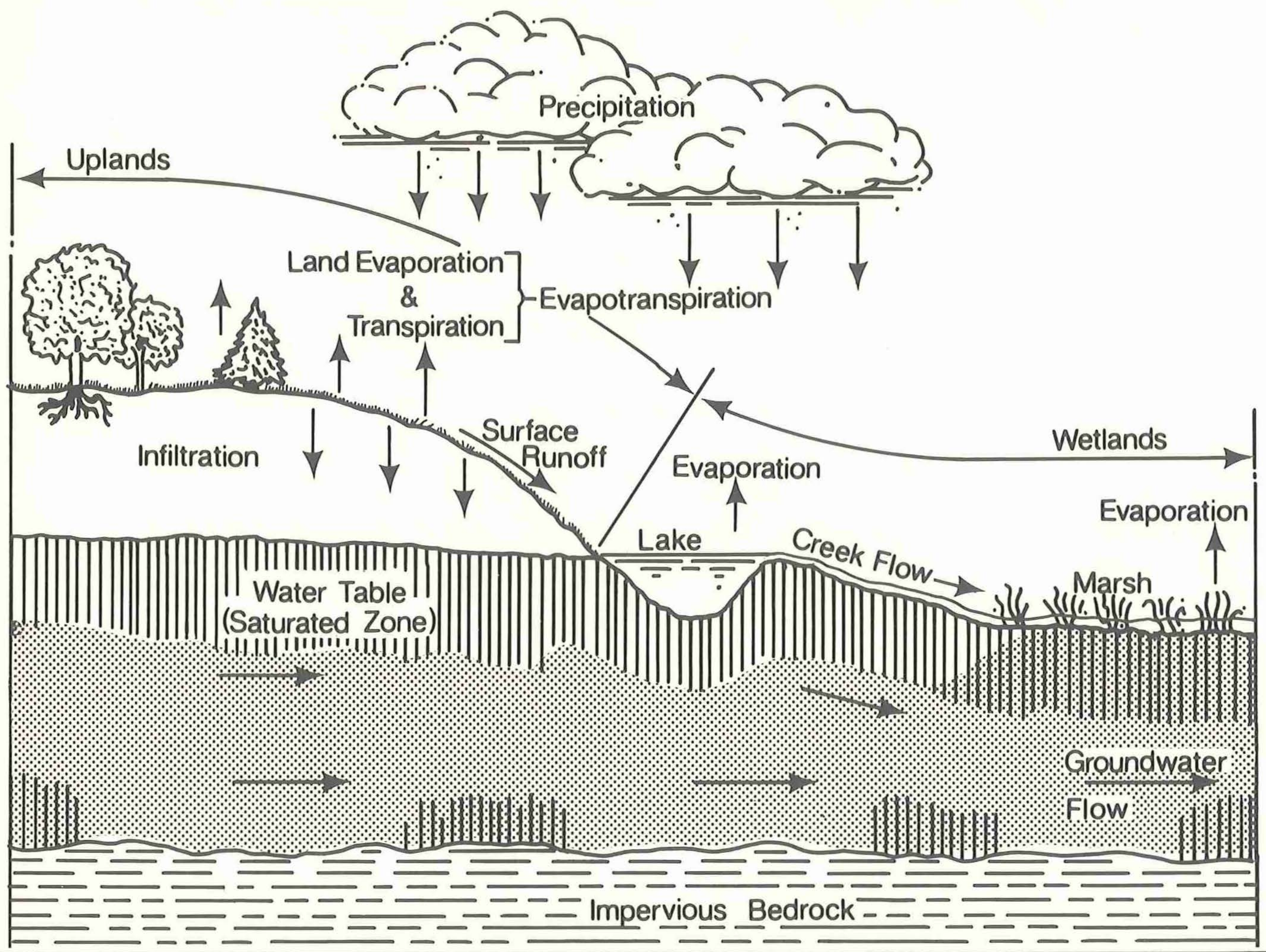
*Calculations for Mile Post 7 included in this table were performed by Barr Engineering based upon data from Reserve Mining Company Report - Mile Post 7; On-Land Tailings Disposal and Air Quality Plan; May 26, 1975.

During operations, construction of a tailings basin will change the surface character of the area inside the basin by covering certain areas which presently are wetlands with tailings and by creating wet areas in the form of settling ponds over certain areas which are presently upland. Table 84 summarizes the approximate ratio between wetland and upland area for pre-operational and operational conditions. The effect of such modification on runoff within the basins and their tributary drainage area has been determined and is reflected in the computed runoff rates used in the water balance. This impact on internal hydrology, therefore, interrelates with the makeup water impacts discussed above. Table 85 summarizes the runoff available for use at all sites.

The relative modification in wetland and upland area from present conditions to post-operation conditions will result in only minor changes in downstream runoff for the Embarrass, Partridge, and Dunka Rivers. The post-operational effect will depend upon the final basin reclamation plan including post-operational pond size and surface vegetation. The relative impact on downstream runoff can be reduced by careful planning of basin reclamation.

BARTON-ASCHMAN ASSOCIATES, INC.
MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

78 GENERALIZED HYDROLOGIC CYCLE



Filling of Streams, Marshes, and Lakes Used for Conveyance and Storage of Runoff Within the Watershed

An impact common to all of the sites is the removal or filling of some portion of a stream, marsh or lake. This has a permanent impact on them, and results in an impact on the hydrology of the basin and watershed. Table 86 summarizes the loss of streams, marshes and lakes for the various sites.

During basin operations, the streams, marshes and lakes will be covered with tailings, thus eliminating their ability to convey or store runoff. Inside the basin, this impact is of no concern since runoff must be stored anyway. The impact outside the basin of filling streams, marshes and lakes coincides with the impact of removing the basin drainage area from the watershed. Since the runoff conveyed and stored in these features is eliminated from outside areas, the filling has no hydrologic impact during operations. Impacts related to the use of streams, marshes and lakes is considered in other study areas. The internal hydrologic impact of filling lakes and marshes is partially offset by creation of a settling pond.

Elimination of streams, marshes and lakes is permanent, and the post-operational impact is, therefore, also permanent. However, following basin operations, runoff must again be released from the site. Therefore, the streams eliminated must be replaced by an overflow channel and drainage system to convey the runoff to downstream areas. This system will partially offset loss of the streams. If a permanent settling pond is left on the site in reclamation, the loss of lakes and marshes may also be partially offset. Development of detailed reclamation plans should be a continuous process during operations.

TABLE 84
RELATIVE AMOUNTS OF WETLAND AND UPLAND AREA FOR MILE POST 7 AND ALTERNATIVE SITES
(Percent)

Site	Present Condition Wetland	Present Condition Upland	Average During Basin Operation Wetland	Average During Basin Operation Upland	Condition at End of Operation Wetland	Condition at End of Operation Upland
East Embarrass	8	92	33	67	37	63
West Embarrass	28	72	85	15	90	10
North Colvin	23	77	37	63	43	57
South Colvin	23	77	46	54	57	43
Snowshoe	66	34	90	10	90	10
Mile Post 7	20	80	43	57	50	50

TABLE 85
RUNOFF TO THE TAILINGS POND
(all values in gpm)

Site	Wet Cycle+	Average	Dry Cycle+
North Colvin	8,175	4,500	1,625
South Colvin	5,475	2,850	675
Diversion Area*	3,025	1,675	650
East Embarrass	5,425	3,050	1,300
West Embarrass	3,125	1,500	-125
Snowshoe	4,250	1,950	-325
Mile Post 7**	6,025	4,025	3,125

*This is an area which includes the Big Lake watershed and some area to the northwest of Big Lake. It is naturally tributary to North Colvin, but could be easily diverted to South Colvin. The value shown for North Colvin includes this, while the value shown for South Colvin does not.

+Five year period based on past records.

**Calculations for Mile Post 7 included in this table were performed by Barr Engineering based upon data from Reserve Mining Company Report - Mile Post 7; On Land Tailings Disposal and Air Quality Plan; May 26, 1975.

TABLE 86
STREAMS, MARSHES, AND LAKES FILLED BY TAILINGS

Site	Name	Location	Tributary To	Filled Length* (miles)	Surface Area (acres)
E. Embarrass	Spring Mine Creek	T60N R14W Sec. 24, 25, 36; T60N R13W Sec. 30	Embarrass River	3.4	--
E. Embarrass	Ridge Creek	T60N R13W Sec. 30	Spring Mine Creek	1.2	--
E. Embarrass	Marshes***	--	--	---	60
W. Embarrass	Mud Lake	T60N R14W Sec. 27, 34	--	---	7
W. Embarrass	Kaunonen Lake **	T60N R14W Sec. 22	Embarrass River	---	13
W. Embarrass	Unnamed outlet of Kaunonen Lake**	T60N R14W Sec. 21, 22	Embarrass River	.8	--
W. Embarrass	Marshes***	--	--	---	1,170
N. Colvin	Unnamed	T59N R12W Sec. 19, 20, 29, 30, 31; T59N R13W Sec. 25	Partridge River	6.3	--
N. Colvin	Marshes***	--	--	---	960
S. Colvin	Colvin Creek	T58N R13W Sec. 13, 14; T58N R12W Sec. 7, 17, 18	Partridge River	4.4	--
S. Colvin	Unnamed	T58N R13W Sec. 10, 11	Colvin Creek	2.3	--
S. Colvin	Marshes***	--	--	---	1,300
Snowshoe	Dunka River	T59N R12W Sec. 15, 22	--	2.3	--
Snowshoe	Marshes***	--	--	---	2,740
Mile Post 7	Big Thirtynine Creek	T56N R8W Sec. 28, 29, 30, 32, 33; T55N R8W Sec. 5	Beaver River	7.0	--
Mile Post 7	Little Thirtynine Creek	T56N R8W Sec. 19, 20, 29	Big Thirtynine Cr.	2.7	--
Mile Post 7	Marshes***	--	--	---	800

*Filled length includes portion of the stream which is covered by tails or by a seepage collection pond.
**These are not covered by tails, but become part of the seepage collection system.
***Includes total of marshes covered by tailings, but not marshes affected by seepage collection system

WATER QUALITY

The tailings disposal basin will have an impact on the water quality of surrounding waters during construction, operation, and post operation.

COMMON IMPACTS

Immediate impacts are those impacts associated with construction activities and their preliminary operations.

Construction of a basin and the associated support facilities will require unearthing large quantities of soil. These activities will remove the protective vegetation and expose the soil to erosion. Solids from erosion will be discharged to the creeks and rivers receiving the drainage from these areas. These solids will cause turbidity which can have deleterious effects on aquatic organisms.

Removal of topsoil and exposing mineral layers to rainfall and runoff would enhance the potential for dissolution of these substances, and their transport to the watercourse.

Since a portion of the watershed of each site would be removed there could be a change in pH of downstream river water. The pH is a function of sub-watershed characteristics and in each instance the removal of a substantial portion of the sub-watershed will affect pH (as well as other parameters). The characteristics of the tailing basin area will determine the effect on pH. For example, if the area were primarily a bog and the remainder of the watershed were highlands, a pH increase might be realized if the low pH water from the bog were eliminated. The opposite would be true if the situation were reversed. No large changes in pH are anticipated.

Adverse water quality impacts associated with basin operation can be divided into two categories: the effects on groundwater and the effects on surface waters due to seepage of impounded waters. The proposed Mile Post 7 plan calls for the recycling of process and runoff waters that are impounded within the tailings disposal area. This recycle will eventually result in the dissolution of many ore-bound substances. Results from studies conducted by Reserve Mining Company(2)(3) and the EPA National Water Quality Laboratory(4)(5) show that tailings are not chemically inert, but dissolve at slow but measurable rates. Calcium, magnesium, sodium, manganese and silica are the major constituents comprising the soluble portion.(6) A steady state concentration will be reached (for all chemicals but not asbestiform fibers) that is dependent upon the specific substance involved and other chemical factors (e.g., pH). Once a steady state is reached there would be no significant additional accumulation of these substances. In the Reserve Mining Company Report (C-75147), a plan for recycling these waters and preventing their deliberate discharge to the waterways is presented. This plan involves the collection of surface runoff and dam seepage waters in a basin, and pumping this water back into the tailings basin. Some water would be lost to groundwaters and would not be collected by the collection system. The effects of these substances depend upon present ground water quality and its expected uses.

Any accident that would discharge significant quantities of impounded waters to an adjacent watercourse could affect the receiving stream. The effects would depend upon the quantity of waters reaching the stream, its chemical and physical characteristics, and the flow of the stream.

Loss of tailings through minor pipeline ruptures would affect the waterways. The effects of such disasters would depend largely upon the topography, the location of the accident, and the amount of tailings involved in the spill. The discharge of the impounded solids would be the immediate concern.

The presence of asbestiform fibers in the receiving streams would be influenced by the air borne dust (see air quality section) and possibly uncollected seepage. The ability of soils to filter asbestiform fibers is unknown. At present, there is no way to assess this impact. Since some of the waters are classified for domestic consumption, the elimination of any potential health hazard is an objective.

Impacts on water quality during post operation could result from overflow, runoff and seepage. Initially, these waters could contain steady state concentrations of all the elements included in the tailings and any added chemicals (e.g., amines, flocculents). Post-operational overflow is likely to contain asbestiform fibers and therefore, represents a potential impact on surrounding surface water.

The more stringent water quality classification and the present high water quality of the north shore streams suggest a greater potential for water degradation compared to the inland streams for impacts of similar magnitude.

Since available water quality data will not allow a quantitative estimate of the impacts described above, they are compared by the differences in the magnitude of the tailings basin design variables at each site. This approach is valid because many of the water quality impacts involved (e.g., dissolved solids and turbidity) should increase relative to the magnitude of the design variables. A compilation of the activities associated with tailings basin planning, construction, operation, and post operation are shown in Table 87. The magnitude of selected design variables for each of these activities is also given. This table should allow an estimation of the relative magnitude of water quality impacts at each site.

SITE SPECIFIC IMPACTS

Impacts to water quality that are site specific and represent a difference among sites are shown in Table 88.

TABLE 87
GENERAL IMPACTS - WATER QUALITY

Activity	Design Variable	Mile Post 7	Colvin*	Embarrass*	Snowshoe*
Planning					
1. Access Road Construction	Length	17,000 feet	1,000 feet	4,000 feet	15,000 feet
Implementation					
1. Clearing (Initial)	Area	325 acres	303 acres	360 acres	1,044 acres
2. Starter Dam Construction	Dam Length	5,800 feet	4,700 feet	19,050 feet	17,700 feet
3. Pipeline Corridor	Length	28,000 feet	1,000 feet	1,000 feet	5,000 feet
4. Processing Facilities Corridor	Construction Area	About 20 acres	130 acres	130 acres	130 acres
5. Seepage	Initial Uncollected Seepage Loss Rate	180 gal/min	100 gal/min	500 gal/min	75 gal/min
Operation					
1. Clearing (During Operation)	Area	539 acres	1,612 acres	1,675 acres	1,426 acres
2. Dam Construction	Dam Length	22,320 feet	62,600 feet	68,300 feet	53,000 feet
3. Pipeline Breakage	Pipeline Length	39,000 feet	2,000 feet	1,000 feet	5,000 feet
4. Seepage	Seepage Loss Rate During Operation	180 gal/min	100 gal/min	500 gal/min	75 gal/min
Post-Operation					
1. Uncollected Seepage and Runoff	Post-Operation Seepage Lost Rate	500 gal/min	580-720 gal/min	1,600-1,700 gal/min	2,030 gal/min
2. Spillway Overflow Discharge		Yes	Yes	Yes	Yes
3. Reclamation Activities	Basin Area	4,864 acres	7,898 acres	4,794 acres	3,187 acres

*Estimates for proposed alternatives not based on detailed engineering.

TABLE 88
SITE SPECIFIC COMPARISON OF ALTERNATIVES (SUMMARY)

	Mile Post 7	Embarrass	Colvin	Snowshoe
1. Potential for Benefit to Water Quality From Use of Mine Pit Water Discharges for Make-up(1)	No	Yes	Yes	Yes
2. Potential for Turbidity Impact From Stream Diversion(2)	Yes	No	Yes	No
3. Potential for Water Quality Degradation by Introduction of Chlorides(3)	Yes	No	No	No
4. Potential for Water Quality Degradation From Pipeline Breakage(4)	High	Low	Low	Low
5. Potential for Water Quality Degradation From Coarse Tailings Storage Area(5)	Yes	No	No	No

(1) Based on NPEDES permit application.

(2) The Mile Post 7 plan will require diversion of Big Thirtynine Creek, Little Thirtynine Creek and an unnamed creek. Colvin will require diversion of one creek.

(3) No chlorides would be required at alternative sites during the winter because of the short transport distances for crude ore and tailings.

(4) Based on comparison of pipeline lengths, gradient, and number of crossings.

(5) Only Milepost 7 would require storage of coarse tailings outside of basin.

AQUATIC HABITAT AND BIOTA

The disposal of tailings on land will have an impact on the aquatic environment during construction, operation and post operation.

IMPACTS COMMON TO ALL SITES

Construction

Impacts on the aquatic environment will begin with the initial survey and construction of the tailings basin. The most obvious impact from this construction will be complete destruction of streams within the basin boundaries. Aquatic habitat and organisms will be buried (or isolated and buried later) as will large sections of watershed drainage area.

Construction of seepage collection systems could affect the aquatic environment. Erosion of seepage recovery dams could increase sediment and turbidity levels in nearby streams, adversely affecting many aquatic organisms.

Erosion of newly constructed dikes is of prime importance to nearby streams. Rainfall occurring before revegetation is complete may introduce quantities of dike material into area streams. If the rains are heavy, significant environmental damage may occur.

Access roads and railroad grades built across small streams will destroy some aquatic habitat, and temporarily cause high turbidity and silt levels. Road construction occurring during fish spawning season could severely reduce hatching success.

Destruction of stream spawning grounds will also occur with silt deposition. Both trout and smallmouth bass require gravel or rocky bottoms for spawning and generally will not spawn over substrate composed of fine sediments. Silt and sediments can accumulate over redds, and block the flow of oxygenated waters to developing embryos, resulting in their suffocation. High streamflows can prevent sediment accumulation, but streams in the proposed disposal sites are small and do not experience high flows with the frequency required for sediment removal. If excessive sedimentation were prolonged, a complete alteration of the fish population would result.(8) Sportfish would most likely be replaced by rough fish.

Even if road and grade building activities were timed to coincide with non-spawning periods, environmental effects could still be severe. High turbidity levels reduce light penetration in water, thus reducing the amount of light available for photosynthesis. In addition, silt covers the stream bottom and if present in excessive quantities, may reduce the benthic invertebrate population through suffocation.

The number and type of benthic organisms change with location and substrate type. Certain substrates are generally more productive than others with rubble and coarse gravel being most productive and fine, inorganic materials such as sand being lease productive.(7) Silt or sediments deposited in streams will alter much of the substrate and create a benthic environment comprised primarily of fine materials. Benthic invertebrate production in these areas is likely to decline. Since benthic organisms are a major food source for fish, a reduction in the benthic population would adversely affect the fish population. Competition for prey would be intensified, especially in streams found in the proposed disposal areas. Low habitat diversity in these streams limits the variety of resident prey organisms. Some fish species would likely disappear from the area in response to a reduced benthic invertebrate population.

If the amount of sediment is excessive, fish gills and other sensitive tissues may be injured and become susceptible to bacterial infection.(8)

Rerouting streams by means of man-made channels will physically preserve the streams but will not create desirable aquatic habitat in the new channel. Stream cover and riffle-pool interspersion will be nonexistent reducing the total carrying capacity of that section of stream. The final result will be a reduction of species diversity, affecting ecosystem stability.

In addition, diversion channels of considerable length may alter stream temperature. Slow moving shallow waters, especially brown water over dark substrate typical of the area, can be warmed significantly as it flows through the unshaded diversion channel.

Operation

A consequence of basin operation will be the loss of watershed area and reduction of runoff. Some of the streams involved are low order streams that depend entirely on surface runoff for water supply. Water levels in streams will decline reducing habitat abundance and availability. This will increase the competition for remaining food space and possibly eliminate less tolerant species.

Reduced stream water levels and periods of severe low flow may change species composition in streams. During dry periods, all species will migrate downstream to areas with permanent flow. When flow is reestablished upstream, the more mobile and more generalized species are able to utilize the space immediately. As a result their numbers increase.(9) These species may be able to dominate a small stream, forcing many other species out of the area.

The threat of tailings basin seepage and runoff reaching surrounding streams and lakes will persist during operation due to the possiblity of failure of the seepage recovery system. The immediate effect would be a change in water chemistry which would secondarily have an effect on aquatic organisms.

An important factor in any tailings basin is wind-blown dust (discussed under air quality). This could have an adverse effect on surrounding aquatic environment by increasing turbidity and reduction in light penetration.

Post Operation

Post-operational impacts on the aquatic environment would most probably be associated with runoff and seepage from the basin. Following termination of operations seepage and/or runoff from the basin will enter surrounding streams and lakes. This runoff and seepage could contain high levels of fertilizer used for ongoing revegetation. It could also contain undesirable concentrations of heavy metals, salts, and other chemicals associated with the tailings disposal process.

SITE SPECIFIC IMPACTS

The impact of tailings disposal and basin construction on the aquatic environment will differ considerably for the various sites. Each site differs with respect to quantity of water, quality of habitat and productivity. The impacts of stream relocation, seepage and runoff reaching the streams, construction and turbidity will be as described. However, quantification is extremely difficult. Table 89 shows impacts on aquatic habitat and biota that are common to all sites as well as those impacts that are site specific.

Mile Post 7

Since Mile Post 7 is located in the Beaver River drainage, it has a potential impact on a trout stream area. Turbidity during construction would be unavoidable. The quantity, however, could be reduced and is described in Part V, Mitigating Measures. The silt load which would cause turbidity would settle to the bottom, coarse material first. It would remain in the system slowly moving downstream with each significant runoff. This could be extremely harmful to the benthic and fish fauna. The silt load could damage one area only to be moved by increased flow to another area until it becomes stabilized or reaches

TABLE 89
COMMON AND SITE SPECIFIC IMPACTS ON AQUATIC HABITAT AND BIOTA

IMPACTS (Local Common)	Mile Post 7	Embarrass	Colvin	Snowshoe
Loss of Aquatic Habitat:				
Streams (Miles[1])	Big Thirtynine Creek 7.0 Little Thirtynine Creek 2.7	Spring Mine Creek 3.4 Ridge Creek 1.2 Unnamed outlet of Kaunonen Lake 0.8(2)	Unnamed Creek 6.3 (N. Basin) Unnamed Creed 2.3 (S. Basin) Colvin Creek 4.4	Dunka River 2.3
Lake (Acres[2])	None	Mud Lake 7 Kaunonen Lake 13(2)	None	None
Marshes (Acres[3])	800	1,230	2,260	2,740
Fish Tolerance	Trout tolerance	Northern pike, walleye, & yellow perch tolerance	Northern pike, walleye, & yellow perch tolerance	Northern pike, walleye, & yellow perch tolerance
Changes in Water Quality:				
Dissolved Oxygen	Low	Moderate	Moderate	Moderate
Temperature	Low	Moderate	Moderate	Moderate
Turbidity	Low	Moderate	Moderate	Moderate
Reduction in fish Spawning & nursery area	Yes	Yes	Yes	Yes
Dust from Basin	Yes	Yes	Yes	Yes
IMPACTS (Site Specific)				
Designated Trout Streams(4) Affected	Beaver River Big Thirtynine Creek East Branch Beaver	None	None	None
Disruption of Unique Cold Water Lake	Bear Lake	None	None	None
Stream Diversions:				
Number	6	None	One	None
Potential for Water Temp. Increase	Yes	No	Yes	No
Potential for Increase in Stream Turbidity from Levee Runoff	Yes	No	Yes	No
Stream Crossing by Tailings Pipeline	Yes	No	No	No

(1) Data from Appendix A.
(2) These are not covered by tailings but become part of seepage collection system.
(3) Includes total of marshes covered by tailings, but not marshes affected by seepage collection system.
(4) Minnesota Department of Natural Resources designation.

the lake. Important spawning beds for trout could be covered for a considerable amount of time. Generally speaking (the only way possible when discussing the impact of unknown facts: silt quantity location, time and flows), the impacts of an increased silt load are realistic and would be harmful.

The tailings basin will occupy 7.6 square miles and eliminate approximately 9.7 miles of stream. This reduction in drainage basin and consequent loss of surface runoff will reduce flows downstream. This could be a critical factor during periods of low flow.

Although flow will be reduced in the overall drainage basin because of river mile loss, it will increase in certain sections. The flow from Little Thirtynine Creek will be diverted into Big Thirtynine Creek. This will increase the flow and velocity of the latter which could be detrimental. The increased flow will re-orient the finer substrata until equilibrium is reached. It may also allow mixing of populations otherwise separated. The added flow may also be beneficial. Low flow would be augmented and new habitats may be made available. The same possibilities hold for the diversion of Big Thirtynine Creek to the Beaver River.

A reduction in river miles means the loss of fishing habitat.

Adjacent to the Mile Post 7 site is Bear Lake. Bear Lake is a clear cold-water lake with a variety of resident fish. A prolonged wind carrying large quantities of tailings basin dust could increase turbidity and reduce photosynthesis. This in turn would reduce the productivity of the lake. It is possible that this turbidity would not have enough time to settle before it receives additional wind-blown dust. Under this circumstance, the lake could remain turbid for long periods.

The threat of tailings slurry reaching the aquatic environment will persist during operation and filling of the tailings basin at Mile Post 7 since pipeline leakage or rupture is possible.

In the event of pipeline breakage over or adjacent to a river, the release of abrasive taconite tailings would be expected to cause significant injury to gills of fish exposed to the material.

Phytoplankton are the primary producers in an aquatic ecosystem. With sunlight as the energy source, these organisms transform inorganic substances into sugar and other organic material. From this level, it moves into the food chain through invertebrate and vertebrate species.

Studies have shown the tailings to be a mild stimulant to phytoplankton growth at levels as low as 4 parts per million, and there is evidence which suggests strong stimulatory effects on periphyton.(10) Likewise, heterotrophic baterial growth is stimulated; however, other pathogenic bacteria remain relatively low. Studies by Shapiro(11) agree with those mentioned above, for he has shown that tailings stimulate growth of Lake Superior algae.

An important factor in phytoplankton productivity is light penetration. It has been shown that a 0.5 parts per million suspension of tailings will reduce this penetration by 48 percent and lower the rate of photosynthesis by 50 percent.[10]

Taconite tailings are known to adversely affect populations of benthic organisms. Several bioassays have demonstrated that the tailings are not directly toxic to most aquatic species.[12,13] Any detrimental effect is due to sedimentation and filling.[14] In addition, the introduction of taconite tailings into aquatic systems can alter the pH and dissolved oxygen levels which may represent a limiting factor to certain fish species.
Statistical analysis shows that populations of benthic organisms (Pontoporeia) in Lake Superior were reduced over a distance of 30 to 40 miles downstream relative to prevailing currents.[10] The importance of the reduction in benthic organisms is not only limited to loss of the organisms themselves, but may be reflected at other tropic levels. For example, sculpins living in the area of reduced Pontoporeia populations have reportedly altered their food habits.[10]

Embarrass

If the tailings basin is built at the Embarrass site, there would be little impact on the aquatic environment in the area for little productive aquatic habitat exists. Two extremely small creeks, Spring Mine and Ridge and one small lake, Mud Lake, are within the basin boundaries. The loss of these areas should not significantly affect the ecosystem of the Embarrass River. Possible spawning and nursery habitat for fish does exist in this area. However, a viable fishery is not known to be present. This conclusion is supported by local fishermen and officials who state that the area is essentially unfished. Flows in the Embarrass River would be reduced slightly. However, the impact should not be significant.

A possible impact would be uncollected runoff and seepage from the tailings basin into the downstream areas.

Colvin

A number of aquatic impacts will result if the Colvin alternative is chosen for the disposal site. The most serious impacts will be the loss of stream miles and reduced flow downstream. The possible effects of increased turbidity are real and probable, and have been discussed in earlier sections.

Approximately 13 miles of stream habitat will be destroyed by the basin proper. This area has been described as offering a marginal sport fishery, with extremely light fishing pressure. However, it must be remembered that this area is considerably remote, requiring fishermen to travel many miles on gravel roads to reach the area.

A number of lakes lie adjacent to the Colvin site including: Big, Seven Beavers, Round, Stone and Cranberry. Excellent fishing and unique settings are available; however, access is poor. These lakes could be adversely affected by wind-blown dust settling on them. A constant prolonged wind could accumulate a considerable quantity of tailings dust on a lake surface possibly causing turbidity and sedimentation problems, including reduced photosynthesis and productivity. If wind transport were controlled, the lakes should be unaffected by the basin.

Snowshoe

Quantification of impacts which can be expected if the tailings basin is constructed at the Snowshoe site is impossible due to recent change in boundaries, and the general lack of specifications regarding construction, roads, pipelines and other facilities.

A possible impact would be that of fugitive dust from the basin. A number of lakes lie to the east of the Snowshoe area including Sand Lake, Lobo Lake, Bonga Lake, Lake Colkin. Those lakes discussed in the Colvin section lie to the south of the basin. If uncontrolled, dust may reach these lakes causing turbidity and other problems associated with dust.

Approximately 2.3 miles of the headwaters of the Dunka River would be covered if the Snowshoe site is used. The fish and other aquatic species in these headwaters are unknown as a survey was not made at this site.

TERRESTRIAL HABITAT AND BIOTA

COMMON IMPACTS

Fauna

On-land tailings deposition will eliminate the faunal components of the selected site. With few exceptions, the area used for tailings disposal will not be suitable for higher animal life for at least 40 years. In addition, the quality of the habitat on adjacent land will be modified, by the activities associated with the action.

This operation will impair the habitat to such an extent that the plant and animal species which are now present, and would be present if the site were undisturbed will not be replicated for one hundred years or more.

Since the disposal site will be covered by tailings in solid or slurry form, the smaller, less mobile animals will be destroyed. Many animals which escape the tailings deposition and the associated activity will attempt to establish themselves in adjacent habitable areas. In all probability, the surrounding area will be at or near carrying capacity for the various species of this area. Therefore, many of the displaced animals will experience winter kill, starvation, stress, and increased predation. In addition, there would probably be a temporary adverse effect on surrounding habitat because of the pressure created by a short-term surplus population.

At the end of the operation (40 years), if appropriate measures are undertaken, many of these same species can be expected to begin to re-establish themselves on the site. If rehabilitation plans do not include provisions to establish a diverse terrestrial community, the disposal area will only support an extremely simplified faunal component.

The bird species using this area for nesting will be adversely affected by the habitat lost. Many of the displaced species are territorial. Unless there is habitat utilization flexibility, little increased use of nearby areas can be expected because they are probably used to capacity.

The slow process of plant succession will prohibit the use of this area by certain species for a long period after vegetation becomes established on the tailings basin. Such species as woodpecker, martin, fisher, many warblers, spruce grouse and lynx will not find the modified habitat suitable for many years after vegetation is established.

Flora

The deposition of tailings on any of the proposed sites will result in the complete elimination of the vegetation on the selected site. Associated with the loss of vegetation will be reduced soil stability and reduced nutrient cycling within the community.

SITE SPECIFIC IMPACTS*

Mile Post 7

Fauna

All site comparisons, in relation to impacts on wildlife will be discussed on a per unit basis. More moose will be eliminated per unit area by the selection of this site than any other examined. The number of bear eliminated will be less than any other alternative. The number of deer eliminated will be less than at Colvin and about the same as at Embarrass. The number of wolves eliminated would be less than at either Colvin or Embarrass. The loss of snowshoe hare will be less than at Colvin and probably comparable to Embarrass. The number of ruffed grouse lost would be less than at Colvin and probably about the same as at Embarrass. Spruce grouse are probably more abundant here than at either of the other sites and would be eliminated.

Flora

The plant species composition of the Mile Post 7 site is more varied than at either the Colvin or Embarrass sites. However, many of the stands, such as sugar maple, are not merchantable for sawlogs at this time. Most of the aspen, birch and balsam poplar stands are at or past economic maturity.

The site contains about 4,842 acres, most of which is forested (see Figure 79). The effects on the production of wood materials will be the elimination of this acreage from production for an indeterminate period of time. Most of the trees are mature or over mature. Therefore, the volume of material commercially useable will remain static for some

*The site specific impacts do not include the Snowshoe alternative as no data were collected.

time and slowly decrease over time unless harvested. Most of the trees of commercial size are suitable only for pulp under present market conditions. Therefore, the impact on the site will be the removal of 4,842 acres of land from wood fiber production. Most of the trees will be harvested prior to the time of tailings disposal if this site is selected. In the long-term this area can probably be returned to timber production if mitigating measures are incorporated into rehabilitation plans.

This is the only site selected for study where sugar maple is found in abundance. At present, there is no evidence that these trees are used for the production of maple syrup. It is possible that the sugar maple on this site could be used for sawlogs at some future date.

Agriculture

There are no active farms on or adjacent to the site. The abandoned farm site which is approximately in the center of the proposed tailings disposal area was marginal and was abandoned during the World War II era. There will be no adverse agricultural impact if this site is used for tailings disposal.

Embarrass

Fauna

The coverage of this site by tailings will result in the loss of 5,888 acres of habitat for a variety of wildlife species. This represents moose habitat of a lesser quality than at Mile Post 7 and deer habitat similar to that of Mile Post 7 but of lesser quality than that of Colvin. Wolf habitat of lesser quality than Colvin but greater than Mile Post 7 would be lost. The loss of habitat for snowshoe hare and ruffed grouse on a per unit area basis would be similar to that of Mile Post 7 but less than that at Colvin. The loss of spruce grouse would be less than that of Mile Post 7.

Flora

An approximation of timber types and volumes for the Embarrass site is given in Tables 90 and 91.

The forest type on the Embarrass site appears to be rather homogenous and the overstory vegetation is largely aspen-birch with aspen predominant.

Most of the areas of the Embarrass site, which support either jack pine or black spruce have been harvested for pulpwood within the last few years. At present, it is estimated that no more than 12 percent of the site is occupied by these two species in combination. The only other timber type large enough to be considered is the black ash type which probably covers no more than 2 percent of the surface area.

TABLE 90
ESTIMATED VOLUME OF PULPWOOD BY SPECIES FOR EMBARRASS SITE[a,b]

	Mean Volume per Acre (C Units)[c]	Total Volume (C Units)	Percent
Aspen	7.9	28,835	56
Birch	8.7	12,295	24
Jack Pine	14.9	7,018	14
Spruce	12.8	3,021	6
Black Ash	--	--	--
Total		51,169	100

(a) Personal Communication, Steve Parsons, Aurora District, U.S. Forest Service, USDA.

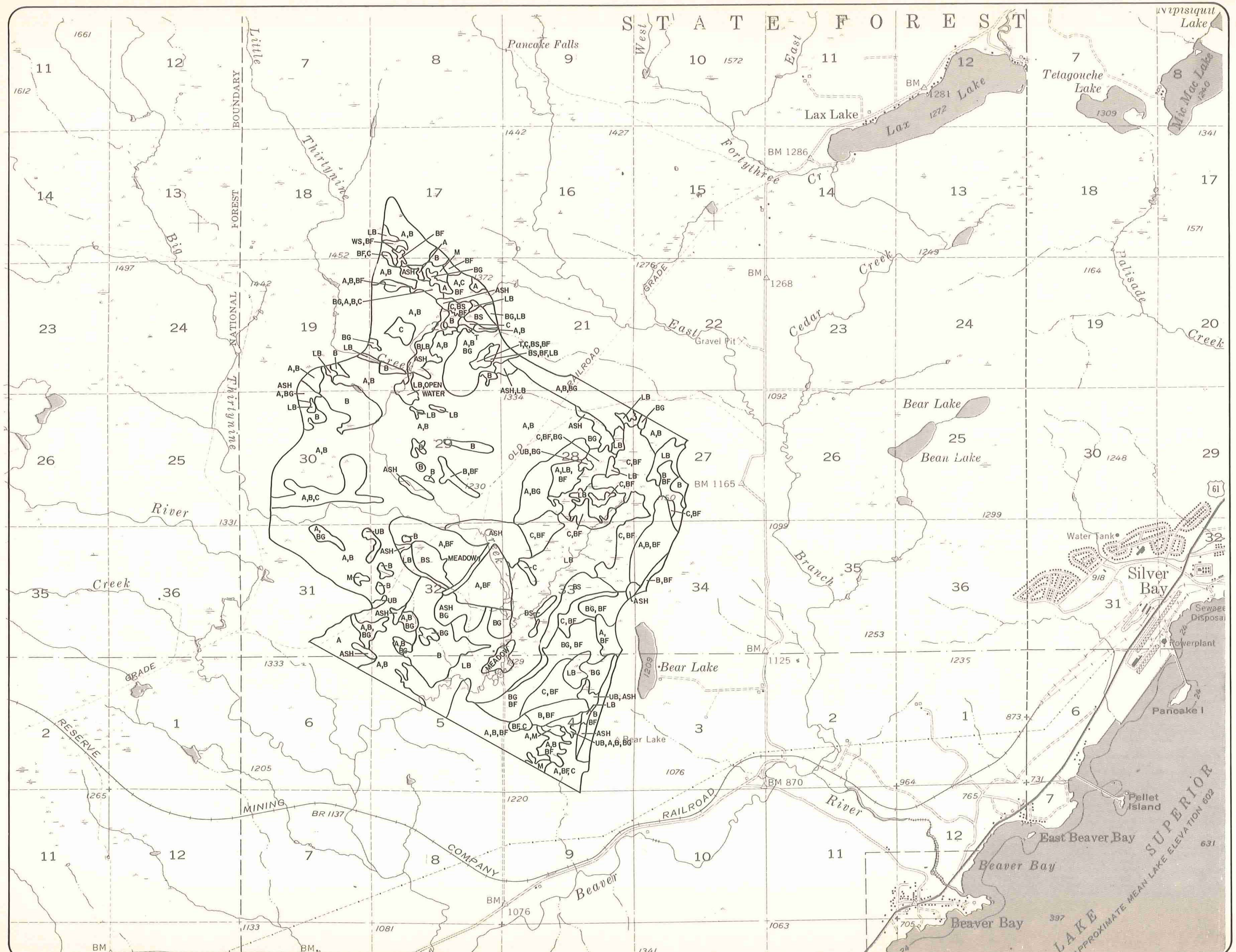
(b) These total volumes are an approximation and subject to error.

(c) C Units = 100 feet^3.

TABLE 91
AREA OF TIMBER TYPES - EMBARRASS SITE[a]

Type	Area	Percent
Aspen	1,531 Acres	26
Aspen-Birch	3,533 Acres	60
Jack Pine	471 Acres	8
Black Spruce	236 Acres	4
Ash	117 Acres	2
Total	5,888 Acres	100

(a) These areas are a rough approximation and subject to error.



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

79 GENERALIZED FOREST TYPE MAP - MILE POST 7

LEGEND

- ASH — BLACK ASH
- A — ASPEN
- B — BIRCH
- BF — BALSAM FIR
- BG — BALM OF GILEAD (BALSAM) (POPLAR)
- C — WHITE CEDAR
- M — MAPLE
- LB — LOWLAND BRUSH
- UB — UPLAND BRUSH
- BS — BLACK SPRUCE
- WS — WHITE SPRUCE
- T — TAMARACK
- R — ROCK
- MEADOW — OPEN MEADOW
- COMB. OF THE ABOVE MAY BE INDICATED.

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If the Embarrass site is selected for tailings disposal, all the vegetation on that site will be eliminated.

Agricultural Impacts

At the present time, there are no data on the value of agriculture for the Embarrass alternative. There are some small private landholdings on the north edge of the Embarrass site. A few of these owners have truck patches, raise livestock or cut hay. All are marginal farms. If this site was selected for a tailings basin, these farms would be forced out of production.

Colvin Alternative

Fauna

The use of the Colvin site entails the loss of 6,488 acres of wildlife habitat. The represents a loss of fair moose habitat, good (and improving) deer habitat, and fair to good habitat for black bear. In addition, there is a deer wintering area which partially intrudes into the Colvin site. (Refer to table 92)

Snowshoe hare are abundant on this site and the loss of habitat will adversely affect this population. This site provides higher quality habitat and food supply for timber wolves than either Mile Post 7 or Embarrass. The removal of this acreage will adversely effect wolf habitat.

Since the Colvin site contains more wet land area than the other sites, riparian and semi-aquatic furbearers which this habitat supports will be lost or displaced.

Flora

The estimated volume of pulpwood by species which presently occurs on the Colvin site is shown in Table 93. Under present market conditions, jack pine and black spruce command a higher price than aspen and birch. However, market values change rapidly at times. The United States Forest Service adjusts prices quarterly (every 3 months) so that excessive profits or deficits will not occur on long-term timber sales.

If the Colvin area is chosen for a tailings disposal site, the merchantable material will probably be harvested and utilized. However, young timber or "ingrowth" will probably be disposed of without utilization. A generalized forest type map for this site has been prepared (see Figure 80).

TABLE 92
AREA OF TIMBER TYPES - COLVIN SITE

Type	Area	Percent
Aspen	760 Acres	11.8
Aspen-Birch	552 Acres	8.5
Aspen-Spruce	1,178 Acres	18.2
Aspen-Lowland Brush	29 Acres	0.4
Jack Pine-Aspen-Spruce	174 Acres	3.3
Jack Pine-Aspen	1,139 Acres	17.6
Jack Pine	438 Acres	6.8
Spruce	1,241 Acres	19.2
Spruce-Aspen-Lowland Brush	51 Acres	0.8
Spruce-Lowland Brush	34 Acres	0.5
Lowland Brush-Aspen	51 Acres	0.8
Brush and Non-Forested	605 Acres	9.4
Total	6,468 Acres	100.0

TABLE 93
ESTIMATED VOLUME OF PULPWOOD BY SPECIES FOR COLVIN SITE*

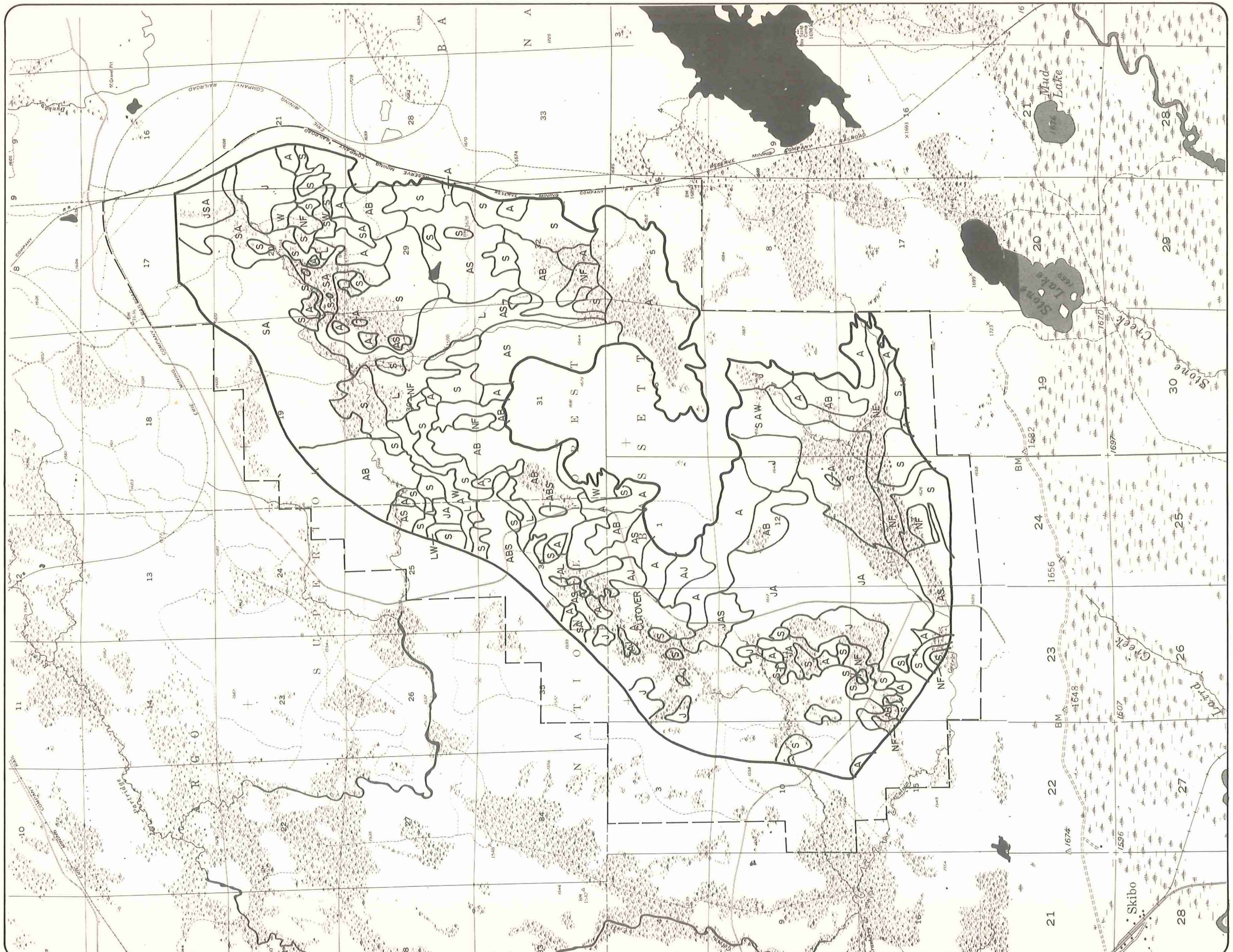
Tree Species	Mean Volume Per Acre (C Units)**	Total Volume For Site (C Units)	Percent
Aspen	7.90	20,911	33
Birch	8.70	2,618	4
Black Spruce	12.80	21,798	34.5
Jack Pine	14.90	17,984	28.5
Total		63,311	10010

* Estimates from USFS, Aurora District Ranger Office
** C Units = 100 x cubic feet

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

80 GENERALIZED FOREST TYPE MAP - COLVIN



LEGEND

A - ASPEN
B - BIRCH
J - JACKPINE
S - SPRUCE
W,L- LOWLAND BRUSH
NF - NON-FORESTED

TAILINGS BASIN
PROPOSED SITE BOUNDARY

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SOCIOECONOMICS

PLANNING PHASE

During the period of planning, which concludes with final design and award of a construction contract for implementation, there will be minimal, if any, impacts from a socioeconomic point of view. However, in this instance, there may be a secondary affect due to the fact that prior to entering the final design stage the existing litigation and administration proceedings will have been resolved. Once these have been resolved, the outlook of Silver Bay and Babbitt residents will undoubtedly stabilize as compared to the uncertainties which currently exist.

