[Crandon Mine Project comments]. Volume 1 1982-1983

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State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Carroll D. Besadny
Secretary

BOX 7921
MADISON, WISCONSIN 53707

November 8, 1983

IN REPLY REFER TO: 1630
(Exxon)

Dear Librarian:

A copy of the Department of Natural Resources initial comments on Exxon's Mining Permit Application for the proposed Exxon/Crandon Mine is enclosed. The September 19, 1983 letter indicates general concerns, while the October 10, 1983 letter contains a more detailed response. Please place the enclosed information along with the other comments which are being kept with the Exxon Environmental Impact Report material.

Thank you for your cooperation. If you have any questions, please contact me at (608) 267-7538.

Sincerely,
Bureau of Environmental Impact

Carol Nelson

Carol Nelson
Environmental Specialist

CN:us/1907C
Encl.

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES
Carroll D. Besadny
Secretary

BOX 7921
MADISON, WISCONSIN 53707

September 19, 1983

IN REPLY REFER TO: 2720-2

Mr. Robert L. Russell
Manager, Crandon Project
Exxon Minerals Company
P.O. Box 813
Rhinelander, WI 54501

Dear Mr. Russell:

The Department has completed its review of the material submitted in support of Exxon's mining permit application on December 22, 1982. The review has been coordinated by the Mine Reclamation Section. The following comments reflect major concerns of the Department which will have to be addressed before the permit application can be considered complete. Another letter containing additional and more detailed comments on the application will follow in about two weeks.

Because of the all-encompassing nature of the mining permit (by definition it covers the entire mining site), the submittal of the permit application so early in the process has made review rather difficult. Various aspects of the proposal have undergone or may be subject to change from the original proposal. Exxon has recognized this fact in its introductions to both the Mine Plan and the Reclamation Plan with the statement: "Many of the concepts discussed herein will be subject to refinement as engineering progresses to completion. Accordingly, to the extent it may be required this Mine Plan (Reclamation Plan) will be supplemented to reflect the resulting refinements."

It should be recognized that the final mining permit application which will be the subject of the master hearing, will have to be completely up-to-date and will constitute Exxon's actual proposal for the mining and reclamation activities it wishes to have permitted. Therefore, material which was submitted early in the process and which is no longer appropriate will have to be removed and the proper material inserted. Also, NR 132.06(3)(f) requires as part of the application that evidence that the applicant has applied for all approvals, licenses or permits required by the Department be submitted. Obviously, the mining permit application will not be complete until this requirement has been met.

However, in recognition of Exxon's expressed desire to receive Department comment on their efforts thus far, we are providing these comments at this time within the limitations of the materials submitted to date.

Comments:

Comments on the application have been broken down into two categories: General Comments which reflect overall concerns the Department has with major aspects of the permit application as contained in this letter; and Specific Comments which detail comments of the reviewers as they apply to specific sections of the application. Many of the detailed comments are similar to or identical with comments submitted to Exxon on the EIR review letter of May 11, 1983. As indicated previously these detailed comments will be sent to you in a second letter in about two weeks.

General Comments

I. A major concern is the effect of dewatering of the mine on the groundwater level in the mine area, and in turn what this would do to private wells and surface water bodies in the area. We will need a much better description of the hydrology of the ore body and surrounding area and especially how the mining process will change the present conditions. Much of this description and explanation has been presented to DNR staff verbally at meetings, but it will have to be submitted as written material. In connection with this idea, I am sure you are aware that a number of wells in the Shullsburg area were contaminated after the mines were closed and allowed to fill with water. A number of people have major concerns that once the Exxon mine is backfilled with pyrite-rich material and allowed to become saturated with groundwater, similar problems could arise. The situations are not analogous, but the application should point out in detail what the differences are, and why such a problem would not occur. Enough background data regarding fracture systems, permeability, and geology should be presented to back-up this conclusion.

II. Another item of concern is the control of surface run-off, especially during the construction phase of the surface facilities. Calculations are needed to show what the maximum run-off would be and to demonstrate that proposed collection and holding methods will be adequate to handle such run-off. Considerably more detail (contour maps, structure cross-sections and dimensions) are needed for both the mill-site area and the tailings pond area.

III. The tailings disposal system with its possible threat to groundwater is an item of major concern to us. It is expected that the Feasibility Report review process will address most of these concerns. However, the haul roads and tailings pipelines are permitted under Chapter NR 132, Wis. Adm. Code, and therefore must be addressed in detail in the mining permit application. Our concerns with the haul roads have to do with what materials they will be constructed from, the source of those materials, and measures to control dust and surface run-off. Most of our concerns with the tailings pipelines stem from the fact that they are proposed to be buried and therefore we need details on those items which would assure protection of the groundwater. For example, pipe material and strength, resistance to weathering and to inside wear, methods of monitoring for leaks, handling of leaks, methods of installation, etc.