CONSTRUCTION

Changes in Employment

Construction jobs for the concentrator revisions and the construction of Mile Post 7 are estimated to reach a maximum of 500 to 1,000 at some point in the 3-year construction period.(15) The majority of the labor force will be drawn from Duluth and the Iron Range, if the skills are available. The taconite expansion construction force of 3,000 on the Iron Range will be decreasing through 1976 thus providing the most likely labor pool. The Silver Bay area will provide very few of the construction workers from the present labor force which is virtually fully employed. It is also reasonable to expect that some of the work force will come from areas outside the region.

A maximum of 1,000 to 1,500 construction workers will be needed at the peak of construction if the new facilities are built in the Babbitt area. Construction at one of these sites will require approximately 4 years, which means one additional year for the construction labor force in comparison with Mile Post 7. It is expected that the construction workers will come from the nearby towns of Babbitt, Ely, Virginia, Hoyt Lakes and other towns on the Iron Range. It is quite possible that because of demand for construction workers in the study area, Duluth and other nearby cities will also supply construction workers. In either case, workers would probably commute either on a daily or weekly basis, or would find temporary housing in the area. Indirect employment resulting from construction is expected to be minimal. However, the number of service employees will rise in proportion to the number of construction workers that settle in the area on a permanent or semi-permanent basis.

Very little secondary employment will be generated by this construction work. Widespread supplier locations, commuting by many of the workers and the short-term nature of construction impacts will minimize the non-direct employment.

Housing and Public Services

Mile Post 7

Due to a number of factors, it is not anticipated that a significant increase in permanent housing would take place in the Silver Bay vicinity during the construction phase:

1. The implementation or construction phase for the Mile Post 7 proposal would last for only three years.

2. A substantial labor supply exists in the Duluth and Iron Range areas, which are within commuting distances.

3. The new home construction industry is currently at a very deprived level, as discussed earlier. Specifically, economic factors are not favorable for new home construction at this time.

Mobile homes could be utilized to a certain, although unknown extent, and private resorts could possibly provide living accommodations. It is impossible to determine how many workers would or could take advantage of such facilities, but the number is felt to be insignificant. Rather, the great majority of construction workers will choose to commute from Duluth and the Iron Range, either of which is not an uncommon commuting distance for this part of the state.

Since no significant increase in housing is expected in the Silver Bay vicinity, none is expected in the education or health care sections.

Impacts on electrical power, sewer and water systems during the construction phase are expected to be negligible, and are addressed in the utilities section.

Embarrass, Colvin and Snowshoe

All impacts on housing and public services during the construcion phase which were identified for the Mile Post 7 proposal also true for all of the Babbitt sites, with respect to the impacts themselves and the extent of the impacts. The exception to this is the possibility of the establishment of a construction camp in or near Babbitt. At the end of the construction phase, the camp could be converted into residences for permanent employees during the operation phase.

Changes in Population

Mile Post 7

Population relocation impacts during the construction phase of this alternative will depend primarily upon personal decisions of the construction labor force. However, previous employment assumptions coupled with a lack of permanent housing are expected to hinder significant permanent population growth in the Silver Bay area.

Embarrass, Colvin and Snowshoe

Population changes resulting from the construction of an inland concentrator and tailings basin depend upon the location and origin of the construction labor supply. However, as discussed under the impacts relating to employment for this alternative, it is anticipated that most if not all of the labor force will already be in the area. Therefore, no significant additional population increase is expected.

Tax Impacts

Mile Post 7

Generally, little or no change in tax base or tax receipts is expected to occur during the construction period.

Embarrass, Colvin and Snowshoe

Little or no change in tax base or tax receipts is expected to occur during the construction period.

OPERATIONS

Changes in Employment and Economic Base

Mile Post 7

With the proposed Mile Post 7 plan, employment will "increase slightly"(16) presumably for operating and maintaining the tailings basin. If this statement does not include the presumed reduction in manpower to operate the modified concentrator, then a net labor force reduction may result. However, the potential change in employment of plus or minus one or two percent of Reserve's labor force is comparable to typical monthly turnover.

There is a longer term impact of the proposed Mile Post 7 plan on the economic base at the local level. Once a decision is made and implemented, the social and economic stability of the Silver Bay area will be restored. Uncertainty and doubt pending the resolution of the litigation and administrative proceedings on the Reserve Mining tailings disposal issue has pervaded Silver Bay, reportedly impacting the local commercial economy.

Purchasing patterns of local residents are such that virtually total reliance is placed on Duluth for all major purchases. The local Silver Bay market may draw new investment capital to provide commercial and professional services on the basis of a firm and secure future for Silver Bay.

Embarrass, Colvin and Snowshoe

Approximately 450 to 480 employees are expected to be needed if the on-land tailings disposal system and new concentrator/fine crusher facilities are builtat one of the Babbitt sites. In the short term, it is assumed that most affected employees at the Silver Bay operation will follow their jobs to the new site by daily or weekly commuting.

Depending on the commuting versus moving decisions by the Silver Bay and north shore area residents employed at the new site, secondary employment in retail and services businesses will develop in the area, in which the employees decide to reside. Significant impacts will develop when permanent residents are changed by employees moving from Silver Bav to the Babbitt area. Those communities gaining population are most likely to experience an economic expansion. Silver Bay may experience the greatest loss of population and reduction in economic base, depending on the present opportunities and future community action.

A substantial in-migration of people will generate demand for retail commercial and services-based businesses. If the local employment multiplier applies about one new job is generated for every two mining jobs; on a regional basis the multiplier suggests one new job for each mining job.(17)

Housing

Mile Post 7

No significant impacts are anticipated during the operation phase of the Mile Post 7 proposal with respect to the housing.

Embarrass, Colvin and Snowshoe

The impact on the housing section which would take place as a result of the implementation of the Colvin, Embarrass or Snowshoe alternatives would be dependent on the number of new Babbitt employees who could be hired, if need be, from the surrounding area, and the number of Silver Bay employees who would move to Babbitt and could sell their houses in Silver Bay and buy new houses in the Babbitt vicinity. This last factor may be the most limiting of all due to the diminished market for houses in Silver Bay. Although precise figures are impossible to project, it would appear that some employees would choose to move to Babbitt, which currently has very little available housing, as discussed earlier. The net impact on housing will depend on the factors mentioned above in relation to the data in the description of the environmental setting.

Education

Mile Post 7

The relocation of families out of Silver Bay would reduce school enrollment in the Silver Bay-Two Harbors school district. State aid to local schools is based in part on a certain amount of money per pupil unit. Decreasing enrollment means reduced revenue for the school district. Special program funding or operation may also depend on the number of students in a school. Mitigating measures for such impacts are readily available, but seem to rest on legislative and administrative action to devise and authorize.

Embarrass, Colvin and Snowshoe

As in the case of housing, the impact on the educational sector cannot be determined without knowing the number of employees who would move to Babbitt. The current excess capacity in the Babbitt district could handle most, if not all, of the new student influx. Any increase beyond the existing capacity would have to be met either by expanding the facilities and hiring more teachers, or by shifting some of the student load to nearby school districts, which are also currently operating with excess capacity.

Health Care

The impact on health care manpower and facilities is a function of the number of facilities that would move to the Babbitt area. Given the spatial distribution of manpower and facilities throughout the study area, as indicated earlier, no significant change in health care is anticipated as a result of implementing any of the Babbitt alternatives or the proposed Mile Post 7 plan.

Population Changes

Mile Post 7

It is not anticipated that the proposed Mile Post 7 plan will have any perceptible effect on population during the operational life of the Reserve complex.

Embarrass, Colvin and Snowshoe

Population changes or shifts will vary depending upon a number of related elements that may generate various changes. The following is a compilation of the factors that will limit shifts or significant changes in population in the short run:

-As described previously, there are currently no housing units available in sufficient number to house Silver Bay employees who would transfer, or new employees who would move, into the vicinity of Babbitt. In addition, Silver Bay employees would probably be unable to sell their homes except at a loss, especially in the short term.

-Daily or weekly commuting over long distances is not unusual for residents of Northeast Minnesota. Approximately 7 percent of the employees currently employed at Reserve spend from one to two hours travelling each way to work. Information from other studies supports the assertion that people are generally willing to commute up to one hour each way to their place of work.

-Current family income of Reserve employees in comparison with new housing costs minimizes the opportunity to purchase or rent new housing on the Iron Range.

-Alternate employment centers for short-term employment (such as Two Harbors or Duluth) exist within commuting distances.

-As attrition reduces the labor force in the pelletizer, employees not wishing to continue to work in the concentrator in its new more distant location may take openings in the Silver Bay facilities. This would reduce relocation or commuting.

In general, a combination of two elements can be expected to characterize the locational nature of the population under any of the Babbitt area alternatives. These include some persons remaining in Silver Bay and commuting and some relocation to the Babbitt area. As the life of this alternative is extended through time, the Silver Bay area will have experienced a net loss of population approximately equal to the number of employees in the concentrator plus their average family size (1200 to 1500). The Babbitt area will experience a like net increase in population.

It is important to note that a significant degree of personal choice will influence the outcome and nature of population relocations.

Changes in Taxes

Mile Post 7

The reduced quantity of pellets to be shipped under the proposed action will reduce the state and local taxes payable by Reserve by an estimated $2.7 million per year, or about 18 percent of their 1975 taxes payable.(18) Estimated total taxes payable by Reserve on the 40-year life vary from $537 million to $559 million. Estimated federal taxes, payable by the parent companies over the 40-year life, range from $678 million to $770 million. The range in taxes payable results from the proportion of debt financing used for the project.

Embarrass, Colvin and Snowshoe

It is estimated that there will be a net reduction in the taxes receivable by Lake County. This is based on present laws governing the distribution of taconite tax and the fact that the concentrator is moved out of Lake County into St. Louis County. St. Louis County will most probably benefit from the changes and relocation. These impacts may require an addition to the Lake County residential taxes which may occur as a result of increase in property tax levees induced by a reduction in revenues from taconite taxes. Should this occur, the tax burden would be transferred to the residents of Lake County. Legislative action restoring the previous tax distribution between the two counties may be the most effective remedy of this impact. It is estimated that there will be no net reduction of state and local taxes payable by Reserve at any of the alternatives. Total state taxes payable are estimated to range from $597 million to $631 million over the 40-year life. Federal taxes payable by the parent companies over the 40-year life are estimated to vary from $814 million to $940 million.

POST OPERATION

Given the lack of insight inherent in the long range forecasting, reliable projections of impacts due to Reserve Mining Company ceasing operations are impossible to determine. Undoubtedly, there will be an elimination of jobs. Based on the current Reserve employment level, it would appear that this could affect approximately 3,000 employees.

Under the proposed Mile Post 7 plan, approximately 1,600 employees would be working at the mine pit, with 1,400 employees located at the Silver Bay operations. Based on present evidence, the mining industry will remain in the same locale. Consequently, those employees located near the Babbitt operations would have a better potential for reemployment in the mining industry than those at Silver Bay, without incurring relocation costs.

For those alternatives in the Babbitt area, the employee concentration would be heavier at Babbitt (approximately 2,000 to 2,100 employees) than at Silver Bay (approximately 900 to 1,000 employees). Consequently, reemployment opportunities in the mining industry, without relocation, would be greater for these alternatives as opposed to the proposed Mile Post 7 plan.

Major financial impacts will occur to St. Louis and Lake counties due to the loss of all taxes attributable to Reserve Mining Company. This would include all taconite oriented taxes paid by Reserve as well as state income taxes and sales tax from Reserve employees. Reserve Mining Company's state and local taxes are estimated to amount to $15.3 million in 1975.

Based on 1974 data, loss of all taconite revenues would mean a reduction by over 60 percent of the total revenue of the City of Silver Bay and 57 percent of the total revenue for the City of Babbitt. The impacts would extend throughout Lake County, parts of St. Louis County and the State of Minnesota. In the short run, eventual shutdown would generate an increased demand on local and state welfare and social services while being accompanied by a reduction in the total funds available for supporting these services.

LAND USE

LOCAL IMPACTS

Land use impacts fall into two general categories: those associated directly with the disposal sites and the immediate area and those of a regional nature. This discussion identifies impacts as they relate to cultural land use activities for the proposed Mile Post 7 and the alternative sites. Three general areas are affected:

1. The tailings basin
2. The associated project area
3. The area adjacent to the site

The following are the common types of impacts which will occur in each of the areas. The impacts are summarized in Table 94.

Common Impacts - Tailings Basin

Development of the tailings basin at any of the sites will eliminate all of the existing uses and activities identified for the individual sites. These cultural activities are identified in the summary table. During the period of operation, the tailings basin will only be utilized as an industrial use. Following operation, its re-use potential is somewhat limited. No revegetation or topographic relief will occur of any significance on the site without specific actions of man.

Common Impacts - Associated Project Area

The area immediately surrounding the tailings basin will be controlled for industrial use. This area will contain necessary roads, railroads, pipelines and utilities, and supporting structures necessary for utilization of the tailings basin.

Common Impacts - Surrounding Area

A variable amount of land adjacent to the tailings basin and associated project area will witness change as a result of man's activities. The most significant impact is the limitation of recreational activities with which the industrial use would conflict. Urbanization nodes other than those presently existing are not contemplated in the areas adjacent to the disposal sites. In addition, new uses will be introduced into this area for the support facilities for the industrial use such as access roads, pipeline corridors, railroad tracks and spurs, utility corridors, construction facilities, potential construction housing and other associated uses. The land value, aesthetic appeal, and recreation potential of these adjacent areas will be significantly compromised during operations and potentially for an extended period of time following operations depending, on the nature and type of reclamation activities.

Although existing land ownership is more directly related to implementation it does have significance from two standpoints:

1. The availability of the area for public use.
2. The cost and time implications for site assembly and acquisition.

The presence of publicly owned land at each of the sites has been documented in the Recreation section and is summarized in the summary table. Removal of public land removes its existing and potential capacity for public purposes. The Colvin and Snowshoe alternatives are located within the Superior National Forest. The Embarrass and Mile Post 7 sites are located adjacent to the Superior National Forest. The Snowshoe and Colvin sites are almost totally publicly owned. Approximately 50 percent of the proposed Mile Post 7 site is publicly owned while 25 percent of the Embarrass site is publicly owned.

Cultural Land Use Impacts

Mile Post 7

The proposed action will intrude on the natural setting of the privately owned lake and residence abutting the project. Construction of the facility will eliminate the potential for future recreational development and enjoyment associated with the high use north shore recreational corridor.

Embarrass

Utilization of the Embarrass site by Reserve may necessitate modification of expansion plans for Erie Mining tailings basin. However, preliminary Erie Mining plans indicate that their tailings basin expansion can be accommodated without encroaching on the proposed site.

TABLE 94
LAND USE SITE SPECIFIC IMPACTS SUMMARY

LAND USE	Mile Post 7			Embarrass			Colvin			Snowshoe		
	Tailings Basin	Remaining Project Area	Total	Tailings Basin	Remaining Project Area	Total	Tailings Basin	Remaining Project Area	Total	Tailings Basin	Remaining Project Area	Total
DIRECT												
Roads[1] (miles)	0.6	1.8	2.4	3.8	10.6	14.4	5.7	1.8	7.5	0.3	1.3	1.6
Trails[1,2] (miles)												
Existing-State Designated	2.9	1.0	3.9	0	0	0	0	0	0	2.0	0.6	2.6
-Non-State Designated	5.1	3.0	8.1	3.5	1.5	5.0	9.0	6.0	15.0	10.0	6.8	16.8
-Sub Total	8.0	4.0	12.0	3.5	1.5	5.0	9.0	6.0	15.0	12.0	7.4	19.4
Planned-State Designated	0	0	0	0	0	0	0	0	0	3.0	0.9	3.9
TOTAL	8.0	4.0	12.0	3.5	1.5	5.0	9.0	6.0	15.0	15.0	8.3	23.3
HISTORIC AREAS[3]												
Railroads	1	1	1	2	2	2	1	1	1	0	0	0
Trails	0	1	1	0	2	2	2	2	2	0	1	1
Indian Camps	0	0	0	2	0	2	0	0	0	0	0	0
UTILITIES[1,4] (miles)												
Electric Transmission	0	1.4	1.4	7.6	3.9	11.5	0	0.6	0.6	0	2.2	2.2
RAILROADS (miles)	0	0	0	0	0	0	0	0	0	0	2.2	2.2
AGRICULTURAL LAND[4] (acres)	0	0	0	76	N.A.[5]	N.A.[5]	0	0	0	0	0	0
STRUCTURES[1]	2	4	6	13	16	29	0	0	0	0	0	0
RECREATION AREAS[2] (sq. miles)												
Planned	0	0	0	0	0	0	N.A.	N.A.	10	0	0	0
TO BE CREATED												
RESERVE (sq. miles)	7.6	7.11	14.71	7.49	9.36	16.85	12.34	8.82	21.16	4.98	6.48	11.46
PUBLICLY OWNED (sq. miles)	N.A.	N.A.	6.91	N.A.	N.A.	2.50	N.A.	N.A.	18.16	N.A.	N.A.	10.52
ASSOCIATED PROJECT AREA												
Railroad Corridor (sq. mi.)	0	0.8	0.8	0	0.17	0.17	0	0.10	0.10	0	0.10	0.10
Roads (miles)	0	3.22	3.22	0	0.76	0.76	0	0.19	0.19	0	2.84	2.84
Pipeline & Utility Corridor (sq. mi.)	0	0.05	0.05	0	0.01	0.01	0	0.01	0.01	0	0.01	0.01
Plant Area (sq. mi.)	0	N.A.	N.A.	0	0.20	0.20	0	0.20	0.20	0	0.20	0.20

1. U.S.G.S. Maps
2. Rec. Section
3. Land Use Section
4. DNR Report-Reserve/Babbitt
5. Not Available

Colvin

Utilization of the Colvin alternative would infringe on the proposed Seven Beaver Recreation Area.

Snowshoe

The site is not in a high recreation activity area and has limited potential. Utilization of the Snowshoe alternative would elimate any recreational potential. Adjacent area cultural support activities conflicting with recreational potential would be the most significant impact beyond those previously identified.

REGIONAL LAND USE PLANNING IMPACTS

From the land use planning standpoint the individual actions occurring within the region cannot be examined independently and comparatively outside of the regional context. The region and its activities are dynamic, and interrelate to each other. There are limited opportunities to manage development on a coordinated, consolidated basis.

The character of the study area is clearly natural resource base oriented. Existing activity concentrations have been clearly established. Industrial and urban activities are disruptive to the basic natural resource oriented recreational activities. From a long range planning standpoint it would be desirable to group and concentrate these conflicting activities rather than dispersing them throughout the study area. Concentration permits establishing a continuity of experience and character consistent with the area's resource base. Concentration minimizes the points of disruption and conflict. Concentration minimizes the difusion of cultural land activities and uses which are necessary to support industrial development. This includes activities such as roads, cities, and other related features. Finally, concentration of man's activities permits consolidation which minimizes the need for extensive support facilities such as roads, utilities, hospitals and commercial activities and reduces the public cost required for transportation, utilities, education and social services.

Incremental public policy and private investment decisions have pointed to the concentration of industrial and urban activities along the Mesabi Iron Range corridor. Policy clarification is definitely needed, particularly along the north shore corridor where conflicting activities have been promulgated.

Recreational and wilderness experience activity areas have likewise been concentrated by individual actions. Prime recreational corridors have been established. Extensive intrusion of man's urbanized and industrialized activities is not compatible with this emerging policy. The primitive wilderness corridor has been established through land acquisition and public management areas. This corridor includes the Voyageurs National Park, the Boundary Waters Canoe Area, and Grand Portage National Monument.

The north shore corridor is less clear because of the diffusion of public actions and policies. However, it is emerging with a natural resource recreational priority emphasis. This direction is supported by:

a. Consideration of the area for inclusion under the Critical Areas Act for the State of Minnesota.
b. Intensive planning efforts undertaken under the Coastal Zone Management Act.
c. The existing concentration of recreational usage.
d. The portal entrance nature of the corridor into the established primitive wilderness recreational resource referenced above.
e. The unique aesthetic appeal offered by the views of the lake, the surrounding rugged terrain and natural features.
f. The concentration of stream fishing resources and the emphasis on maintaining and managing fish populations.
g. The improvement and enhancement of fishing activities within Lake Superior.
h. The development of harbors of refuge to encourage recreational boating on Lake Superior.
i. Land acquisition programs establishing state parks and national monuments.
j. Management plans for wildlife and forestry management for the area.

The most significant impact of the proposed actions is that it adds another incremental decision to the planning policy base in the absence of a coordinated comprehensive context which encompasses all existing and proposed activities and their relationships.

Regional land use planning impacts can be summarized as follows:

1. The proposed action absent regional land use planning policy will tend to foster incremental decision-making without a long range compatible and comprehensive perspective.

2. Each individual action in the absence of overall land use policy therefore becomes a policy direction without full knowledge of its implication.

3. Any proposed action which is not viewed in a comprehensive regional context runs the possibility of closing out future options and potentials within the region.

In the absence of established and stated comprehensive and coordinated public policy the following regional land use planning principles appear to be emerging:

1. Encourage the consolidation of manageable regional land use activities.

2. Minimize or eliminate further intrusion of man's activities into the natural resource recreational oriented areas.

3. Eliminate or consolidate conflicting land use activities in the Voyageurs-BWCA and north shore prime recreation/scenic corridors.

4. Minimize the development of resource oriented activity so as to maintain the natural and recreational character of the area.

Again, these principles have not been established specifically by public action but tend to be supported by past and emerging public actions. Applied they would support the consolidation of mineral processing and industrial activities adjacent to existing concentrations. These principles support protection of the major recreational corridors from further encroachment to preserve future options for eliminating conflicting and incompatible utilization. These principles, when applied to the specific sites, are summarized in Table 95.

TABLE 95
SUMMARY OF EMERGING REGIONAL LAND USE PLANNING PRINCIPLES FOR ALTERNATIVE DISPOSAL SITES

Principle	Mile Post 7	Embarrass	Colvin	Snowshoe
Colsolidate manageable regional land use activities	D	S	L	L
Minimize further intrusion of man's activities into natural/recreational areas	D	S	D	D
Eliminate conflicting land use activities in VNP-BWCA and North Shore Prime Recreational Corridors	D	S	S	S
Minimize development intensity of resource oriented activities in natural/recreation character areas	D	S	D	D

S = supports
L = limited effect
D = detracts

RECREATION

Changes in individual elements of the recreational system will produce change to the overall recreational experience.

In theory, recreation activities and non-recreation activities can, through careful design, be located adjacent to each other. In practice, however, and particularly in the overall study area, care must be exercised to assure that major activities do not erode the desirability of the overall recreational system. Locations of many activities are manageable (i.e., roads, utilities, cities and towns, and industrial activities). The location of resource based activities is less manageable, or not manageable at all, such as stream and lake locations, forest locations and mineral deposits. The region's recreational base is natural resource oriented. Therefore, the design of all activities must respect the concept of minimal intrusion of man's activities in the wilderness and natural setting.

OVERVIEW

The three county study area has long been enjoyed by visitors to the area as a total unique recreational experience. Due to the large geographic expanse of the study area, utilization of any of the tailings disposal sites is not readily perceived to have a measurable impact on the study area as a whole. However, to the extent that recognized recreational components within the study area, such as the BWCA, the north shore of Lake Superior, Voyageurs National Park and to a degree, the Iron Range, are of state and national significance, any impact on them must be viewed as impacting the whole.

The major negative recreational impact associated with any of the tailings disposal sites is the taking of land which exists largely in a primitive state and which may be of major importance in maintaining the primitive image of the study area in the future. Inasmuch as the Colvin, Snowshoe, and Embarrass alternatives are all located within or near a mining district and a substantial distance form the BWCA, the north shore of Lake Superior and Voyageurs National Park, the use of any of them for a tailings basin would not produce negative impacts of state or national significance. Due to their proximity to the mining district, the use of any of these sites could coincide with the use of the Iron Range as a recreational (interest) facility.

The use of the proposed Mile Post 7 site would impact upon the north shore of Lake Superior as a recreational corridor of state and national significance.

As indicated earlier, the recreational character of an area is viewed as a function of several environmental factors. The disruption of any of these factors will therefore have a direct impact on the recreational quality of the area. With the character of the north shore being typified by hiking trails, trout streams, unique landforms, waterfalls, campgrounds and resorts, and other features described elsewhere in this report, the potential for negative environmental impact by developing the proposed Mile Post 7 plan is substantial.

The proposed Mile Post 7 site has the greatest potential for recreation user contact due to its proximity to the North Shore Drive (U.S. Highway 61) of Lake Superior and to existing and proposed recreational areas of intense use. The North Shore Drive of Lake Superior is one of the major recreational corridors in the study area. The proposed Mile Post 7 site is located only two and one-half miles north of this roadway and is also directly accessible by automobile.

The proposed Mile Post 7 site is located in an area of existing and proposed intensive recreational use. The Baptism River State Park is located eight miles east of the site, Split Rock State Park four miles south, and the proposed Tetagouche State Park four miles east. The introduction of a tailings disposal basin within this natural area would have a negative environmental impact due to its proximity to the above facilities.

COMMON IMPACTS AND SITE SPECIFIC IMPACTS

Six quantifiable impact measures were originally established to aid in the assessment of probable impacts:

1. Impact on lodge resorts as measured in number of units lost,
2. Impact on public lands available for active and passive recreation as measured in increase or decrease of acreage,
3. Impact on recreational employment as measured in the number of jobs gained or lost,

4. Impact on recreational income as measured in the amount of recreational earnings gained or lost,

5. Impact on recreational facilities as measured in the increase or decrease of facilities,

6. Impact on recreational demand as measured in the estimated increase or decrease of activity.

As was determined in the analysis of existing conditions, none of the sites contain any lodge resorts (impact 1) nor recreational related employment (impact 3); therefore, there is no impact for these factors or for recreational income (impact 4). Most sites do contain some public land and would have a loss of passive (i.e., wilderness areas not developed for recreational activities) and/or active recreational facilities (i.e., campsites and trails).

It appears there would be negligible recreation-related impacts during the planning period, except to the extent that land acquisition will take place. Impacts for the construction, operation, and post-operation periods have been described.

Common Recreational Impacts

Some recreational impacts will be common to all of the sites. These common recreational impacts include the loss of public lands and their associated facilities and the loss or reduction of fishing and hunting activities on the sites and site-adjacent areas. The magnitude of the impacts on the individual sites varies, due to the amount and quality of recreational facilities on each site. A complete description of site specific impacts follows.

Site Specific Recreational Impacts

Of the six impact measures established to aid in the assessment of probable impacts, three apply site specifically:

- Impact on public lands.
- Impact on recreational facilities.
- Impact on recreational demand.

For a summary of probable site specific impacts on recreation, see Table 96.

Impact on Public Lands

All sites currently contain a certain amount of public land. The disposal of tailings at any of the sites will cause a loss of this public land (which may be exchanged for other land) commencing during the land acquisition phase and not recoverable until the post-operation phase. At that time, the character of the land will have changed considerably, probably to the form of a large plain. Presented in Table 97 is a summary of the probably public land loss at each site.

TABLE 96
SUMMARY OF PROBABLE IMPACTS ON RECREATION-SITE SPECIFIC

IMPACTS	MILE POST 7	COLVIN	SNOWSHOE	EMBARRASS
Public Lands	- Loss of 4,420 acres.	- Loss of 11,624 acres.	- Loss of 6,732 acres.	- Loss of 1,600 acres.
Recreational Facilities	- Loss or relocation of 3.9 miles of State designated hiking and snowmobile trails. - Loss or relocation of 8.1 miles of other trails. - Loss of 9.7 miles of designated trout streams. - Possible adverse impacts upon existing and proposed state parks and recreational area. - Loss of possible state park expansion. - Possible adverse impacts upon adjacent fish habitats. - Adverse impact upon wildlife habitat.	- Loss or diversion of 13.0 miles of stream. - Possible adverse impacts upon fish habitats. - Direct adverse impact upon proposed recreation area. - Adverse impact upon wildlife habitat. - Loss or relocation of 15.0 miles of non-State designated trails.	- Loss or relocation of 2.6 miles of State designated hiking and snowmobile trails. - Loss or relocation of 16.8 miles of other trails. - Possible adverse impact upon proposed recreation area. - Adverse impact upon wildlife habitat. - Loss of 2.3 miles of stream.	- Loss or relocation of 5.4 miles of stream. - Adverse impact upon wildlife habitat. - Loss or relocation of 5.0 miles of non-State designated trails.
Recreational Activity	- Negligible impact on snowmobiling. - Negligible impact on hiking. - Significant adverse impact upon trout streams in the area. - Loss of potential good fishing area. - Possible significant adverse impact upon proposed Tetagouche State Park. - Adverse impact upon hunting in the area which is characterized as fair.	- Negligible impact upon fishing activity as it is currently low. - Significant adverse impact upon activities at the proposed Seven Beavers Recreational Area. - Adverse impact upon hunting in the area which is characterized as fair to good. - Negligible impact upon hiking.	- Negligible impact on snowmobiling. - Negligible impact on hiking. - Possible adverse impact upon activities at the proposed Seven Beavers Recreational Area. - Adverse impact upon hunting in the area which is characterized as fair.	- Negligible impact on fishing activity as it is currently low. - Slightly adverse impact upon hunting in the area which is characterized as currently poor. - Negligible impact upon hiking.

Impact on Recreational Facilities

All sites have recreational value. They contain aquatic and wildlife habitats and provide facilities for hiking, cross-country skiing, and snowmobiling. The magnitude of the impact of tailings disposal varies on each site and varies according to the recreational facilities provided.

Mile Post 7: The proposed action will necessitate the relocation or abandonment of approximately 3.9 miles of state designated snowmobile and hiking trails, 8.1 miles of non-state designated trails, and 9.7 miles of designated trout streams. In addition, possible air-quality

TABLE 97
PUBLIC LAND LOSS - SITE SPECIFIC

Site	Total Size in Acres	Total Public Land Lost in Acres
Mile Post 7	9,415	4,420
Snowshoe	7,334	6,732
Colvin	13,540	11,624
Embarrass	10,783	1,600

impacts may be registered at nearby recreational areas. These impacts will commence with the land acquisition phase and will continue at least until the post-operation phase.

The proposed action will have an impact of causing a relocation or abandonment of about 3.9 miles of state designated hiking and snowmobile trails which is about ten percent of the state designated trails in Lake County. There is a total of over 400 miles of snowmobile trails in the three county study area. There are three state designated hiking trails in Lake County: North Shore, Moose Walk, and Top Township (note: These trails are also used for snowmobiling in winter and are about 60 miles in length). There is a total of over 100 miles of hiking trails in the three county study area. The 3.9 mile section of trail which will be affected by the proposed action is a part of the North Shore Trail. The trail currently begins seven miles north of Duluth and ends one mile west of Finland.[19] It is proposed to be extended to Grand Portage and will ultimately extend approximately 150 miles.[20] The proposed action will cause an abandonment or relocation of about seven percent of the state designated hiking trails in Lake County. There are also 8.1 miles of non-state designated trails which will be lost.

The proposed action will necessitate the loss or diversion of one designated trout stream, the Big Thirtynine Creek, and the loss or diversion of its tributary trout stream, the Little Thirtynine Creek.

The site lies within the major moose and wolf range of Minnesota[21,22] and contains various other game and fur animals. The proposed action will cause a loss of about 4,842 acres of wildlife habitat and its associated wildlife and hunting activity. It is estimated that this site contains the best moose habitat and supports more moose than the other sites.

The site is in an area of existing park development. Within eight miles are the Baptism River State Park, Split Rock State Park, the Silver Bay golf course, and a major recreation corridor to the north shore and U.S. Highway 61. The site is also located about four miles west of the proposed Tetagouche State Park and two miles west of a proposed county recreation area. Should wind-blown dust become uncontrollable, the proposed action will have an adverse impact upon these areas.

Embarrass

This alternative would cause a loss of approximately 5.4 miles of Spring Mine Creek, Ridge Creek, and an unnamed creek. These creeks, however, contain little productive aquatic habitat, and the loss of these creeks would not significantly affect the ecosystem of the Embarrass River.

This alternative would cause the loss of 5.0 miles of non-state designated trails.

The site lies within the major moose and wolf range of Minnesota.[21,22] This alternative would cause a loss of about 5,888 acres of wildlife habitat and its associated wildlife and hunting activity. It is estimated that this site contains more animals associated with man's activities, such as red fox and skunks, than do the other sites.

Colvin

This alternative would have a direct negative impact upon a proposed recreational area, would cause the diversion or abandonment of 13.0 miles of streams, and have possible adverse impacts on other recreational facilities in the area.

Seven Beaver Recreation Area, a proposed 50,000 acre wilderness area including Seven Beaver, Round, Pine, Long, Stone, and Big Lakes, will be adversely impacted by this alternative. Approximately half of the Colvin site lies within the boundaries of the proposed recreation area. The use of the Colvin site would at a minimum cause a substantial decrease in the size of the proposed recreation area and significantly alter the primitive setting of the area.

This alternative would cause a loss of 13.0 miles of the Partridge River and Colvin Creek. While undesignated, these waterways offer a variety of habitat types and a number of different fish.

This alternative would cause the loss of 15.0 miles of non-state designated trails.

Should wind-blown dust become uncontrollable, this alternative would affect the use of a number of lakes including Big, Seven Beaver, and Stone Lake all offering excellent fishing.

The site lies within the major moose and wolf range of Minnesota.[21,22] This alternative would cause a loss of about 6,500 acres of wildlife habitat and its associated wildlife and hunting activity. This site contains the best deer habitat and supports more deer and waterfowl than the other sites.[23]

Snowshoe

This alternative would necessitate the relocation or abandonment of approximately 2.6 miles of state designated snowmobile and hiking trails, 16.8 miles of non-state designated trails, and could have adverse air-quality impacts upon the proposed Seven Beaver Recreation Area located one mile south of the site. These impacts will commence with the land acquisition phase and continue at least until the post operation phase.

This alternative would have an impact of causing a relocation or abandonment of 2.6 miles of state designated multipurpose trails, which is about five percent of the state designated trail system in Lake County. Also, 16.8 miles of on-state designated trails would be lost.

The northern boundary of the proposed Seven Beaver Recreation Area will be located approximately one mile south of the Snowshoe alternative. Should windblown dust become uncontrollable, the proposed action will have an adverse impact upon the recreational area.

This alternative would cause the loss of 2.3 miles of the Dunka River. This river was not surveyed for fish habitat.

The site lies within the major moose and wolf range of Minnesota.[21,22] This alternative would cause a loss of about 4,371 acres of wildlife habitat and its associated wildlife and hunting activity.

Impact on Recreational Demand

While quantifiable measures such as user days, are not available for most recreation activities on these sites, a determination of facility impact as related to the amount of similar facilities in the area was made. Impact upon activities (i.e., demand) was then directly related to impact upon facilities.

Mile Post 7: The proposed action will probably have a negative impact on snowmobiling and hiking activity and its impact on fishing activity could be substantial in the immediate area of the site. These impacts will begin with the land acquisition phase and continue at least until the post operation phase.

The proposed action will cause a disruption of the existing North Shore Trail as about 3.9 miles are contained within the project boundaries. While the action only affects seven percent of the state designated trails in Lake County, an important link in the Duluth to Finland trail will be abandoned. This trail while currently being used for snowmobiling primarily, is planned to be used for hiking and bicycling and is planned to be extended to Grand Portage.

The loss of the Big and Little Thirtynine Creeks, tributaries to the Beaver River, would have a direct negative impact on fishing activity in the Big and Little Thirtynine Creeks and in the Beaver River. The Beaver River supports a significant number and variety of fish, and the proposed Mile Post 7 site is capable of supporting a significant trout population. Stream turbidity during construction phases, loss of drainage basin, and a reduction of stream miles (approximately 9.7 miles), all mean the loss of fish habitat. Fishing pressure on the site has been light.

In addition, possible wind-blown dust from the tailings area into neighboring recreational areas such as the lower Beaver River, Lax Lake, Silver Bay golf course, or the proposed Tetagouche State Park would have a negative, although unquantifiable, impact on all recreational activities. Attendance in 1974 at the Baptism River State Park (which will become part of Tetagouche) was about 18,000. While no attendance projections are available for the proposed Tetagouche State Park, it can be expected that the proposed park would have at least that many in attendance. The proposed action, if wind-blown dust cannot be controlled, would probably have a negative impact upon park attendance.

The proposed action will also reduce the aesthetic quality of a potential park expansion area.

The proposed action will also cause a loss of about 4,842 acres of habitat and its associated wildlife. The effect upon hunting activity in the area would probably be directly related to the effect upon game animals and their habitat. Game bird populations in the area are generally low. The moose and bear habitat is fair to good, and the deer habitat is fair.

Embarrass: This alternative will have negligible impact upon fishing activity in the area as the streams contain poor fishing habitats.

Hunting activity currently on the site may be high due to the proximity of population. Therefore, the taking of about 5,888 acres of wildlife habitat will have a negative impact upon hunting activity.

Snowshoe: This alternative will cause a disruption of the existing Top Township trail system as about 2.6 miles are contained within the project boundary. This would cause a decrease of about five percent of the state designated trail system in Lake County.

While not directly taking lands within the proposed Seven Beaver Recreation Area, this alternative could have some adverse impacts upon activity in the park. Should wind-blown dust become uncontrollable, the recreational experiences at the park will be negatively affected.

While specific site information regarding hunting activity is not available, it is assumed that hunting activity is low due to limited on-site access. This alternative would cause a loss of wildlife habitat, about 4,371 acres, and a resultant loss of hunting activity.

Colvin: This alternative would probably have little impact upon fishing activity on the site as fishing pressure has been reported as being low due to limited access. Adverse impacts upon the trout stream and lakes in the area could have a greater impact on fishing activity; however, access would probably have to be improved to these lakes, and this is not currently planned.

The probably impact upon the proposed Seven Beaver Recreation Area could be substantial. This alternative would cause a decrease in the size of the recreation area and could have a detrimental impact upon the remainder of the area, reducing attendance and activities at the park.

This alternative would also cause a loss of about 6,468 acres of habitat and its associated wildlife. The effect upon hunting activity in the area would probably be directly related to the effect upon game animals. This area currently provides fair habitat for moose, good habitat for deer, and fair to good habitat for black bear. In addition, the site currently supports a deer wintering area and has the highest quality wolf habitat of all the sites. Game bird populations are not abundant. The site supports more furbearers than the other sites.

TRANSPORTATION

The transportation impacts associated with the alternatives consist of providing additional roadways, changes in vehicle miles of travel for work trips, fuel consumption, noise and air quality, and the economic aspects of the altered travel patterns. Two methods of commuting to each of the alternative sites were examined:

1. All travel occurs in private automobiles.

2. Travel occurs as a combination of mass transit and private automobile.

Transit by rail and by bus were both examined. Because bus transportation proved to be the most realistic and economical, all comparisons to automobile travel were made with bus transit.

The alignment for proposed Forest Road 11 would be a major transportation corridor for all of the alternative tailings disposal sites. The roadway as proposed by the St. Louis County Highway Department will have adequate capacity to accommodate the traffic that would be generated by development of any of the alternative sites, as well as the regional traffic that has been forecast by the St. Louis County Highway Department. However, additional public roadways as well as private access connections will be required for each alternative in order to obtain the needed access.

COMMON IMPACTS

The transportation impacts common to all alternatives are: Added miles of public roadways (Forest Road 11), which is currently in the planning stage and probably will be implemented regardless of Reserve; added miles of private roadways; change in vehicle miles of travel for work trips; fuel consumption changes required by the change in vehicle miles of travel; change in transportation costs.

These impacts are summarized in Tables 98 thru 100. Table 99 assumes all employees will either drive or be a passenger in an automobile, while Table 100 assumes approximately 75 percent of the employees will take the bus between Silver Bay and the alternate tailings disposal site with the rest traveling by automobile (except Mile Post 7 where it is assumed all travel will occur by automobile).

Although access to the alternative sites is available without Forest Road 11 one-way travel time would decrease by approximately 1/2 to 3/4 of an hour to the alternate sites if Forest Road 11 were available.

SITE SPECIFIC IMPACTS

Mile Post 7

No public roads will be affected by implementation of the proposed Mile Post 7 action.

Embarrass

Approximately 4 miles of County Road 104 will be covered if this alternative is implemented. This road is of minimal standards. In addition, two local roads which connect County Road 104 with County Road 21, will be partially covered. However, access to property served by these two roads will still be provided off of County Road 21.

Colvin

A portion of Forest Route 113 (minimal standards) will be covered due to placing the tailings on this site. Inasmuch as this road is only used as access into the site, there should be no need to replace it.

Snowshoe

Forest Highway 114 (minimal standards) provides access to the site and may be partially covered. Should the Snowshoe alternative be implemented, this road would not have to be replaced.

TABLE 98
SITE SPECIFIC TRAVEL

Site	Two-Way Travel Distance from Silver Bay (miles)	Miles of New Public Road Required*	Miles of New Private Road Required	Vehicle Occupancy
Mile Post 7	6	0	0.5	1.60
Colvin	120	53	0.5	2.30
Snowshoe	125	53	2.0	2.30
Embarrass	154	70	0.5	2.30

*This is Forest Road 11 which has been proposed earlier and is not a result of the proposed Mile Post 7 plan or any of the alternatives.

Note: All figures have been rounded to nearest 5.

TABLE 99
ALL TRAVEL BY AUTOMOBILE

Site	Vehicle-Miles of Travel (Daily)	*Transportation Costs (Daily)	**Fuel Consumption (Daily)
Mile Post 7	1,070	$ 160	70 gals.
Colvin	23,125	3,470	1,540
Snowshoe	23,960	3,595	1,595
Embarrass	30,175	4,525	2,010

* Based on F.H.W.A. 1975 estimate of $0.15 per mile.
** Based on F.H.W.A. 1975 estimate of 15 miles per gallon for average vehicle on roadway.

Note: All figures have been rounded to nearest 5.

TABLE 100
COMBINATION OF BUS AND AUTO TRAVEL

Item	Site: Mile Post 7	Colvin	Snowshoe	Embarrass
Vehicle Miles of Travel (Daily)	1,070	6,945	7,235	8,915
Auto	1,070	6,105	6,360	7,835
Bus		840	875	1,080
Transportation Cost (Daily)	160	1,670	1,720	2,055
Auto	160	1,145	1,185	1,405
Bus*		525	535	650
Fuel Consumption (Daily)	70	615	645	790
Auto	70	405	425	520
Bus**		210	220	270

*See Appendix For Computations
**Based on average of 4 miles per gallon in 1975
Note: All figures have been rounded to nearest 5

AESTHETICS

The aesthetic impact was expressed in quantifiable terms through determining the visibility of the proposed Mile Post 7 site and alternative tailing basins. This was accomplished through the use of a computer analysis, which determines which areas of the alternative tailings basins would be visible from roads, developed areas, lakes, and streams. This analysis divided the dam faces into cells, and counted the number of these cells which would be visible taking into account landforms, vegetation, the location of the natural and cultural features mentioned above, and the description of the proposed action and alternatives. The analysis was conducted assuming ultimate dam heights (See Appendix F). A schematic of this analysis is shown in Figure 81.

Based on this visual analysis, it was determined that the proposed Mile Post 7 site would have the highest frequency of visual impact of the four sites. Following the proposed Mile Post 7, the visual impacts are highest at Embarrass, then Snowshoe and Colvin. Figure 82 displays a comparative summary of all the sites. The visual analysis was carried out for both summer and winter views, to take account of the seasonal variations in vegetative cover.

The proposed Mile Post 7 plan and ancillary facilities would affect the aesthetic qualities of part of the north shore of Lake Superior. The Embarrass, Colvin and Snowshoe alternatives would affect the aesthetic quality of part of the inland area at the eastern end of the Mesabi Iron Range.

MILE POST 7

Development of the proposed Mile Post 7 site would result in visual impacts on Cedar Creek, the East Branch of the Beaver River, Big and Little Thirtynine Creeks, Lake County Roads 3 and 4, Bear Lake, and the development on the north side of Lax Lake. Should Forest Route 11 be constructed as proposed, the proposed Mile Post 7 site would affect visual quality along this route.

The construction of a tailings basin at the proposed Mile Post 7 site would eliminate the following natural and cultural features: The Swanstrom Farm, a portion of an old logging railroad grade, portions of Big Thirtynine and Little Thirtynine Creeks, the waterfall on Big Thirtynine Creek, and the East Ridge topographic features.

A tailings disposal pipeline is part of the proposed Mile Post 7 plan. The pipeline would be a double pipeline extending from the concentrator at Silver Bay to the southeast portion of the proposed Mile Post 7 site. Parts of the pipeline would be visible. However, parts of the pipeline would be visually absorbed into the landscape via topographic changes and vegetative cover. A maintenance road is to parallel the pipeline. A proposed railroad spur is to be located directly south of Dam #1. It is likely that the character of the vegetation would visually absorb the spur near its immediate intersection with County Road 4. For both the railroad spur and the pipeline, corridor linear swaths of right-of-way would have to be cut. These would not harmonize with the surrounding natural landscape.

EMBARRASS

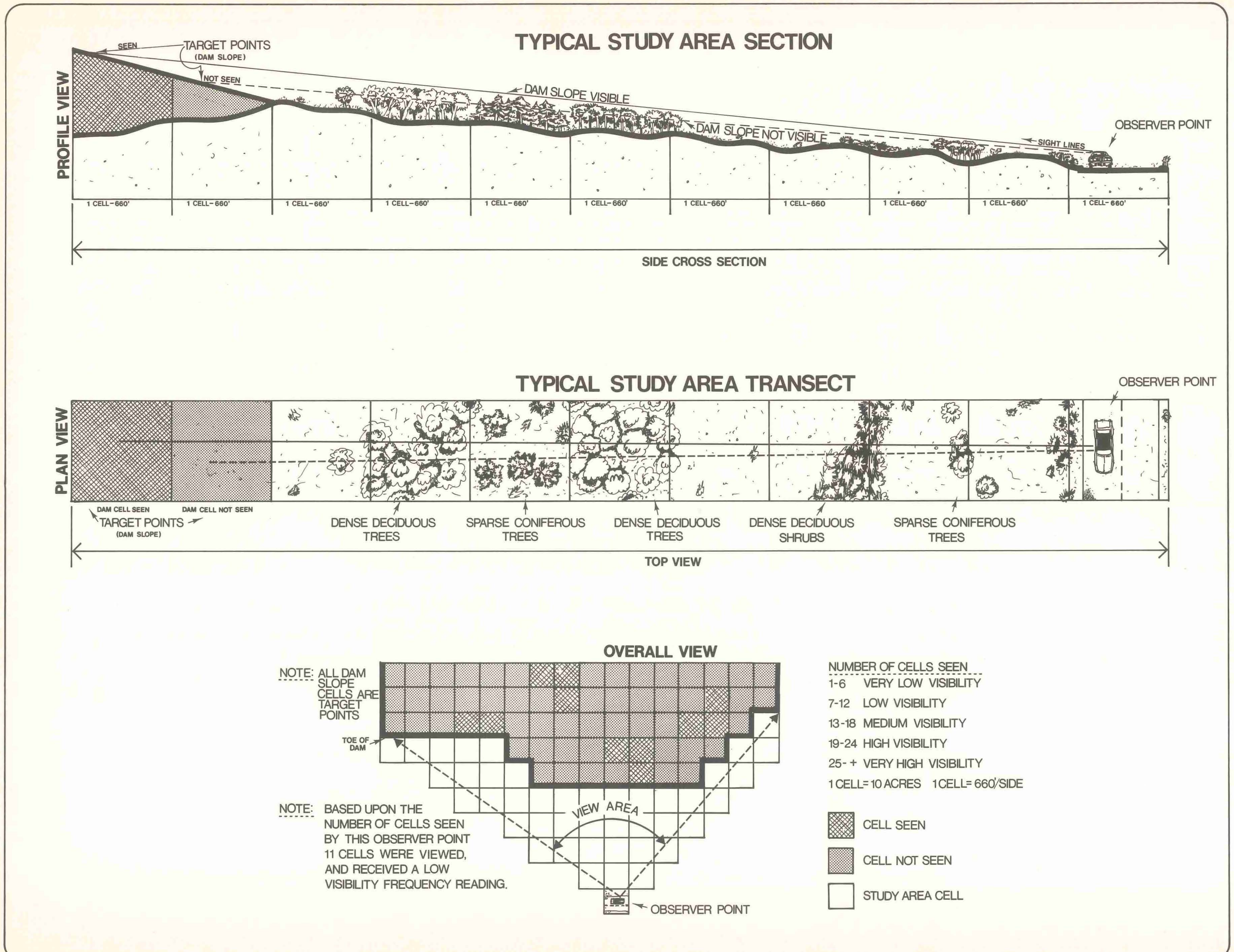
The area most vulnerable to visual impacts of the Embarrass alternative dam face would be north of the site on St. Louis County Road 21. This area along County Road 21 is basically open consisting of pasture lands and swampy vegetation.

The Giant's Ridge acts as a backdrop and contributes to the visual quality in the vicinity of the Embarrass alternative. The ridge has been identified as a significant natural feature. The tailings basin would have an impact on this visual quality. The nearest unique cultural feature is an 1874 mine shaft which is approximately four miles northeast of the Embarrass alternative.

COLVIN

The Colvin alternative would have the least amount of visual impact of the alternatives. The only point at which the visual impact would occur is along Forest Route 120 approximately 1.25 miles southwest of the alternate basin. Portions of the waterways mentioned in the environmental setting would be eliminated. These include portions of Colvin Creek, Cranberry Creek and the Partridge River.

No unique cultural features are within the Colvin site. However, an inactive sawmill is about 2.5 miles to the southwest near Skibo.



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

81 SCHEMATIC OF VIEW ANALYSIS METHODOLOGY

LEGEND

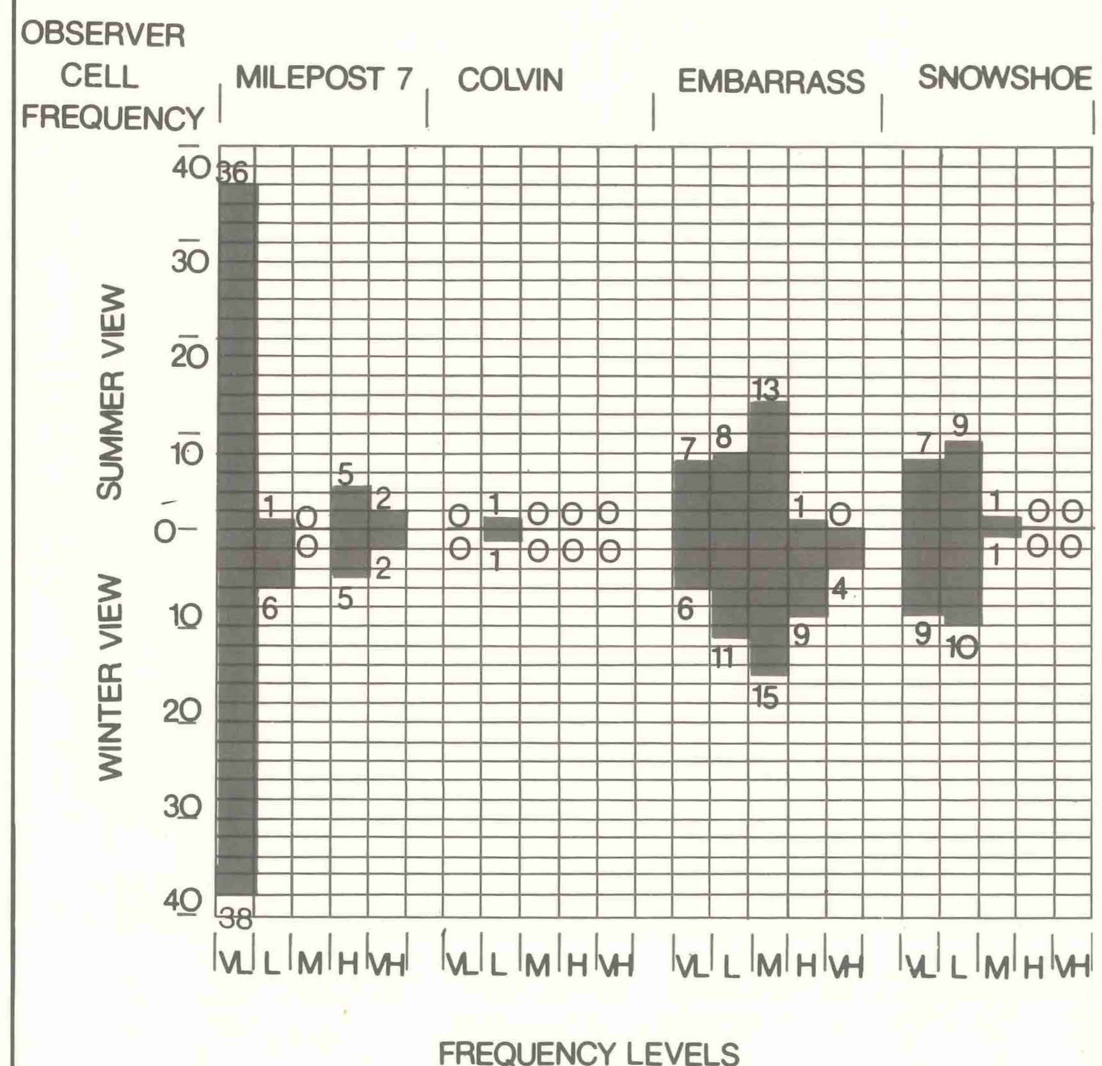
BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

SNOWSHOE

The visual impacts of the Snowshoe alternative would occur along Forest Route 116-114 along the northwestern portion of the site. Because of the deciduous vegetation in the north portion of the alternative, more of the proposed dam face would be visible in the winter.

There are no known unique cultural or natural features that would be affected by implementing the Snowshoe alternative.



FREQUENCY LEVEL LEGEND

VL - VERY LOW VISIBILITY - 1 - 6 DAM SLOPE CELLS VISIBILE
L - LOW VISIBILITY - 7 -12 DAM SLOPE CELLS VISIBILE
M - MEDIUM VISIBILITY - 13-18 DAM SLOPE CELLS VISIBILE
H - HIGH VISIBILITY - 19-24 DAM SLOPE CELLS VISIBILE
VH - VERY HIGH VISIBILITY - 25-+ DAM SLOPE CELLS VISIBILE

82 AESTHETICS COMPARATIVE SUMMARY

BARTON-ASCHMAN ASSOCIATES, INC.
MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

AIR QUALITY

This section presents the results of the assessment of air quality impact of on-land tailings disposal at the proposed Mile Post 7 site and the Embarrass, Colvin and Snowshoe alternatives. The details of the technical approach and computational methods used in the assessment are given in Appendix E.

The measures of air quality impact are the predicted increases in air pollution levels resulting from the proposed action, in relation to existing levels and to limitations imposed by applicable air quality standards discussed in the Environmental Setting. Impact assessment will focus on the air pollutants which are judged to represent the predominant impacts (i.e., total suspended particulates (TSP) and airborne asbestos).

SOURCES OF AIR POLLUTION

Air pollutant emissions would be generated by a wide variety of sources during both the implementation and operations phases of on-land tailings disposal. Particulate emissions from unconfined (fugitive) sources would substantially exceed total particulate emissions from other sources. Estimated emissions from the processing facilities which would be constructed at Silver Bay in the case of the proposed Mile Post 7 plan or in the vicinity of the alternate sites are comparatively small, reflecting the planned use of efficient pollution control devices.

In general, fugitive emissions of particulate matter will occur whenever dry earth or tailings are exposed to the atmosphere and acted upon by wind or mechanical forces. During site preparation and construction, the major sources of fugitive dust will be (1) wind erosion of cleared land, (2) transfer and transport of earth and tailings during construction of access roads, dams, and plant facilities, and (3) vehicular traffic on temporary unpaved roads. The major sources of fugitive dust associated with the operation phase are (1) wind erosion of dry tailings around the perimeter of the basin and (2) vehicular traffic on unpaved roads.

IMPACT ASSESSMENT

Tables 101 and 102 give the predicted increase in ground level TSP concentrations resulting from the construction and operations phases respectively of tailings disposal at the proposed Mile Post 7 and alternative sites. During the period of time that implementation and operations are occurring simultaneously, the TSP concentration increases would be below the levels shown for the operations phase. Concentrations (annual geometric mean values) are given for population centers which lie within about 20 km of Mile Post 7 or the alternative sites. Also shown are approximate values for the existing air quality at each locality.

Although none of the plans would cause TSP levels in the given communities to exceed the primary standard (75 $\mu g/m^3$) during the construction or operation phases, the disposal of tailings at the Snowshoe site would cause the TSP level in Babbitt to exceed the secondary standard (60 $\mu g/m^2$) during both phases unless mitigated. There are several cases where the anticipated increases in TSP concentrations during both phases would be larger than the non-degradation increment (10 $\mu g/m^3$) applicable to geographic areas which do not presently exceed the national air quality standards. These cases are Silver Bay for the proposed Mile Post 7 site and Babbitt for Embarrass, Colvin and Snowshoe alternatives.

The average asbestiform fiber content of TSP emissions generated during the construction and operations phases of the proposed on-land tailings disposal plan and the alternatives is given in Table 103. These values do not account for increase in average fiber content that would occur if taconite tailings were used as surface aggregate on unpaved roads. No recognized ambient air quality standard exists for safe concentrations of asbestiform fibers.

Without mitigating measures, a representative increase in mass concentration of asbestiform fibers at population centers is projected to be 1 $\mu g/m^3$). This corresponds to an asbestiform fiber concentration of 6×10^6 fibers per cubic meter of air.

TABLE 101
PREDICTED IMPACT OF CONSTRUCTION ACTIVITIES ON TSP LEVELS*

Population Center	Population	Existing Air Quality	TSP Concentration ($\mu g/m^3$) Increases due to Construction: Mile Post 7 Increase	Mile Post 7 Total	Snowshoe Increase	Snowshoe Total	Colvin Increase	Colvin Total	Embarrass Increase	Embarrass Total
Aurora	2,531	40	2	42	3	43	5	45	5	45
Babbitt	3,076	45	0	45	23	68	14	59	13	58
Beaver Bay	362	40	9	49	3	43	1	41	1	41
Hoyt Lakes	3,634	40	2	42	4	44	6	46	6	46
Silver Bay	3,504	30	29	59	4	34	2	32	2	32
Tower	699	35	1	36	4	39	6	41	7	42

* Primary Standard: 75 $\mu g/m^3$
Secondary Standard: 60 $\mu g/m^3$

TABLE 102
PREDICTED IMPACT OF DISPOSAL OPERATIONS ON TSP LEVELS

Population Center	Population	Existing Air Quality	TSP Concentration ($\mu g/m^3$) Increases due to Operations: Milepost 7 Increase	Milepost 7 Total	Snowshoe Increase	Snowshoe Total	Colvin Increase	Colvin Total	Embarrass Increase	Embarrass Total
Aurora	2,531	40	1	41	2	42	5	45	5	45
Babbitt	3,076	45	0	40	17	62	15	60	13	58
Beaver Bay	362	40	5	45	2	42	1	41	1	41
Hoyt Lakes	3,634	40	1	41	3	43	6	46	6	46
Silver Bay	3,594	30	15	45	3	33	2	32	2	32
Tower	699	35	1	36	3	38	6	41	7	42

TABLE 103
AVERAGE ASBESTIFORM FIBER CONTENT OF TSP EMISSIONS

Alternatives	Implementation Phase	Operations Phase
Mile Post 7	5%	12%
Embarrass	5%	7%
Colvin	5%	5%
Snowshoe	5%	7%

Note: All values given are percent of emissions generated by weight.

NOISE

Considering the low existing noise levels in the vicinity of the alternative sites (see Environmental Setting, Part III) any major on-site activity would increase noise levels on adjacent lands. For the purpose of determining the areas impacted, the anticipated noise levels generated during both the site construction and site operation phases have been projected. The methodology is described in Appendix F.

COMMON IMPACTS

Construction

The construction process will be essentially the same at the alternative sites. The proposed Mile Post 7 site will not require the construction of a new concentrator. Almost all the noise from site construction will be attributable to the major pieces of equipment used in the construction area. The construction process will involve different phases of activity each of which will have its own mix of equipment and usage pattern, and consequently, its own noise characteristics. The location of activity will also vary for these phases (both on-site and off-site).

The construction noise level beyond the clearing limits will be attenuated by distance as well as by topography and vegetation. The degree of attenuation will vary depending upon the characteristics of the "line of sight" between observer and noise source. Table 104 shows the attenuation rates assumed for each site. These assumed rates were determined using information contained in the Terrestrial Habitat and Landform sections of Part III.

Operations

Increases in noise levels during the operation of each site would be attributable to both the tailings disposal operation and the concentrator operations (except at the proposed Mile Post 7 site). The tailings disposal operations at any site would be essentially the same. The combined noise effects of the disposal operation would depend upon the relative frequency and duration of activities associated with the operations. The actual noise levels would be sporadic due to the intermittent operation of much of the equipment.

For any area beyond the site clearing limits, the corresponding noise levels would depend upon the height of the dam. The higher the dam, the less effective the surrounding terrain and vegetation would be in reducing the noise from the hauling, grading and compaction operations connected with the ongoing dam construction or coarse tailings disposal.

The combined noise levels from all sources within the new concentrating plant at the alternatives would produce Leq noise levels of approximately 47 dB(A) at a distance of 500 feet (approximate distance to clearing limits) from the nearest major building.

The criteria used to evaluate the projected impacts are shown in Table 105.

Any projected increase of 1 to 6 dB(A) above the criteria listed was considered a minor impact while increases of 6 or more dB(A) were considered a major impact to the existing noise environment.

The effect of increased noise levels also depends upon the magnitude of the increase above the ambient conditions. While minor changes to the surrounding noise environment may go unnoticed (until they interfere with an activity represented by the standards) a radical change may elicit a response of annoyance. This is due to an individual's natural aversion to a significantly different noise environment than one to which he has become accustomed or has come to expect. This factor would include the desire to maintain (non-degradation) the existing areas of solitude. For the noise analysis it was assumed that any increase of noise levels above the ambient conditions of between 6 dB(A) and 15 dB(A) would represent a minor impact and any increase greater than 15 dB(A) would represent a major impact.

The projected impact zones for each of the alternatives and the proposed Mile Post 7 site for construction and operation phases are shown in Figures 85 through 90. Table 106 shows the total number of acres over which the projected noise levels would have major and minor impacts and the residences that would be affected for the construction and operations phases.

The amount of land that would be impacted by noise from site construction and operations is very closely related to the length of the site

TABLE 104
ATTENUATION RATES

Mile Post 7	5 dB(A)/100 feet
Colvin	2 dB(A)/100 feet
Embarrass	2 dB(A)/100 feet
Snowshoe	4 dB(A)/100 feet

TABLE 105
NOISE LEVEL CRITERIA

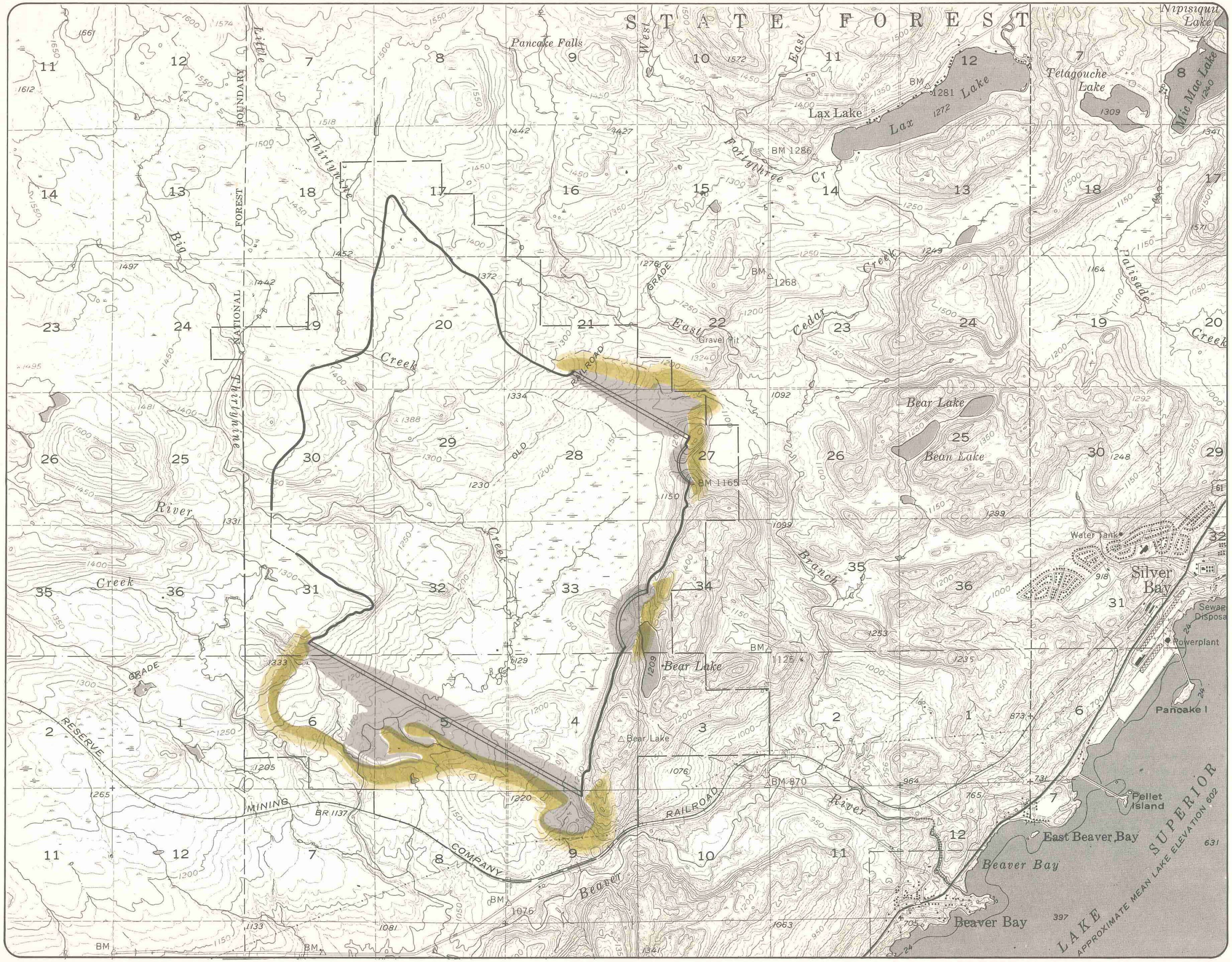
	Noise Level Criteria dB(A)		
Land-Use Type	L_{10}	L_{50}	L_{eq}
Uninhabited forest areas suitable for camping and/or hunting	42	35	38
Residential	55	50	52

TABLE 106
PROJECTED NOISE IMPACTS

	Construction Phase				Operating Phase			
	# of Acres Affected		# of Resicences		# of Acres Affected		# of Residences	
Alternative	Major	Minor	Major	Minor	Major	Minor	Major	Minor
Mile Post 7	410	220			2,400	950		
Colvin	1,800	800			3,500	3,000		
Embarrass	1,100	600	5	4	800	1,300	2	8
Snowshoe	1,700	1,000			3,400	3,600		

perimeter and height of the dam. Thus, the Colvin and Snowshoe alternatives would affect the greatest amount of land. However, the areas that would be affected are small when compared to the size of the sites and the vastness of the area. The construction noise impacts represent a temporary situation which would cease when construction activity is completed. The areal differences in construction noise impacts between sites is therefore considered insignificant.

The noise from site operations would represent a permanent condition as long as the site was being used for tailings disposal. After 40 years, the noise levels would subside to the ambient conditions. Thus, the noise impacts would be reversable. Another factor in the noise impact of the site operations is the usefulness of the impacted lands. At present the areas surrounding the sites (except perhaps Embarrass) are little used, even for recreational purposes. Activities such as snowmobiling would create higher noise levels in the vicinity of the user than the site operations (although the areas impacted are substantially less) and thus the site noise would often not be perceptible above the recreational activity noise. Also, much of the noise impacted land will be site buffer land and will not be opened to public use. All of these factors would indicate the differences in the operations noise impacts between sites should not be significant.



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

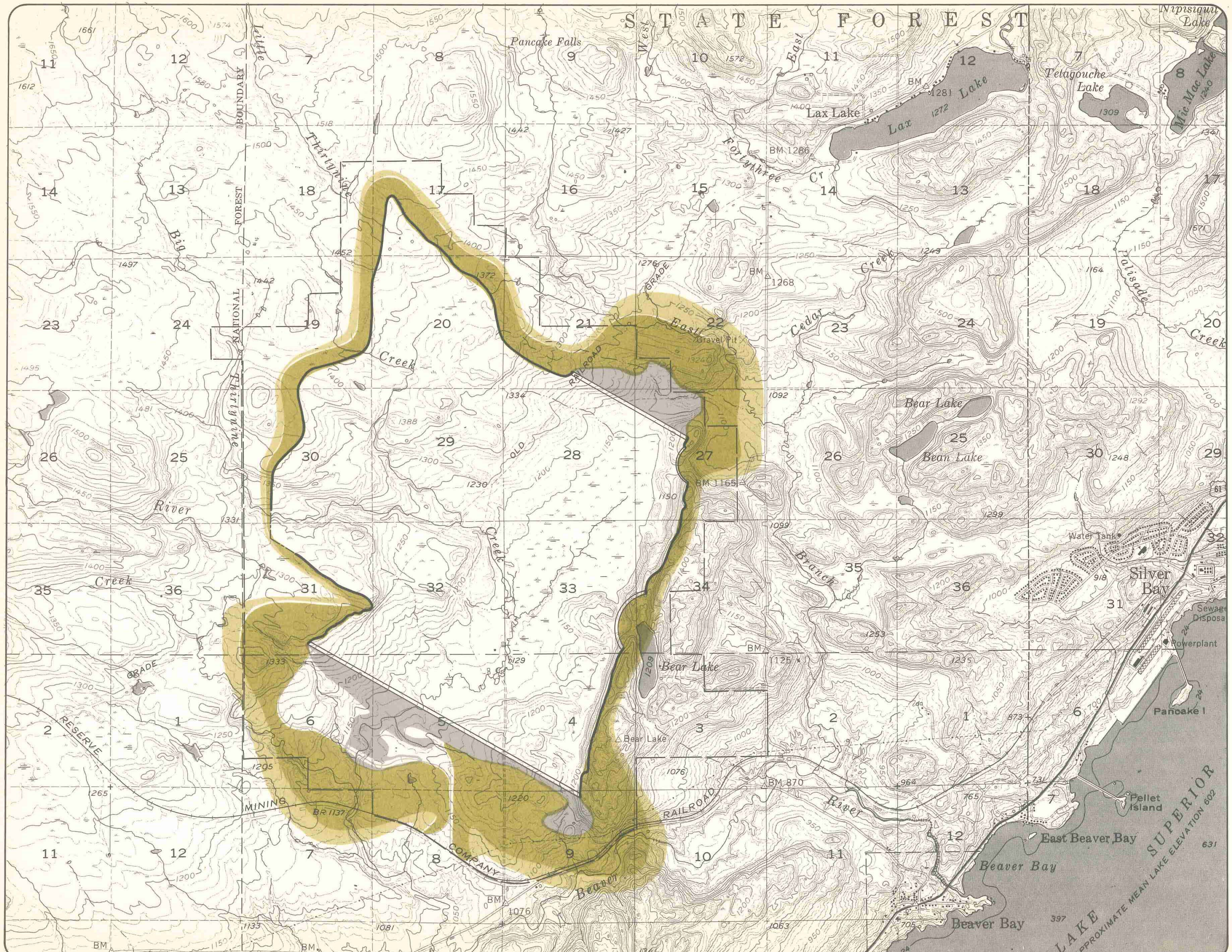
83 NOISE IMPACT ZONE - MILE POST 7 CONSTRUCTION

LEGEND

- MINOR IMPACT
- MAJOR IMPACT
- CLEARING FOR CONSTRUCTION
- TAILINGS BASIN
- ASSUMED SITE BOUNDARY

BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

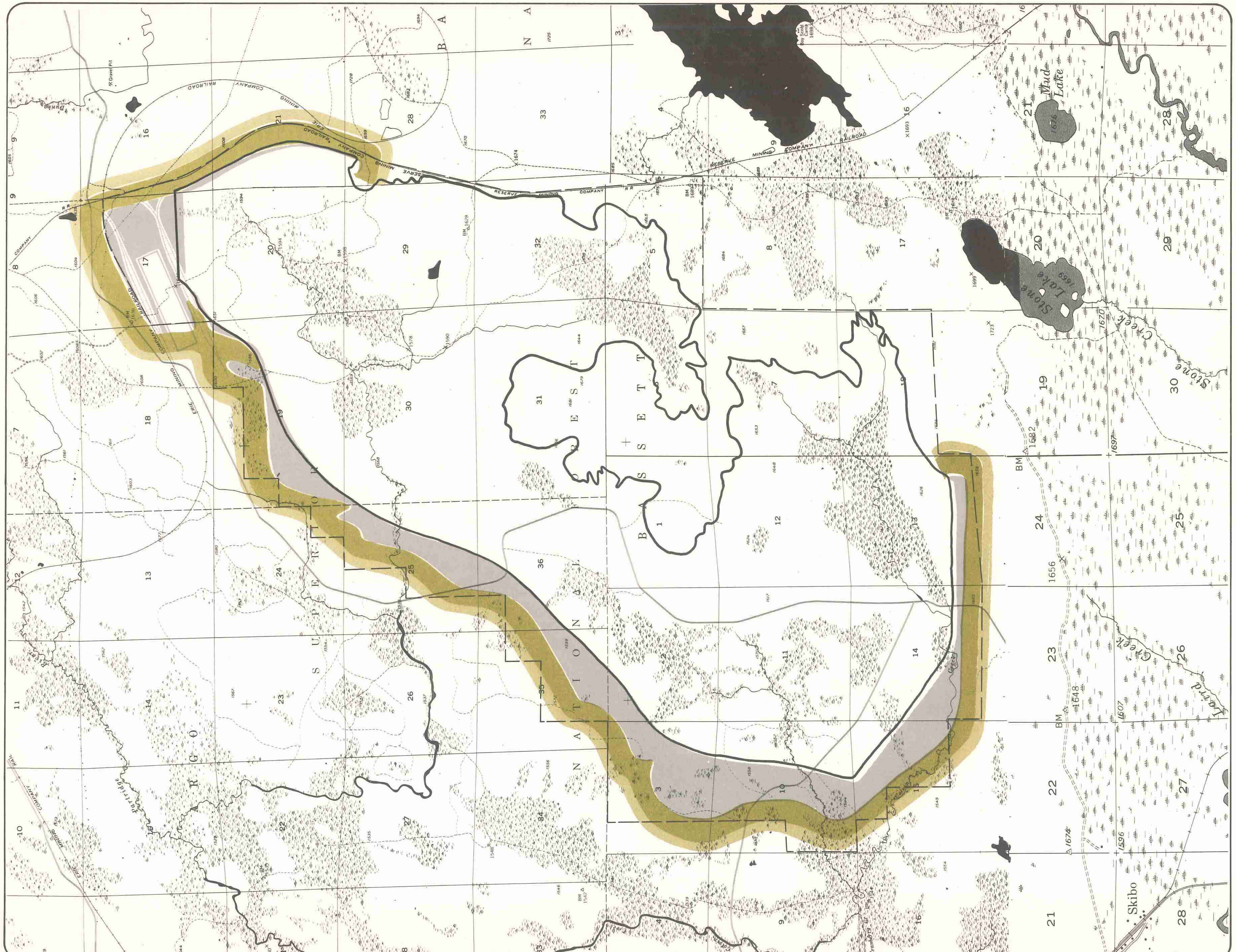
84 NOISE IMPACT ZONE - MILE POST 7 OPERATIONS

LEGEND

- MINOR IMPACT
- MAJOR IMPACT
- CLEARING FOR CONSTRUCTION
- TAILINGS BASIN
- ASSUMED SITE BOUNDARY

BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

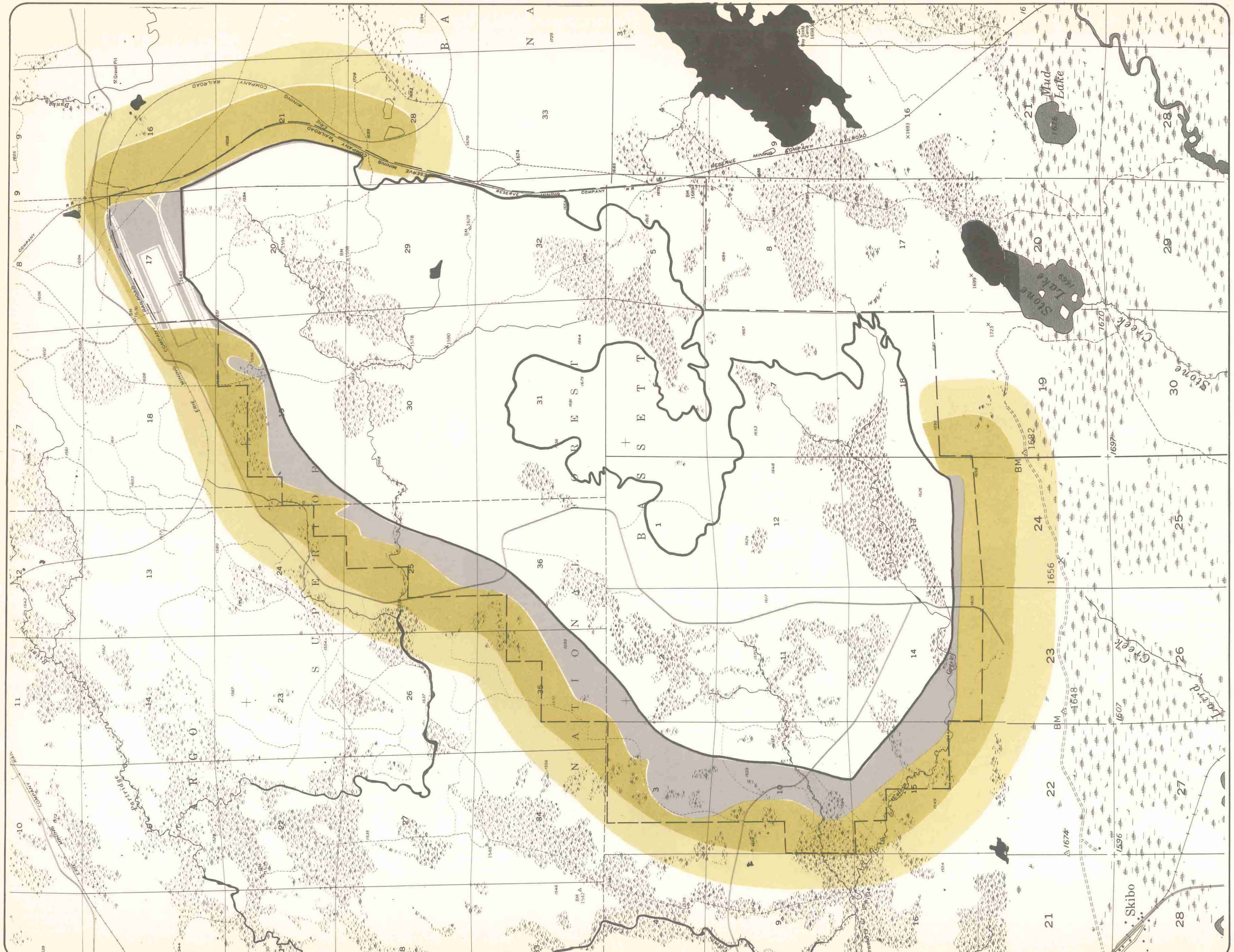
85 CONSTRUCTION NOISE IMPACT ZONE - COLVIN

LEGEND

- MINOR IMPACT
- MAJOR IMPACT
- CLEARING FOR CONSTRUCTION
- TAILINGS BASIN
- ASSUMED SITE BOUNDARY

BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454



ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

86 NOISE IMPACT ZONE - COLVIN OPERATIONS

LEGEND

- MINOR IMPACT
- MAJOR IMPACT
- CLEARING FOR CONSTRUCTION
- TAILINGS BASIN
- ASSUMED SITE BOUNDARY

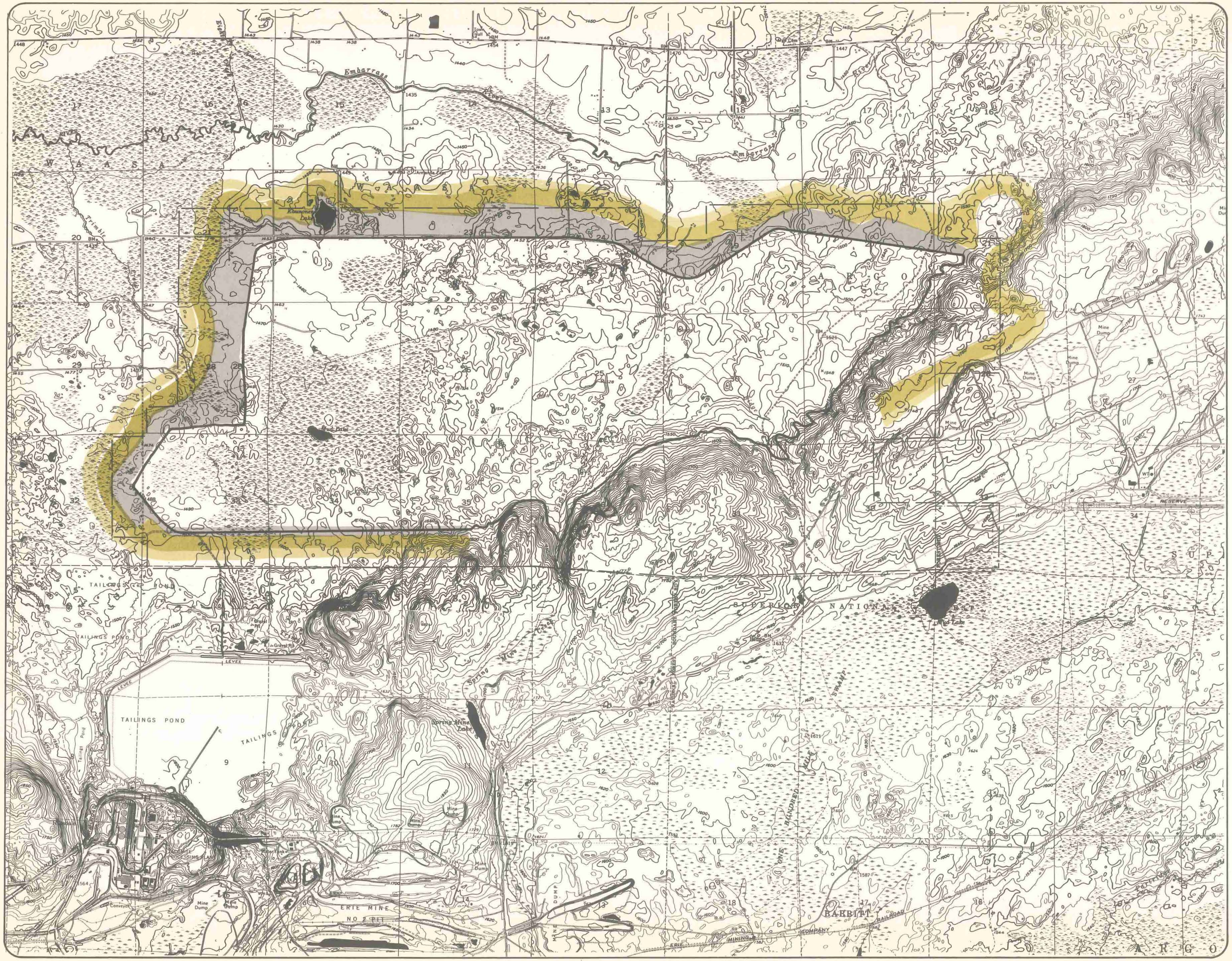
BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