IV. Our major problem with the Reclamation Plan is its lack of perspective with regard to the total mining site. It appears that each of the major components is considered by itself with regard to final reclamation and ultimate land use. The reason Wisconsin passed the Metallic Mining Reclamation Act in 1974 and the philosophy behind the Act (confirmed in its revision in 1978) was to ensure that if mining were carried on in this state, it would be done in such a manner as to minimize disturbance to the environment and provide for reclamation of the mining site "to either its original state or, if this is shown to be physically or economically impracticable or environmentally or socially undesirable, to a state that provides long-term environmental stability." (NR 132.03(21)).

NR 132.08 requires submittal of a "comprehensive long-term plan" for the area affected by mining, "in detail satisfactory to the Department." Exxon's proposed Reclamation Plan merely refers to this requirement with the statement "See this Reclamation Plan". In our judgement, this is not an adequate response. What is needed is a description, with graphics such as air photos, artists conceptions, drawings and maps which treat the site as a unit within the surrounding area. The plan and graphics should demonstrate in a manner understandable to technical and non-technical reviewers and other interested parties what the total area is like before mining, what it will be like during maximum disturbance of mining, and what it will be like following completion of reclamation. In this connection I would like to point out that a key requirement for the acceptability of a reclamation plan is found in NR 132.08(1)(d) "proposed final land use and relationship to surrounding land and land use." This must be shown for the entire mining site and surrounding land. Also, 132.08(3) requires that if the affected area is not to be returned to its original state, the Reclamation Plan must give the reasons why this is proposed. The Plan as submitted does not adequately address this requirement.

The Mine Reclamation Section staff will be glad to discuss with you our problems with this lack of overall perspective and possible ways of remedying what we see as a major deficiency in the proposed Reclamation Plan.

In summary, the mining permit application while quite comprehensive is not considered complete. The concerns and requirements described above as well as the more specific comments which will be presented in the succeeding letter will have to be addressed before a finding of completeness can be made. Also, any changes in applications for other permits or approvals which affect surface disturbance of the mining site and its reclamation will have to be accounted for in the final mining permit application.

If you have have any questions concerning these comments or other aspects of the mining permit process, please feel free to contact me at any time.

Sincerely,
Bureau of Solid Waste Management

Gordon H. Reinke

Gordon H. Reinke, Chief
Mine Reclamation Section

GHR:mk/4018Y

cc: North Central District
L. F. Wible - ADM/5
P. Didier - SW/3
H.S. Druckenmiller - BEI
C. Hammer - LEG/5
L. Bochert - ADM/5

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Carroll D. Besadny
Secretary

BOX 7921
MADISON, WISCONSIN 53707

October 10, 1983

IN REPLY REFER TO: 2720-2

Mr. Robert L. Russell
Manager, Crandon Project
Exxon Minerals Company
P.O. Box 813
Rhinelander, WI 54501

Dear Mr. Russell:

This letter contains the Department's detailed comments on Exxon's two volume mining permit application and is the follow-up to our September 19, 1983 letter to you which listed our general concerns with the application. For your convenience, an asterisk(*) preceding a comment indicates that comment was also included in the May 11, 1983 letter to you on the EIR review.

Section A, Item 7 - This description of the mining site is inadequate. A breakdown of the site in a manner similar to that in Table A-8 would be more appropriate. What is the actual acreage to be covered by the mining permit?

Section A, Item 8 - The description and table regarding land ownership should identify the State of Wisconsin as the owner of the lake beds in the area. Table A-8 states that a portion of Section 20, T35N, R13E is owned by Everett Rudlof but Figure A-8 shows Ernest Rudlof as the owner. Also, the table shows Gerald Solpers as an owner in Section 33, T35N, R13E, but the map shows Gerald Solper.

Table A-8, Page 5 of 5 - As of February 23, 1983, all pipeline easements were not yet recorded at the Forest County Register of Deeds Office. Please indicate which easements have not been finalized and/or recorded.

Section A, Item 9 - Table A-9 should be amended pursuant to the comments made regarding Table T.1-2 of Exxon's EIR. Also, Table A-9 indicates that an operating license for the MWDF is required prior to construction. In actuality, this license will not be issued until after the facility has been constructed.

Section A, Item 12 - Unless Exxon can definitively demonstrate an alternate use for the access road, reclamation costs for the road should be included. The reclamation costs presented in Table A-12 must be further itemized and broken down to unit costs. If these are not available, a discussion of how the costs were derived should be included.

Section A, Item 13 - Table A-13 states that one of the owners in Section 33, T35N, R13E is John Campshure but Figure A-8 shows John Campshire.

Section A, Item 14 - Are the Wetlands Assessment Report and Inventory considered part of this permit application? If not, maps should be provided to show the proposed site and the potentially affected wetlands. If the reports are part of the application, they should be attached.

Contrary to what is stated in the application, since area 41 is hydrologically upgradient of area 40, then area 41 has to have as much, if not more, downgradient domestic use of groundwater.