87 NOISE IMPACT ZONE - EMBARRASS CONSTRUCTION



LEGEND

- MINOR IMPACT
- MAJOR IMPACT
- CLEARING FOR CONSTRUCTION
- TAILINGS BASIN
- ASSUMED SITE BOUNDARY

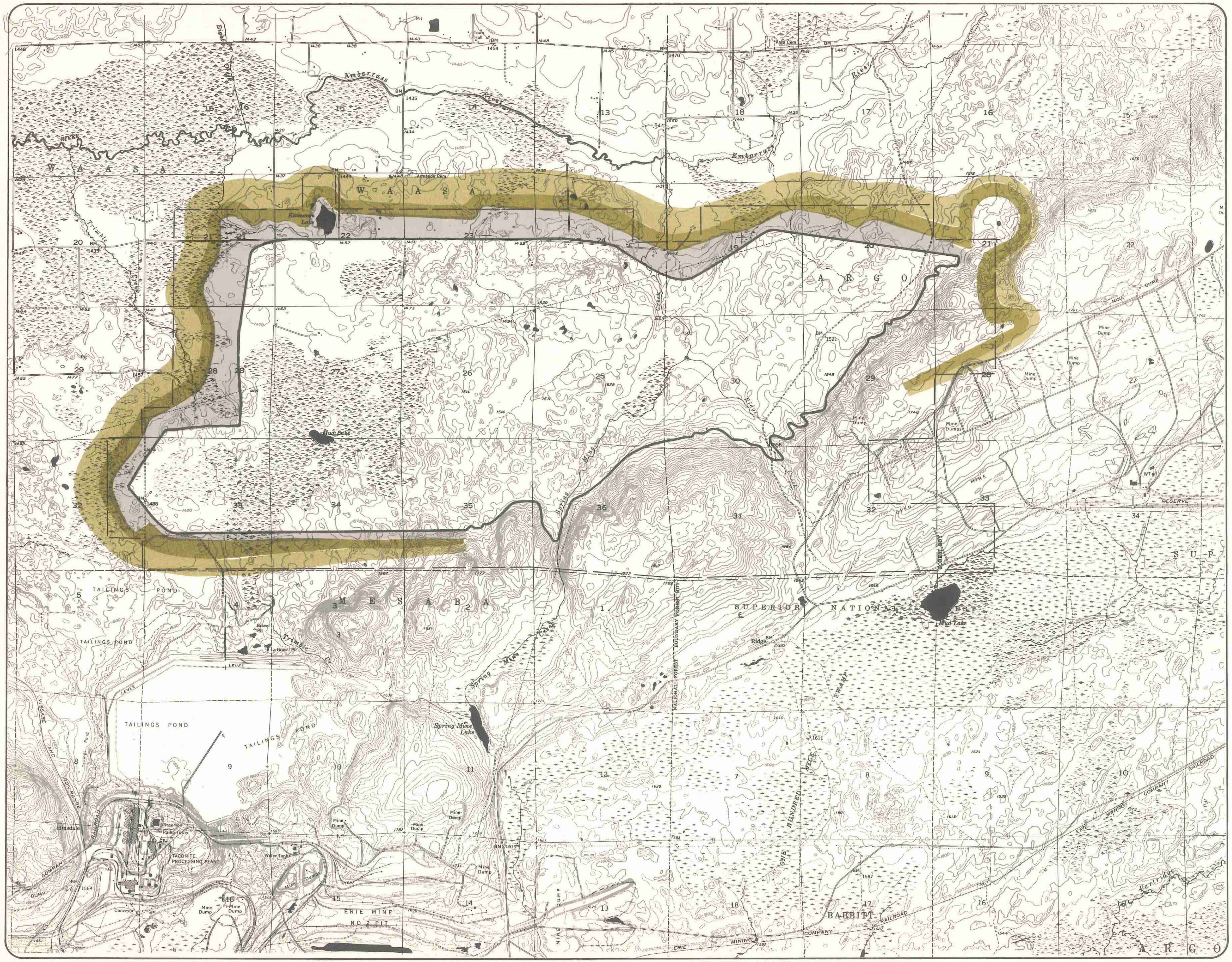
BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

88 NOISE IMPACT ZONE - EMBARRASS OPERATIONS



LEGEND

- MINOR IMPACT
- MAJOR IMPACT
- CLEARING FOR CONSTRUCTION
- TAILINGS BASIN
- ASSUMED SITE BOUNDARY

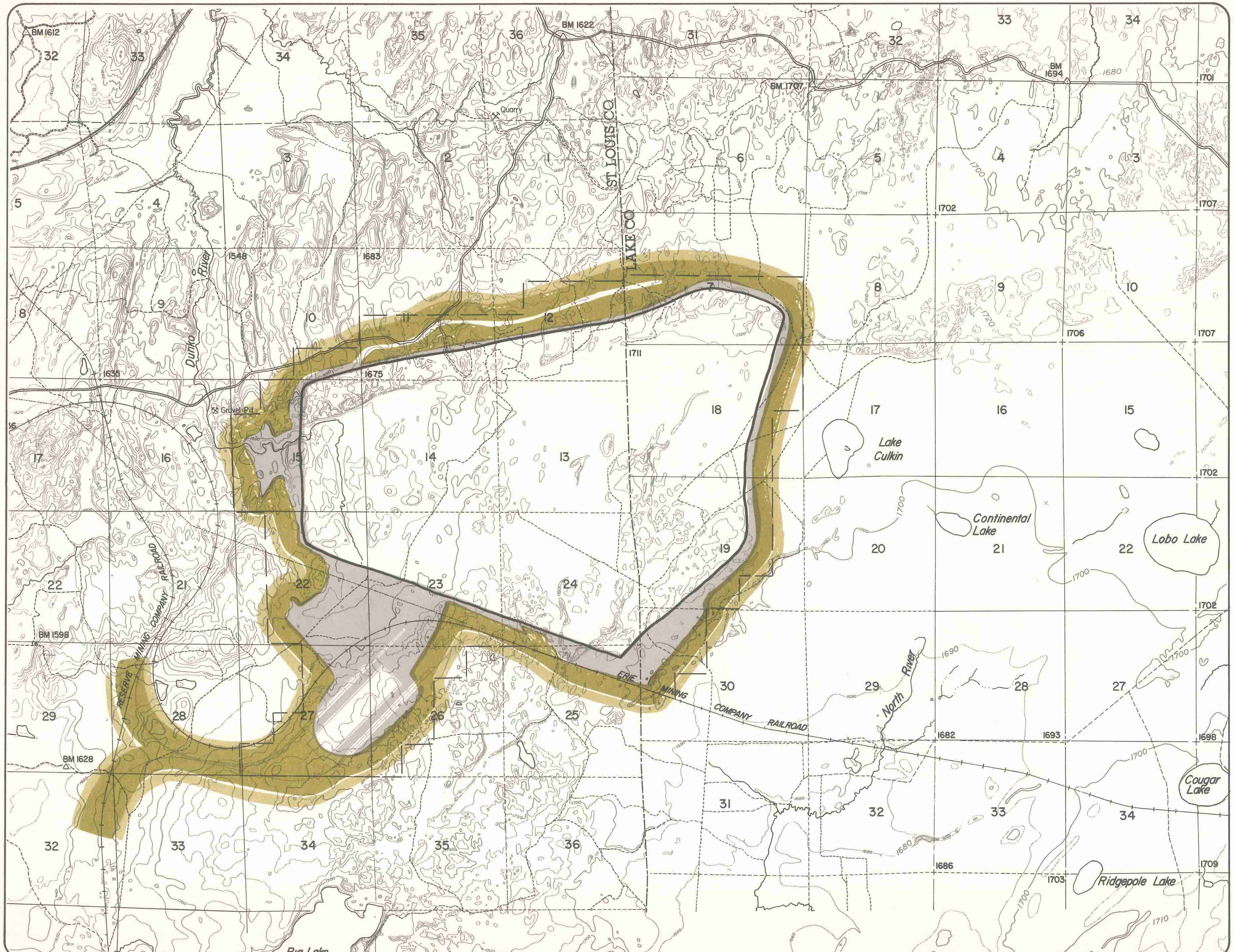
BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

89 NOISE IMPACT ZONE - SNOWSHOE CONSTRUCTION



LEGEND

- MINOR IMPACT
- MAJOR IMPACT
- CLEARING FOR CONSTRUCTION
- TAILINGS BASIN
- ASSUMED SITE BOUNDARY

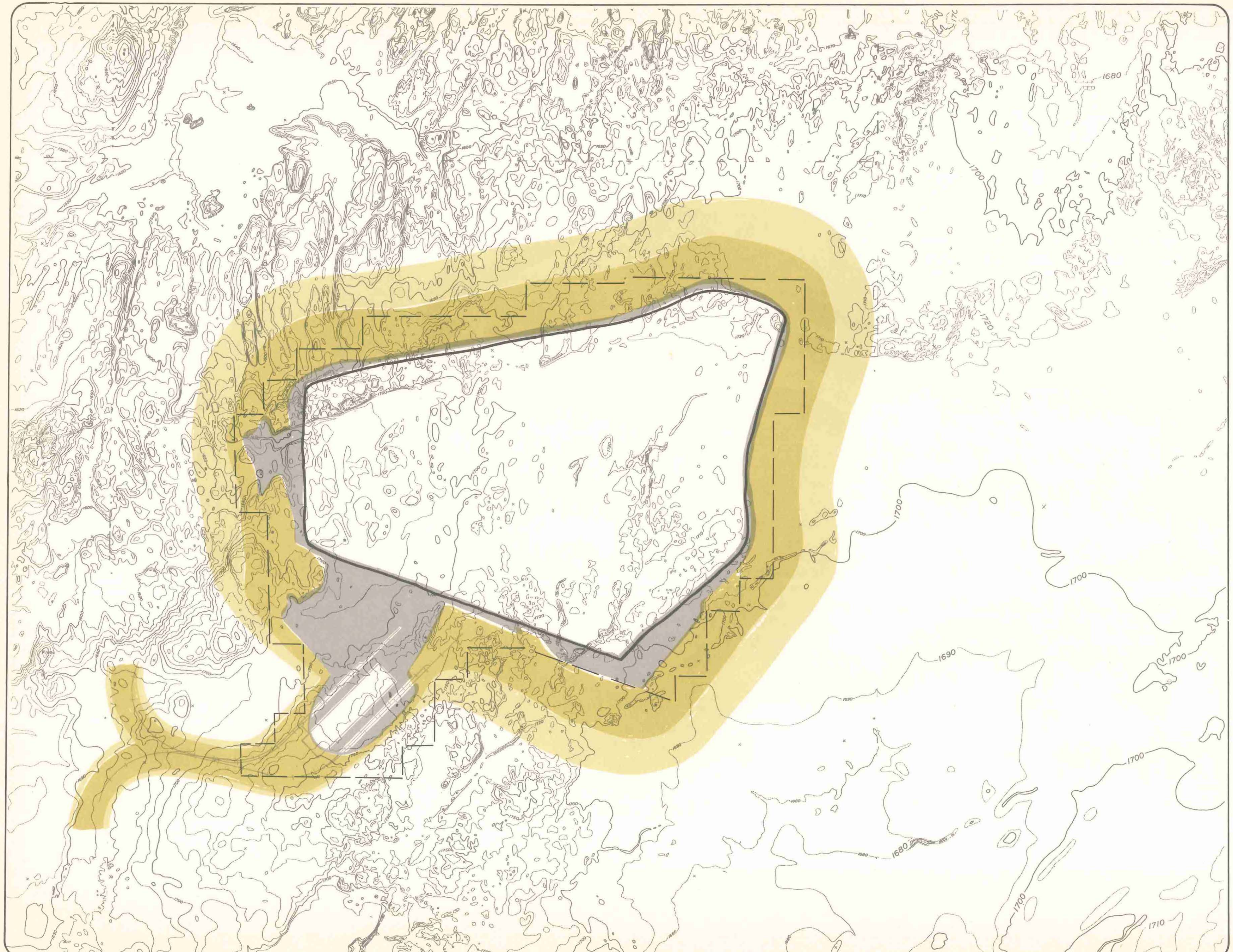
BARTON-ASCHMAN ASSOCIATES, INC.

MINNEAPOLIS/ST. PAUL, MINNESOTA 55454

ENVIRONMENTAL IMPACT STATEMENT

RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL PLAN

90 NOISE IMPACT ZONE - SNOWSHOE OPERATIONS



LEGEND

- MINOR IMPACT
- MAJOR IMPACT
- CLEARING FOR CONSTRUCTION
- TAILINGS BASIN
- ASSUMED SITE BOUNDARY

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ENERGY

The production and consumption of energy is recognized as a critical concern on a national scale. The planning, construction, and operation of a tailings basin and process facilities requires large amounts of energy.

ENERGY EVALUATION

The objective is to evaluate the energy usage for each of four tailings disposal plans: Mile Post 7, Colvin, Snowshoe, and the Embarrass sites.

The record of fuels consumed by Reserve in 1974 is presented in Table 107. Fuel oil, gaoline, natural gas, and coal were used in quantities given in the table. However, the demand for electrical energy was satisfied primarily by on-site generation. Approximately 80 percent of the kilowatt-hours were generated using natural gas as the heat source, while the remaining 20 percent was fueled by coal. Fuel oil played a very small role in the on-site generation of electricity.

Following the quantity of each fuel consumed is a corresponding number of equivalent BTU's. (The conversion from quantities of fuel to BTU's was accomplished by using the conversion factors presented in Table 108.) It can be seen that over 80 percent of the energy requirements for the Reserve Mining operation were supplied by natural gas, with coal and fuel oil each supplying approximately 10 percent.

Appendix B includes materials and water balances for a new concentrator to be located at the Embarrass site. However, the material and water flow rates are also valid for a concentrator constructed at the Colvin or Snowshoe sites.

The overall analysis or energy usages is divided into the following four categories:

Energy required for transportation of materials;

Energy required for operation of facilities;

Energy required for construction of new facilities;

Energy required for commuters from Silver Bay to the new concentrator facility.

Each of these energy usage categories is examined in some detail.

Tables 109 and 110 show the energy required for the transportation of materials. This category is subdivided due to the different mechanisms of transporting the material. Hauling by railroad is used for the following materials:

Ore from the coarse crushing facilities to the concentrator building;

Product from the concentrator building to the pelletizer at the alternate sites.

Coarse tailings are moved from the concentrator building to the tailings area by truck, except for the proposed Mile Post 7 site where rail haul was used in conjunction with the truck haul.

Pumping or gravity flow is required to move:

Fine tailings from the concentrator building to the tailings area;

Water from the tailings pond to the concentrator building.

Pumping power is supplied by electric energy, 80 percent of which comes from natural gas and 20 percent from coal.

National statistics on the amount of energy required for freight hauling by rail were obtained from two separate sources. The first source, (26) indicates a value of 690 BTU's per ton-mile. The second source (27) gives a value of 180 ton-miles per gallon of distillate fuel oil. Combining this with the conversion factor for BTU's per gallon of distillate fuel oils yields 770 BTU's per ton-mile. These two estimates are in fair agreement.

An examination of the energy usage by Reserve Mining Company indicates that 505 billion BTU's were consumed by the railroad system. When

TABLE 107
RESERVE MINING COMPANY 1974 FUEL CONSUMPTION

	Fuel Oil		Gasoline		Natural Gas		Coal		Electricity*	
	Gallons	Equivalent BTU's(10^9)	Gallons	Equivalent BTU's(10^9)	10^6 Cubic Feet	Equivalent BTU's(10^9)	Tons	Equivalent BTU's(10^9)	10^3 KWHR	Equivalent BTU's(10^9)
Power Plant	8,570	1.28			7,995.096	7,995.10	89,801	1,906.48		
Service Others-Silver Bay			266	0.03	1,027.661	1,027.66			103,726	1,089
Service Others-Babbitt	518,222	77.572	360	0.04					1,595	16.7
Maintenance-Silver Bay			2,932	0.37						
Maintenance-Babbitt			4,993	0.62						
Mobile Equipment-Silver Bay	127,446	19.08	43,089	5.39					362	3.8
Mobile Equipment-Babbitt	1,751,214	262.14	18,292	2.29					13,059	137.1
Maintenance Shop-Silver Bay	52,482	7.86	13,630	1.70					120	1.3
Maintenance Shop-Babbitt	144,326	21.60	147,622	18.45					6,902	72.5
Mining	3,393,364	507.95	166,551	20.82					3,951	41.5
Coarse Crushing	413,150	61.84							20,433	214.5
Railroad	3,376,078	505.37	30,489	3.81					886	9.3
Fine Crushing	7,771	1.16							47,512	498.9
Concentrating									524,466	5,506.9
Pelletizing	1,627	0.24	9,220	1.15	6,549.635	6,549.63			259,864	2,728.6
Pellet Storage	43,760	6.55	148	0.02	0.737	0.74			5,450	57.2
Management	60,993	9.13	44,351	5.54					913	9.6
Townsites	36,841	5.52	118	0.01						
Stripping Development	604,682	90.52							1,147	12.1
Research and Development	136	0.02	2,987	0.37					7,221	75.8
Total Fuel Consumption	10,540,662 gallons		485,048 gallons		$15,573.129 \times 10^6$ cu ft		89,801 tons		997.607×10^6 KWHR	
Purchased Fuel/Electricity	10,540,662 gallons		485,048 gallons		$15,573.129 \times 10^6$ cu ft		89,801 tons		33.677×10^6 KWHR	
Generated Power	--		--		--		--		963.930×10^6 KWHR	
Equivalent BTU's Purchased	$1,577.83 \times 10^9$		60.63×10^9		$15,573.13 \times 10^9$		$1,906.48 \times 10^9$		353.61×10^9	
Percent of 1974 Energy Usage by Reserve Mining	8.25		0.32		81.46		9.97		--	

*Electricity generated using 80 percent natural gas and 20 percent coal energy.

Source: Reserve Mining Company Cost Sheets for 1974.

this energy is distributed over the 29.7 million long tons of ore hauled 50 miles, the resultant energy usage is approximately 300 BTU's per short ton per mile.

TABLE 108
ENERGY CONVERSION FACTORS

			Source
Coal	1 pound	= 10,615 Btu	(1)
Natural gas	1 cubic foot	= 1,000 Btu	(2)
Liquefied Petroleum gas	1 gallon	= 92,000 Btu	(3)
Gasoline	1 gallon	= 125,000 Btu	(4)
Distillate oil	1 gallon	= 138,690 Btu	(4)
Kerosene	1 gallon	= 135,000 Btu	(4)
Residual oil	1 gallon	= 149,690 Btu	(4)
Electricity			
Consumption	1 KWH	= 3,412 Btu	(5)
Production	1 KWH	= 10,500 Btu	(4)

(1) U.S. Bureau of Mines, "Bituminous Coal and Lignite Distribution, 1973," and information provided by telephone (weighted average of coal shipped to Minnesota in 1973).

(2) American Gas Association, Gas Facts, 1972 and 1973. (Average Btu value of natural gas sold in Minnesota.)

(3) Approximate value based on conversion factors used by Twin City area propane dealers.

(4) U.S. Bureau of Mines, "Crude Petroleum, Petroleum Products, and Natural Gas Liquids: 1972" (average values for U.S.).

(5) U.S. Congress, Subcommittee on Energy of the House Committee on Science and Astronautics, "Energy Facts," (1973).

Source: "Energy Consumption in Manufacturing and the Minnesota Economy," Venegas, Ernesto C., and James E. Carter, Minnesota Energy Agency, December 1974.

The most probable explanation for the difference between the actual energy usage of 300 BTU's per ton-mile and the national usage of 690 to 770 BTU's per ton-mile is in the type of freight being hauled. Taconite ore is extremely dense and the packing factor is high. Therefore, the energy used per ton-mile would be less for ore hauling than for most other freight.

Where trucks are used to haul coarse tailings, energy usages based on Reserve Mining Company's operation for 1974 indicate that about 4,640 BTU's are required per ton-mile.

It is apparent from Table 109 that the proposed Mile Post 7 plan consumes more energy in the transportation of dry materials than do the other three alternatives. This is true even though no movement of the product is required for the proposed Mile Post 7 plan.

Table 110 indicates a similar situation for the transportation of wet materials. The proposed Mile Post 7 site has a much greater total dynamic head to overcome than the three alternative sites (due primarily to the large change in elevation at the proposed Mile Post 7 site).

The energy required for the operation of all Reserve Mining Company facilities (excluding transportation of materials) is presented in Table 111. The basis for this evaluation was to start with the 1974 energy statistics, subtract out the energy used in transportation of materials and add the energy requirements calculated for Tables 109 and 110. Energy usages for mining, coarse crushing, and stripping were ratioed by the amount of material processed when necessary.

It is important to recognize the limitations of the calculations presented in Table 111. Fairly detailed analyses were made for both the proposed Mile Post 7 site and the Embarrass alternative. Energy usages for the other two alternatives were assumed to be equal to that consumed at the proposed Embarrass plant.

The energy required for construction of new facilities is taken directly from the report prepared for Reserve.(28) The only liberty that was taken was to convert kilowatt-hours per ton to equivalent BTU's per ton. This conversion is consistent with the Reserve report.(29)

The energy requirements outlined in the Reserve report consist of two factors: The tons of each material needed and the energy content of each material. The first of these factors was provided by Kaiser Engineers and cannot be questioned without a systematic analysis. This component of the analysis was accepted as factual.

A secondary source was used to verify the validity of the energy content of each material. Brookhaven National Laboratory has established the energy required to produce many of the basic metals, cement, glass, etc.(30) A comparison between the numbers used by Brookhaven and the report prepared for Reserve revealed that the differences were small enough to be disregarded.

Table 112 shows that the energy required to construct new facilities is greater at all of the alternate sites than at the proposed Mile Post 7 site. This is primarily due to the fact that a new crusher-concentrator facility would not have to be constructed at the proposed Mile Post 7 site.

TABLE 109
ENERGY REQUIRED FOR TRANSPORTATION OF DRY MATERIAL (annual usuage)

Parameter	Mile Post 7	Colvin	Embarrass	Snowshoe
A. Transportation of Ore (coarse-crusher - concentrator)				
1. Amount (long tons natural per year)	30,746,500	34,800,000	34,800,000	34,800,000
2. Distance hauled (rail - miles)	50	7.3	6.7	10.3
3. Energy required for ore hauling (equivalent Btu's)	517×10^9	85×10^9	78×10^9	120×10^9
4. Equivalent diesel fuel (10^3 gallons)	3,450	570	523	805
5. Percent annual consumption of fuel oil by Minnesota (1973 base)	0.24	0.04	0.04	0.05
B. Transportation of Product (concentrator - pelletizer)				
1. Amount (long tons natural per year)	--	11,466,700	11,466,700	11,466,700
2. Distance hauled (rail - miles)	--	43	53	41
3. Energy required for hauling of product (equivalent Btu's)	-- --	166×10^9	204×10^9	158×10^9
4. Equivalent diesel fuel (10^3 gallons)	--	1,107	1,364	1,055
5. Percent annual consumption of fuel oil by Minnesota (1973 base)	--	0.08	0.09	0.07
C. Transportation of Coarse Tailings (concentrator tailings pond)				
1. Amount (long tons natural per year)	8,966,700	9,776,700	9,776,700	9,776,700
2. Distance hauled (miles)	14.7	3.8	5.7	3.7
3. Energy required for hauling of tailings	157×10^9	193×10^9	290×10^9	188×10^9
4. Equivalent diesel fuel (10^3 gallons)	1,050	1,290	1,934	1,256
5. Percent annual consumption of fuel oil by Minnesota (1973 base)	0.07	0.09	0.13	0.09

TABLE 110
ENERGY REQUIRED FOR TRANSPORTATION OF WET MATERIAL (annual usage)

Parameter	Mile Post 7	Colvin	Embarrass	Snowshoe
A. Transportation of Fine Tailings (concentrator- to tailing pond)				
1. Amount of slurry (10^6 gallons per year)	3,453			5,213
2. Pumping rate (gallons per minute)	7,013			10,467
3. Specific gravity of slurry	1.648			1.487
4. Total dynamic head (feet)	700			70
5. Pumping power (equivalent Btu's)	156×10^9	These alternatives use gravity flow.		21×10^9
6. Electricity required for pumping (10^6 KWHR)	14.890			2.005
7. Percent of 1974 electric energy usage by Reserve Mining	1.49			0.20
B. Transportation of Process Water (tailing pond - concentrator)				
1. Amount of water (10^6 gallons per year)	2,596	4,335	4,335	4,335
2. Pumping rate (gallons per minute)	10,000	11,000	11,000	11,000
3. Specific gravity of water	1.000	1.000	1.000	1.000
4. Total dynamic head (feet)	100	90	360	100
5. Pumping power (equivalent Btu's)	10×10^9	10×10^9	40×10^9	11×10^9
6. Electricity required for pumping (10^6 KWHR)	0.959	0.950	3.799	1.055
7. Percent of 1974 electric energy usage by Reserve Mining	0.10	0.10	0.38	0.11

Table 111
ENERGY REQUIRED FOR OPERATION OF FACILITIES (less transportation of materials)

Parameter	1974 Operations at Silver Bay	Mile Post 7	Embarrass, Colvin, Snowshoe
A. Mining			
1. Ore (long tons natural per year)	29,671,300	30,746,500	34,800,00U
2. Energy usage			
a. Fuel oil (gal/Btu's)	4,466,050/669x10^9	4,627,894/693x10^9	5,238,013/784x10^9
b. Gasoline (gal/Btu's)	175,138/22x10^9	181,485/23x10^9	205,411/26x10^9
c. Natural gas (10^6 cu ft/Btu's)	-	-	-
d. Coal (tons/Btu's)	-	-	-
e. Electricity (10^6 kwh/Btu's)	10.770/113x10^9	11.160/117x10^9	12.632/133x10^9
B. Coarse Crushing			
1. Ore (long tons natural per year)	29,671,300	30,746,500	34,800,000
2. Energy usage			
a. Fuel oil	499,228/75x10^9	517,319/77x10^9	585,520/88x10^9
b. Gasoline	5,078/1x10^9	5,262/1x10^9	5,956/1x10^9
c. Natural gas	-	-	-
d. Coal	-	-	-
e. Electricity	20.949/220x10^9	21.708/228x10^9	24.570/257x10^9
C. Stripping			
1. Amount stripped (long tons natural per year)	11,318,000	8,203,200	9,284,600
2. Energy usage			
a. Fuel oil	1,429,827/214x10^9	1,036,324/155x10^9	1,172,948/176x10^9
b. Gasoline	8,568/1x10^9	6,210/1x10^9	7,029/1x10^9
c. Natural gas	-	-	-
d. Coal	-	-	-
e. Electricity	7.275/76x10^9	5.273/55x10^9	5.968/63x10^9
D. Fine Crushing			
1. Amount crushed (long tons natural per year)	28,788,500	30,746,500	34,800,000
2. Energy usage			
a. Fuel oil	7,771/1x10^9	7,771/1x10^9	7,771/1x10^9
b. Gasoline	-	-	-
c. Natural gas	-	-	-
d. Coal	-	-	-
e. Electricity	47.512/499x10^9	50.743/533x10^9	78.265/822x10^9
E. Concentrating			
1. Energy usage			
a. Fuel oil	--	-	-
b. Gasoline	-	-	-
c. Natural gas	-	-	-
d. Coal	-	-	-
e. Electricity	524.466/5,507x10^9	741.188/7,782x10^9	780.408/8,194x10^9
F. Pelletizing			
1. Amount pelletized (long tons natural per year)	9,993,900	9,500,000	10,700,000
2. Energy usage			
a. Fuel oil	45,387/7x10^9	43,144/6x10^9	48,594/7x10^9
b. Gasoline	9,368/1x10^9	8,905/1x10^9	10,030/1x10^9
c. Natural gas	6,550/6,550x10^9	6,036/6,036x10^9	6,798/6,798x10^9
d. Coal	-	-	-
e. Electricity	265.314/2,786x10^9	252.202/2,648x10^9	284.059/2,983x10^9
G. Electric Power Plant			
1. Energy usage			
a. Fuel oil	8,570/1x10^9	8,570/1x10^9	8,570/1x10^9
b. Gasoline	-	-	-
c. Natural gas	7,995/7,995x10^9	9,647/9,647x10^9	10,479/10,479x10^9
d. Coal	89,801/1,906x10^9	108,360/2,300x10^9	117,696/2,499x10^9
H. General Operation			
1. Energy usage			
a. Fuel oil	707,751/106x10^9	707,751/106x10^9	707,751/106x10^9
b. Gasoline	256,463/32x10^9	256,463/32x10^9	256,463/32x10^9
c. Natural gas	1,028/1,028x10^9	1,028/1,028x10^9	1,028/1,028x10^9
d. Coal	-	-	-
e. Electricity	120.436/1,265x10^9	120.436/1,265x10^9	120.436/1,265x10^9

TABLE 112
ENERGY REQUIRED FOR CONSTRUCTION OF NEW FACILITIES*

	Mile Post 7 *		Colvin		Embarrass		Snowshoe	
	Tons	Equivalent Btu's	Tons	Equivalent Btu's	Tons	Equivalent Btu's	Tons	Equivalent Btu's
1. Fixed steel	25,080	907 x 10^9	51,050	1,846 x 10^9	51,050	1,846 x 10^9	51,050	1,846 x 10^9
2. Moveable steel	20,600	1,336 x 10^9	37,650	2,441 x 10^9	37,650	2,441 x 10^9	37,650	2,441 x 10^9
3. Cement	9,800	75 x 10^9	11,300	87 x 10^9	11,300	87 x 10^9	11,300	87 x 10^9
4. Sand	27,200	2 x 10^9	31,700	3 x 10^9	31,700	3 x 10^9	31,700	3 x 10^9
5. Gravel	37,000	10 x 10^9	43,500	12 x 10^9	43,500	12 x 10^9	43,500	12 x 10^9
6. Lumber	780	3 x 10^9	2,457	8 x 10^9	2,457	8 x 10^9	2,457	8 x 10^9
7. Copper	70	4 x 10^9	250	15 x 10^9	250	15 x 10^9	250	15 x 10^9
8. Aluminum	--	--	300	53 x 10^9	300	53 x 10^9	300	53 x 10^9
9. Excavation	7.15 x 10^6	610 x 10^9	7.88 x 10^6	655 x 10^9	7.88 x 10^6	655 x 10^9	7.88 x 10^6	655 x 10^9
10. Architectural	2,700	128 x 10^9	4,700	223 x 10^9	4,700	223 x 10^9	4,700	223 x 10^9
TOTAL EQUIVALENT BTU'S	3,075 x 10^9		5,343 x 10^9		5,343 x 10^9		5,343 x 10^9	

* Numbers for Mile Post 7 taken from Volume III of the report by Arthur D. Little, "Environmental Report Concerning On-Land Tailings Disposal and Air Quality Plan for the E. W. Davis Works," Reserve Mining Company, Silver Bay, Minnesota, April 30, 1975.

The energy required for the transportation of workers from Silver Bay to the new facilities at alternative sites is shown in Table 113. It was assumed that the mode of travel would be bus powered by diesel fuel. The Energy Index [27] gives a value of 925 BTU's per passenger-mile, while Hittman [26] reports 1,070 BTU's per passenger-mile. It appears that a reasonable average would be 1,000 BTU's per passenger-mile.

TABLE 113
ENERGY REQUIRED FOR COMMUTERS FROM SILVER BAY (annual usage)

Category	Mile Post 7	Colvin	Embarrass	Snowshoe
1. Number of personnel commuting	--	400	400	400
2. Distance traveled (Miles) *	NA	100	125	110
3. Mode of travel	Bus	Bus	Bus	Bus
4. BTU's per passenger-mile	1,000	1,000	1,000	1,000
5. Total BTU's required	--	10 x 10^9	12.5 x 10^9	11 x 10^9
6. Equivalent diesel fuel (gallons)	--	66,800	83,500	73,500

*Assuming new road along portions of Reserve's railroad.

Total energy requirements for the Reserve taconite works are presented in Tables 114-117 for one year of operation at each of the sites. Energy requirements for each function are given in terms of both the type of fuel consumed and the equivalent BTU's.

TABLE 114
ENERGY REQUIREMENTS FOR RESERVE MINING TACONITE OPERATIONS USING PROPOSED MILE POST NO. 7 PLAN

	FUEL TYPE				
	Fuel Oil (gallons/Btu's)	Gasoline (gallons/Btu's)	Natural Gas ($10^6 ft^3$/Btu's)	Coal (tons/Btu's)	Electricity (10^6kwhr's/Btu's)
I. Operation of Facilities					
A. Mining	4,627,894/693 x 10^9	181,485/23 x 10^9	--	--	11.160/117 x 10^9
B. Coarse Crushing	517,319/77 x 10^9	5,262/1 x 10^9	--	--	21.708/228 x 10^9
C. Stripping	1,036,324/155 x 10^9	6,210/1 x 10^9	--	--	5.273/55 x 10^9
D. Fine Crushing	7,771/1 x 10^9	--	--	--	50.743/533 x 10^9
E. Concentrating	--	--	--	--	741.188/7782 x 10^9
F. Pelletizing	43,144/6 x 10^9	8,905/1 x 10^9	6,036/6,036 x 10^9	--	252.202/2648 x 10^9
G. Electric Power Plant	8,570/1 x 10^9	--	9,647/9,647 x 10^9	108,360/2,300 x 10^9	--
H. General Operation	707,751/106 x 10^9	256,463/32 x 10^9	1,028/1,028 x 10^9	--	120.436/1265 x 10^9
II. Transportation of Materials					
A. Dry Materials					
1. Ore	3,450,000/517 x 10^9	--	--	--	--
2. Product	--	--	--	--	--
3. Coarse tailings	1,050,000/157 x 10^9	--	--	--	--
B. Wet Materials					
1. Fine tailings	--	--	--	--	14.890/156 x 10^9
2. Process water	--	--	--	--	0.959/10 x 10^9
III. Energy for Transportation of Personnel	--	--	--	--	--

TABLE 115
ENERGY REQUIREMENTS FOR RESERVE MINING TACONITE OPERATIONS USING THE COLVIN ALTERNATIVE

	FUEL TYPE				
	Fuel Oil (gallons/Btu's)	Gasoline (gallons/Btu's)	Natural Gas ($10^6 ft^3$/Btu's)	Coal (tons/Btu's)	Electricity (10^6 kwhr's/Btu's)
I. Operation of Facilities					
A. Mining	5,238,013/784 x 10^9	205,411/26 x 10^9	--	--	12.632/133 x 10^9
B. Coarse Crushing	585,520/88 x 10^9	5,956/1 x 10^9	--	--	24.570/257 x 10^9
C. Stripping	1,172,948/176 x 10^9	7,029/1 x 10^9	--	--	5.968/63 x 10^9
D. Fine Crushing	7,771/1 x 10^9	--	--	--	78.265/822 x 10^9
E. Concentrating	--	--	--	--	780.408/8194 x 10^9
F. Pelletizing	48,594/7 x 10^9	10,030/1 x 10^9	6,798/6,798 x 10^9	--	284.059/2983 x 10^9
G. Electric Power Plant	8,570/1 x 10^9	--	10,479/10,479 x 10^9	117,696/2,499 x 10^9	--
H. General Operation	707,751/106 x 10^9	256,463/32 x 10^9	1,028/1,028 x 10^9	--	120.436/1265 x 10^9
II. Transportation of Materials					
A. Dry Materials					
1. Ore	570,000/85 x 10^9	--	--	--	--
2. Product	1,107,000/166 x 10^9	--	--	--	--
3. Coarse tailings	1,290,000/193 x 10^9	--	--	--	--
B. Wet Materials					
1. Fine tailings	--	--	--	--	--
2. Process water	--	--	--	--	0.950/10 x 10^9
III. Energy for Transportation of Personnel	66,800/10 x 10^9	--	--	--	--

TALBE 116
ENERGY REQUIREMENTS FOR RESERVE MINING TACONITE OPERATIONS USING EMBARRASS

	FUEL TYPE				
	Fuel Oil (gallons/Btu's)	Gasoline (gallons/Btu's)	Natural Gas ($10^6 ft^3$/Btu's)	Coal (tons/Btu's)	Electricity (10^6 kwhr's/Btu's)
I. Operation of Facilities					
A. Mining	5,238,013/784 x 10^9	205,411/26 x 10^9	--	--	12.632/133 x 10^9
B. Coarse Crushing	585,520/88 x 10^9	5,956/1 x 10^9	--	--	24.570/257 x 10^9
C. Stripping	1,172,948/176 x 10^9	7,029/1 x 10^9	--	--	5.968/63 x 10^9
D. Fine Crushing	7,771/1 x 10^9	--	--	--	78.265/822 x 10^9
E. Concentrating	--	--	--	--	780.408/8194 x 10^9
F. Pelletizing	48,594/7 x 10^9	10,030/1 x 10^9	6,798/6,798 x 10^9	--	284.059/2983 x 10^9
G. Electric Power Plant	8,570/1 x 10^9	--	10,479/10,479 x 10^9	117,696/2,499 x 10^9	--
H. General Operations	707,751/106 x 10^9	256,463/32 x 10^9	1,028/1,028 x 10^9	--	120.436/1265 x 10^9
II. Transportation of Materials					
A. Dry Materials					
1. Ore	523,000/78 x 10^9	--	--	--	--
2. Product	1,364,000/204 x 10^9	--	--	--	--
3. Coarse tailings	1,934,000/290 x 10^9	--	--	--	--
B. Wet Materials					
1. Fine tailings	--	--	--	--	--
2. Process Water	--	--	--	--	3.799/40 x 10^9
III. Energy for Transportation of Personnel	83,500/13 x 10^9	--	--	--	--

TABLE 117
ENERGY REQUIREMENTS FOR RESERVE MINING TACONITE OPERATIONS USING SNOWSHOE

	FUEL TYPE				
	Fuel Oil (gallons/Btu's)	Gasoline (gallons/Btu's)	Natural Gas ($10^6 ft^3$/Btu's)	Coal (tons/Btu's)	Electricity (10^6 kwhr's/Btu's)
I. Operation of Facilities					
A. Mining	5,238,013/784 x 10^9	205,411/26 x 10^9	--	--	12.632/133 x 10^9
B. Coarse Crushing	585,520/88 x 10^9	5,956/1 x 10^9	--	--	24.570/257 x 10^9
C. Stripping	1,172,948/176 x 10^9	7,029/1 x 10^9	--	--	5.968/63 x 10^9
D. Fine Crushing	7,771/1 x 10^9	--	--	--	78.265/822 x 10^9
E. Concentrating	--	--	--	--	780.408/8194 x 10^9
F. Pelletizing	48,594/7 x 10^9	10,030/1 x 10^9	6,798/6,798 x 10^9	--	284.059/2983 x 10^9
G. Electric Power Plant	8,570/1 x 10^9	--	10,479/10,479 x 10^9	117,696/2,499 x 10^9	--
H. General Operation	707,751/106 x 10^9	256,463/32 x 10^9	1,028/1,028 x 10^9	--	120.436/1265 x 10^9
II. Transportation of Materials					
A. Dry Materials					
1. Ore	805,000/120 x 10^9	--	--	--	--
2. Product	1,055,000/158 x 10^9	--	--	--	--
3. Coarse tailings	1,256,000/188 x 10^9	--	--	--	--
B. Wet Materials					
1. Fine tailings	--	--	--	--	2.005/21 x 10^9
2. Process water	--	--	--	--	1.055/11 x 10^9
III. Energy for Transportation of Personnel	63,500/10 x 10^9	--	--	--	--

Table 118 presents the annual energy requirements for the taconite operation at each of the sites. The information shown in this table is a summation of the energy usages given in Tables 109-117. The only complicating factor is the energy required for construction of new facilities. Since this is a one-time expenditure of energy, it is charged against the expected lifetime of the plant, 40 years, prior to being included in the annual energy consumption.

Also included in Table 118 is the energy required per long ton of taconite pellets produced. The total annual energy requirements indicate that while the energy consumption is nearly constant for all of the sites, the Colvin alternative is the least energy consuming one. An expenditure of 2,115,000 BTU's is required per ton of pellets compared to 2,213,000 BTU's at proposed Mile Post 7 site.

TABLE 118
ANNUAL ENERGY REQUIREMENTS FOR RESERVE MINING TACONITE OPERATIONS (equivalent BTU's)

Category	Milepost No. 7	Colvin	Embarrass	Snowshoe
1. Operation of facilities	$20,108 \times 10^9$	$22,028 \times 10^9$	$22,028 \times 10^9$	$22,028 \times 10^9$
2. Transportation of materials	840×10^9	455×10^9	612×10^9	498×10^9
3. Transportation of personnel	--	10×10^9	13×10^9	10×10^9
4. Construction of new facilities	77×10^9	134×10^9	134×10^9	134×10^9
5. Total energy requirements	$21,025 \times 10^9$	$22,627 \times 10^9$	$22,787 \times 10^9$	$22,670 \times 10^9$
6. Energy required per long ton of taconite pellets produced	2,213,158	2,114,673	2,129,626	2,118,692

In addition to the total number of BTU's required using each alternate site, some information is also gained as to the type of fuel used at each site. This factor could become important in future years as natural gas and fuel oil become less abundant. Table 119 presents the annual fuel requirements as a function of site and type of fuel.

The quantities of energy resources committed during the 40-year life of the plant are presented in Table 120. Fuel oil, gasoline, natural gas, and coal will be consumed, and electricity will be generated on-site. The energy consumed in the construction of new facilities is shown as a separate category.

TABLE 119
ANNUAL FUEL REQUIREMENTS FOR RESERVE MINING TACONITE OPERATIONS

Category	Mile Post 7	Colvin	Embarrass	Snowshoe
1. Fuel oil (10^3 gallons)	11,449	10,803	11,674	10,949
2. Gasoline (10^3 gallons)	458	485	485	485
3. Natural gas (10^6 cu. ft.)	16,711	18,305	18,305	18,305
4. Coal (tons)	108,360	117,696	117,696	117,696
5. Long tons pellets produced	9,500,000	10,700,000	10,700,000	10,700,000

Probably the most significant factor in the energy usage as a function of location is that there is not a large differential among the sites. Although the proposed Mile Post 7 site requires less energy for the construction of new facilities than the alternatives, the energy required for the transportation of materials is greater. It must also be realized that the consumption of fuels as presented in Table 120 will result in the production of 380 million long tons of taconite pellets over the 40-year life of the plant at the proposed Mile Post 7 site. This is considerably less than the 428 million long tons of taconite pellets produced at the alternate sites due to differences in designed annual production.

TABLE 120
LIFETIME FUEL REQUIREMENTS FOR RESERVE MINING TACONITE OPERATIONS

Fuel Type	Mile Post No. 7	Colvin	Embarrass	Snowshoe
Fuel oil (10^6 gallons)	458	432	467	438
Gasoline (10^6 gallons)	18.3	19.4	19.4	19.4
Natural Gas (10^9 cubic feet)	668	732	732	623
Coal (10^3 shore tons)	4,334	4,708	4,708	4,708
Energy for construction (10^9 equivalent BTU's)	3,075	5,343	5,343	5,343

MEASURES TO MITIGATE ADVERSE ENVIRONMENTAL IMPACTS.

PART V

MEASURES TO MITIGATE ADVERSE ENVIRONMENTAL IMPACTS

INTRODUCTION

One of the functions of the EIS is to examine the proposed action to determine if some of the adverse impacts of the proposed Mile Post 7 plan can be minimized through the implementation of design standards or mitigation measures. In most cases, adverse impacts at the alternatives could also be mitigated using similar measures.

In this section, mitigation measures and design recommendations are suggested by work area. Some of the work areas do not appear because impacts were judged to be minor (or non-existant) and therefore, did not require mitigation; some impacts cannot be mitigated. Aesthetic impacts can be mitigated only to the extent that landform, terrestrial and aquatic habitat and biota impacts are mitigated. Transportation and utilities affect other work areas, and mitigation of the resulting impacts are treated in the affected work areas.

Noise impacts are presently minor because noise level changes are not significant, population is removed from the noise sources and no documentable noise impacts on wildlife are available. Mitigation of noise would be extremely costly given the size and nature of the operation, and should only be considered if cultural development occurs closer to noise sources than is presently anticipated.

Mitigating measures cited in this document are based on current technology. They should be continually reviewed during and after the life of the operation, to take advantage of the best available technology.

Throughout the design, construction, and operation phases, additional data should be continuously collected for work areas such as revegetation, air quality, water quality, hydrology, socioeconomics, recreation and energy. This monitoring would indicate potential changes which might adversely affect the environment and would aid in developing mitigation measures, particularly for the post operation phase.

SOILS

Mitigating the loss of soils due to the creation of a tailings basin could be accomplished by enriching tailings and developing a new topsoil layer. One method for enrichment of the unproductive tailings during dam building and filling of the basin is the application of large amounts of fertilizer. However, taconite tailings have very low ability to absorb and retain cations. Also, low organic matter and low water storage capacity contributes to the probability that plant nutrients, native and supplied, will readily leach below the root zone. This problem will be reduced as organic matter builds up over a period of years. However, leaching is likely to be a permanent concern. It can be moderated by management practices such as frequent fertilizer additions, incorporation of organic material or peat into the tailings before planting, use of legumes to supply nitrogen, and the application of slow-release commercial fertilizers (see Appendix E for additional information). The use of chemical fertilizers should be carefully monitored to assure that runoff does not degrade water quality.

Fertilizer applications could probably be reduced if naturally-occurring organic soils could be incorporated into or cover the dam and basin surfaces and coarse stockpile.

One of the most serious problems in maintaining plant cover on the coarse tailings storage area and dams is low water storage ability. The 3 to 1 ratio of dry cobbed to filtered tailings will behave like a very droughty sand soil. Without irrigation, successful seeding will be confined to spring and fall. Once established, plants will suffer from water stress during relatively brief rainless periods. Some of the grasses will become dormant, some plant species will die, possibly leaving a thin plant cover. Drought-tolerant weed species are likely to invade the area, partly offsetting this thinning of the planted grass and legume cover. Additionally, less droughty soils obtained from materials stripped from the basin and stockpiled could be used to cover the coarse tailings pile and dams prior to revegetation.

Fine tailings retain excessive pore water so that plants may "drown-out" during periods of high precipitation. A high water table (less than 3 feet in depth) would result in such a problem. On the other hand, a shallow water table at 30 to 40 inches below the soil surface would be beneficial to growth on the dry cobbed and filtered tailings mixture. The depth of ground water table could possibly be controlled by the use of layers of material. For example, in the fine tailings area a layer of dry cobbed or filtered tailings could be used to increase surface drainage. A layer of soil may have to be added over this drainage course. This would aid in stabilizing the surface of the fine tailings and controlling the water table depth, aiding in revegetation.

For additional information concerning revegetation of the tailings basin see Appendix E.

LANDFORMS

Reserve Mining Company has suggested that the completed basin would resemble a large plateau with one or more small shallow lakes. The main dams are proposed to block the valley with straight lines and uniform bench widths.

In order to mitigate the aesthetic impact of this uncharacteristic landform and make the surface capable of supporting other land uses as well as proper drainage for establishment of vegetation, several measures could be taken. Coarse tailings could be spread over the surface for stabilization. Additionally these coarse tailings and filtered tailings could then be used to create a more natural rolling topography. Dam faces and seepage collection dikes might be curved and bench widths planned to be non-uniform, providing sound engineering standards are maintained. Stream diversions could be curved or meandered to present a more natural appearance using applicable hydrological design measures.

HYDROLOGY

Reserve plans to construct Diversions #1 and #2 at Mile Post 7 to divert runoff from Little Thirtynine Creek and Big Thirtynine Creek around the basin site. Flow rates in these streams will be modified during the construction phase. Increased flow rates due to diversions in portions of Big Thirtynine Creek and the Beaver River will likely create some modifications. Observation of unstable banks along these streams during the construction stage and following runoff during operations should enable corrective measures to be undertaken to minimize adverse impacts.

Diversion of runoff around the basin area will have the effect of reducing flow rates in Big Thirtynine Creek between the dam construction area (Dam #1) and the Beaver River. This effect, coupled with the potential for increase in sediment loads due to upstream construction will modify flow conditions in this stretch of stream. Plans are to construct the seepage collection system along with an overflow spillway prior to stripping for Dam #1 to control sediment from construction.

Careful monitoring of the quantity of water in the basin during operations can assure that a minimum of makeup water is used from outside sources. Should excess water occur in the basin, corrective measures would include increasing dam height or allowing for the release of water, with treatment if found necessary.

Consideration should also be given to methods for reducing seepage from tailing basin sites. Each of the sites investigated has been designed under the assumption that during operations, seepage through the tailings dams and some portion of the seepage under the dams will be collected by a ditch and small dike located a distance of approximately 1,000 feet outside the toe of the dam. It has also been recognized that some portion of the seepage from each basin into the underlying aquifer could escape collection by passing under the seepage collection system.

Construction of tailings dams incorporating impervious cores or blankets could substantially reduce seepage through the dams. Cutting off or reducing seepage through the aquifers under the dams may also be possible, however, this may be quite costly. Major factors involved would include the depth to bedrock, condition of the bedrock surface, and the presence of boulders and rocks in the glacial till.

The above measures should be considered more fully in detailed design. Prior to deciding to attempt to reduce seepage, an effort should be made to evaluate the effect of filtration on seepage water quality. Seepage water could be found to be of higher quality than surface runoff from the basin. Since release of water from the basin after operations is inevitable in this region due to excess runoff, it may be preferrable to permit seepage through the dams as an alternative to releasing surface water through a spillway.

The post operational impact upon hydrology relates primarily to the effect on runoff rates and volumes. As discussed in Part IV (Probable Impacts of the Proposed Action and Alternatives on the Environment), changes in the amount of upland and wetland areas in the tailings basin and its tributary drainage area affects the quantity of runoff generated by precipitation. Also, the filling of streams, marshes, and lakes can alter the timing and quantity of runoff from the tailings basin areas. The effect of these changes can be minimized by implementation of a reclamation plan including revegetation, soil stabilization, a retention pond and overflow system. However, the actual streams and marshes filled during operations cannot be reclaimed.

Spillway locations should be carefully planned and wherever possible be located in a natural rock ridge.

Appendix A provides additional data concerning hydrological mitigating measures.

WATER QUALITY

Erosion control is very critical during construction. Measures should be taken to retain disturbed soil within the construction area. Erosion could be minimized by interceptor barriers, shallow trenches, and temporary settling basins.

Roads and railroads should be located away from streams wherever possible, and could be surfaced with gravel or other material which does not contain asbestiform fibers. Access road crossings of streams and drainageways should use material other than asbestiform fiber containing material for fill around the culverts placed to allow the continuity of stream and drainage flow.

Diversion construction should begin after the spring runoffs and be completed before the following spring. This should generally apply to all drainage facilities. The diversion should be completely constructed before the connection is opened. All banks and dikes should be revegetated and stabilized before water is permitted to flow through the diversion channels.

Once the diversions are complete, all creeks and wetlands within the basin could be dammed and water flow out of the basin controlled via a settling basin. Collection basins should be constructed downstream from dam and borrow areas.

Timber should be harvested with minimal soil disturbance. No stump or brush removal should occur during or subsequent to timbering operations except where required for dam safety.

At dam sites #1 and #2-3, precautions should be taken to minimize the effects of construction on the turbidity of the East Branch of the Beaver River and Big Thirtynine Creek. These precautions involve two basic steps. First, Diversions #1 and #2 should be constructed before work begins on stripping for Dam #1. Second, the seepage recovery dam should be constructed before stripping starts so that their reservoirs could serve as sedimentation basins (adequate storage should be provided) in which suspended solids and organic materials can settle out before water is discharged to receiving drains. These recovery dams should be provided with spillways so that the release of water can be controlled without excess erosion.

The water and sediment trapped behind the seepage recovery dams would be pumped into the tailings pond before beginning of tailings discharge. Revegetation or other stabilization measures should be taken to protect the surfaces of seepage recovery dams against erosion.

During or soon after the stripping operations for Starter Dam #1, the water in the natural drainage course is proposed to be controlled and diverted to permit work over the entire valley bottom. A low diversion dike could be constructed upstream of the upstream toe of the dam and a channel dug towards the right abutment. The stream would then be diverted in a culvert under Starter Dam #1.

Before placement of the coarse tailings portion of Dam #1, additional clearing and grubbing is required. Scheduling of this operation should be closely tied to coarse tailings placement, so as not to leave any cleared area open to erosion for long periods.

The pipeline design should include design features to minimize impacts. For instance, the pipeline should be continuously monitored by electronic means for leaks. A small ditch between the pipeline and the maintenance road could collect the discharge from small leaks. Wherever the pipeline has to cross a road, it should be placed under the road in a culvert. This would eliminate possible spills on the roadway itself. Wherever the pipeline crosses a stream or major drainageway, it should be placed on a launder bridge. Any spill could then flow down on this launder bridge to the lower end of the bridge into a catchment basin sized to hold the maximum spill. This design would eliminate any direct spill into the stream or drainageway. Spilled tailings should be collected and pumped to the tailings basin.

Since substantial revegetation may be attempted during the post operation period, precaution must be taken to prevent commercial fertilizer runoff from reaching the surrounding river system. A possible solution would be continued operation of seepage collection systems to return the runoff water to the tailings basin until such time that the nutrients are utilized or tied-up in the basin (see Appendix E).

AQUATIC BIOTA AND HABITAT

The tailings basin will destroy the aquatic habitat within its boundaries and will have an effect on the aquatic ecosystems in the area. A number of measures can be taken in an effort to mitigate the harmful effect on these neighboring systems.

Diversion channels are typically straight, wide shallow ditches constructed to handle seldom occurring extremely high flows. Such channels afford little habitat diversity and pose a problem of warm stream temperatures. A better ecological practice would be to construct a smaller low flow channel within the larger diversion channel. The low flow channel could be meandered to produce areas with varying flow velocity and a variety of habitats (inside and outside of bends). This channel could also be improved ecologically by the addition of gravel, rocks and boulders to increase habitat diversity. Revegetation of channel banks with trees would reduce the change of river temperature alteration caused by exposure to sunlight.

TERRESTRIAL HABITAT

The vegetated communities on the site will be destroyed as will the ability of the site to produce like vegetation for an extremely long period. These communities cannot be replicated once the soil is covered. Mitigating measures for revegetation were discussed earlier in this section under Soils.

The timber producing capacity of the area will be destroyed. Presently the majority of the area supports stands of trees of varying value. It is assumed that this material will be harvested and processed at the time on-land disposal commences.

Mitigating measures for wildlife available over the short term are few. Without aggressive attention, the probability of accomplishing any of them is small. One possible mitigating measure is that a disposal site be chosen on the basis of least damage to wildlife. Another possibility, is that a parcel of land equal in size to the site be managed to provide prime quality wildlife habitat. A third, and most likely measure is that during disposal operations the basin dams be seeded with some type of grass and legumes, and after cessation of operation the basin itself be seeded with variable vegetation which supports wildlife.

The underlying need in mitigating wildlife impacts is to find substitute habitat. If this can be done and movement from one location to another can be accomplished, it is important to recognize that this will place pressure upon resident populations elsewhere which is likely to lead to mortality rates beyond those normally expected until equilibrium is restored. Generally, it is not possible to add population to a specific habitat without extensive rehabilitation. This is true since most habitats are already at present carrying capacity.

SOCIOECONOMICS

The proposed action at Mile Post 7 will involve the influx of up to 500 to 1,000 construction workers at the peak of construction activity. Construction planning should take into account tourist movement along Highway 61, during the tourist season, because of the economic importance of tourism to local business. Furthermore, any necessary housing accommodations should be provided in anticipation of the work force, to minimize the disruption to the local communities in the Silver Bay area.

The potential range of post operation impacts and mitigating measures depends on a wide range of options and decisions by Reserve Mining Company, its parents (Armco Steel Corporation and Republic Steel Corporation), and its employees, as well as economic and social conditions in the local area. A detailed analysis and description of all options and influences on these options should be conducted as the first step in a long range planning process which can define anticipated impacts and mitigating measures for consideration and implementation by those responsible.

This planning process should begin early and continue through the duration of the project. The impacts of closure should be analyzed and described in detail to develop effective and timely mitigating measures for closure, such as:

- Identifying specific Reserve Mining Company plans and timetables to avoid uncertainty with respect to future operations.

- Retraining programs for employees.

- Extension of retirement age to minimize new hires late in the project life.

- Expand and diversify the local economic base to provide alternative employment opportunities.

- Seek out new employers to use existing facilities (e.g., power plant and docks), after Reserve closes.

Planning cannot in itself mitigate such impacts but it is a vital first step in identifying, authorizing, funding and implementing effective mitigating measures.

LAND USE

During the planning stages of the proposed Mile Post 7 action, responsible governmental agencies should take steps to provide proper zoning controls to assure minimal conflict with noncompatable land uses adjacent to the tailings basin, proposed pipeline route and along roads servicing the tailings basin. Lost public lands should be replaced by lands of comparable quality.

RECREATION

Trail related activities can be mitigated by the provision of relocated trails in similar setting with similar qualities for riding and hiking comfort. Relocated trails may have to be longer than the existing routes to screen the tailings basin activity and to connect with trails on both sides of the site. Once operations cease and if revegetation efforts are successful, trails can be routed back through the site or new trails developed.

AIR QUALITY

The degree to which air quality impacts can be mitigated depends on tailings pond management practices.

Blowing dust and erosion of areas cleared and/or excavated for access or construction purposes can be minimized in several ways. Water could be applied to unpaved road surfaces with water sprinkler trucks. During excavation for buildings, pipelines and roadways, sprinkling the area by hand and sprinkler system could be utilized. On roads with heavy traffic, crushed gravel could be spread in conjunction with the normal sprinkling of the road with water. For unusual circumstances in which water and crushed gravel application does not suffice, a bituminous emulsion could be used.

Care should be used when incorporating taconite tailings into roadway construction, less additional breakdown occur and air quality is adversely affected. Fugitive dust problems at the tailings basin could be minimized by operating the tailings pond in such a manner that the fine tailings are always covered by water. The only exceptions would be the beach areas, immediately in front of the dams and along the east side of the valley. Here it is proposed that a 200 to 300 foot wide beach be maintained at all times. This is necessary to provide the upstream seal on the tailings dams and against the east valley wall. Several methods may be used to control fugitive dust in this area. The beach could be kept wet and moist by alternate spigotting into various sections of the beach with a maximum rotational period of ten days or less. An alternative would be the installation of a sprinkling system.

The beach may be frozen or snow-covered in winter and may not become a source of dust even under severe wind conditions. If necessary, the use of dust retardants could be considered. Vegetation could be implemented in areas not used for a period of time. Such areas could be used for spigotting later. Covering the tailings basin beach with a layer of dry cobbed tailings might be considered.

Watering is most often selected as a control method since water and necessary equipment are usually available at relatively low cost. The effectiveness of watering for control depends mostly on the frequency of application. It is estimated that twice daily watering over an entire area will reduce dust emissions by up to 50 percent.[1]

Chemical stabilizers would be useful primarily for application on land that is not to be disturbed for longer periods of time. Chemical stabilization is not an effective means of reducing the fugitive emissions caused by equipment traffic or active excavation and operations. Wind erosion emissions at construction sites from inactive land areas can be reduced by 80 percent[1] in this manner, but this represents only a relatively small portion of the total emissions during periods of high activity.

Continuous chemical treatment, coupled with watering can reduce total particulate emissions by up to 90 percent.[1] This type of application of chemical wetting agents will provide better wetting of the fine material and longer retention of moisture. However, care should be used in selecting materials that will not produce side effects such as leaching of materials into the groundwater, into surface water, or damage to vegetation.

Windbreaks as commonly used in agricultural practice could be used. However, under conditions of high winds, they may cause more turbulence but reduce the distance of downwind transport.

Common techniques for controlling emission from unpaved roads include: paving, working of soil stabilization chemicals into the roadbed, and traffic control regulations. Chemical soil stabilization should be frequently applied for effective results (only within the tailings basin). Traffic control may be difficult to enforce. Paving of a roadway will reduce emissions by up to 85 percent while soil stabilization can be 50 percent effective.

For vehicle speeds between 30 and 50 miles per hour, emissions are linearly proportional to vehicle speed. Below 30 miles per hour, emissions due to increases in speed appear to be proportional to the square of the vehicle speed.[2] Thus, vehicle speeds should be controlled to reduce fugitive dust emissions.

Continuous monitoring should be required to gauge the need for, and effectiveness of mitigation measures, as dust must be controlled.

DAM SAFETY

To insure proper design, it is normal practice that various state agencies review the preliminary and final construction drawings and specifications. To assure that proper construction techniques are followed in accordance with the plans and specifications, regular field inspections should be made by qualified professionals. In addition it has been recommended that a board of independent consultants be established to review the design, and to make periodic inspections during construction and operations.

Reports dealing with dam design and safety have been submitted to the state by Casagrande Consultants[3]; Michael Baker Jr., Inc.[4]; and W.A. Wahler & Associates.[5]

ENERGY

Mitigating measures could be employed to reduce the energy consumption by Reserve Mining Company. Energy usage by fuel type has already been presented in the section on "Energy Evaluation of Alternate Sites."

All of the work done with respect to the energy usage was based on the premise that a continued demand for taconite pellets would exist. Therefore, the need for both process heat and electricity would also continue to exist.

Because of the nature of the taconite operation, it may not be feasible to significantly reduce the consumption of energy in any meaningful manner. Energy conservation measures should be instigated on a routine basis wherever possible. Such conservation measures are represented by the installation of additional insulation to save heating applications. Reserve should implement energy saving techniques to the maximum extent possible.

Mitigating measures in the area of energy are diverse in type. A recent improvement has been made in the use of energy within the Grate-Kiln taconite pelletizing operation. Basically, the energy saving is achieved by installing a heat recuperator at the end of the heat treatment facility for drying pellets prior to firing. Heat given off by the cooling pellets is recovered and used in the pellet drying stage. This preheating operation is claimed to save approximately 1/3 of the heat required for the heat treatment of pellets. While Reserve Mining does not currently use the Grate-Kiln method of drying pellets, the basic principle of gas preheating can be utilized in many drying operations.

One mitigating measure that can be taken involves not the quantity of energy required, but rather the fuel from which the energy is obtained. It is recognized that both natural gas and petroleum products will become less available in the near future. Over 80 percent of the energy currently consumed by the Reserve Mining operation comes from natural gas, of which more than half is used in the generation of electricity. A reasonable measure would be to switch to coal for the production of electric energy. Coal is not expected to be in short supply over the lifetime of the proposed operation.

The switch from natural gas to coal could possibly be employed in the generation of process heat for the pelletizing operation. Combining this with the use of coal in generating electric energy would virtually remove the need for natural gas.

Probably the most significant measure which could be taken to mitigate excessive uses of energy would be to implement a "total energy system." The term "total energy" is used to refer to systems that generate electricity on-site, and make use of the heat recovered from electric generation for process steam, hot water, space heating, air conditioning, and other purposes. Since about two-thirds of the energy used in generating electricity is commonly exhausted as waste heat, the utilization of this heat offers the possiblity of substantial energy conservation as well as a reduction in the environmental impact of the waste heat release. There are hundreds of total energy systems operating in the United States in applications such as housing developments, shopping centers, and hospitals.

As an indication of the amount of energy which could be saved through the use of a total energy system, conventional steam-electric power plants have an overall efficiency of approximately 35 percent (no transmission losses for on-site generation). For total energy systems using full heat recovery equipment, 60 percent of the waste heat can be extracted where there is a use for it. Thus, the total energy system would require less than 50 percent as much raw energy input as for the conventional plant. This is a substantial savings of energy resources.

REFERENCES

(1) Jutze, G. A., K. Axetell, Jr., and W. Parker, Investigation of Fugitive Dust - Sources, Emissions and Control, PEDCo Environmental, U.S. Environmental Protection Agency, Contract No. 68-02-0044, Task 9, May 1973.

(2) Cowherd, C., Jr. K. Axetell, Jr., C. M. Guenther, Development of Emission Factors for Fugitive Dust Sources, Midwest Research Institute, U.S. Environment Protection Agency, Contract No. 68-02-0619, Report No. EPA-459/3-74-037, June 1974.

(3) Casagrande Consultants, Final Report on Evaluation of Proposed Design Mile Post 7 Project; August 1975.

(4) Michael Baker, Jr. Inc., Geotechnical Evaluation On Land Tailings Disposal Plan Reserve Mining Company, Mile Post No. 7 Site, August, 1975.

(5) W. A. Wahler & Associates, Review of Reserve Mining Company's Preliminary Mile Post 7 Tailings Disposal Plan, August, 1975.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES.

PART VI

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

INTRODUCTION

Irreversible and Irretrievable Commitment of Natural Resources includes the proposed use of non-renewable resources, irreversible commitments of resources to a particular use, and any irreversible and irretrievable damage that may result from the proposed Mile Post 7 plan. While this part is directed towards the proposed Mile Post 7 plan many of the items discussed are equally applicable to alternatives.

Construction of facilities associated with the proposed Mile Post 7 plan would result in the commitment of the natural resources required for buildings, pipelines, roadways, rail spurs and the like. These resources have limited potential for retrieval at the end of the project.

At full plant capacity, over the 40 year life of the proposed Mile Post 7 plan, approximately 1,215 million long tons of crude taconite ore would be mined to produce 380 million long-tons of taconite pellets containing 244 million long tons of iron. The result would be an irreversible commitment of a non-renewable but recyclable natural resource.

SOILS

The filling of the proposed tailings basin at Mile Post 7 would render irretrievable the natural soils by covering them with tailings. This will result in a loss of the productive capacity of the existing soils and replacing them with material of little or no productive capacity.

LANDFORMS

With the construction of the proposed Mile Post 7 plan, certain landforms would be irretrievably encumbered. The tailings basin would fill the existing valley and utilize the west face of the east ridge in the creation of a large plateau of tailings. The filling of the basin and diversion of streams will eliminate a water-fall and 9.7 miles of streams. Construction of the tailings basin will result in the creation of a landform of a significantly different character than what naturally occurs in this part of the state.

AQUATIC HABITAT AND BIOTA

A major irretrievable loss will occur to Bear Lake. Bear Lake is a unique cold water lake on the north shore. While Bear Lake will not be eliminated as will streams within the tailings disposal area, the natural equilibrium of physical and biological processes will be disturbed through the regulation of lake levels and through the possible introduction of wind borne contaminants from the disposal area. Principally what will be lost extends beyond the natural biological elements of the lake to man's perception of an undisturbed area, an aesthetic value which cannot be evaluated.

The aquatic habitat within the proposed Mile Post 7 disposal site would be lost. 9.7 miles of trout stream will be lost. However, the impact does not end with a loss of area organisms and productivity. The temperature of a stream may be altered considerably by the loss of several miles of stream.

An important irretrievable resource would be the water loss to downstream areas. The majority of streams are dependent on surface runoff as a water source and a reduced drainage area would decrease water quantity. A slight reduction could be critical especially during low flow. Stress caused by low water could eliminate some less tolerant aquatic organisms.

Essentially all the original aquatic ecosystems within the tailings basin would be lost with practically no chance for retrieval.

TERRESTRIAL HABITAT AND BIOTA

The plant communities which exist today, and the animals which are associated with them are the products of centuries of interaction between climate, soil and the preceeding biotic communities. With the proposed action, these communities would be eliminated.

The communities which are present now could not be replicated on the site after the end of operations.

The habitat for the animals existing on the site would be eliminated and the animals displaced. The suitable value of the area immediately surrounding the site would be reduced for wildlife due to man's activities. The impact on the surrounding area would not cease at the end of operations. The slow revegetation might replace some of the habitat lost during operations, but it is unlikely that it would support the same types and numbers of terrestrial biota it now supports.

SOCIOECONOMICS

The proposed Mile Post 7 plan could result in a net reduction of state and local taxes (based on assumed plant capacity of 9.5 million long tons/year) of $2.7 million per year.

LAND USE

During the life of operation, use will conflict with predominant land use in the north shore corridor. After operation, land use would be limited.

RECREATION

The irretrievable loss of aquatic habitat for trout and other game fish within the basin along with the loss of the existing terrestrial habitat for wildlife would result in the loss of almost all opportunities for hunting, fishing and hiking in the area. This would include loss of a section of the North Shore Trail. All activities requiring a wilderness setting would be eliminated with presence of a tailing basin. Also, the potential for future diversified recreational activity would be diminished.

ENERGY

All of the fuel consumed by Reserve Mining in their taconite operations is an irretrievable commitment of resources. Fuel oil, gasoline, natural gas and coal would be consumed. It must be realized that based upon assumed plant capacity, the consumption of fuels would result in the production of 380 million long tons of taconite pellets over the 40 year life of the proposed Mile Post 7 plan.

SHORT TERM USES OF THE ENVIRONMENT VERSUS LONG TERM PRODUCTIVITY.

PART VII

SHORT TERM USES OF THE ENVIRONMENT VERSUS LONG TERM PRODUCTIVITY

INTRODUCTION

A discussion of Short Term Uses of The Environment Versus the Long Term Productivity of the area must be set in the context of issues. The decision-making issues related to the selection of the proposed Mile Post 7 plan, or an alternative, focus in large measure upon the manner in which the north shore and northeastern Minnesota will ultimately develop. This is especially true with regard to the proposed Mile Post 7 plan because of the manner in which the short and long term must be defined; and the significance and magnitude of the action proposed.

Definition of Short Term and Long Term

Under day to day circumstances, the short term is generally considered as the relatively foreseeable and predictable future. The short term related to this project is a relatively long period--the life of the project or about 40 years. In this case, the long term is the post project period, or beyond the 40 year project life.

Project Significance

This project represents a significant action. If it proceeds, it will commit a sizable land area, approximately 15 square miles, to a use which will eliminate or seriously disrupt the present natural environment (see Part IV). In addition, it represents a sizable economic action. The magnitude is such that, once commited to this course of action, there will be relatively little opportunity to turn back or modify (see the Industrial Economics subpart of Part II).

Reason for the Proposed Action

The proposal to implement the proposed Mile Post 7 plan is set in a context of needs:

1. The need for a reasonable and rapid solution to a potential health hazard that has been recognized by courts of law to require abatement.
2. The need of Reserve Mining Company to remain in operation by complying with the court decision and, at the same time, to remain economically competitive.
3. The need of some 3,000 Reserve employees and families to realize a secure economic future. In addition, this need is also required by those who rely on indirect induced employment in support of Reserve's employees.

The Trade Off

To meet these needs, a trade off is being faced. It essentially focuses upon two major factors.

1. The real or perceived economic limitations of an area and a company and the possibility of relief from these limitations through short term growth and economic stability.
2. The natural environment and the long term commitment of a natural resource area to a highly specialized and intensive single purpose use, a tailings disposal area.

These are not simple circumstances. The proposed action will completely destroy the existing environment on and near the site. The existing natural environment will probably not be replaced to any substantial degree for over 100 years. When it is replaced, the environment may possess similar vegetative cover and wildlife, but overall the environmental setting will be in sharp contrast to that which previously existed. The need for economic growth and stability is equally pressing, particularly for local residents who are dependent upon Reserve for livelihood.

The Policy Context

The basic consideration underlying the resolution of the issue is how future mining will be guided, as a dominant land intensive use in northern Minnesota. The relationship of short term use versus long term productivity can only be answered in the policy context. This context under the best of circumstances is a management plan, which assigns uses and priorities to uses. Proposals to function within this plan are responded to within the context of the plan and the management devices contained therein.

While such a policy context does not exist as a single document for northern Minnesota, there has been a number of individual public actions and policies which provide some indication of direction for natural resource usage in the north shore area and portions of northern Minnesota generally. This emerging policy direction for recreational priority is supported by:

1. Consideration of the north shore area for inclusion under the Critical Areas Act for the State of Minnesota.

2. Intensive planning efforts for the north shore undertaken under the Coastal Zone Management Act.

3. The existing concentration of recreational usage in the north shore.

4. The portal entrance nature of the north shore corridor into the established primitive wilderness recreation resource areas.

5. The unique aesthetic appeal offered by the views of the lake, the surrounding rugged terrain and natural features on north shore.

6. The concentration of designated trout streams and trout populations in the north shore which are actively maintained and managed.

7. The improvement and enhancement of fishing activities on Lake Superior.

8. The development of harbors of refuge to encourage recreational boating on Lake Superior.

9. Land acquisition programs establishing state parks.

10. Management plan for wildlife and forestry management for the area.

These elements would support a policy which is directed toward:

1. Encouraging the consolidation of manageable regional land use activities into concentrated patterns;

2. Controlling and limiting further intrusion of man's activities into natural resource based recreation areas; and

3. Eliminating or consolidating conflicting land use activities in the north shore recreation corridor.

The issue of short term use of the environment and the maintenance of long term productivity is essentially a land use decision. The decision to commit land to an industrial use is another increment in the basic formulation of policy toward land use in the north shore corridor. The decision to permit this land use forecloses certain options and opportunities with respect to the future environmental productivity and land use in this corridor (see Land Use subpart of Part IV). These values should be weighted against the needs of a rapid solution to a potential health problem, and to secure the economic future of Reserve and its 3,000 employees.

THE IMPACT ON STATE GOVERNMENT OF ANY FEDERAL CONTROLS ASSOCIATED WITH THE PROPOSED ACTION.

PART VIII

THE IMPACT ON STATE GOVERNMENT OF ANY FEDERAL CONTROLS ASSOCIATED WITH THE PROPOSED ACTION

The Eighth Circuit Court of Appeals directed the resolution of the on-land tailings disposal controversy to be carried out through administrative proceedings involving the State of Minnesota and Reserve Mining Company as governed by provisions of Minnesota state law. Direct impacts, therefore, upon the state by federal intervention in the hearings or exercise of federal control over the ultimate decision are limited.

Various federal statutes and regulations may affect the time table for implementation of any action resulting from Reserve Mining Company's applications for on-land disposal of taconite tailings by imposing certain prerequisites on the applicant. Such statutes and regulations as described below could delay the Eighth Circuit's suggested time table for resolution of the disposal issue.

The National Environmental Policy Act (NEPA) of 1969[1] and the Council on Environmental Quality's (CEQ's) Guidelines[2] require that all agencies of the Federal Government prepare detailed environmental impact statements on major Federal actions significantly affecting the quality of the human environment. NEPA requires that agencies include in their decision-making process, appropriate and careful consideration of all environmental aspects of a proposed action, an explanation of potential environmental effects of a proposed action and reasonable alternatives for public understanding and a discussion of how to restore or enhance environmental quality as much as possible. The Corps of Engineers has decided to prepare a Federal EIS in response to the two applications for Section 10 permits filed with the District Engineer in St. Paul.[3]

Section 10 of the Rivers and Harbors Act of 1899[4] prohibits the creation of any obstruction of the navigable capacity of any of the waters of the United States unless affirmatively authorized by Congress. Section 10 makes it unlawful to excavate, to fill or in any manner, to alter navigable waters of the United States unless the work has been recommended by the Chief of Engineers, Corps of Engineers and authorized by the Secretary of Defense. The proposed Mile Post 7 plan requires permits for stabilization or other treatment of the tailings delta and dredging for placement of the power plant cooling water diffuser jet.

The Corps of Engineers is participating with the State of Minnesota to the extent necessary for the Corps to possibly utilize the State EIS as a base document for the Federal EIS.

Section 404 of the Federal Water Pollution Control Act Amendments of 1972[5] requires that a permit be filed with the Corps of Engineers for any obstruction of a waterway for tailings disposal. It appears that Reserve would not be grandfathered under these regulations unless construction is completed prior to July 1, 1977. Reserve has been advised by the Corps[3] to apply for the necessary permits for the proposed Mile Post 7 plan according to these regulations.

If the exchange of U.S. Forest Service land is necessary to implement the selected disposal scheme, two conditions must be met. First, the land to be exchanged must be of equal or greater value than that sought and, second, the exchange must diminish the total Forest Service perimeter.[7] (refer to Appendix F). Because of these and other stringent conditions attached to land exchange,[6][7] the process can consume up to five years. When land exchanges are made full title and rights would be given for the use of the land surface. However, mineral rights would not be included.

The State of Minnesota has assumed authority over air pollution control in this case, and Reserve has agreed to install pollution control devices at the Silver Bay plant. Air pollution control studies are presently underway at EPA of the beneficiation of low grade iron ores, such as taconite, and standards may be set in the future. The State of Minnesota's water quality standards have been approved by the Federal Government under the Federal Water Pollution Control Act Amendments of 1972.[5]

At present, none of the sources of energy (or fuel) needed to implement the proposed action are subject to allocation. Natural gas is supplied on an interruptible basis to the power plant, but Reserve has plans to convert to the use of coal within a short period of time due to the unreliability of the natural gas supply.

REFERENCES FOR PART VIII

(1) National Environmental Policy Act of 1969. 42 U.S.C. § 4321 et. seq.

(2) Council on Environmental Quality. NEPA Guidelines. 40 CFR 1500.

(3) U.S. Corps of Engineers. Letter to Barton-Aschman Associates, Inc. dated October 8, 1975.

(4) Rivers and Harbors Act of 1899. Section 10. 33 U.S.C. § 403.

(5) Federal Water Pollution Control Act. Amendments. 1972. 33 U.S.C. § 1344.

(6) General Exchange Act of March 20, 1922.

(7) Weeks Act of March 11, 1911.

THE MULTI-STATE RESPONSIBILITIES ASSOCIATED WITH THE PROPOSED ACTION.

PART IX

PART IX. THE MULTI-STATE RESPONSIBILITIES ASSOCIATED WITH THE PROPOSED ACTION

The "responsibilities" of Minnesota to other states appear to be limited. Quality of public water supplies is of concern to all communities which use water from Lake Superior. The U.S. District Court found that a certain portion of the tailings deposited by Reserve into Lake Superior are dispersed throughout the lake.(1) Wisconsin, Michigan and Minnesota have been involved in the Lake Superior Enforcement Conference, and Wisconsin and Michigan were joined by the U.S. District Court proceedings along with Minnesota. However, the Eighth Circuit Court of Appeals has ruled that the resolution of the controversy over the location of the on-land disposal site does not fall within the jurisdiction of the federal courts; rather, that it is a matter to be decided in accordance with Minnesota law. Under the terms of the Court of Appeals order,

> ...it follows that neither Michigan, Wisconsin, nor the environmental groups have any right of participation in that decision-making process except as may be otherwise provided by Minnesota law.(2)

Under Minnesota law, other states may seek to intervene in permit hearings but no particular "responsibilities" fall on Minnesota other than those given in Minnesota statutes and regulations. Minnesota sent notice of the proposed Mile Post 7 plan permit hearings to both Wisconsin and Michigan, but neither state has chosen to intervene or participate in the hearings.

Minnesota has a responsibility to follow its own laws and regulations as well as relevant parts of the Federal Water Pollution Control Act and other environmental legislation.

If other states or Canada have concerns over pollution effects to their environments as a result of Reserve's ultimate operations, remedies may be available under those states' statutes or federal law.(2)

REFERENCES FOR PART IX

(1) United States v. Reserve Mining Company. 380F. Supp. 11, 16, 22, 38, 50 (D. Minn. 1974).

(2) Reserve Mining Company v. United States. 514F. 2d 492 (8th Cir. 1975).

ORGANIZATIONS AND PERSONS CONSULTED.

PART X

ORGANIZATIONS AND PERSONS CONSULTED

This listing identifies the federal, state and local agencies, other organizations and private individuals contacted during the preparation of the Draft EIS. Many letters were sent requesting information and inquiring as to permit authority. In addition, personal as well as telephone interviews were made to determine policies, identify areas of concern and collect data.

FEDERAL GOVERNMENT

U.S. ENVIRONMENTAL PROTECTION AGENCY

Kenneth Cantor
Health & Ecology Division
Research and Development

Peter Clapper
Office of Public Affairs

Phillip Cook
National Water Quality Laboratory

Robert Coughlin
Economist, Region X

H. Lanier Hickman, Jr.
Director
Office of Solid Waste Management Program

Clarence Oster, Director
Minnesota/Wisconsin District Office

Pamela Quinn
Office of General Counsel

Reinhold W. Thieme
Office of Enforcement

I.E. Wallen
Deputy Director
Office of Toxic Substances

Robert W. Zeller
Director, Municipal Permits
Operations Division

U.S. FOREST SERVICE

Kenneth Dahlquist
Forester

Edward Hill
Forester

Merle McManigle
Timber Management Staff Officer

Richard Pederson
Lands Staff Officer

U.S. DEPARTMENT OF JUSTICE

Thomas Bastow
Attorney
Pollution Control Section
Land and Natural Resources Division

U.S. ARMY CORPS OF ENGINEERS

Richard F. Berry
Biologist

Ernest Dodson, Chief
Soil Mechanics Branch
Engineering Division

David Parsons
Civil Engineer

George Watts, Chief
Coastal Engineering Research Center

U.S. BUREAU OF MINES

Daniel Kealy
Mining Research Center

WATER SUPPLY RESEARCH LABORATORY

Gary Logsdon
Research Sanitary Engineer
Physical and Chemical Removal Branch

U.S. GEOLOGICAL SURVEY

Bruce B. Hanshaw, Ph. D.
Hydrologist

OFFICE OF CONTROL TECHNOLOGY

Stanley T. Cuffe
Chief

COUNCIL ON ENVIRONMENTAL QUALITY

Warren R. Muir
Senior Staff Member for Environmental Health

FEDERAL HIGHWAY ADMINISTRATION

E.Dean Carlson
Division Engineer

STATE GOVERNMENT

Governor Wendell R. Anderson

Joan Growe
Secretary of State

James F. Lord
State Treasurer

Robert W. Mattson
State Auditor

Representative William M. Munger

Lt. Governor Rudy Perpich

Warren R. Spannaus
Attorney General

DEPARTMENT OF ADMINISTRATION

Richard L. Brubacher
Commissioner

DEPARTMENT OF AERONAUTICS

Lawrence E. McCabe
Commissioner

DEPARTMENT OF AGRICULTURE

Jon Wefald
Commissioner

STATE BOARD OF ASSESSORS

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Secretary-Treasurer

BICENTENNIAL COMMISSION

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Aesthetic Environment Programs

Lois Pollari
Director

DEPARTMENT OF COMMERCE

Edward J. Driscoll
Commissioner

DEPARTMENT OF CORRECTIONS

Kenneth F. Schoen
Commissioner

DEPARTMENT OF ECONOMIC DEVELOPMENT

Francis H. Geisenhoff
Industrial Economist

James R. Heltzer
Commissioner

Lisa L. Lebedoff, Director
Tourism Division

David Rademacher
Research Division

Anthony R. Trow, Director
Industrial Development Division

DEPARTMENT OF ECONOMIC OPPORTUNITY

Ronald E. O'Neal
Director

DEPARTMENT OF EDUCATION

Howard B. Casmey
Commissioner

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Research and Planning Division

Emmet J. Cushing
Commissioner

R. Pinola
Director of Research and Planning

John Tauzztal
Research and Planning Division

ENERGY AGENCY

James Carter
Research Division, Director

Dixie L. Diehl, Coordinator
Fuel Allocation Division

John C. McKay
Director

John D. Peterson
Conservation Division

DEPARTMENT OF FINANCE

Edward G. Ziegler
Commissioner

GOVERNOR'S OFFICE

Thomas A. Kelm
Executive Secretary

Andrew V. Kozak
Staff Assistant to Governor

DEPARTMENT OF HEALTH

Frederick F. Heisel, Director
Environmental Health Division

Warren R. Lawson, M.D.
Commissioner

HIGHER EDUCATION COMMISSION

Richard C. Hawk
Executive Director

MINNESOTA HIGHWAY DEPARTMENT

Keith V. Benthin
Bridge Engineer

Dwight E. Bonin, Director
Government and Community Relations

Robert G. Brennan, Director
Office of Right-of-Way

Douglas H. Differt
Assistant Commissioner
Transportation Planning and Programming Division

Lawrence E. Foote, Director
Office of Environmental Services

Lyle L. Hansen, Director
Office of Transportation System Planning

Walter Hartland
District Appraisal Supervisor

Walter Jiracek
Photo Lab Chief

Dennis R. Johnson
District Transportation Planner

Erling H. Jonassen
District Preliminary Design Engineer

Russell J. Kauzlaric
District Traffic Engineer

Earl R. Larson, Director
Surveying and Mapping Office

Paul LeTour
District Environmental Unit Supervisor

Francis C. Marshall
Assistant Commissioner

Frank D. Marzitelli
Commissioner

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Arlo Knoll
Reserve Project Team

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Representing Northeastern Minnesota Intervenors
Supporting the Mile Post 7 Plan

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Representing Reserve Mining Company

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Department of Geology

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GLOSSARY

Accipiter	The genus of small or medium-sized hawks that have rather short wings and comparatively long legs and tail, and that usually fly low, darting in and out among trees.
Amphibian	Any of a class of vertebrate animals most of which pass through an aquatic larval stage with gills and then through a terrestrial stage with lungs (e.g., salamanders, frogs and toads).
Anaerobic	Capable of life or activity in the absence of air or free oxygen.
Anthophyllite	An orthorhombic mineral of the amphibole group, often clove-brown in color, lamellar or fibrous. It is essentially a silicate of magnesium and ferrous iron, (MgFe) SiO_3.
Association	A definite or characteristic assemblage of plants living together in an area essentially uniform in environmental conditions; any ecological unit of more than one species.
Benthic	Of/the bottoms of lakes or oceans or organisms which live on the bottom of water bodies.
Bimodal Curve	A statistical term denoting a sample within which are two populations, (i.e., a curve with two humps).
Biota	The flora and fauna of a region.
Boreal Forest	A forest type, consisting largely of white spruce and balsam fir, that extends from Newfoundland to the New England states and westward to Cook Inlet, Alaska; its southern boundary touches the Great Lakes Region.
Buteo	A genus of hawks that have broad rounded wings and fan-shaped tails and that soar and wheel high in the air.
Calcareous	Consisting of or containing calcium or any calcium compound.
Carnivore	An organism that eats living animals.
Cation	A positively charged ion, such as hydrogen, calcium or aluminum.
Chelate	A cyclic structure usually containing a 5 or 6-atom ring in which a central metallic ion is held in a coordination complex by one or more groups, each of which can attach itself to the central ion by at least two chemical bonds.
Chelating Agent	A substance that, when added to metal ions, forms chelates with them.
Clear-Cut	In forestry, the cutting out of all trees within a logging area.
Climax Community	The final, stable community in an ecological succession, which is able to reproduce itself indefinitely under existing conditions.

Rotenone	A poisonous crystalline pentacyclic compound ($C_{23}H_{22}O_6$) found in various fish poisons.
Secondary Succession	Refers to succession which occurs on formerly vegetated areas (i.e., having an already developed soil) after disturbance or clearing.
Seed-Tree	In forestry, a healthy, mature, selected tree left after logging operations to provide seed for natural revegetation.
Seral Stages	Developmental, temporary communities in a sere.
Sere	A developmental series of communities that will exist for an interval of time.
Serotinous Cones	Cones that appear late in the summer.
Shelter Wood	A type of tree-shrub planting designed to provide wind and snow shelter for farms and animals; a forest of sufficient age and species composition to provide shelter and protection for animals.
Site Index	A measure of the worth of a particular area as a habitat for forest; usually given as the average height in feet of the dominant or codominant trees at a given age (50 or 100 years).
Soil Horizons	Soil layers - there are four: A. Mostly organic matter, some mineral soil - horizon of maximum leaching. B. Zone of maximum accumulation of materials leached from above. C. Weathered parent material. D. Unweathered parent material.
Stream Order	A classification of the branches of a river system in which the smallest-size streams have the smallest numerical designation.
Strip Ratio	The tons of waste materials that must be removed to make one ton of crude ore available for mining.
Subangular Rock	Rock that is free from sharp edges though not smoothly rounded.
Successional Community	Any community occurring between the pioneer (first) and climax (last) communities during succession; a seral stage.
Synergism	The combined action of two or more agents that is greater than the sum of the action of each of the agents used alone.
Taiga	The northern extent of the boreal forest.
Taxon (pl-Taxa)	A taxonomic group or entity (genus, species, family, etc.).
Till	Nonstratified deposits left by glacial ice.
Understory	The layer extending from twenty feet in height to a short distance below the overstory.
White Pine Blister Rust	A fungal infection (carried by currants) of white pines, characterized by blister or jelly-like exudations; ultimately fatal to the tree.
Xerosere	The seral stages of a xerarch (little available moisture) succession.

STATE OF MINNESOTA

ENVIRONMENTAL QUALITY COUNCIL
CAPITOL SQUARE BUILDING
550 CEDAR STREET
ST. PAUL, 55101

Dear Interested Party:

This letter and the accompanying documents include all items but one constituting the Final Environmental Impact Statement (EIS) in the Matter of the Application by Reserve Mining Company for Permits for the Mile Post 7 On-land Tailings Disposal Plan at Silver Bay, Minnesota, as required under MEQC 33 of the Rules and Regulations of the Minnesota Environmental Quality Council.

The remaining item necessary to constitute the Final EIS is the notice of completion from the MPCA. This will be mailed to you as soon as it is received, together with a notification of the time and place at which the MEQC will consider the Final EIS. The Draft EIS in the Reserve Mining Company matter dated October 1975, is incorporated into the Final EIS and is supplemented by the materials contained herein.

Enclosed with this letter you will find the findings and conclusions by Hearing Officer Wayne Olson concerning the Draft EIS, a list of witnesses appearing and testifying in the Reserve hearings, a list of exhibits received into evidence at the Reserve hearings, an index of items to be found in the hearings, and the Midway Supplement to the Draft EIS. The complete record of the permit proceedings may be reviewed in Duluth and Minneapolis by contacting William Gordon, Director of Libraries, Duluth Public Library, Duluth, Minnesota, or Julie Copeland, Environmental Library, Minneapolis Public Library, Minneapolis, Minnesota.

Very truly yours,

Peter L Vanderpoel

Peter Vanderpoel, Chairman
Environmental Quality Council

STATE OF MINNESOTA

COUNTY OF RAMSEY

MINNESOTA DEPARTMENT OF

NATURAL RESOURCES

In the Matter of the Applications of Reserve Mining Company for All Necessary Permits, Approvals and Certifications for the Mile Post 7 (Lax Lake) On-land Tailings Disposal System Near Silver Bay, Minnesota

NOTICE OF COMPLETION OF FINAL EIS

PLEASE TAKE NOTICE that pursuant to MEQC 26(j)(1) of the Rules and Regulations of the Minnesota Environmental Quality Council, the Minnesota Department of Natural Resources, one of the Responsible Agencies for the purpose of preparing the Final Environmental Impact Statement in the above-entitled matter, does hereby deem the Final Environmental Impact Statement to be complete as of June 2, 1976 and does transmit the same to the Minnesota Environmental Quality Council for its review.

MINNESOTA DEPARTMENT OF NATURAL RESOURCES

By Robert L. Herbst

Robert L. Herbst, Commissioner

0087

STATE OF MINNESOTA

DEPARTMENT OF NATURAL RESOURCES POLLUTION CONTROL AGENCY

Reserve Mining Company, On-land Tailings Disposal

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

Pursuant to notice, public hearings commenced at Roseville, Minnesota before Wayne H. Olson, Hearing Officer/Referee on June 2, 1975 on the applications of Reserve Mining Company [Reserve] for permits for the construction and operation of facilities for on land disposal of tailings at a site in Lake County, Minnesota, designated as Mile Post 7. Public hearings on the draft environmental impact statement relating to the applications were incorporated into the hearings on the applications and commenced pursuant to notice on December 1, 1975.

By orders previously filed, applications to intervene on behalf of the following parties were granted:

Armco Steel Corporation (Armco)
Republic Steel Corporation (Republic)
City of Silver Bay, City of Beaver Bay, Town of Beaver Bay, Lake County, St. Louis County, Northeastern Minnesota Development Association (NEMDA) Duluth Area Chamber of Commerce, City of Babbitt and Range League of Municipalities, Lax Lake Property Owners Association, and Silver Bay Chamber of Commerce, (Northeastern Minnesota Intervenors)
United Steel Workers of America (Steel Workers)

Minnesota Public Interest Research Group (MPIRG)
Minnesota Environmental Control Citizens Association (MECCA)
Sierra Club
Save Lake Superior Association (SLSA)
Rodney B. Nelson

The following appearences were entered:

On behalf of Reserve Mining Company: Edward T. Fride and Raymond Erickson of Hanft, Fride, O'Brien and Harries and Maclay R. Hyde, Timothy Butler and Lawrence Waldock of Lindquist and Vennum.

On behalf of Armco: G. Alan Cunningham and John Gordon of Faegre and Benson.

On behalf of Republic: William T. Egan and Richard Nygaard of Rider, Egan, Johnson and Arundel.

On behalf of Northeastern Minnesota Intervenors: Wayne G. Johnson of Johnson and Thomas and Fred Cina.

On behalf of United Steel Workers of America: John G. Engberg of Helgesen, Peterson, Engberg and Spector.

On behalf of MPIRG and MECCA: Elliot C. Rothenberg.

On behalf of Sierra Club and SLSA: Charles K. Dayton and John H. Herman of Dayton, Herman and Graham.

On behalf of the State of Minnesota: Byron E. Starns, Chief Deputy Attorney General.

On behalf of Minnesota Department of Natural Resources: Morris M. Sherman, Special Attorney, James M. Schoessler, Special Assistant Attorney General, and Edward M. Moersfelder, Special Attorney.

On behalf of Minnesota Pollution Control Agency: Eldon G. Kaul, Special Assistant Attorney General, and Paul G. Zerby, Special Assistant Attorney General.

Testimony was taken at Roseville and Silver Bay, Minnesota beginning June 23, 1975 and ending March 18, 1976. Armco and Republic, while not applicants, technically, have participated interchangeably with Reserve in the hearings and therefore, unless otherwise noted, the term Reserve herein includes Armco and Republic. Sworn statements were filed by several persons and are part of the record.

Reserve filed its brief and suggested findings on March 18, 1976. Northeastern Minnesota Intervenors filed their brief on March 24, 1976 and United Steel Workers of America filed their brief on March 31, 1976. Minnesota Department of Natural Resources filed its brief on April 5, 1976. Minnesota Pollution Control Agency and Sierra Club, Save Lake Superior Association filed their respective briefs on April 8, 1976. Reserve filed its rebuttal brief, together with affidavits of Merlyn G. Woodle, C. William Verity and William J. DeLancey, drawing of the revised Mile Post 7 site tailings disposal area, and final report on costal investigations, on April 15, 1976.

Having heard and considered all of the testimony, having considered all of the exhibits received in evidence and all sworn statements filed, and having read and considered all of the briefs submitted by the parties and arguments of counsel, I make the following findings, conclusions and recommendations:

FINDINGS

Present Operations

1. Reserve obtains all of its ore from the Peter Mitchell Mine located near Babbitt, Minnesota. After removal of the glacial till which lies above the ore body, blasting operations are conducted to break the ore into sizes which can be carried by truck to the crushers which are located near the mine. The crushing process reduces the rock to sizes of four inches or less. The ore is then loaded into railroad cars and transported 47 miles to Silver Bay.

2. The Peter Mitchell Mine is approximately ten miles in length, 2800 feet in width and 175 feet deep at its deepest locations. Due to the varying nature of the taconite rock, the ore must be blended in order that a uniformity in the end pellet product can be obtained. The ore is blended according to four parameters: iron content, grindability (hardness), concentratability and hauling distance to the crushers. The blending of the ore is a prerequisite to the continued successful operation of Reserve. Under the mining plan presently in use the entirety of the mine is in operation.

3. At Silver Bay, the taconite ore is dumped from the railroad cars and subjected to various crushing, grinding and milling processes. During the milling process, water

is introduced into the system and various stages of magnetic separation are used to separate the iron-bearing materials from the ore. The remaining materials constitute the tailings. Under the present method of discharge, the tailings are carried via tailings launders to the delta, and the tailings which are not deposited on the delta enter Lake Superior.

4. The iron ore concentrate which results from the separation processes is then fed into a filter where approximately 90 percent of the excess water in the concentrate is removed. The concentrate at about 10 percent moisture content is then conveyed to the pelletizing buildings where it is rolled into pellets in the balling drums. At this stage, 25 to 30 pounds of a fine clay called "Bentonite" is added to each ton of concentrate to bind the material into pellet form. The pellets are then heated to 2,300 degrees which converts the material from the magnetite to the hematite form. The pellets which are approximately one-quarter inch in diameter are then cooled and conveyed to the dock area for transportion by ore boat to the steel mills.

<u>Mile Post 7 Proposal</u>

<u>Changes in Operations</u>

5. Reserve's Mile Post 7 Plan for on land tailings disposal would involve major changes in the concentrating

and separating processes at Silver Bay. Reserve proposes construction of a "dry cobbing" building which would be located between the fine crusher and the concentrator building. The dry cobber would separate approximately 22 percent of the crushed ore material as dry cobber tailings. The dry cobber tailings would be placed on conveyers and transported to loading bins from which they would be hauled by railroad approximately 12 miles to the tailings basin. The concentrate from the dry cobber building would then be fed into the rod mills which presently are fed directly from the fine crusher. The tailings from the concentrating equipment would be separated into fine tailings and filtered tailings portions by hydraulic and cyclone separation. The coarser fraction of concentrator tailings would be put through a filter which would reduce the moisture content to about ten percent. These filtered tailings would then be conveyed along with the dry cobber tailings to loading bins for transportation by railroad to the tailings basin. These combined dry cobber and filtered tailings would be the "coarse tailings," part of which would be used in dam construction.

6. The fine tailings which would remain, approximately 59 percent of the total tailings, would then be pumped approximately five miles to the tailings basin in a 24 inch slurry pipeline.

7. In addition to the changes designed to accomodate on land disposal of tailings, the proposed plan includes major changes in plant operations to improve the physical and chemical quality of Reserve's pellets by increasing the iron content and reducing the silica content.

8. Reserve's current 40 year mining plan provides for mining approximately 30,000,000 tons of ore per year. The ore body being mined is sufficient for 50 to 60 years of open pit mining. In addition the mine contains extensive reserves of ores which will likely be useable in the relatively near future as new processes are perfected.

9. The proposed tailings disposal facility would store only 40 years of tailings from Reserve's operations, and the possibilities for expansion in the original design have been eliminated by design revisions. There is no evidence that Reserve plans to terminate operations at the end of its current 40 year mining plan.

Description of Proposal

10. The on land disposal plan is designed as a closed-circuit system with no intentional discharge of water or tailings to Lake Superior or any streams flowing into the lake, except for relatively small amounts of uncollected seepage.

11. The proposed tailings disposal area occupies a portion of the Beaver River watershed approximately 14.3

square miles in size, including approximately six square miles for a tailings basin and the remainder for the necessary roads, railroad tracks, pipeline terminus and other related facilities and buffer areas.

12. The proposed tailings basin would require construction of four dams, the designs for which have been substantially modified since the preparation of the draft environmental impact statement. The south dam, the largest structure in the plan was originally designed to be about 12,600 feet along and about 150 feet high. The most recent modifications would increase the length to nearly 14,000 feet and the height to about 180 feet. The north dam as originally designed would have been 5,200 feet long and about 120 feet high, the Bear Lake dam 2,800 feet long and about 130 feet high, and the northeast saddle dam 1,700 feet long and about 80 feet high. The modified design would require comparable increases in the height and some adjustment in the length of these dams. In addition, seepage recovery dams, diversion dikes and saddle dikes would be constructed.

13. Prior to the start of construction of the main north and south dams, starter dams would be constructed of material from a borrow pit at Mile Post 32 on the Reserve railroad. This construction would take two to three years to complete.

14. The modified dam design provides that the upstream faces of all dams would be covered with a blanket of clay-glacial till approximately 15 feet thick to reduce seepage through the dams and allow for elimination of the tailings beaches.

Dam Construction

15. Four principal concerns in dam construction, in addition to location, are foundation, design, construction material and construction procedures.

16. The proposed design utilizes the "downstream" method of dam construction, which is desirable from an engineering standpoint. As the height of the dam increases, the dam is constructed in the direction away from (or downstream from) the basin. Thus, in contrast with the upstream method of dam construction which had been used in prior years, the downstream method avoids the placement of dam construction materials on previously deposited fine materials, which would be unsuitable as a base for the dam. The slopes of the dams are relatively flat, a conservative design. The modified design provides for temporary use of steeper slopes to achieve greater height in a shorter period of time in order to permit placement of nearly all fine tailings underwater. While the state's dam design consultants have not reviewed the modified design, it is the opinion of Reserve's consultant, and it is not contradicted, that the modified design is conservative.

17. The coarse tailings and borrow material which will be used for dam construction is suitable material for that purpose.

18. Construction must be carried out in accordance with the dam design. Where, as in this case, construction is extended over a period of many years, the possibility of errors and omissions is increased. Assurance of full compliance with design requirements throughout the construction period would be possible only through close cooperation and an open, forthright relationship among the owner, the designer, the builder and the public agencies involved.

19. The structural quality and stability of the bedrock underlying portions of the proposed disposal area was investigated by core drilling. The geological evidence indicates that there are no structural problems in the bedrock which would affect dam stability. Reserve did not have access to the two proposed dam sites at the east side of the area, and specific geological information for those is not available. Information presently available does not indicate foundation problems at those locations, but no such determination can now be made.

20. A substantial portion of the foundation material at the proposed site of the south and largest dam is clay material, up to 30 to 40 feet in thickness, which is saturated with water and will provide suitable dam foundation only if the water is expelled and the clay consolidated.

21. Laboratory tests conducted by separate consultants for Reserve and the state on a limited number of clay samples indicate that the clay would consolidate during an appropriate construction period so as to provide suitable foundation for the dams as originally proposed.

22. Reserve's consultant testified that, in his opinion, the modification in dam design, height and construction schedule now proposed would not alter that conclusion.

23. Additional testing is required to establish the effects, if any, of dam modifications and changes in rates of construction on consolidation of foundation clays.

24. Contingent plans for installation of sand drains to facilitate consolidation, if needed, originally proposed by Reserve, were deleted from the design as a result of the doubts expressed by the state's consultants as to their necessity and desirability.

25. Instrumentation would be built into the south starter dam to measure the rate of consolidation of the clay in actual field conditions to determine if the clay reacts in accordance with present predictions. At the end of two years, additional tests would be conducted to determine the actual extent of the strength gain resulting from the consolidation process. Results of those tests would determine whether construction would proceed in accordance with the design or whether modifications were

required. Further monitoring would be required during construction.

Effects of Dam Failure

26. Careful investigation, design and construction greatly reduces but does not eliminate the risk of dam failure. Despite all efforts to avoid it, dams designed to be safe do fail because of accidents, errors, oversights and other causes.

27. Examination of the consequences of dam failure is required in order to determine whether the level of risk resulting from the location of the dam, as distinguished from its design, is acceptable.

28. The Mile Post 7 site is located some 600 feet vertically above Lake Superior and approximately three miles from the shore of the lake.

29. Sudden failure of a section one thousand feet long out of the more than 13,000 feet long south dam at Mile Post 7 would produce a wall of water twenty-eight feet high traveling at over 20 miles per hour down the Beaver River valley to Lake Superior. Only eight residences are presently located within the area which the water would occupy. No calculations were made of the additional flow which would result from the movement of tailings with the water. No calculations were made of the effects of a failure of the entire dam.

30. Failure at Mile Post 7, whether it occurred during operation or years after, would frustrate the sole objective of its construction, the termination of tailings disposal in Lake Superior, since stored tailings would be carried to the lake with no opportunity for recapture.

31. Risk of dam failure would not end when operations cease, but would continue in perpetuity.

Water Resource Effects

32. The proposed Mile Post 7 tailings disposal area is located within the drainage area of Big Thirty-nine Mile Creek and Little Thirty-nine Mile Creek, both of which comprise a portion of the Beaver River watershed.

33. Since the proposal contemplates a closed circuit system, it would be necessary to divert as much of the natural runoff as possible to reduce the amount of water being stored in the tailings basin. Little Thirty-nine Creek would be diverted into Big Thirty-nine Creek and Big Thirty-nine Creek would be diverted at a point farther south into the west branch of the Beaver River. The diverted flow of these creeks will continue into the Beaver River downstream of the seepage recovery dam at the south dam.

34. The diversions would remove eight square miles from the Beaver River watershed area. While the approximate mean flow on Thirty-nine Mile Creek prior to diversion would be slightly lower after diversion, the greatest

potential for detrimental effects caused by reduced watershed area lies in the further reduction of flow during critical periods of low flow.

35. Waters downstream from the diversions will be adversely affected by periods of increased turbidity during and following construction of the diversions and will be subject to the more prolonged adverse effects of increased sedimentation.

36. The waters of the state located within the proposed disposal area would be obliterated. The total amount involved is relatively small, however they are of relatively high quality and include designated trout waters, a limited state resource.

37. The amount of seepage through the dams would be relatively small. The seepage recovery ponds have been designed to contain all runoff from a storm of such magnitude as is likely to occur only once every 500 years. Such storms do occur, and at any given location they can occur at intervals greater or less than 500 years. Waters which could not be contained by the seepage collection system would enter Lake Superior via the Beaver River. The seepage water would be largely runoff from the coarse tailings dams and would contain varying amounts of tailings material.

38. A relatively small amount of water would seep through the ground underlying the tailings basin and be

transported slowly with the ground water beyond the seepage collection system and remain uncollected.

39. Calculations by Reserve's consultant indicate that uncollected seepage may be approximately 170 gallons per minute or 250,000 gallons per day.

40. Present information suggests that uncollected seepage would be filtered to some degree by the soils through which it travels but the information is inconclusive as to the water quality which filtration would achieve. Additional investigation is required to insure that any uncollected seepage is of a quality that is satisfactory for the receiving waters.

41. Waters outside the tailings basin may be adversely affected by accidental spillage resulting from pipeline rupture. Collection facilities would be incorporated into the pipeline design to minimize spillage from this cause. The proposed pipeline system which would pump the tailings slurry has been designed according to the normal methods, and has presented no unique or difficult problems. The pipeline design uses a dual pipeline structure, incorporating monitoring and testing devices. In the event of a break or leak in the pipeline, automatic monitoring and periodic patrols would indicate the existence of such a break. The pipeline flow would be automatically switched from the damaged pipeline to the standby line.

42. Waters outside the tailings basin would also be adversely affected if accidental other spillage should occur such as through dams failure.

43. Waters outside the tailings basin may also be adversely affected by the deposition of fugitive dust emanating from the tailings area.

Air Quality Effects

44. Construction and operation of the proposed on land tailings system would result in the distribution of air borne dust containing asbestiform fibers outside the limits of the tailings area. The principal source would be fugitive dust generated by construction activity, transporting and movement of coarse tailings and wind action on exposed areas.

45. Use of water sprinkling or chemical treatment can reduce, but cannot eliminate fugitive dust. The evidence on the effectiveness of revegetation of dam slopes in reducing fugitive dust is inconclusive.

46. One of the major potential sources of fugitive dust in the original design of the Mile Post 7 disposal area would be the fine tailings beach between the water surface and the outer limits of the basin.

47. Following preparation of the draft environmental impact statement, Reserve in January, 1976, revised its design to eliminate the beach by raising the height of the

dams, adding an impervious blanket of earth material on the upstream face of the dams and maintaining the water level in the basin so as to cover the fine tailings. Some small areas of exposed fine tailings may develop at points of discharge into the basin.

48. Another major potential source of fugitive dust would be the fines which form a part of the coarse tailings used for dam construction or stored in disposal area.

49. In a further effort to reduce fugitive dust, Reserve in February, 1976, revised its proposed process by incorporating air elutriation, which, if successful, would separate a greater portion of the fine tailings from the coarse tailings at the plant.

50. Extremely limited laboratory investigation of the air elutriation process was conducted by Reserve. That investigation demonstrated that the process is not feasible unless the tailings are relatively dry.

51. There is no reliable evidence that air elutriation can be successfully incorporated into Reserve's process and fugitive dust emissions from coarse tailings significantly reduced thereby.

52. At the suggestion of the Pollution Control Agency, Reserve further revised its design for the Mile Post 7 disposal area in March 1976, during the last week of testimony, by incorporating coarse tailings disposal into the

fine tailings basin, thereby eliminating the separate coarse tailings storage area adjacent to the basin. This revision significantly modified the configuration of the disposal area and required further modification of the south dam and provision of additional dikes. The purpose of the revision was to place coarse tailings underwater to further reduce fugitive dust emissions.

53. The latest revision was further modified following the close of testimony in a drawing prepared by Reserve's consultant, numbered X-1965-41, and submitted with Reserve's rebuttal brief on April 15, 1976. The modified design would reduce the number of coarse tailings dikes within the tailings basin along which both fine tailings and coarse would be transported, by pipeline and railroad respectively.

54. While the April modification has not been subjected to cross-examination, it has been reviewed and considered.

55. The letter from its consultant Klohn to Reserve dated April 14, 1976, which was submitted with drawing X-1965-41, explains the drawing and indicates that small lateral dikes, in addition to those shown in the drawing, may also be required.

56. Reserve's estimate of the maximum acreage of exposed coarse tailings dikes under the last modification appear to be optimistic, but even assuming it to be accurate, it would not substantially reduce the estimated total

dust emissions from the estimates made for the design submitted during the last week of testimony.

57. Estimates of total expected fugitive dust emissions by both Reserve and the State agencies are below the levels of emission which can reasonably be expected to occur.

58. Reserve's estimates of dust emissions are unduly optimistic in that they unjustifiably assume highly effective incorporation of the air elutriation process, assume no emissions from distribution dikes (which would have been required for fine tailings distribution even before the latest design revision), assume no emissions from small fine tailings deltas within the tailings basin, assume only one transfer or turnover of coarse tailings at the disposal area (most tailings would be moved a substantially greater distance), assume that snow cover would eliminate 100 percent of wind erosion during five months of the year, and unjustifiably assumed wind erosion of coarse tailings for only one year after storage.

59. The state's estimates of dust emissions are likewise optimistic for the same reasons, except that the state did not assume effectiveness of air elutriation, and correctly assumed continued wind erosion of coarse tailings beyond the first year of storage.

60. The state's estimates for the latest design are optimistic for the additional reason that time did not

permit estimates to be made for additional construction activity and coarse tailings transfers associated with the construction and raising of the dikes within the basin.

61. The climatological dispersion modeling used by both Reserve and the state to estimate concentrations of fugitive dust at population centers is subject to error due to inability to duplicate actual conditions precisely. The modeling used by the state assumes emissions throughout the basin during construction and more nearly represents actual conditions. Reserve's modeling for Mile Post 7 assumes concentration of emissions at a point generally more distant from Silver Bay and Beaver Bay and thereby underestimates concentrations of dust at those population centers.

62. While the state's estimates of fugitive dust emissions and annual mean concentrations at population centers are conservative, they are adequate for purposes of these proceedings and represent the best available information considering the uncertainties as to final design of the disposal area. No estimates have been made of maximum daily concentrations.

63. Fugitive dust concentrations at population centers is critical because of the presence of potentially hazardous fibers.

64. Estimates of the number of fibers per unit of dust vary widely depending on methods of estimating and capabilities of equipment and personnel.

65. Estimates of fiber content based on counting fibers in samples of dust are conservative since only identified fibers are counted and not all fibers are identifiable with equipment presently in use at various laboratories. Techniques used in sampling and in handling samples can result in the loss of fibers, further reducing fiber counts.

66. Estimates of the number of fibers based on computation of the total fiber mass and average fiber size probably more accurately reflect the actual number of fibers present, but proof is more difficult.

67. Estimates of amphibole fiber content by the Pollution Control Agency staff were based on the count of only positively identified amphibole fibers.

68. Both Reserve's consultant and the state's consultant agreed that most fibers in Reserve's tailings which cannot be positively identified are, in fact, amphibole. Both included most such ambiguous fibers in their estimates of total amphibole fibers.

69. While the Pollution Control Agency staff estimates of fiber content are significantly low, they are valid for the purpose for which they were prepared, namely the comparison of the projected impact at various population centers which would result from the various disposal sites.

70. The testimony of Dr. Phillip Cook is the best evidence on fiber content per unit of dust emanating from a

tailings disposal area. Dr. Cook estimated the fiber content at 900,000 fibers per microgram of dust and testified that the actual number that might be present was probably closer to 2,900,000 per microgram.

71. The state's projected increases of annual geometric mean concentrations of total suspended particulates at Silver Bay resulting from the Mile Post 7 disposal area are 15 micrograms per cubic meter during construction, one microgram per cubic meter during the first 10 years of operation and one to three micrograms per cubic meter during the last 30 years of operation.

72. Reserve contends that the combined effects of the installation of improved dust collection facilities at the processing plant, pursuant to stipulation with the Pollution Control Agency, and implementation of the Mile Post 7 disposal area, including the doubtful air elutriation process, would result in a net annual reduction of total suspended particulates at Silver Bay of approximately fifty percent. Assuming the validity of that contention, Mile Post 7 emissions, even as optimistically estimated by Reserve, would negate approximately one half of the benefits flowing from stipulation, since the improved dust collectors will eliminate about 97 percent of stack emissions.

73. The Reserve estimate of 50 percent overall improvement is based on the unjustified assumption that air

elutriation would be effective. Immediately prior to formulation of the air elutriation proposal, Reserve's consultant computed the effects of Mile Post 7 without elutriation and concluded that on an annual basis the total suspended particles at Silver Bay contributed by Mile Post 7 would be equal to or greater than that presently contributed by stack emissions. Annual geometric mean concentrations of total suspended particles at Silver Bay would not be materially reduced by the combined effects of implementation of the Mile Post 7 proposal and stack emission controls.

74. There is no evidence that fiber concentrations at Silver Bay would be reduced below a medically significant level by the combined effects of reduced stack emissions and implementation of the Mile Post 7 disposal area.

Other Natural Resource Effects

75. The mineral potential at the Mile Post 7 site is low and development of a tailings disposal area would not interfere with any potential mineral development. No significant amounts of peat are present at the site.

76. Existing timber resources at the Mile Post 7 site would be harvested. The potential for timber production within the disposal area, which is relatively high, would be eliminated. The site would not return to anything similar to its present vegetated condition for several hundred years. Covering the tailings with soil material would speed

revegetation, and some vegetation can be grown directly on the tailings provided there is adequate fertilization and moisture.

77. The Mile Post 7 site provides a modest amount of habitat for various species of wildlife. The habitat would be destroyed, and most wildlife would migrate to other suitable areas.

78. Fishery resources within the disposal area will be destroyed, including 9.7 miles of trout streams. Streams downstream from the disposal area would be adversely affected by erosion at construction areas, including stream diversion dikes and channels, roadways, railroads and pipelines, causing turbidity and sedimentation which would adversely affect the fishery resource. Loss of a portion of the watershed could result in reduction in flow and rise in temperature to critical levels adversely affecting the fishery resource downstream from the site, including the anadromous fishery of the lower portion of the Beaver River. Windblown dust, nutrients related to revegetation efforts, seepage and accidental spillage could adversely affect the fishery resource in the vicinity of the site.

79. Construction and operation of the tailings disposal system at Mile Post 7 would cause pollution, impairment, and destruction of the air, water, land and other natural resources located within the state.

Alternatives

80. The draft environmental impact statement examines in detail three alternative locations for tailings disposal designated the Embarrass site, the Colvin (Mile Post 42) site, and the Snowshoe site, and a supplement examined in detail the Midway (Mile Post 20) site.

In Pit Disposal

81. In addition the draft examines in less detail the alternative of disposal in the Peter Mitchell mine. The evidence relating to that alternative is sufficient to require its rejection at least for the present, because of the limited capacity, delays that would be inherent in the further complication of Reserve's operations and lease restrictions on placing waste on potentially merchantable ore.

82. No detailed review of Reserve's mining plan was made by the state to determine whether adjustments could be made to accommodate in pit disposal of tailings without jeopardizing Reserve's requirements for blending of ores and other operational concerns.

83. In view of the future need for tailings disposal sites, it would be desirable to ascertain the feasibility and desirability of using both depleted and operating pits for that purpose, and to evaluate the relative costs of covering potentially merchantable ores versus the use of additional land areas for tailings disposal.

Changes in Operations for Alternatives

84. Operation of the mine and processing plant and handling of tailings would be identical for the Midway and Mile Post 7 sites except for the greater distance to Midway. Midway would require longer pipeline, more pumping stations and longer haul roads.

85. Use of the Embarrass, Colvin or Snowshoe sites would require construction of new fine crushing and concentrating facilities in the vicinity of the site and transport of only the concentrates to Silver Bay for pelletizing. Transport of the concentrates could be either as a slurry by pipeline or by railroad after reducing moisture content to an appropriate level. Present fine crushing and concentrating facilities at Silver Bay would be dismantled. The process is technically feasible with transport of concentrates by either pipeline or railroad. Questions as to various technical problems raised by Reserve do not establish infeasibility, and the evidence is to the contrary.

Comparison of Environmental Effects

86. Longer dams would be required at the alternative sites than at Mile Post 7. All alternative sites have suitable foundation for dam construction. Dams of the same design and construction would have higher safety factors at each alternative site than at Mile Post 7. The consequences of a dam failure would be significantly lower at each

alternative than at Mile Post 7. Approximately 100 residences that would be affected by a dam failure at Embarrass, but the depth and velocity of water movement resulting from a 1,000 foot breach is much less: 4 feet depth and 2.7 miles per hour at Embarrass; 28 feet depth and 21.1 miles per hour at Mile Post 7. No residences would be affected at Colvin, Snowshoe or Midway. In the event of dam failure at any of the alternatives, stored tailings would not be deposited directly into Lake Superior, and opportunity for corrective measures to protect Lake Superior and other waters would be available. Failure at Snowshoe could affect the Boundary Waters Canoe area. The risk of overtopping the dams as a result of unusually heavy rainfall is greater at Mile Post 7 than at the alternative sites.

87. Construction and operation of tailings disposal facilities at any of the alternative sites would also destroy or degrade, or have the potential for the destruction or degradation of some portion of the waters of the state.

88. Contrary to the contentions of Reserve, the waters affected or potentially affected at the various sites are substantially different in character and quality notwithstanding some similarities in individual characteristics.

89. Classification of waters by the Pollution Control Agency and designation of waters as trout streams reasonably

reflect the character and quality of those waters and their susceptibility to damage from disturbance of the natural conditions.

90. Individual water temperatures do not establish whether a stream or body of water is to be considered "cold" or "warm" water; rather it is the characteristic of the waters to remain below critical levels of temperature beyond which certain aquatic life does not survive.

91. Placement of tailings at any of the alternative sites would result in the destruction of less waters of the state than would occur at Mile Post 7.

92. The quality of the waters which would be destroyed is lower at each alternative site than at Mile Post 7.

93. The quality of the waters in the vicinity of each alternative site is lower and less susceptible to degradation than at Mile Post 7.

94. None of the alternative sites, except Colvin, requires diversion of streams and no degradation of downstream waters by siltation and sedimentation resulting from stream diversion would occur. Degradation resulting from stream diversion would be less at Colvin than at Mile Post 7.

95. The potential for harmful effects resulting from reduction of stream flow is less at each of the alternatives than at Mile Post 7.

96. The potential for degradation of waters resulting from erosion at construction areas and from fugitive dust is less at each alternative than at Mile Post 7.

97. The expected uncollected seepage would be lower at Mile Post 7 than at some alternative sites, but if the quality of the seepage water is lower than anticipated, the potential for degradation of water would be higher at Mile Post 7. If the quality of the seepage water is acceptable, additional seepage would not be harmful and could aid in maintaining proper water balance.

98. The increase in total suspended particulates and potentially hazardous fibers at population centers resulting from fugitive dust would be less for each alternative site than for Mile Post 7. Increases at Silver Bay from Mile Post 7 would be approximately three times that from Midway. Existing levels at Babbitt from mining operations in that area make Embarrass, Colvin and Snowshoe less desirable than Midway from the standpoint of air pollution unless mitigating measures are instituted at existing sources.

99. The potential for mineral development is greatest at Snowshoe and Colvin where the possibility of future underground copper-nickel mining exists. Development of a tailings disposal area could conflict with the development of surface facilities associated with underground mining.

No conflict with potential mineral development exists at Embarrass, Midway or Mile Post 7.

100. Adequate water resources are available for the operation of each of the alternatives. Use of Embarrass, Colvin or Snowshoe would require accommodation with other water users in the area. Use of pit water from the Peter Mitchell mine would end discharge of waters containing fibers which might otherwise require treatment.

101. Use of the Embarrass site would require accommodation with the potential use of a small part of the site for tailings disposal by Erie Mining Company.

102. Destruction of timber resources would be less at Snowshoe than at Mile Post 7 and would be comparable to Mile Post 7 at Embarrass, Colvin and Midway.

103. Damage to wildlife resources would be lowest at Snowshoe and highest at Colvin, Midway and Mile Post 7.

104. Damage to the fishery resources would be lower at each of the alternative sites than at Mile Post 7.

105. Energy consumption per ton of pellets produced would be greater with disposal at the Midway site than at Mile Post 7 because of the greater distance to transport tailings. Energy consumption at Embarrass, Colvin and Snowshoe would depend upon final design, but would be roughly comparable per ton of pellets produced as for the Mile Post 7 plan.

106. Use of the Embarrass, Colvin or Snowshoe site would be preferable from the standpoint of land use because of their proximity to existing mining operations. The Midway site is more distant from existing mining operations except for the proximity of Reserve's railraod on the west and south. The Duluth, Masabi and Iron Range railroad is adjacent to the site on west and north. Some timber has been harvested at the Midway location. The Mile Post 7 site is the most distant from existing mining operations except for the Silver Bay plant and Reserve's railroad. The Midway site is preferable to Mile Post 7 based on existing and potential land use of the areas.

107. Use of the Embarrass, Colvin or Snowshoe site would require the transfer of approximately 400 jobs from Silver Bay to the Babbitt site in addition to those who would be added for construction on operation of the tailings disposal systems.

108. Commuting from Silver Bay to a near Babbitt site, while not beyond reason, would constitute a significant, detrimental change in the pattern of life of a substantial number of people. Construction of proposed Forest Road 11 would ameliorate the effects to some degree. Use of Reserve's railroad could speed communting but at substantial cost.

109. Many transferred employees would ultimately relocate near Babbitt with substantial impacts for both Babbitt and Silver Bay.

Economic Feasibility of Alternatives

110. Officials of Reserve, Armco and Republic testified that rejection of Mile Post 7 would likely lead to shut down of Reserve's operations because no alternative site is economically feasible.

111. It is fruitless to speculte as to the motives for such testimony or its accuracy in predicting future events. It is accepted as the opinions held by those officials based on the information then available to them.

112. It is reasonable to assume that the corporate determination as to whether to continue Reserve's operations in Minnesota will, and perhaps must, be made largely on the basis of economics.

113. It is reasonable to assume that there is a level of cost beyond which Reserve will not go. That level will vary depending upon all of the other factors which must be taken into account at the time the decision is made, including market conditions, alternate sources of supply, and cost of termination.

114. There is no evidence that a corporate determination has been made as to the level of cost which would trigger termination of operations. Presumably, any such

determination would be premature unless and until a decision is necessary and, in any event, would be subject to change if circumstances changed.

115. It is impossible to determine in advance whether the opinions of the officials who testified as to the consequences of rejection of Mile Post 7 will or will not be the same when and if a decision is required.

116. It is appropriate to give consideration to the opinions of such officials, and the basis for those opinions as reflected in the record. However such opinions are not determinative of the question of whether there are feasible and prudent alternatives to Mile Post 7, a determination which rests by law with the responsible state officials.

117. The cost estimates for the construction and operation of the Mile Post 7 proposal and all of the alternative sites are inexact and subject to change depending on numerous factors including final design, presently unknown geologic data and future rates of inflation.

118. All cost estimates introduced in evidence include substantial amounts to cover unknown contingencies and cost escalation.

119. Reserve's financial analysis anticipates, to some extent, future increases in costs without anticipating increases in the price of taconite pellets, or even taking

into account price increases already in effect. The result is an understatement of the economic benefits to Armco and Republic which would flow from the Mile Post 7 proposal and all alternatives.

120. Reserve's estimates of the pellet supply requirements of Armco and Republic ignores the growth trends in the industry and Reserve's own testimony of anticipated industry growth.

121. Reserve's contention that none of the alternative sites is economically feasible is contrary to recent experience in the expansion of taconite facilities in Minnesota.

122. The cost estimates for the alternative sites in the draft environmental impact statement are based on more detailed analysis and are generally more reliable than Reserve's estimates for those sites.

123. Based on present knowledge and design, the costs for construction at Mile Post 7 are considerably less than at the alternative sites, and construction costs at Midway are substantially less than at Embarrass, Colvin or Snowshoe. Operating costs per ton of pellets produced would be higher at Midway and probably lower at Embarrass, Colvin or Snowshoe than at Mile Post 7.

124. Whether 100 percent debt financing would be available for any of the sites would depend on market conditions

at the time, but it is unlikely for the alternative sites and more likely for Mile Post 7.

125. Unavailability of 100 percent debt financing, taken alone, does not render a project economically infeasible.

126. Recognizing the possibility of increased costs based on final design and more detailed information, the Embarrass, Colvin, Snowshoe and Midway sites are, nevertheless, economically feasible alternatives.

Effects of Termination

127. It must nevertheless be assumed that Reserve's operations may be terminated if permits for Mile Post 7 are not granted.

128. The draft environmental impact statement did not address the effects of termination on the theory that termination was not a feasible and prudent alternative. Those effects have been adequately addressed in testimony both before and following preparation of the draft.

129. The permanent shut down of the Reserve operations would have major detrimental effects.

130. Loss of employment provided by Reserve would directly affect most of the population of Silver Bay, a substantial part of the population of Babbitt, many in Ely and other areas of Lake and St. Louis Counties.

131. Indirect effects on suppliers and other related industries would be substantially more widespread.

132. Loss of federal, state and local tax revenues would be substantial.

133. During 1974, Reserve produced 10,367,000 tons of taconite pellets and employed an average of 2,843 persons. Reserve's employment costs for the year were $46,780,000. The company purchased $50,529,000 worth of materials and supplies during 1974. Approximately $37,000,000 of the $50,000,000 in total purchases were made in Minnesota, with the majority occurring in the northeastern Minnesota area and the Twin Cities.

134. During the period between 1955 and 1974, Reserve's total taxes amounted to $70,757,673. Reserve's tax liability for 1975 was approximately $15,000,000, or about double the liability for 1974. During the next four to five years Reserve's tax obligations will total approximately $70,000,000.

135. Reserve paid $7,775,000 in Minnesota taxes, both state and local, during 1974. In addition, federal income taxes withheld from Reserve employees in 1974 totaled $5,638,607, while state income taxes withheld from Reserve employees totaled $2,245,984.

136. Royalties paid by Reserve to the owners of the ore body at the Peter Mitchell mine totaled $16,000,000 in 1974.

137. Unemployment compensation and other forms of substituted income would only partially and temporarily alleviate the economic effects on the employees and their families and would in no way alleviate the social and psychological effects inherent in the loss of employment.

138. The possibility of obtaining other employment in the Silver Bay and Babbitt areas is remote.

139. It is likely that many new jobs will become available during the next several years due to the current and proposed expansion in the taconite industry in Minnesota. However, the possibility, or even likelihood, of obtaining employment in other locations in northeastern Minnesota, with the resulting uprooting of families, loss of seniority and multiple side effects, is a bleak substitute for the relative security provided by the continuation of Reserve's operations.

140. Consideration must also be given to the difficulties associated with retraining, loss of pension rights, loss of health and welfare benefits, loss of vacation and holiday benefits, and losses associated with decreases in values of worker's homes and similar economic losses which would result.

Time Required to Implement

141. The time required to implement the Mile Post 7 plan and end discharge to Lake Superior is estimated to be approximately three years, while the time required for the alternative sites is estimated at more than four years.

142. All time estimates are based on only a 40 hour weekly work schedule and could be reduced, at some additional cost, by utilizing additional shifts or overtime.

143. While much more information has been gathered by Reserve at Mile Post 7 than at the alternative sites, all sites possess the potential for delay in gathering additional data, solving known and presently unknown technical problems, and acquiring land.

144. Most of the investigation and analysis required to determine the environmental impacts attributable to the alternative sites has been completed and need not be repeated.

145. Despite assurances by Reserve that it wishes to end discharge to Lake Superior as soon as possible, economic considerations are a powerful incentive to continue present operations as long as possible. Net profit to the owners resulting from Reserve's present operations are estimated by Reserve's consultant at $40 million per year during construction of on land disposal facilities. The evidence establishes that that is a conservative estimate.

Delta Stabilization

146. Reserve proposes to construct certain structures necessary for its Mile Post 7 plan on the existing tailings delta near the natural shore of Lake Superior, and to stabilize the delta by depositing large rock transported from the Peter Mitchell mine on the delta to construct a

breakwater, using Beaver Island on the west and a rock point on the east as anchor points. The rock used for the stabilization process would be obtained from material stripped from the ore body preparatory to mining taconite. The rock is very hard and would be resistant to wave action and deterioration.

147. The plan contemplates placement of the rock about 600 feet back from the present shore of Lake Superior at the edge of the delta. Wave action would scour out the tailings delta to the rock. The lakeward portion of the rock would then move over the new slope of the delta under the surface of the water to form a rock armor over the tailings beach.

148. The concept of a self-armoring beach has been used in several parts of the world, but chiefly for controlling river bank erosion.

149. The primary concerns related to the delta are its erosional patterns as they relate to the potential health problem, the safety of the structures proposed to be built on its surface, and the control of the littoral drift or movement of tailings in Lake Superior.

150. Because of inadequate sampling and analysis, the asbestiform fiber content of the delta is not known. Until it is known, the quantity of asbestiform fibers which will be liberated by delta erosion cannot be determined and a

decision cannot be made on whether it is necessary to remove the delta material quickly or over a long time period.

151. No consideration has been given to the potential for breakdown of the coarser particles in the delta by wave action and the generation of additional fines, nor to the effect termination of discharge will have on the delta.

152. Reserve's three dimensional model studies, made on a scale of 1 to 50 and for only isolated portions of the delta, are inadequate to establish that the proposed beach armoring will function as planned.

Adequacy of Environmental Impact Statement

153. The draft EIS, including the Midway Supplement, the public comment on the draft EIS, and the other testimony and exhibits introduced in evidence in these hearings provide the decision-makers with as complete information regarding the environmental and other impacts of an on-land disposal site for Reserve's tailings as can reasonably be obtained at this time.

154. The agencies responsible for the drafting of the EIS have fulfilled their responsibilities with good faith objectivity.

155. All other issues raised by the parties have been considered but findings thereon are deemed unnecessary to the determination of this matter and would not affect the result.

Conclusions

1. Dust emissions from Mile Post 7 would cause substantial numbers of potentially hazardous fibers to reach Silver Bay, at least partially negating the effect of planned emission controls at the processing plant. There is no evidence that the fiber concentrations emanating from Mile Post 7, even after installation of planned emission controls, would be medically insignificant.

2. Precautions taken in the design and construction of dams can greatly reduce, but cannot eliminate, the risk of failure.

3. The Mile Post 7 site is located approximately three miles from Lake Superior and 600 feet vertically above the lake level.

4. A 1,000 foot breach in the 13,000 foot south dam at Mile Post 7 would produce a 28 foot high wall of water moving down the Beaver River valley at more than 20 miles per hour to Lake Superior.

5. Major failure at Mile Post 7 would thwart the entire purpose of on land disposal by emptying stored tailings into Lake Superior. The threat to Lake Superior would not end when operations cease, but would persist indefinitely.

6. Significant water resources would be destroyed, impaired and polluted by implementation of the Mile Post 7 proposal.

7. Implementation of on land tailings disposal at alternative sites designated Embarrass, Colvin, Snowshoe and Midway would cause significantly less pollution, impairment, or destruction of air, water, land and other natural resources located within the state than would Mile Post 7.

8. Fugitive dust and fiber concentration at Silver Bay resulting from tailings disposal at Midway would be substantially lower than for Mile Post 7 because of its greater distance. Existing dust emissions affecting Babbitt should be mitigated if Embarrass, Colvin or Snowshoe were to be used for disposal.

9. Dams of the same design and construction at each of the alternative sites would have a greater safety factor than at Mile Post 7.

10. The effects of dam failure would be significantly less at each of the alternative sites than at Mile Post 7.

11. Failure at any of the alternative sites would not deposit stored tailings in Lake Superior.

12. Destruction, impairment or pollution of water resources would be significantly less at each of the alternative sites, and the waters which would be affected are of lower quality.

13. From the standpoint of land use planning, Embarrass, Colvin and Snowshoe are located near concentrations of existing mining operations and are significantly better locations for tailings disposal than Mile Post 7; Midway is clearly preferable to Mile Post 7, but less desirable than the other alternatives.

14. Expansion of the tailings disposal area to accommodate tailings produced after the present 40 year mine plan would be feasible at the alternative sites. Expansion would not be possible at Mile Post 7 and the operations during the remaining 10 to 20 years of mine life would require development of another disposal area.

15. Construction costs would be higher for each of the alternative sites than for Mile Post 7 but all are economically feasible. Construction costs for the Midway site would be substantially less than for Embarrass, Colvin or Snowshoe, but operating costs would be higher.

16. Tailings disposal at Embarrass, Colvin or Snowshoe would result in serious dislocation resulting from the transfer of some 400 employees from Silver Bay to the Babbitt area.

17. Energy consumption per ton of pellets produced would be comparable to Mile Post 7 at Embarrass, Colvin and Snowshoe, and would be somewhat higher at Midway.

18. The use of the Midway site would avoid the employee dislocation and greater air pollution problems which would result from the use of Embarrass, Colvin or Snowshoe, and is therefore preferred despite its lower ranking from the land use standpoint and its higher energy consumption.

19. The Environmental Impact Statement has been properly prepared in accordance with the provisions of Minn. Stat. 116D.04 and the applicable regulations of the Environmental Quality Council.

20. The draft EIS has been reviewed in accordance with the procedures established by the Environmental Quality Council. Comments have been received from public agencies. Members of the public, and particularly those members of the public in the counties affected by the proposed action, have had access to the draft EIS and have had an opportunity to comment upon the document in writing and in public hearings.

21. Public hearings have been held on the contents of the draft EIS in conjunction with the permit hearings and the record on the draft EIS has been held open for the requisite time period established by regulation. The draft EIS and the procedures in relation thereto fully meet the requirements of the Environmental Policy Act and the applicable regulations.

MEMORANDUM

Since June 23, 1975, when evidentiary hearings opened in Silver Bay in these proceedings, testimony covering 17,884 pages of transcript has been taken from 160 witnesses during 82 days of hearings. More than 600 exhibits have been received in evidence, ranging from single photographs to reports covering several hundred pages.

Throughout the hearing and consideration of this complex matter, one objective has predominated: to bring an end to the agony of uncertainty which grips the people of Silver Bay. I am compelled, instead, to add to the uncertainty.

With the benefit of thirty years of hindsight, it is painfully apparent that Reserve Mining Company, its owners and its employees were not well served by the original decision to allow tailings disposal in Lake Superior. If the mistake of 1947 teaches nothing else, we should have learned that even risks which appear relatively small cannot be taken when the consequences are catastrophic and irreversible.

The record in this proceeding clearly establishes that Mile Post 7 is not a suitable location for disposal of Reserve's tailings and would be contrary to law. Those who believe that the tailings pose no health hazard, that disposal in Lake Superior is minor pollution at the most, will be puzzled by concerns about blowing dust reaching Silver Bay and possibilities of dam failure which could flush 40 years of stored tailings into Lake Superior. But questions of health hazard and pollution have been determined by the United States Court of Appeals. We are bound by those determinations.

In my judgment, tailings disposal at the Midway alternative site could be implemented speedily and Reserve Mining Company could move forward as a profitable and respected operation in Minnesota. If Midway is not implemented and Reserve's operations are terminated, the consequences would be horrendous for a great many people, but the Mile Post 7 site would be no more suitable and no more legal.

Officers of Reserve and its owners, Armco Steel Corporation and Republic Steel Corporation, have testified that rejection of Mile Post 7 would likely result in termination of Reserve's operations. I accept their testimony as their honestly held opinions based on information available to them at that time.

I do not assume that they will re-examine their positions and seek to find a way to move to on land disposal at Midway. But I believe that they should, and I respectfully request that they do.

If Reserve is to continue operations in Minnesota, solution to its problems can only be reached through mutual respect and confidence between the company and the state regulatory agencies. That respect and confidence can be established if procedures can be developed by the parties which guarantee an open and forthright exchange of information. I commend the parties, their counsel and their witnesses for their conduct during these proceedings. Except for occasional lapses, which I specifically refrain from itemizing, they have pointed the way toward the desired goal.

Respectfully submitted,

Wayne W. Olson

Wayne W. Olson
Hearing Officer/Referee

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STATE OF MINNESOTA

DEPARTMENT OF NATURAL RESOURCES POLLUTION CONTROL AGENCY

In the Matter of the Applications by Reserve Mining Company for Permits for the Mile Post 7 (Lax Lake) On-land Tailings Disposal Plan at Silver Bay, Minnesota

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STATE OF MINNESOTA

DEPARTMENT OF NATURAL RESOURCES   POLLUTION CONTROL AGENCY

In the Matter of the Applications by Reserve Mining Company for Permits for the Mile Post 7 (Lax Lake) On-land Tailings Disposal Plan at Silver Bay, Minnesota

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LISTING OF EXHIBITS

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RESERVE MINING COMPANY EXHIBITS

MATTHEW R. BANOVETZ

1. Witness Statement of Matthew R. Banovetz

2. Reserve's Application to the Minnesota Water Pollution Control Commission dated January 28, 1947.

3. Reserve's Application to the Minnesota Department of Conservation dated January 28, 1947.

4. Reserve's Application to the United States Army Corps of Engineers dated January 28, 1947.

5. Reserve's Permit from the Minnesota Water Pollution Control Commission dated December 16, 1947.

6. Reserve's Permit from the Minnesota Department of Conservation dated December 18, 1947.

7. Reserve's Permit from the Department of the Army dated April 22, 1948.

8. Letter of November 30, 1950 - Modification of Reserve's Federal Permit to extend time for construction of docks to December 31, 1960.

9. Letter of July 23, 1952 - Modification of Reserve's Federal Permit approving revised plans for the construction of breakwaters.

10. Reserve's Amendment to its permit from the Minnesota Water Pollution Control Commission dated November 12, 1956.

11. Reserve's Amendment to its permit from the Minnesota Department of Conservation dated July 6, 1956.

12. Reserve's Application to the United States Army Corps of Engineers dated June 20, 1960.

13. Reserve's Supplemental Application to the United States Army Corps of Engineers dated August 19, 1960.

14. Reserve's Amendment to its Permit from the Minnesota Water Pollution Control Commission dated September 8, 1960.

15. Reserve's Amendment to its Permit from the Minnesota Department of Conservation dated September 29, 1960.

16. Reserve's Amendment to its Permit from the United States Army Corps of Engineers dated October 11, 1960.

17. Map - Peter Mitchell Mine plan.

RESERVE MINING COMPANY EXHIBITS

MATTHEW R. BANOVETZ

18. Cross-section of the East pit - Peter Mitchell Mine.
18A. Cross-section of the East pit - Peter Mitchell Mine (overlay--original topography
19. Cross-section of the West pit - Peter Mitchell Mine.
19A. Cross-section of the West pit - Peter Mitchell Mine(overlay--original topography
20. Schematic representation of Reserve's existing taconite process.

21. Schematic representation of Silver Bay operations.

22. Schematic representation of the modifications proposed as a part of the Mile Post 7 plan.

23. Reserve's slide program - Mile Post 7 Plan.
23A. Script - Reserve's Mile Post 7 slide program.
24. Movie - Research and Development overview.
24A. Script - Reserve's Research and Development movie.
25. Letter of the Honorable Wendell R. Anderson, Governor of State of Minnesota, to E. M. Furness dated August 16, 1974.

26. Letter of Reserve Mining Company to Commissioner Robert L. Herbst dated October 21, 1974, which furnished the Agencies preliminary drafts of Reserve's principal documents to its Mile Post 7 Permit Applications.

27. Letter of Reserve Mining Company to Agencies dated November 18, 1974, with Reserve's Applications and Appendices for the requisite permits relating to its Mile Post 7 On-Land Tailings Disposal and Air Quality Plan.

27A. Application for Permits for Mile Post 7 On-Land Tailings Disposal Plan to Department of Natural Resources.

27B. Application for Permits for Appropriation, Consumptive and Non-Consumptive Use of Water, Peter Mitchell Mine, Babbitt, Minnesota to Department of Natural Resources.

27C. Application for Permits for Mile Post 7 On-Land Tailings Disposal Plan to Minnesota Pollution Control Agency.

27D. Application for Permits for Operations at Peter Mitchell Mine, Babbitt, Minnesota to Minnesota Pollution Control Agency.

27E. Application for Permits to U. S. Army Corps of Engineers.

27F. Appendix 1 - Feasibility Report On-Land Tailings Disposal Study - Mile Post 7 Site - Klohn Leonoff Consultants Ltd.

27G. Appendix 3 - Consultant Reports - Mile Post 7 Site.

27H. Engineering Report - On-Land Tailings Disposal and Air Quality Facilities - Mile Post 7.

RESERVE MINING COMPANY EXHIBITS

MATTHEW R. BANOVETZ

27I. Appendix 5 - General Arrangement Drawings - On-Land Tailings Disposal and Air Quality Facilities - Mile Post 7.

27J. Appendix 6 - Appendix A(Volume 1) - Feasibility Report On-Land Tailings Disposal Study- Mile Post 7 Site - Klohn Leonoff Consultants Ltd.

27J-1, J-2, J-3 - Revised (August, 1975) versions of Appendixes 6 and 7 (now expanded to three volumes -- 6, 7, and 7-A), Klohn Feasibility Report.

27K. Appendix 7 - Appendix A(Volume 2) - Feasibility Report On-Land Tailings Disposal Study - Mile Post 7 Site - Klohn Leonoff Consultants Ltd.

27L. Appendix 8 - Environmental Assessment of Mile Post 7 Plan Pursuant to MEQC25, State of Minnesota - Arthur D. Little, Inc.

27M. Reserve Mining Company Mile Post 7 On-Land Tailings Disposal and Air Quality Plan - Revised May 26, 1975.

27N. Appendix 2 - Reserve Mining Company Environmental Monitoring Program - Revised May 26, 1975.

28. Letter of Reserve Mining Company to Commissioner Robert L. Herbst and Agencies dated November 21, 1974, correcting November 18 Applications.

29. Letter of Reserve Mining Company to Grant J. Merritt and Agencies dated November 25, 1974, correcting November 18 Applications.

30. Letter of Reserve Mining Company to Minnesota Pollution Control Agency dated January 20, 1975, correcting November 18 Applications.

31. Letter from Messrs. Merritt and Herbst dated December 7, 1974, requesting additional information from Reserve.

32. Reserve's letter of December 19, 1974, providing additional information to Agencies.

32A. Reserve's letter of February 1, 1975, providing additional information to Agencies.

33. Reserve's letter to Agencies dated February 6, 1975.

34. Reserve's letter to Agencies dated March 7, 1975.

35. Reserve's letter to Agencies dated March 27, 1975.

36. Reserve's letter to Agencies dated April 21, 1975, attaching Klohn Leonoff Design Report (April 1975).

RESERVE MINING COMPANY EXHIBITS

MATTHEW R. BANOVETZ

37. Reserve's letter of April 30, 1975, with Arthur D. Little Environmental Report enclosure.

37A. Arthur D. Little Environmental Report - Volume I.

37B. Arthur D. Little Environmental Report - Volume II.

37C. Arthur D. Little Environmental Report - Volume III.

37D. Arthur D. Little Environmental Report - Appendix.
37E. Arthur D. Little Supplemental Report - August, 1975.
38. Supplemental Air Quality Stipulation Agreement dated May 21, 1975.
38A Amended Supplemental Air Quality Stipulation Agreement dated Dec., 1975.
39. Reserve's letter to Agencies dated May 30, 1975, with revised Mile Post 7 On-Land Tailings Disposal and Air Quality Plan and Environmental Monitoring Program.

40. Map reflecting the location of the ten surface water sampling stations, 14 ground water stations, pipeline routes and air monitoring stations.

41. Chart listing the 43 separate parameters which will be monitored monthly under the Environmental Monitoring Program proposed by Reserve.

41A. Sample - Dry cob tailings.

41B. Sample - Filtered tailings.

41C. Sample - Fine tailings.

42. Model representation of the Mile Post 7 site viewed pre-operationally.

43. Model representation of the Mile Post 7 site viewed post-operationally.

44. Model representation of a cross-section of the South Dam reflecting the various components of dam construction.

45. Reserve's preliminary construction schedule.

46. Chart reflecting the estimated project cost including financing and land acquisition.

47. Chart reflecting the additional net operating cost of the Mile Post 7 plan.

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JOHN A. HOLMQUIST

48. Witness Statement - John A. Holmquist.

49. Poster depicting "Seismic Risk Map for Conterminous U. S." developed by ESSA/Coast and Geodetic Survey.

50. A map depicting the Mile Post 7 site with the location of the cross-section lines.

51. Chart of the "Geologic Column."

52. Chart of the "Cross-Section Photo Alignment--Section A-A."

53. Chart of the "Cross-Section Photo Alignment--Section B-B."

54. Chart of the "Cross-Section Photo Alignment--Section C-C."

55. Chart of the "Cross-Section Photo Alignment--Section D-D."

56. Mosaic photo overview of the present Mile Post 7 site.

57. Report of Eugene A. Hickok and Associates dated January, 1975, entitled "General Geology of the Mile Post 7 Site."

57A Report of E. A. Hickok and Associates dated November, 1975, entitled "Ground Water Investigation - Milepost 7 Site."

57B Report of E. A. Hickok and Associates dated November, 1975, entitled "Dike Rock Investigation Delta Stabilization."

57C Chart - "Approximate Location of Ground Water Wells."

57D Chart - "Monitoring Well Design."

57E Chart - "Deep Seepage Analysis."

57F Chart - "Groundwater Map - Dam 1 - Glacial Till Formation."

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EARLE J. KLOHN

58. Witness Statement - Earle J. Klohn.

59. Slides of typical tailings grain size curves.

60. Slide of the upstream and downstream methods of tailings dam construction.

61. Slide of the water balance for typical "closed-circuit" tailings dam.

62. Slide of the upstream method of tailings dam construction.

63. Slide of tailings dam construction using upstream spigotting and wooden forms to support downstream dikes.

64. Photograph of dam being built upstream by spigotting.

65. Slide photograph of tailings dam construction using wooden forms to support downstream dike.

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67. Slide of the upstream tailings dam construction using cyclones.

68. Slide photograph of a tailings dam utilizing cyclones in upstream construction.

69. Slide of "Comparison between convention water storage dam and tailings dam built using an upstream method of construction."

70. Slide of "Downstream construction using heavily compacted cycloned sand."

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74. Slide of "Comparison between typical water storage dam and tailings dam built using one of the downstream methods of construction."

75. Slide of "Semi-pervious tailings dam constructed using waste rock."

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78. Slide of "Seismic Map for British Columbia."

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80. Slide of a cross-section through the Brenda tailings dam.

81. Slide photograph of the Brenda tailings dam.

82. Slide showing piezometric levels in Brenda tailings dam.

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86. Slide of a plan view of the Gibraltar tailings dam.

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98. Slide of a cross-section through the Bell Copper tailings dam.

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102. Slide of grain size curves for Reserve tailings.

103. Slide of table of laboratory test data for Reserve tailings.

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106. Slide of a mosaic showing planned on-land tailings storage facility.

107. Poster of longitudinal sections along centerlines of Dam No. 2-3 and along centerline of Dam No. 1.

108. Poster of Damsite No. 1.

109. Poster of Damsite No. 2-3.

110. Poster of Damsite No. 4.

111. Poster of Damsite No. 5.

112. Design Report for the On-Land Tailings Disposal Study of Mile Post 7 Site by Klohn Leonoff Consultants Ltd. - April, 1975.

113. Slide of "Lacustrine Clay at Mile Post 7 Site."

114. Slide of "Consolidation of Soil."

115. Slide of "Consolidation of Soil--Simplified Method of Clay Element."

116. Slide of "Consolidation of Soil--Consolidation Process Using the Piston and Spring Model."

117. Slide of "Consolidation of Soil--Laboratory Consolidation Test."

118. Slide of "Stability Analysis."

119. Slide of "Shear Strength of Soil."

120. Slide of "Shear Strength of Soil--Simple Shear Test May Be Used to Determine the Two Shear Strength Components."

121. Slide of "Shear Strength of Soil--Simple Shear Test Results."

122. Slide of "Lacustrine Clay at Mile Post 7 Site--Lake Drains Exposing Clay Deposit."

123. Slide of "Lacustrine Clay at Mile Post 7 Site--Condition of Clay at Mile Post 7."

124. Slide of "Lacustrine Clay at Mile Post 7 Site--Effect of Loading Clay."

125. Slide of "Sand Drains."

126. Slide of "Sand Drains to Speed Up Consolidation--Case One."

127. Slide of "Sand Drains to Speed Up Consolidation--Case Two."

(RMC 447. "Report on Foundation Clay Characteristics - On-Land Tailings Disposal Milepost #7 Site for Reserve Mining Company" - Klohn Leonoff)

127A "Progress Report Mile Post 7 On-Land Tailings Disposal for Reserve Mining Company, Silver Bay, Minnesota - January 9, 1976," Klohn, Leonoff Consultants Ltd.

127B Sketch plan for proposed coarse tailings immersion.

127C "Dike Surface Areas" computations -- proposed coarse tailings immersion.

127D Engineering Drawing - #VA-1965-38 - dikes, etc., re proposed coarse tailings immersion. Includes E. Klohn's pencilled notes.

LISTING OF EXHIBITS

RESERVE MINING COMPANY EXHIBITS
EUGENE A. HICKOK

128. Witness Statement - Eugene A. Hickok.

129. Poster of "Major Watersheds."

130. Poster of "Mile Post 7 Site" depicting coarse and fine tails storage.

131. Poster - Annual Flow Hydrograph.

132. Poster - "Mile Post 7 Site--Infiltration Locations."

133. Poster - "Mile Post 7 -- Geologic Cross-Section - Saturated Thickness - Dam 1."

134. Poster- "Mile Post 7 -- Geologic Cross-Section - Saturated Thickness - Dam 2-3."

135. Poster - "Bear Lake Diversions."

136. Report - "Hydrological Analysis of the Mile Post 7 Site" - October, 1974 - Eugene A. Hickok and Associates.

137. Report - "Hydrological Analysis of the Beaver River Watershed" - January 8, 1975 - Eugene A. Hickok and Associates.

138. Infiltration Test - January 17, 1975.

139. Seepage Estimates - January 20, 1975.

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RESERVE MINING COMPANY EXHIBITS
DR. GERALD A. PLACE

140. Witness Statement - Dr. Gerald A. Place.

141. Slide photograph of "Establishment of Vegetation on Taconite Tailings."

142. Slide of "Typical Soil Factors Limiting Plant Growth."

143. Slide of "Soil Test Explanation (pH)."

144. Slide of "Soil Test Explanation (soluble salts)."

145. Slide of "Soil Test Explanation (sodium)."

146. Slide of "Soil Test Explanation (major nutrients)."

147. Slide of "Limiting Factors of Plant Growth Based on Soil Test Results and Interpretations Established by the University of Minnesota's Soil Testing Laboratory in 1974."

148. Slide of "Foote Mineral Company."

149. Slide photograph of Foote Mineral Company tailings dam.

150. Slide photograph of steep embankment of Foote Mineral Company tailings dam.

151. Slide photograph of vegetation on Foote Mineral Company tailings dam.

152. Slide photograph of vegetation on Foote Mineral Company tailings dam.

153. Slide photograph of excavated soil area on Foote Mineral Company tailings dam.

154. Slide of "Predominant Vegetation Observed at Foote Mineral Company."

155. Slide of Great Canadian Oil Sands, Ltd.

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157. Slide photograph of tailings dam at Great Canadian.

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163. Slide of "Predominant Vegetation Observed at Great Canadian Oil Sands, Ltd."

164. Slide of "Cleveland Cliffs Iron Company -- Marquette, Michigan."

165. Slide of "Republic Site of Cleveland Cliffs Iron Company."

166. Slide photograph of vegetation at Republic site.

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177. Slide photograph of vegetation at East Basin.

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179. Slide photograph of vegetation at East Basin.

180. Slide of "Predominant Vegetation Observed at Cleveland Cliffs Iron Company."

181. Slide of "Erie Mining Company."

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183. Slide of test plots at Erie Mining Company.

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185. Slide of vegetation at Erie Mining Company.

186. Slide photograph of closeup of vegetation at Erie Mining Company.

187. Slide photograph of root development on north slope of Erie Mining Company's tailings basin.

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189. Slide photograph of conifer tree on Erie's basin.

190. Slide photograph of tree vegetation on Erie Mining Company's basin.

191. Slide photograph of farm equipment utilized at Erie Mining Company.

192. Slide photograph of cultivation of vegetation site at Erie Mining Company.

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195. Temporary seeding near water's edge at Erie Mining Company.

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197. Slide photograph of temporary vegetation near Erie Mining Company's tailings pond.

198. Slide photograph of geese in Erie Mining Company's tailings pond.

199. Slide photograph of deer on Erie Mining Company's basin.

200. Slide of "Predominant Vegetation Observed at Erie Mining Company."

201. Slide of "Effective Varieties Observed at All Sites."

202. Slide photograph of slopes at each of the tailings basins observed.

203. Slide of "Reserve Mining Company Vegetation Research Program Designed By Dr. Gerald A. Place."

204. Slide of "Objectives" of Reserve Mining Company's Vegetation Research Program.

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205. Slide photograph of location of test plot.

206. Slide of "Test Plot Diagram for One Slope."

207. Slide of "Experimental Design."

208. Slide of "Varieties X Fertilizer X Fertilizer Application Time."

209. Slide of "Fertilizer Recommendations for Tailings Based on Soil Test Results."

210. Slide of "Varieties X Fertilizer X Fertilizer Application Time."

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212. Slide of "Variables to Be Measured."

213. Slide of "Reserve's Test Plot."

214. Slide of seeding of Reserve's test plot.

215. Slide of plotting of seeds at Reserve's test plot.

216. Slide of seeding of Reserve's test plot.

217. Slide of quarter on coarse cobs at Reserve's test plot.

218. Slide of cross-section view of alternate tailings dam.

219. Slide of vegetation at Reserve's tailings basin in Babbitt, Minnesota.

220.)
221.) Errors in numbering.

222. Report - "Reserve Mining Company Vegetation Research Program," Designed by Dr. Gerald A. Place.

223. Sample - Foote Mineral Company Bare Sand.

224. Sample - Foote Mineral Company Bare Sand.

225. Sample - Great Canadian Oil Sands Fresh Tailings.

226. Sample - Great Canadian Oil Sands - Below Root Zone - Creeping Red Fescue.

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227. Sample - Great Canadian Oil Sands, Ltd. - Root Zone - Creeping Red Fescue.

228. Sample - Cleveland Cliffs Iron Company - Below Root Zone - Reed Canary Grass - Republic Site.

229. Sample - Cleveland Cliffs Iron Company - Fines - Humboldt, West Basin.

230. Sample - Cleveland Cliffs Iron Company - Root Zone - Reed Canary Grass - Republic Site.

231. Sample - Cleveland Cliffs Iron Company - Root Zone - Reed Canary Grass - Republic Site.

232. Sample - Erie Mining Company - Below Root Zone - Reed Canary Grass.

233. Sample - Erie Mining Company - Root Zone - Reed Canary Grass.

234. Sample - Erie Mining Company - Root Zone - Reed Canary Grass.

234A. Report - "Tailings Dam Revegetation Research Plot Plans for Reserve Mining Company by Gerald A. Place and Vernon L. Hall" - October 8, 1974.

234B. Report - "Tailings Dam and Pond Vegetation Program for Reserve Mining Company at Silver Bay, Minnesota By Gerald A. Place" - October 8, 1974.

234C. Report - "Experimental Vegetation of Taconite Tailings" - RMC #23-3113 November 10, 1975.

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RESERVE MINING COMPANY EXHIBITS

DUNCAN HAY

235. Witness Statement - Duncan Hay.

236. Slide of "Wave Definitions."

237. Withdrawn.

238. Slide depicting breaking waves on a flat beach.

239. Slide of breaking waves on a steep beach.

240. Withdrawn.

241. Slide of "Beach Development and Stabilization--Stage One Present Condition."

242. Slide of "Beach Development and Stabilization--Stage Two Rubble Seawall in Place."

243. Slide of "Beach Development and Stabilization--Stage Three Armoring Process."

244. Slide of "Plan of Beach Development."

245. Slide of "Beach Development and Stabilization--Stage Four Final Beach Profile."

246. Photograph of 40-inch mine quarry rock.

247. Poster depicting the three-dimensional model apparatus.

248. Poster depicting the purposes of the hydraulic model studies.

249. Film of the Development and Stabilization of Nearshore Beach. (39 still shots from the film are also available.)

250. Script for the film of "Development and Stabilization of Nearshore Beach."

251. Poster depicting "Proposed Delta Stabilization Plan and Sections."

251A Report - "Draft of Final Report - Hydraulic Model Studies of Tailings Delta Stabilization" - Western Canada Hydraulic Laboratories, Ltd., September, 1975.

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DR. ROBERT A. RAGOTZKIE

252. Witness Statement - Dr. Robert A. Ragotzkie

253. Poster depicting aqua temp and current meter locations.

253A Drill hole logs and laboratory test results for delta stabilization project - May 16, 1975.

254. Poster depicting "Upwelling."

255. Poster depicting "Downwelling."

256. Poster depicting "Vertical Motions Near Silver Bay."

257. Report - "Water Motions in Lake Superior" - Robert A. Ragotzkie dated July 31, 1973.

257A Report - #23-1112-1 - October 19, 1973 - "In Situ Current Meter Studies - Silver Bay Area - 1973." WITHDRAWN

258. Report - "Hydrography Near Silver Bay" - Robert A. Ragotzkie - July 30, 1973.

259. Report - "Temperature Regime of Lake Superior at Silver Bay, 1971-1973" - Robert A. Ragotzkie dated August 7, 1973.

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RESERVE MINING COMPANY EXHIBITS
LEIF K. JACOBSEN

260. Witness Statement - Leif K. Jacobsen.

261. Kaiser Engineers' "Proposal for Engineering, Procurement and Construction," dated June, 1974.

261A Kaiser Engineers' "Proposal" dated December 19, 1974.

261B Kaiser Engineers' "Proposal" dated February 14, 1975.

262. Kaiser Engineers' Agreement with Reserve Mining Company dated May 20, 1975.

263. Poster of "Tailings Pumping Diagram."

264. Poster of "Tailings Pumping Station Diagram."

265. Poster of "Proposed Typical Cross Section of Tailings Pipeline System."

266. Poster of "Tailings Line Road Crossing Sketch - Short Cross Section."

267. Poster of "Tailings Line Road Crossing Sketch - Long Cross Section."

268. Poster of "East Beaver Creek Crossing."

269. Poster of "Tailings Pipeline Profile, Highway #4 to Beaver River."

270. Poster of "Proposed Project Schedule - Mile Post 7."

271. Poster of "Flowsheet Preparation of an Estimate."

272. Poster of "Escalation Forecast - Industrial Construction Project."

273. Poster of "Escalation Study - Mile Post 42."

274. Poster of "Estimate Types."

275. Poster of "Contingency Variation."

276. Poster of "Estimate Accuracy Variation."

277. Kaiser Engineers' report entitled "Preliminary Estimate for Mile Post 20," dated April 21, 1975.

278. Kaiser Engineers' report entitled "Preliminary Estimates for Alternative Schemes for Transporting of Concentrate From Mile Post 42 to Silver Bay," dated April 16, 1975.

279. Letter from L. K. Jacobsen to M. G. Woodle dated April 21, 1975, in regard to "Preliminary Review of the Embarrass Site for Construction of an Iron Ore Concentrator."

280. Poster of "Summary of Capital Costs."

280A. Engineering Drawing #22-3154 - General Plant Arrangement

RESERVE MINING COMPANY EXHIBITS
LEIF K. JACOBSEN

280B "Engineering Report - Volume I - Draft - On-Land Tailings Disposal and Air Quality Control Facilities for Reserve Mining Company" - Kaiser Engineers - January, 1976.

280C "Engineering Report - Volume II - Draft - On-Land Tailings Disposal and Air Quality Control Facilities for Reserve Mining Company" - Kaiser Engineers - January, 1976.

280D "Design Criteria - Reserve Mining Company Taconite Ore Preparation Plant - Silver Bay, Minnesota" - October 17, 1975; Revised January 5, 1976 - Kaiser Engineers.

280E Engineering Drawing - CPM Summary - Construction Schedule - Mile Post 7.

280F Kaiser Engineers Memorandum - D. E. Cardarelle to L. K. Jacobsen and A. A. Wallach - June 30, 1975 - re "Reserve Mining Company Iron Ore Project Dust Control Program During Construction."

280G L. K. Jacobsen hand-written "Construction Schedule Comments and Comparison."

280H Letter - A. A. Wallach, Kaiser Engineers, to R. L. Reed, Reserve, re construction schedule.

280I New Construction Dates - revised dates from Exhibit 280B.

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RESERVE MINING COMPANY EXHIBITS

ROBERT A. LEE

281. Witness Statement - Robert A. Lee

282. "Reserve Mining Company Various Statistics - 1969-1974."

283. "Income Taxes Withheld From Reserve Employees in 1974."

284. "Purchases in Excess of $5,000 From Minnesota Vendors."

285. "Distribution of 1974 Tax Liability - Minnesota Taxes."

286. Chart - "Distribution of Tax Liability - 1955-74 Inclusive - Minnesota Taxes."

287. Chart - "Summary of Minnesota State and Local Taxes - 1975 Estimated Liability Compared With 1974 Liability."

288. Table 2.3.3.1-A from Arthur D. Little Environmental Report - "Financial Position - Reserve Mining Company - Years Ended December 31, 1974 and December 31, 1973."

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DR. WILLIAM MARSHALL

289. Witness Statement - Dr. William Marshall.

290. Chart - "Ratings of Big Game Habitats on the Mile Post 7 Site."

291. Chart - "Ratings of Game Bird Habitats on the Mile Post 7 Site."

292. Chart - "Ratings of Big Game Habitats on the Colvin Site."

293. Chart - "Ratings of Game Bird Habitats on the Colvin Site."

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RICHARD L. REED

294. Witness Statement - Richard L. Reed.

295. Topographic map (enlarged to: 1" = 2,000') of the Silver Bay Quadrangle.

296. Topographic map (identified as Reserve Drawing No. 292-0003) of the Mile Post 7 site.

297. Engineering Drawing No. 292-0041 of Dam No. 1.

298. Engineering Drawing No. 292-0050 of Dam No. 2-3.

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RESERVE MINING COMPANY EXHIBITS

WILLIAM F. WILSON

299. Witness Statement - William F. Wilson.

299A. "Reserve Mining Company Detailed Cost Estimate - Mile Post 7."

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RESERVE MINING COMPANY EXHIBITS

ROBERT S. LEMIRE

300. Witness Statement - Robert S. Lemire.

301. Withdrawn.

302. Memorandum - J. R. Oxberry to to A. H. Samuel - "Data From Stream Biota Monitoring of Mile Post 7 - May, 1975," dated June 25, 1975.

303. Memorandum - D. M. Wagner to A. H. Samuel - "Recycled Water Chemistry: Evaluation of Calcium Chloride Addition Rates and Various Flotation Reagents on Water Quality Parameters," dated June 23, 1975.

304. Research and Development Division Report No. 23-2103 - "Filter Bed for Tailings Thickener Overflow," July 10, 1974.

305. Photograph - Research and Development - Tailings Clarification Pond.

306. "Table 1, Pilot Plant Tailings Circuit Water Chemistry," page 3 of Research and Development Division Report No. 23-2103, "Filter Bed for Tailings Thickener Overflow," July 10, 1974.

307. "Table 2, Pilot Plant Tailings Circuit Water Chemistry," page 5 of Research and Development Division Report No. 23-2103, Filter Bed for Tailings Thickener Overflow," July 10, 1974.

308. Research and Development Division Report No. 23-5106-2 "Effect of of Pilot Plant Discharge on Rainbow Trout," June 26, 1975.

309. Research and Development Division Photograph - Pilot Plant Pond.

310. Research and Development Division Photograph - Pilot Plant Pond With Spawning Stream.

311. Research and Development Division Photograph - Mature Trout From Pilot Plant Pond.

312. Research and Development Division Photograph - Mature Trout From Pilot Plant Pond.

313. Research and Development Division Photograph - Mature Trout From Pilot Plant Pond.

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314. Research and Development Division Photograph - Close-up of Mature Male Trout.

315. Research and Development Division Photograph - Pilot Plant Spawning Stream.

316. Research and Development Division Photograph - Close-up of Pilot Plant Spawning Stream.

317. Research and Development Division Photograph - Stripping of Fish Eggs From Mature Trout.

318. Research and Development Division Photograph - Fertilized Trout Eggs.

319. Research and Development Division Photograph - Sac Fry.

320. Research and Development Division Photograph - Sac Fry.

321. Research and Development Division Photograph - Sac Fry.

322. Research and Development Division Photograph - Kam Loops Rainbow Trout and Regular Rainbow Trout.

323. Research and Development Division Report No. 23-5104 - "Fish Bio-assay-Azamine A-3 and Superfloc 330," April 5, 1973.

324. Research and Development Division Report No. 23-5111 - "Trout Eggs and Sac Fry Bioassay of Tailings," April 24, 1973.

325. Research and Development Division Report No. 23-5111-1 - "Trout Eggs and Sac Fry Bioassay of Tailings," March 25, 1974.

326. Research and Development Division Report No. 23-5112 - "Trout Eggs and Sac Fry Bioassay of Flocculated Tailings," July 27, 1973.

327. Research and Development Division Report No. 23-5113 - "Juvenile Brook Trout and Yellow Perch Bioassay of Tailings," March 27, 1973.

328. Research and Development Division Report No. 23-5114 - "Trout Larvae Bioassay of Azamine A-3," May 4, 1973.

329. Research and Development Division Report No. 23-5118 - "Exposure of Rainbow Trout to Reserve's Suspended Solids From Tailings Effluent," August 23, 1974.

330. Research and Development Division Report No. 23-5120 - "Diatom Bioassay Study," January 28, 1974.

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ROBERT S. LEMIRE

330A. Research and Development Division Report No. 23-7103 - "Mile Post 7 Water Quality Monitoring," November 4, 1975.

330B. Research and Development Division Report No. 23-0100 - "Particle Analyses of Delta Tailings," November 15, 1975.

330C. Research and Development Division Report No. 23-7102 - "Mile Post 7 Ground Water Monitoring - 1975," November 5, 1975.

330D. Research and Development Division Report No. 23-3110 - "Fine Tailings Filter Tests," November 18, 1975.

330E. Research and Development Division Report No. 23-7104 - "Mile Post 7 Stream Biota Monitoring - 1975," November 17, 1975.

330F. Letter and attachments - R.S. Lemire to Eldon G. Kaul - December 11, 1975.

330G. Research and Development Division Report No. 23-3107 - "Closed Circuit Water System," January 7, 1976.

330H. Research and Development Division Report No. 23-7101 - "Ambient Air Quality Monitoring - 1975," January 7, 1976.

330 I. Drawing - Superior Water, Light and Power Company - Wells - Minnesota Point - December 31, 1956.

330J. Letter - Dr. Philip M. Cook to Fred E. Stout re analyses of Superior well water samples.

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RESERVE MINING COMPANY EXHIBITS

FATHER WILLIAM T. HOGAN

331. Witness Statement - Father William T. Hogan.

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RESERVE MINING COMPANY EXHIBITS

DR. RICHARD LICHTY

332. Witness Statement - Dr. Richard W. Lichty.

333. "The Employment Impact of Reserve Mining Company on the Arrowhead Region of Northeast Minnesota Plus Douglas County, Wisconsin," by Wayne A. Jesswein and Richard W. Lichty, University of Minnesota, Duluth.

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RESERVE MINING COMPANY EXHIBITS

JEAN F. BASGEN

334. Witness Statement - Jean F. Basgen.

335. Slide - Aerial view - Silver Creek - 7-13-74.

336. Slide - Aerial view - Encampment River - 7-13-74.

337. Slide - Aerial view - Beaver River Valley - 7-13-74.

338. Slide - Aerial view - East Beaver Bay - 7-13-74.

339. Slide - Aerial view - Silver Bay - 7-13-74.

340. Slide - Aerial view - Mount Rockwood Ski Hill and Williams Creek - 7-13-74.

341. Slide - Aerial view - Baptism River and Illgen Falls - 7-13-74.

342. Slide - Aerial view - Temperance River - 7-13-74.

343. Slide - Aerial view - Carlton Peak - 7-13-74.

344. Slide - Aerial view - Onion River - 7-13-74.

345. Slide - Aerial view - Poplar River, Lutsen Ski Hills - 7-13-74.

346. Slide - Aerial view - Cascade River Valley - 7-13-74.

347. Slide - Aerial view - Grand Marais - 7-13-74.

348. Slide - Aerial view - Brule River - 7-13-74.

349. Slide - Aerial view - Dutchman Lake Behind Ridge - 7-13-74.

350. Slide - Aerial view - Hat Point From Grand Portage Bay - 7-13-74.

351. Slide - Aerial view - Teal Lake - 7-13-74.

352. Slide - Aerial view - Pigeon River and Falls - 7-13-74.

353. Slide - Aerial view - Looking northeast with Reserve railroad in foreground; Bear Lake in extreme center right - May 9 and 16, 1975.

354. Slide - Aerial view - Similar to #354 - Looking a bit more north - May 9 and 16, 1975.

355. Slide - Aerial view - Looking north-northeast with golf course in lower right corner - May 9 and 16, 1975.

JEAN F. BASGEN

356. Slide - Aerial view - Looking west-northwest - Airplane just about over Beaver Bay - May 9 and 16, 1975.

357. Slide - Aerial view - Looking west-northwest showing city of Silver Bay and part of Reserve plant - May 9 and 16, 1975.

358. Slide - Aerial view - Looking west - Mile Post 7 area - May 9 and 16, 1975.

359. Slide - Aerial view - Looking approximately north - Mile Post 20 area - Duluth, Missabe and Iron Range Railroad tracks on left side of slide - June 26, 1975.

360. Slide - Aerial view - Looking southwest with Katherine Lake in foreground; Cloquet Lake in middleground - Mile Post 20 area - June 26, 1975.

361. Slide - Aerial view - Similar to #360 - Mile Post 20 area - Lillian Lake upper left side - June 26, 1975.

362. Slide - Aerial view - Looking to the northeast with Cloquet and Katherine Lakes in upper center - June 26, 1975.

363. Slide - Aerial view - Mile Post 20 area - general view looking north - June 26, 1975.

364. Slide - Aerial view - Looking south - Highway #104 in very extreme lower right; DM&IR tracks on right side of slide; Cloquet Lake just west of slide - June 26, 1975.

365. Slide - Aerial view - Culkin Lake area - general view of the area with Culkin Lake in center looking southeast - June 26, 1975.

366. Slide - Aerial view - Looking approximately east with Lobo Lake in upper right center; a portion of Culkin Lake on lower left side - June 26, 1975.

367. Slide - Aerial view - Similar to #366 - lower altitude - June 26, 1975.

368. Slide - Aerial view - Culkin Lake - June 26, 1975.

369. Slide - Aerial view - Looking north-northwest with Sand Lake across center of slide; Lobo Lake upper right of slide - June 26, 1975.

370. Slide - Aerial view - Looking southwest - Sand Lake - Lobo Lake in upper right hand corner; Cougar Lake upper left and Seven Beaver and Big Lakes on horizon.

RMC EXHIBITS

JEAN F. BASGEN

371. Slide - Aerial view - Mile Post 42 area - Looking north-northeast - Reserve railroad on right-hand side; Long Lake in lower left corner; Stone Lake in center of slide; portion of Seven Beaver Lakes on center right - May 9 and 16, 1975.

372. Slide - Aerial view - Looking northeast - Seven Beaver Lakes in foreground; Big Lake in upper right; Long Lake middle left - May 9 and 16, 1975.

373. Slide - Aerial view - Generally the same direction as slide #372 with most of Seven Beaver Lakes in foreground. Upper right shows junction of Reserve and Erie Mining Company crossing of railroads - May 9 and 16, 1975.

374. Slide - Aerial view - Looking to northeast from approximately Skybo area with Big Lake in upper center and Long Lake on upper right edge - May 9 and 16, 1975.

375. Slide - Aerial view - Same general view as slide #374 looking a little more to the north - May 9 and 16, 1975.

376. Slide - Aerial view - Looking north-northeast with Highway #133 in foreground - May 9 and 16, 1975.

377. Slide - Aerial view - Embarrass area - Looking to southwest with Highway #104 making right angle in foreground; Erie Mining Company tailings pond upper left side - June 26, 1975.

378. Slide - Aerial view - Same general view as slide #377 with camera slightly farther west - June 26, 1975.

379. Slide - Aerial view - Looking south and east with Reserve pit across top of slide - June 26, 1975.

380. Slide - Aerial view - Embarrass area - looking to southwest - June 26, 1975.

381. Slide - Aerial view - Looking west with Highway #1 on right side; Highway #104 on left side - June 26, 1975.

382. Slide - Aerial view - Looking east with Mud Lake on center right side - June 26, 1975.

382A. U. S. Forest Service map showing proposed tailings disposal sites.

LISTING OF EXHIBITS

RESERVE MINING COMPANY EXHIBITS

CHAKRA J. SANTHANAM

383. Witness Statement - Chakra J. Santhanam.

384. Brochure - "ADL Today" - Arthur D. Little, Inc.

385. Annual Report, 1974 - Arthur D. Little, Inc.

386. Brochure - "ADL Qualifications in Environment."

387. Chart - "Impacts Studied."

388. Chart - "I. Physical Environmental Impacts - Mile Post #7, Colvin."

389. Chart - "II. Biotic Environmental Impacts - Mile Post #7, Colvin."

390. Chart - "III. Social Impacts - Mile Post #7, Colvin."

391. Chart - "Visibility and Aesthetics" - Mile Post #7.

392. Chart - "IV. Economic Impacts - Mile Post #7, Colvin."

393. Chart - "Economic Comparison of Plans - Mile Post #7, Mile Post #20, Colvin."

393A. Chart - "Basic Economic Data - MP 20, Colvin Plans."

394. Chart - "V. Energy Related Impacts - Mile Post #7, Colvin."

395. Chart - Map showing copper nickel drill holes, Reserve's mine, Colvin site, and BWCA in Northern Minnesota.

396. Revised Cost Evaluations - Mile Post #7, 20 and 42 - July, 1975.

397. Table 3.9.2.3-A - Energy Requirements for Construction of Milepost #7 and Colvin Assuming Recycle of Materials. WITHDRAWN

(37E Arthur D. Little Supplemental Report - August, 1975.)

397A Arthur D. Little, Inc. "Comments Report on Draft Environmental Impact Statement" - January, 1976.

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RESERVE MINING COMPANY EXHIBITS

JAMES I. STEVENS

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RESERVE MINING COMPANY EXHIBITS

DR. CHARLES B. WURTZ

401. Witness Statement - Dr. Charles B. Wurtz.

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RESERVE MINING COMPANY EXHIBITS

DR. RICHARD L. MEYER

402. Witness Statement - Dr. Richard L. Meyer.

402A. Memorandum - J. R. Oxberry to K. M. Haley - January 21, 1975.

402B. Memorandum - J. R. Oxberry to K. M. Haley - February 19, 1975.

402C. Memorandum - J. R. Oxberry to A. H. Samuel - June 12, 1975.

402D. Memorandum - J. R. Oxberry to A. H. Samuel - June 26, 1975.

402E. "Compilation of Algal Genera."

402F. "Stream Biota Monitoring."

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RESERVE MINING COMPANY EXHIBITS

RICHARD W. HYDE

403. Witness Statement - Richard W. Hyde.

404. Chart - "Total Shipments of Iron-Bearing Raw Materials By CVRD and Its Associated Companies."

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RESERVE MINING COMPANY EXHIBITS

G. RICHARD YOUNG

405. Witness Statement - G. Richard Young.

406. Figure 3.8.2.2-A - Net Income Per Year - Republic Steel - 1950-1975.

407. Figure 3.8.2.2-B - Net Income Per Year - Armco Steel - 1950-1975.

408. Table 3.8.2.4-A - Funds Available for Capital Expenditures - Armco and Republic.

409. Table 3.8.2.4-B - Average Annual Funds Flow and Capital Expenditures - Milepost #7, Milepost #20, Colvin.

410. Table 3.8.2.4-C - Effect on Income Before Taxes - Armco, Republic.

411. Table 3.8.2.4-D - Ratios of Market Value to Equity - Armco, Republic.

412. Table 3.8.2.4-F - Republic Debt Interest Coverage - Milepost #7, Milepost #20, Colvin.

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RESERVE MINING COMPANY EXHIBITS

DR. WILLIAM REINFELD

413. Witness Statement - Dr. William Reinfeld.

414. "Chart I: Reserve's Linkage to the Economy."

415. "Chart IIA: Impact of Reserve and Industries Related to It - Minnesota."

416. "Chart IIB: Impact of Reserve and Industries Related to It - Total United States."

417. "Chart III: Reserve's Linkage to Armco and Republic."

418. "Chart IVA: Possible Consequences of Shutdown of Reserve."

419. "Chart IVB: Possible Consequences of Shutdown of Reserve."

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RESERVE MINING COMPANY EXHIBITS

JUDITH F. CAMPBELL

420. Witness Statement - Judith F. Campbell.

420A. Table 2.3.3.2-A "Summary of Economic Impact--Reserve Mining Company in the State of Minnesota, 1973."

420B. Table 2.3.3.2-F "Total Minnesota Taxes Attributable to Reserve Mining, 1973."

420C. "Correspondence Between Estimates Presented in Exhibits 415 and 416 and comparable data in ADL Report (Exhibit 37)."

LISTING OF EXHIBITS

RESERVE MINING COMPANY EXHIBITS

JOHN REED

421. Witness Statement - John Reed.

422. (Foden)

423. "Direct and Indirect Employment Wages Attributable to Reserve Mining Company in the State of Minnesota and Selected Sub-Areas."

424. "Purchases By Area - Reserve Mining Company - 1973."

425. "Summary of Minnesota Taxes Paid By Reserve Mining Company - 1955-1975."

426. Withdrawn.

427. "Estimated Value of Silver Bay Townsite."

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RESERVE MINING COMPANY EXHIBITS

HARRY G. FODEN

422. Witness Statement - Harry G. Foden.

423. (Reed)

424. (Reed)

425. (Reed)

426. Withdrawn.

427. (Reed)

428. Chart - "Summary of Human Impacts."

429. Chart - "Summary of Local Economic Effects."

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RESERVE MINING COMPANY EXHIBITS

DR. BRUCE S. OLD

430. Witness Statement - Dr. Bruce S. Old.

431. Slide - "Process Unit Interrelationships."

432. Slide - "1975-83 Capital Requirements - Millions of 1975 Dollars - Armco, Republic."

433. Slide - "Demand and Supply of Funds - 1974-1985."

434. Slide - "Private Investment - 1962-1973; 1974-1985."

435. Slide - "Ratio of External to Internal Funds."

436. Slide - "Internal Funds as Percent of Capital Spending - 1960-1974."

437. Slide - "Increase in Corporate Debt - 1968-1974."

438. Slide - "Corporate Financial Ratios - 1968-1974; Interest Coverage - 1955-1974."

439. Slide - "Debt/Equity Ratio - 1955-1974."

440. Slide - "Value of New Stock Issues and Number of Stock Underwritings - 1965-1974."

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RESERVE MINING COMPANY EXHIBITS

DAVID L. DINGEMAN

441. Witness Statement - David L. Dingeman.

442. Chart - "Babbitt Area - Potential Copper-Nickel Deposits."

442A. Research and Development Report No. 23-3112 - "Rougher Magnetic Separator Tailings Sump Test," November 14, 1975.

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RESERVE MINING COMPANY EXHIBITS

DR. CHARLES J. KENSLER

443. Witness Statement - Dr. Charles J. Kensler.

444. Organization chart - Arthur D. Little, Inc. - June, 1975.

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RESERVE MINING COMPANY EXHIBITS

MERLYN G. WOODLE

445. Witness Statement - Merlyn G. Woodle

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446. Table prepared by George Weaton - "Pellet Quality: Tons, Iron, Silica, Rice Ratio - Rank" - July 24, 1975 (lists all pellet producers).

447. "Report on Foundation Clay Characteristics - On-Land Tailings Disposal Milepost #7 Site for Reserve Mining Company" - Klohn Leonoff Consultants Ltd.

448. Page 20 of Reserve Mining Company On-Land Tailings Disposal & Air Quality Plan" (Palisade) - shows geographic location only.

449. Witness Statement - Dr. Robert Vranka.

450. Letter - A. J. Jermann, Republic Steel Corporation to J. A. Lowey - April 2, 1975 - Table of data attached to letter.

451. "A Preliminary Report of Fiber Analyses Conducted on Samples Submitted by Reserve Mining Company" by Edward T. Peters, ADL.

452. Superior National Forest Map.

453. Memorandum from L. K. Jacobsen to E. T. Fride - 12-4-75 - "Recommended Cost Adjustments to Torkelson's Estimate for the Embarrass Plant."

453A. Memorandum - D. L. Dingeman & L. K. Jacobsen to E. T. Fride - November 12, 1975 - "Preliminary Critique of the Torkelson Engineering Report for Embarrass Site (moist concentrate handling only)."

453B. Memorandum - D. L. Dingeman to E. T. Fride - November 12, 1975 - "Torkelson Report -- Embarrass Concentrator."

454. "Feasibility of Alternate Tailings Disposal Site - Draft Copy - June 15, 1974" - Barr Engineering Company.

455. Topographic Map - Isaac Lake Quadrangle - Minnesota-St.Louis County.

456. Witness Statement - Donald G. Bonamer.

457. Letter - Charles Czako, McKee, to K. M. Haley - January 29, 1975.

458. Witness Statement - Jerome C. Motz.

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RESERVE MINING COMPANY EXHIBITS

459. Letter - J. C. Motz, Rexnord, to David L. Dingeman - January 9, 1976.

460. Resume - Chester A. Rowland, Jr.

461. Report - "Reserve Mining Company - Grinding Study - Proposed Embarrass Plant Site" - Allis Chalmers - January 5, 1976.

462. Resume - Yves Bajard.

463. Report - "Surficial and Bedrock Geology - On-Land Tailings Disposal - Milepost 7 Site" - January, 1976 - Klohn Leonoff Consultants Ltd.

464. Report - "Data From October-December, 1975 Drilling and Testing Program - On-Land Tailings Disposal - Milepost 7 Site" - January, 1976 - Klohn Leonoff Consultants, Ltd.

465. Research and Development Division Report No. 23-7102 - "Mile Post 7 Ground Water Monitoring - 1975" - January 28, 1976.

466. Letter - October 3, 1975 - Robert A. Lee to M. R. Hyde - with attachments re: operating costs, etc.

467. Letter - December 31, 1975 - Northern Natural Gas to Federal Power Commission.

468. Five-page letter - February 5, 1976 - L. K. Jacobsen, Kaiser, to R. L. Reed re Mile Post 20 Estimate.

469. Letter - February 5, 1976 - L. K. Jacobsen, Kaiser, to R. L. Reed, attaching backup information used in preparation of Mile Post 20 estimate.

470. Letter - no date (received 12-13-71) from Elwood Rafn to Melroy Peterson, Lake County re tax forfeited lands.

471. Excerpts - Upper Great Lakes Regional Commission information from Coastal Zone Management Economic Volume.

472. Excerpts from Volume 2 - Highway Planning Studies Upper Great Lakes Region - Compatibility of Leisure and High Mobility Traffic in a Scenic Corridor - Minnesota.

473. Excerpts from "Minutes of Meeting North Shore Drive From Duluth to Canadian Border " - State Highway Department Building - November 16, 1960.

474. Excerpts from "Minnesota Horizons" sponsored by Legislature, State Planning Agency, Commission on Minnesota's Future.

475. "Report on Examination of Certain Electron Microscope Grids Carried Out for thePollution Control Agency, State of Minnesota.

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RESERVE MINING COMPANY EXHIBITS

476. Arthur D. Little Report "Air Quality Impacts - Reserve Mining Company's Proposed On-Land Disposal Plan" - February 28, 1976.

477. Data relating to sampling procedures for samples used in A. D. Little report - Exhibit #476 ("Samples Utilized by ADL for Air Quality Impacts Study," "Vegetation Plot Particle Size Analysis Data Relating to Sampling Procedures").

478. Letter - February 27, 1976 - Dr. Edward Peters to Arthur Samuel - re: results of fiber analysis on first set of test bed soil seepage experiments.

479. Letter - February 27, 1976 - Dr. Edward Peters to Arthur Samuel re: results of fiber analysis for glacial til and transition zone.

480. State of Minnesota Office Memorandum - March 2, 1976 - to MPCA Board from Peter L. Gove re: Results of Air Sampling for Amphibole Fibers (attaches tabulation of data).

481. Letter - M. R. Banovetz to Peter L. Gove - 12-11-75 - re Minnesota Department of Health air samples; attaches Lemire comments on various reports of fibers in public water supplies, etc.

LISTING OF EXHIBITS

UNITED STEELWORKERS OF AMERICA EXHIBITS

JAMES SMITH

1. "Earnings of Hourly Employees - Reserve Mining Company - Effective August 1, 1975."

2. "Pension Rights and Pension Credit Loss Potential of Reserve Mining Company Employees Represented By United Steelworkers of America - 6-20-75."

3. Table - "Iron Ore Consumption and Imports - 1969 through 1974."

4. Letter - June 30, 1975 - I. W. Abel to Wayne Olson, Hearing Officer.

JACK JONES

5. Letter - July 8, 1975 - Jack Jones to John Engberg re evaluation of Mile Post 7 plan by Harza Engineering Company.

5A. Witness Statement - Jack Jones.

DAVID ROE

6. Resolution - 1974 State AFL-CIO Convention.

NORTHEASTERN MINNESOTA INTERVENORS LISTING OF EXHIBITS

MARVIN MAKI

1. Aerial mosaic of Mile Post 7 area with legal descriptions superimposed

2. Timber Type Map of Mile Post 7

3. Appraisal of Lake County Tax Forfeited Land, Timber

4. Compilation of total timber volume and value as shown on Timber Type Map within the proposed tailings basin at Mile Post 7

ARTHUR LORNTSON

5. Section of County Map in Mile Post 7 area

BEACHER ELAM

6. Northshore Snowmobile Trails, Division of Land and Forestry

7. Silver Bay area snowmobile trails

8. Lake County Five-Year Outdoor Recreation Plan

MELROY PETERSON

9. Taxes paid by Reserve Mining Company to governmental subdivisions in Lake County 1956-1974

10. Lake County 1972 effect of loss of Taconite Revenue on tax levy

11. Comparative analysis of effect of Taconite Tax on home owners tax-1973

12. Lake County Census Report

MELVIN KOEPKE

13. Village of Silver Bay Taconite Tax Receipts and Budget

14. Silver Bay Municipal Sewer & Water Operating Budget

RICHARD MAHAL

15. City of Babbitt Taconite Tax Revenues and Budget

ROBERT GINTHER

16. Independent School District No. 692, Babbitt - Receipts and Expenditures for 1975-76 School Year.
17. Independent School District No. 692, Babbitt - Revenues Derived From Reserve Mining Company; State Aid; Local Debt Service

NORTHEASTERN MINNESOTA INTERVENORS
LISTING OF EXHIBITS

CLEM COSSALTER

18. Letter - March 6, 1941 - E. W. Davis to Blatnik, Lommen, Herried, Vukelich, Huhtala, Peterson, Berlin, Montague, Cina, MacGraw - re taconite tax bill.

19. "Estimated Tax and Economic Losses to Iron Range and Northeastern Minnesota From Closing of Reserve Taconite Operation."

FRANK RUKAVINA

20. Tax Levy - 1974 - Independent School District No. 381, Lake County.

21. Newspaper Clippings - Silver Bay News - 11-22-72; 12-6-72; 12-13-72; 3-7-73; 4-4-74.

LLOYD HOULE

22. 1975 Lake County Budget.

DR. FRED POST

23. "Economic Impact of Reserve Mining Company." by Dr. Fred Post - June 30, 1975.

24. "Demographic and Economic Characteristics for the Coastal Areas of the Minnesota Portion of the North Shore of Lake Superior."

25. "Index for Reserve Mining Company Payments to Governmental Sub-Divisions in St. Louis County."

26. Comments by Arthur Lorntson re Draft EIS and Greenwood Trail. WITHDRAWN (Used as comment on EIS)

26A. Map showing location of Greenwood Trail.

26B. Trygg Composite Map.

27. "Lorntson" photos - Wieland homesite, etc. (10 photos). WITHDRAWN (Used as comment on EIS)

28. Map - "Proposed Embarrass Disposal Site" - location of homes and farms within area.

29. 39 photos of residences within Embarrass site and less than mile from site.

LISTING OF EXHIBITS

MPIRG INTERVENORS
EXHIBITS

1. Letter - Eldon G. Kaul and Morris M. Sherman to Merlyn G. Woodle, dated November 18, 1975

2. Witness Statement - Professional Activity -- Donald E. Olson

3. "A Report on Inadvertant Weather Modifications in the Silver Bay Area and Related Topics" - January 21, 1976

DR. RODNEY NELSON
INTERVENOR EXHIBITS

1. Photograph - taken from Dr. Nelson property.
2. " " " " "
3. " " " " "
4. " " " " "

SAVE LAKE SUPERIOR
INTERVENORS EXHIBITS

1. Witness Statement - Charles H. Stoddard.

2. Witness Statement - Alden E. Lind

3. Outline of Testimony on Land Use in MP 7 Vicinity - Alden E. Lind. WITHDRAWN.

4. Eight slides of the Mile Post 7 site.

4A. Description of slides (SLSA Exhibit 4).

5. Silver Bay Quadrangle Map.

6. Outline of Testimony on State's EIS - Alden E. Lind. WITHDRAWN.

7. Homestake Study

8. <u>The New Yorker</u> Magazine - November 12, 1973

9. <u>The New Yorker</u> Magazine - November 19, 1973

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STATE OF MINNESOTA

DNR/PCA EXHIBITS

1. Reserve Mining Company News Letter - August 30, 1973.

2. Opening Statement of Reserve Mining Company - Federal District Court - August, 1973.

3. "Preliminary Report Re Suitability of Tailings for Dam Construction - Reserve Mining Company" - Parsons Jurden (November 17, 1970 - Klohn).

4. "Reserve Mining Company - Size Analysis of Tailings in Tailings Slurry Standard Circuit vs. Dry Cobber Circuit" - March 18, 1969; week of May 19, 1969; week of July 13, 1970. WITHDRAWN.

5. Ripley, Klohn & Leonoff Report - "Reserve Mining Company On-Land Tailings Disposal Facilities - Preliminary Report" - January 15, 1973 (Palisade Creek area).

6. "Reserve Mining Company Comments on the Draft of a 'Summary Report on Environmental Impacts From Taconite Waste Disposal in Lake Superior' and on the Drafts of Various Reports From Different Federal Agencies Submitted Therewith."

7. Portion of Reserve Mining Company Report to Technical Committee -- February 3, 1971.

7A. "Reserve Mining Company Response to Inquiry From Lake Superior Enforcement Conference Technical Committee" - February 3, 1971 - full report.

8. Portion of Reserve Mining Company Engineering Task Force Progress Report - Revised August 10, 1970. WITHDRAWN

9. E. A. Hickok & Associates field notes - 1974-75 - Geological Reconnaissance - Mile Post 7 site.

10. "Reserve Mining Company - Tailings Disposal - Alternate Studies - Final Recommendation - July 7, 1972"

11. U. S. Department of Commerce - Weather Bureau "Technical Paper No. 37 - Evaporation Maps for United States - 1959" (three maps).

12. "100-Year 24-Hour Rainfall (Inches)"

DNR/PCA EXHIBITS

13. "Minnesota Soil Atlas - Hibbing Sheet" - Report 110, 1971.

14. University of Minnesota Extension Bulletin No. 278 - June, 1963 - "Soils of Minnesota."

15. Minnesota Highway Department - Design Discharge Curves - Drainage Manual - Figure F5-294.223 - July 1, 1963.

16. Approximate Water Balance - Mid-Project (Mile Post 7).

17. Map - Partridge River Watershed.

18. Map - Baptism River Watershed; Beaver River Watershed.

19. "Figure 6 - Maximum Discharge From Small Drainage Areas in Hydrologic Region V."

20. Paper - "Design & Construction of Tailings Dams" - October, 1972 - Earle Klohn.

21. Letter - November 17, 1971 - C. H. Maartman, Ripley, Klohn & Leonoff to K. M. Haley, Reserve.

22. Copy of teletype from Earle Klohn to Reserve - June 24, 1974 - re DNR reports.

23. Letter - William Notz, W. A. Wahler & Associates, to Morris Sherman - August 29, 1975 - attaches resume of William A. Wahler.

24. List of papers and articles by William A. Wahler.

25. W. A. Wahler & Associates Report - August, 1975 - "Review of Reserve Mining Company's Preliminary Mile Post 7 Tailings Disposal Plan."

25A. Project Summary 328 - Evaluation of Mile Post 7 On-Land Tailings Disposal Plan - W. A. Wahler & Associates.

26. Witness Statement - Leo Casagrande.

27. Table - "Range of Shear Strength of Samples From Casa Borings" - Casagrande Consultants.

28. Casagrande Consultants Report - August, 1975 - "Final Report on Evaluation of Proposed Design Milepost 7 Project."

29. Water Balance Chart - Silver Bay Facilities (prepared by State)

DNR/PCA EXHIBITS

30. Witness Statement Dr. James Hamel.

31. Michael Baker, Jr., Inc. Report - "Geo-Technical Evaluation On-Land Tailings Disposal Plan - Reserve Mining Company - Mile Post No. 7 Site" - August, 1975.

32. Slides (17) and descriptions - Dr. James Hamel.

33. Curriculum Vitae - Dr. James R. Kramer.

34. Dr. James Kramer report - "Analysis of Fibres in Reserve Tailings"

34A Photograph - Reserve Tailings - Typical Aggregate of Fibrous and Non-Fibrous Particles (#803948)

34B Photograph - Reserve Tailings - Cleavage and Breakage of Fibres (#8034949)

34C Photograph - Reserve Tailings - Different Fiber Lengths, Diameter, Shapes (#803950)

34D Photograph - Reserve Tailings - Ground Sample, Typical Particles (#803951)

34E Photograph - Reserve Tailings - Splitting Fibers (#803952)

34F Photograph - Reserve Tailings - Ground Sample, Disintegrating Fiber (#803953)

34G Photograph - Reserve Tailings - Fibers (#803954)

34H Photograph - Reserve Tailings - Typical Aggregate of Particles (#803955)

35. Memorandum - Memos Katsoulis to Dr. Ronald Hays - August 4, 1975 - "Soil Sampling at RMC Facilities" (attaches sampling location map)

36. Reserve Mining Company Purchase Order No. RJ-75-34999-B to Kaiser Engineering - June 28, 1974 - Authorizes to Proceed With Preliminary Engineering

37. Kaiser Engineers "Interim Report" - Engineering Report for Disposal of Taconite Tailings at MilePost #20

38. Letter - December 19, 1974 - Merlyn G. Woodle to Messrs. Herbst, Merritt, Christenson requesting meeting.

39. Portions of Kaiser Engineers Preliminary Estimate for Concentrator and Pellet Plant Mile Post 42 dated July 31, 1974.

40. Portions of Kaiser Engineers Estimate Details - Mile Post 42 - July, 1974.

41. Letter - August 16, 1974 - L. K. Jacobsen, Kaiser Engineers, to Merlyn G. Woodle attaching original invoice for Preliminary Engineering Services (Invoice dated August 16, 1974 - #22-8-5.

42. Kaiser Engineers Invoice #74-08-020 - August 21, 1974.

43. Portions of Kaiser Engineerings Mile Post 42 Alternate Estimates Backup and Mile Post 20 Estimate Backup.

44. Kaiser Engineers Invoice #22-4-35 - May 12, 1975.

45. Telex - Kaiser Engineers (R. J. Wolf) to Messrs. Banovetz, Kraus, Browning re factors which could terminate project.

45A. Letter - R. J. Wolf, Kaiser Engineers, to Merlyn Woodle re Proposed Engineering and Construction Porgram at Silver Bay (attaches "Reimbursement Terms").

45B. Memorandum - to A. A. Wallach from L. K. Jacobsen, Kaiser - 7-26-74 re Capital Cost Estimate - Pelletizing Facilities - Mile 42.

45C. Engineering Drawing - #50-1001 - stamped July, 1974 - Plan re Mile Post 42 Estimate.

45D. Kaiser back-up material to Mile Post 20 estimates - April 20, 1975.

45E. Letter - L. K. Jacobsen, Kaiser to M. G. Woodle - 8-5-74 re preliminary estimate - Mile Post 42.

45F. Letter - L. K. Jacobsen, Kaiser, to M. G. Woodle - 8-16-74 - re preliminary estimate for Mile Post 42.

45G. Research and Development Report #17-2901 - June 24, 1970 - "Dry Cobbing of Rod Mill Feed."

45H. Article - "On the Strength of Unfired Pellets" by D. A. Rice and R. L. Stone - Society of Mining Engineers, AIME - March, 1972.

46. Confidential - "Comments on Reserve Mining Study" - 8-22-74.

47. "Blast Furnace Savings With Lower Silica in Reserve Pellets" - R. E. Phillips - 8-22-74 - Confidential.

48. Memorandum - S. R. Crooks, Republic Steel, to J. D. Heckerman - 8-22-74 - "Blast Furnace Savings With Lower SiO_2 in Reserve Pellets." Confidential.

49. Letter - J. R. Lowey to Bruce S. Old - 3-27-75 - re tabulation of average coke sulphurs on Republic blast furnaces for past five years. Confidential.

50. Memorandum - R. E. Kusner, Republic - "Comments on ADL's Silica Related Issues - Reserve Mining - K. M. Haley Version" 3-26-75. Confidential.

51. Memorandum - K. M. Haley to E. M. Furness - 2-20-75 - "Silica Related Issues" - attaches portion of ADL's Environmental Report re subject. Confidential.

52. Memorandum - N. W. Lamb to M. J. Netzly, Republic - 2-24-75 - "Comments of J. Fischley on ADL Study." Confidential.

53. Memorandum - S. R. Crooks to J. J. Loftus, Republic - 5-1-74 - "Blast Furnace Savings With Lower SiO_2 in Reserve Pellets." Confidential.

54. "Changes in Annual Operating Costs - Lax Lake Plan - 8-21-74.

55. "Reserve Mining Company Estimated Project Cost - Mile Post 7" - September 19, 1974.

56. "Effect of Various Reserve Mining Proposals on Republic" - attaches schedule - "Table 5 - Estimated Capital Cost for Plan With Fine Crushing Plant, Concentrator and Pellet Plant at Mile Post 42 Plant Site." December 17, 1974

57. Memorandum - Michael Singerman to M. J. Netzly, Republic - 8-21-74 - "Reserve Mining - Escalation Factors."

58. Letter - Rodger Johnson, Wyatt Company, to R. A. Lee re RMCO pension plans in event of plant shutdown - attaches four-page report.

59. Memorandum - R. M. Fletcher to H. B. Phillips - April 9, 1975 - Re: "Iron Ore Costs - 1975." Confidential.

60. Memorandum - R. M. Fletcher to H. B. Phillips - April 9, 1975 - Re: "Iron Ore Costs - 1975." (Same as #59 with certain figures blocked out.)

61. Memorandum - R. M. Fletcher to G. J. Arnold - May 30, 1975 - Re: "Iron Ore - Blast Furnace Burden Costs." Confidential.

62. Memorandum - R. M. Fletcher to G. J. Arnold - May 30, 1975 - Re: "Iron Ore - Blast Furnace Burden Costs. (Same as #61 with certain figures blocked out.)

63. "Modified Colvin Site - Pumping Concentrate to Silver Bay Pelletizing."

64. Reserve Mining Company - Cash Flow Calculations - 8-21-74. Confidential.

65. Pages 9 and 10 of R. R. Dailey's letter dated 12-3-74 to Commissioner, Internal Revenue - re: Reserve Mining Company pollution control facilities.

66. Attachment A - page 2 to C. S. Robertson's letter dated March 7, 1975, to R. A. Kraus - Invitiation to Submit Proposal - RMCO.

67. "Modified Colvin Site - Pumping Concentrate to Silver Bay for Pelletizing" 12-16-74.

68. "Reserve Mining Company - Mile Post #7 (Lax Lake) On Land Tailings Disposal and Product Improvement Plan" (Board of Directors, Armco) - 4-23-75. Confidential.

69. Program Request - Reserve Mining Company - Supplement to Request dated September 19, 1974. Confidential.

70. "Reserve Mining Company - Lax Lake - 9.25% Interest with Escalation Financial Review" - Armco - K. E. Reiser - 9-13-74. Confidential.

71. "Iron Ore Pellet Price" - description of pellet price changes, reasons why prices will hold or fall, etc. Confidential.

72. Prospectus - Armco Steel Corporation - July 22, 1975 - pages 13 and 14.

73. Official Statement - Armco Steel Corporation - Gulf Coast Waste Disposal Authority - August 14, 1975.

74. State of Minnesota Occupation Tax Report of Reserve - 1974. Confidential.

75. Minnesota Corporate Income Tax Return of Reserve - 1974. Confidential.

76. U. S. Corporation Income Tax Return of Reserve - 1974. Confidential.

77. Reserve Mining Company Operating Costs - January-December, 1974 (Before Audit). Confidential.

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78. Reserve Mining Company Operating Costs - January-June, 1975. Confidential.

79. Reserve Mining Company Operating Costs - July, August, September, October, 1975. Confidential.

79A. Reserve Mining Company Operating Costs - Nov. and Dec., 1975

80. Reserve Mining Company - Estimated Book Depreciation - Tax Depreciation - Depletion - 1975-1990. Confidential.

81A. Reserve Mining Company Books - Depreciation - Tax Depreciation - Investment Credit and Interest - Mile Post 7. Confidential.

81B. Reserve Mining Company Books - Depreciation - Tax Depreciation - Investment Credit and Interest - Mile Post 20. Confidential.

81C. Reserve Mining Company Books - Depreciation - Tax Depreciation - Investment Credit and Interest - Mile Post 42 Slurry Pumping. Confidential.

82. Reserve Mining Company - Tonnage Basis Assets as at December 31, 1974. Confidential.

83. Reserve Mining Company - 1974 Shipments for Account of Mesabi Trust. Confidential.

83A. Reserve Mining Company - Crude Ore Reserve Estimates at January 1, 1975. Confidential.

84. Reserve Mining Company - Estimated Capital Expenditures - 1975 (7-22-75). Confidential.

85. Reserve Mining Company - Audited Financial Statements - December 31, 1974 - Ernst & Ernst.

86. Size Distribution Charts Compiled From DNR/PCA Exhibit 88, RMC Exhibit 104, Drawing 292-0030 from RMC Exhibit 112, Table 1.2.5.2-A from A. D. Little Report (RMC 37A).

87. Letter - Gerald A. Place to M. R. Hyde - August 26, 1975 - re additional information on vegetation program.

88. Chemical and physical analysis of various disposal sites prepared by Dames & Moore.

89. Brown, Place and Pettiet, "The Effect of Soil Moisture Upon Cation Exchange in Soils and Nutrient Uptake by Plants". WITHDRAWN.

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90. Brown and Place, "The Relation Between Soil Moisture and Efficiency of Fertilizer Usage." WITHDRAWN.

91. Memorandum - C. W. Maxwell to R. L. Reed - November 19, 1973 - "History of Delta Seeding and Planting.

92. Photograph of Babbitt Pilot Plant Area.

93. Photograph of Babbitt Pilot Plant Area.

94. Photograph of Babbitt Pilot Plant Area.

95. "Experiments in Propagating Plant Cover at Tailing Basins" by Sam Dickinson, Erie Mining Company - Mining Congress Journal, October, 1972.

96. Excerpts "Preliminary Comments on Weston Report." WITHDRAWN.

97. Witness Statement - Richard P. Braun.

98. Witness Statement - John C. Mullan.

99. Witness Statement - Dennis E. Hawker.

100. Brochure - Barton-Aschman Associates, Inc.

101. Brochure - Professional Staff - Barton-Aschman Associates, Inc.

102. Draft Environmental Impact Statement for Reserve's Proposed On-Land Tailings Disposal Plan Prepared for State of Minnesota - October, 1975.

103. Draft Environmental Impact Statement - Appendix.

104. Witness Statement - Ronald M. Hays.

105. State of Minnesota Notice of Completion of Draft Environmental Impact Statement and Hearing - November 5, 1975.

106. Witness Statement - A. Eugene Vandegrift.

107. Fact Sheet - "Facts About Midwest Research Institute."

108. Brochure - "Toward a Better Environment - Environmental Impact Studies" - Midwest Research Institute.

109. (there is no #109 - mis-numbering)

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110. Witness Statement - Edward J. Samuelli.

111. Brochure - "Engineering and construction from concept to reality..." F. C. Torkelson Company.

112. F. C. Torkelson Company - "Functional Specifications."

113. Witness Statement - Leonard A. West.

114. Contract - Barton-Aschman & Associates and F. C. Torkelson - July 1, 1975.

115. Invoice - F. C. Torkelson to Barton-Aschman - October 16, 1975.

116. Torkelson Manpower Forecast.

117. Witness Statement - Gorden F. Johnson.

118. F. C. Torkelson - Operating Costs - Embarrass Site - Scheme A. Confidential.

119. F. C. Torkelson - Operating Costs - Mile Post 7 Site - Confidential.

120. Witness Statement - Douglas W. Barr.

121. Barr Engineering Company's Staff Resume and Projects List.

122. Witness Statement - Lawrence R. Molsather.

123. Curriculum Vitae - Dr. Donald H. Yardley.

124. Dr. Donald Yardley's "Addendum Report - Alternative No. 1."

124A. Dr. Donald Yardley's "Memorandum Notes" - January 3, 1976.

125. Witness Statement - Dr. R. Glen Berryman.

126. "Effect of Different Financing Methods on the Profitability of Mining Investments" - by E. P. Pfleider - 30th Annual Mining Symposium - 1969.

127. "Metal Prices" - Skillings' Mining Review - July 5, 1975, July 12, 1975, July 19, 1975.

128. Memorandum - Paul Zerby to Ronald M. Hays - "Royalties Paid by Reserve for Computer Program" - August 29, 1975.

128A. Letter - Robert A. Lee to Maclay R. Hyde - September 26, 1975 - enclosing operating cost reports for July and August, 1975.

129. Memorandum - Paul Zerby to Ronald M. Hays - "Variable in Minnesota Taconite and Royalty Taxes Paid by Reserve for Computer Program" - August 29, 1975.

130. Curriculum Vitae - John D. Rogers.

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131. Letter - Douglas Barr to John Mullan - July 9, 1975 - re Erie concern - Embarrass site water problems.

132. Curriculum Vitae - Robert J. Reid.

133. Witness Statement - Ralph Warner.

134. Witness Statement - Donn R. Wiski.

135. Witness Statement - Timothy W. Joseph.

136. Witness Statement - J. Michael Dolan, III.

136A. Letter - Dr. J. Michael Dolan to Edward Moersfelder - 2-20-76 re variation in water quality parameters.

137. Witness Statement - Roderick E. Athey.

138. Roderick Athey "Addenda/Errata for the Energy Evaluation of Alternate Sites - Reserve Mining Comany Environmental Impact Statement."

139. Curriculum Vitae - Chatten Cowherd, Jr.

140. "Projections of Air Quality Impact of On-Land Disposal of Taconite Tailings - Midwest Research Institute - January 19, 1976."

140A. Letter - Chatten Cowherd, MRI, to Eldon Kaul re calculation of percentages of dust emissions from tailings - January 30, 1976.

140B. Letter - Chatten Cowherd, MRI, to Eldon Kaul re revision to projection of air quality impact of on-land disposal at Midway - February 3, 1976.

140C. Letter - Chatten Cowherd, MRI, to Eldon Kaul re revision to projection of air quality impact of on-land disposal at Snowshoe - February 5, 1976.

140D. Letter - Chatten Cowherd, MRI, to Eldon Kaul re corrections to reports dated February 3 and February 5, 1976. (Letter of 2-11-76)

140E. Chart - "Comparison of MRI and ADL Data/Results" - Air Emissions - Dr. Chatten Cowherd, MRI.

140F. Chart - "Effect of MRI/ADL Modeling Differences (Source Distribution at MilePost 7" - 3-6-76 - Dr. Chatten Cowherd, MRI.

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142. Colored photo - Erie Mining Company tailings pond - shows dust.

143. Colored photo - Erie Mining Company tailings pond - shows dust.

144. Colored photo - Erie Mining Company tailings pond - shows dust.

145. Colored photo - Erie Mining Company tailings pond - shows dust.

146. Colored photo - Erie Mining Company tailings pond - shows dust.

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147. Curriculum Vitae - Dr. Philip M. Cook.

148. Report - "Prediction of Fiber Concentrations Associated With Fugitive Dust Emissions From Land Disposal of RMC Taconite Tailings" - Dr. Philip M. Cook.

149. Curriculum Vitae - Rudolph Pinola.

150. "Benefits Received by a Typical Union (Non-Salaried) Reserve Mining Company Employee in the Event of a Plant Shutdown."

151. "Scheduled Startups of New and Expanded Taconite Processing Facilities in St. Louis County, Minnesota and Estimated New Permanent Employment."

152. "Benefits Available to Employees in the Event of a Permanent Shutdown" - D. J. DeLeo.

152A. Letter - Rudolph Pinola, Minnesota Department of Employment Services, to Edward Moersfelder attaching draft "Benefits Available to RMC Employees in Event of Shutdown" etc.

153. "Midway Supplement - Draft Environmental Impact Statement" - DNR/PCA - February, 1976.

154. Witness Statement - William C. Brice.

155. Planning and Environmental Review Team (PERT).

156. Department of Natural Resources "Operational Order No. 40" - May 1, 1975.

157. Reserve Mining Company Project - List of Contacts.

158. Office Memorandum - Department of Natural Resources - June 9, 1975 - From Robert Herbst - re Reserve Mining Studies.

159. Office Memorandum - Department of Natural Resources - July 28, 1975 - From Robert Herbst to Archie Chelseth, Dick Myshak, etc. Re: Review of Draft Documents Related to the Reserve EIS.

160. Memorandum dated August 6, 1975, to Messrs. Sherman, Hays, Brice, etc., from Robert Herbst re Reserve Mining On-Land Disposal.

161. DNR Regional Map - Tailings Sites.

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171. DNR Detail Map - Mineral Potential.

172. State of Minnesota Map - Peat Resources.

173. DNR Regional Map - Peat Resources.

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183. Chart - Existing Wildlife Population-Habitat Ratings.

184. Witness Statement - Thomas F. Waters.

185. Resume - C. R. Burrows.

186. State of Minnesota, Department of Natural Resources - Commissioner's Order No. 1852 - Regulations Designating Trout Streams.

187. DNR Detail Map - Aquatic Habitat.

188. DNR Detail Map - Aquatic Habitat (Ecological).

189. 1975-77 Acquisition Program for Fisheries - attached to letter dated April 2, 1975, from Commissioner Herbst to Minnesota Legislature.

190. Memorandum - February 23, 1942 from T. R. Evans to Mandt Torrison re Lake County trout streams.

191. Lake County Resolution - April 22, 1942 - Re lands classified as conservation lands.

192. Lake County "Certificate of Acceptance of Lands for Conservation Purposes" - July 29, 1942.

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193. DNR Detail Map - Acquired Conservation Lands.

193 A. DNR Detail Map - Acquired Conservation Lands - Ownership.

194. "Data on Waters in and Near Proposed Tailings Basins."

194A. DNR Detail Map - Aquatic Habitat (Ecological).

195. Witness Statement - Alfred B. Pennell.

196. Reserve Mining Company - Appropriation Permits for Mine Pit Dewatering.

197. Resume - Eugene R. Gere.

198. State of Minnesota, Counties of St. Louis and Lake, Department of Highways - Project Development Report & Preliminary Location Report for National Forest Highway 11.

199. "Commuting Characteristics of the Employees of Minntac, Erie, and Eveleth Taconite Operations."

200. "Distribution of Taconite Tax and Additional Taconite Tax."

201. "Distribution of Supplementary Additional Taconite Tax."

202. DNR Regional Map - Existing Land Use.

203. DNR Regional Map - Cultivated Land Use.

204. DNR Regional Map - Pasture/Open Land Use.

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240. Curriculum Vitae - John R. Borchert.

241. Resume - Paul Eger.

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242. DNR Detail Map - Water Discharge.

243. Report - "Fiber Analysis of Water Samples From Reserve Mining Company's Peter Mitchell Pit," - February 23, 1976 - Philip M. Cook.

243A. Photograph - RMC-1 - Crusher #2 - 1-14-76 - Fibers.

243B. Photograph - Figure 2 - Fibers.

243C. Photograph - Figure 3 - SAED of Fiber Bundle in Figure 2.

244. "Summary of Superior, Wisconsin Water Supply Data."

245. Resume - Daniel F. Bigalke.

246. Charts - Comparison of Disposal Sites (Mile Post 7, Embarrass, Snowshoe, Colvin, Midway).

247. DNR Detail Map - Flood Path.

248. DNR Detail Map - Transportation/Utilities.

249. Witness Statement - Gene Hollenstein.

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259. Chart - Total Fibers - Babbitt From Embarrass.

260. Witness Statement - Louis J. Breimhurst.

261. "Water Use Classification at Proposed Site and Alternatives - Reserve Mining Company's Draft Environmental Impact Statement - January 7, 1976."

262. MPCA Division of Water Quality - Major considerations re comparison of Mile Post 7, Embarrass, Colvin, Snowshoe, Midway.

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263. Witness Statement - Curtis J. Sparks.

264. Witness Statement - M. P. Katsoulis.

265. Witness Statement - Colin F. Harwood.

266. Witness Statement - Gary S. Eckhardt.

266A. Table I - prepared by EPA - "Summary of Simulation Model Characteristics."

266B. Table 3 - "Comparison of TSP Levels - Northeastern Minnesota."

267. Table 4 - "Summary of Amphibole Fiber Sampling Programs" - attaches various statistics, reports, 3-2-76 Gove memo to Agency members.

268. Table 5 - "Amphibole Fiber Size Distribution."

269. Table 6 - "Extrapolated OSHA Standard."

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274. Table 11 - "Projected Impact of Amphibole Fiber Levels in Population Centers" (With Mitigation).

275. Table 12 - "Exposure, Fiber-Years Per Cubic Centimeter" (Without Mitigation).

276. Table 14 - WITHDRAWN.

277. Computer Printout "Frequency Distribution of Amphibole Fiber Sizes for Silver Bay" - WITHDRAWN.

278. Figure 11 - "Number of Standard Deviations From Mean - Projected 24-Hour Levels of Total Suspended Particulates - Assumption Standard Geometric Deviation of 1.5."

279. Report of Dr. Philip M. Cook - March 8, 1976 - "Analysis of RMC Coarse Taconite Tailings for Fiber Concentrations."

280. Resume - Tibor Kosa.

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281. Memorandum to MPCA Board Members - 2-28-76 - From Peter Gove - Re: "Analysis of Reserve Mining Company Health Evidence."

282. Memorandums - 11-26-75 from Governor Anderson to Highway Commissioner Frank Marzitelli; 12-3-75 from Highway Commissioner Marzitelli to Governor Anderson; 12-3-75 from W. C. Merritt, Deputy Commissioner of Highways to Highway Department Administration; Letter 12-19-75 from Peter Gove to Lloyd Houle, Lake County Board of Commissioners; all re use of tailings.

283. Memorandums - 11-27-74 to Lewis Barbe from Memos Katsoulis re violation of WPC regulations at Mile Post 7; 11-26-74 to John McGuire from Memos Katsoulis re Field Investigations of Reserve Mining Mile Post 7 Monitoring Stations.

284. Letter - W. T. Egan to Paul Zerby - 3-8-76 - attaches confidential Republic Steel Corporation documents.

285. Overlay to RMCO Exhibit #40 used in cross examination of Dr. Vranka.

285A. Overlay to RMCO Exhibit #40.

285B. Overlay to RMCO Exhibit #40.

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This Index contains a list of those items which may be of general interest to persons wishing to review proceedings in the Reserve permit application hearings for an on-land tailings disposal facility. These items are located both in Duluth and Minneapolis and may be reviewed by contacting William Gordon, Director of Libraries, Duluth Public Library, Duluth, Minnesota, or Julie Copeland, Environmental Library, Minneapolis Public Library, Minneapolis, Minnesota.

A. Complete Transcripts and Exhibits from the Permit and Environmental Impact Statement Hearings including:

1. The EIS presentation by responsible agencies is found in Transcript Vols. 34 through 51, and 57, 58 and 61; see DNR/PCA Exhs. 97-152.

2. Rebuttal testimony presented by applicant in response to the State's EIS is found in Transcript Vols. 52-56, 59-60, 64, 73-77, and 81; see RMC Exhs. 383-469.

3. Testimony and evidence presented prior to the EIS presentation are found in Transcript Vols. 1-33; see RMC Exhs. 1-382A, Union Exhs. 1-6; Dr. Rodney Nelson (Intervenor) Exhs. 1-4; and NMI Exhs. 1-24.

4. The Agencies' policy and supplemental EIS presentation are found in Transcript Vols. 62 and 63 (supp. EIS presentation) and Transcript Vols. 65-72, 78-80 and 82-A and B; see DNR/PCA Exhs. 153-283.

B. Written and Oral Comments from the General Public and Commenting Agencies.

1. Written and oral comments from general public and commenting agencies are found in Transcript Vols. 41 and 44; see NMI Exhs. 28 and 29.

2. Written comments were made by the following general public and commenting agencies and may be found in the folder labeled "Written Comments from the General Public and Commenting Agencies":

   (1) Lloyd Houle, Chairman, Lake County Board of Commissioners - 12/11/75

   (2) Robert A. Murdock - 12/12/75

   (3) Warner Buhman - 12/13/75

(4) Federal Interagency Reserve Mining Task Force - 12/15/75

(5) Mrs. Lillian M. Ruby - 12/15/75

(6) Mrs. Lillian Salo - 12/15/75

(7) Undated petition signed by 93 Waasa Township residents

(8) Mr. and Mrs. Ronald E. Salo - 12/15/75

(9) Mr. and Mrs. Helge Taapa - 12/15/75

(10) Mr. and Mrs. Walter Mattson - 12/15/75

(11) Barney Bischoff, Executive Secretary, Range Municipalities and Civic Association - 12/17/75

(12) James R. Coleman - 12/26/75

(13) John H. Jeffries - 12/27/75

(14) Ms. Ethel Thornley; 8 additional signatures - 12/29/75

(15) Howard and Alice Pierce - 1/9/76

(16) Forrest T. Gay, III, Colonel, Corps of Engineers, St. Paul District - 1/12/76

(17) Frant T. Marzitelli, Commissioner, State of Minnesota, Dept. of Highways - 1/14/76

(18) Francis T. Mayo, Regional Administrator, U.S.E.P.A., Region V - 1/21/76

(19) Jim Lord, Treasurer, State of Minnesota - 1/27/76

(20) John P. Millhone, Director, Minnesota Energy Agency - 1/28/76

(21) Warren R. Lawson, Commissioner of Health - 1/28/76

(22) Milton Mattson, S.L.S.A. - 1/28/76

(23) Robert W. Mattson, State Auditor - 1/28/76

(24) Arthur Lorntson, for Northeastern Minnesota Intervenors - 1/28/76

(25) Alden E. Lind - undated

(26) Jack Hemphill, Regional Director, U.S. Dept. of Interior, Fish & Wildlife Service - 2/5/76

C. Comments Submitted by Parties Including Briefs Addressing the Adequacy and Substance of the Draft EIS.

Parties to the hearings submitted statements to the Hearing Officer regarding the adequacy of the Environmental Impact Statement and briefs addressing the substance of that statement prior to the Hearing Officer's recommendations concerning the Draft EIS and the siting decision. These statements and briefs in part represent comments by the parties to the hearings on the Draft EIS and consist of the following documents:

1. Comments with Respect to Inadequacies of Environmental Impact Statement, by MPIRG and MECCA - 1/21/76

2. Letter from counsel for Dr. Rodney Nelson, Intervenor - 1/21/76

3. Comments by Intervenors SLSA and Sierra Club - 1/23/76

4. Response to Hearing Officer's Request for a Statement of Inadequacies in the Draft EIS, by Reserve - 1/23/76

5. Brief of Reserve Mining Company in Support of Applications for Permits for Mile Post 7 On-land Disposal and Air Quality Plan - 3/18/76

6. Brief of Northeastern Minnesota Intervenors - 3/23/76

7. Brief of United Steelworkers of America, AFL-CIO, In Support of Applications for Permits for Mile Post 7 On-land Tailings Disposal - 3/31/76

8. Brief of Minnesota Public Interest Research Group (MPIRG) and Minnesota Environmental Control Citizens Association (MECCA) - 4/2/76

9. Brief of Intervenors Save Lake Superior Association and Sierra Club - 4/8/76

10. Rebuttal Brief of Reserve Mining Company, Armco and Republic - 4/15/76

D. Response of Responsible Agencies to Comments from the Public, Commenting Agencies, and the Parties to the Hearings Including Agency Briefs, Written Responses to Specific Points Raised, and Response on the Record to Said Comments.

1. DNR Response to Comments is contained in Procedural Conference transcript dated 2/4/76.

2. Brief of MDNR - 4/5/76
Brief of MPCA - 4/8/76

3. Discussion on the record between Hearing Officer and parties regarding treatment of the MP 20 site (Midway) may be found in Transcript Vol. 36, and Procedural Conference transcript dated January 9, 1976.