Section A, Item 15

Groundwater - The monitoring requirements related specifically to the MWDF will be finalized through the Feasibility Report review and the Plan of Operation approval. These requirements will have to be included in the mining permit application once they have been established. Following are some preliminary comments pertaining to the proposed groundwater monitoring program.

The proposed background and operational groundwater monitoring program as shown in Figure 1 is inadequate. More wells north of the mine/mill site and also around Little Sand Lake should be included. Also, more wells will be needed around the mine waste disposal facility in all directions and at variable depths.

Pursuant to s. NR 182.075(1)(d)5, the parameters to be analyzed in the background groundwater monitoring program for the MWDF must include all parameters with a primary or secondary drinking water standard. The list of parameters indicated on Table 1 does not include all of the secondary parameters.

A monitoring plan should also include the backfill storage area.

Oak Lake should be added to the list of surface waters to be sampled quarterly. The parameters to be analyzed in Oak Lake should correspond to the list in Footnote 3, Table 3.

The parameters monitored on Swamp Creek at the proposed discharge location should correspond to the list of pollutants found in Exxon's effluent.

Suspended solids should be added to the monitoring list in Footnote 3, Table 3.

Continuous stream flow recording should occur at Hemlock Creek (Station H) and Swamp Creek (Station S -- above Rice Lake). One additional station on Swamp Creek below Rice Lake (either at CTH "M" or in the vicinity of the proposed discharge) should be monitored continuously for stream flow. Quarterly flow monitoring, as proposed by Exxon, at Stations H, S and the proposed discharge location is simply inadequate to address the impacts of mine dewatering on surface water flows.

Pickerel Creek, Creek 11-4 and Creek 12-9, which are tributaries to Rolling Stone Lake, may be adversely affected by mine dewatering especially during low flow periods. Therefore, these streams should be monitored for flows on a monthly basis from November through May and biweekly from June through October when flows are generally lower.

Table 3 lists the sampling frequency as quarterly for some parameters and annually for others for sampling locations on Swamp and Hemlock Creeks. How was the sampling interval determined for each of the parameters? Quarterly sampling for all the parameters is recommended.

Will Exxon analyze the parameters under footnote 2 on a quarterly basis and those under footnote 3 on an annual basis?

Table 3 lists Skunk Lake as a sampling location. However, the site for Skunk Lake is not included in Figure 4. Please clarify.

Hoffman Springs should be included in the surface water monitoring program.

Parameter lists do not include suspended solids. This should be monitored especially during the construction period.

In general, a discussion section summarizing potential problem areas and reasons for selecting sites to monitor the problem areas is needed. More specifically, the following questions and comments should be considered for inclusion in a discussion section covering monitoring rationale:

- Why were the particular sites on Swamp and Hemlock Creeks selected for study?

- Why were only four lakes selected for study? Do these four lakes have the greatest potential for ecological impacts from the mine operation? If not, why weren't other lakes included for study?

- Are the lakes to be sampled at different depths?

- Productivity indicators like chlorophyl-a, total-P and secchi disc should be included in the lake sampling parameter list.

- Sedimentation pond monitoring should be event-related (sample collection just after significant rainfall and snowmelt events).

- Sedimentation ponds should also be sampled for metals, total suspended solids and oil and grease.

- Any surface receiving waters of sedimentation pond discharges should be monitored for water quality impacts.

- Will the annual creek water chemistry samples be limited to metals and nitrate analysis, or will they also include the general quarterly parameter coverage?

Discharge monitoring from the water treatment plant will be required and specified in the WPDES permit. Daily, weekly and monthly monitoring may be required for various pollutants dependent on the toxicity of the pollutant and possibly the volume of discharge.

Sampling of the runoff from the sedimentation ponds will again be dictated by the WPDES permit. The frequency will depend on the projected contaminants. The parameters which at a minimum will be required include total suspended solids, pH, alkalinity and oil and grease where appropriate. Limitations may be imposed for any or all of these parameters.

Aquatic Ecology

This section states that biological parameters will only be examined at the three locations on Swamp Creek in the vicinity of the discharge. It is essential to monitor the aquatic ecology of all of the surface waters where potential impacts could occur from construction activities, dewatering and the discharge.

In general, much more detail is needed for describing the aquatic ecology study plan.

a. Periphyton or aquatic macrophyte populations are scheduled for study. Which components will actually be studied and on what schedule?

b. What collection methods will be used for fish, invertebrates, periphyton and/or macrophytes?

c. There is no mention of data analysis for macrophytes. Which benthos taxa will be saved for tissue analysis? What analyses will be conducted on the tissue? There is no mention of Biotic Index (BI) analysis of benthos samples (BI analysis is being performed on Swamp Creek baseline samples). What is "total numbers" analysis of benthos data - per unit area, per station, or what? Will any qualitative benthos data be collected? From what habitat types will benthos be collected?

Air Quality

The location of monitor A makes it an upwind rather than a downwind monitor since wind directions recorded at the project site are predominantly from the south through west and northwest while winds from the east and northeast are rare (see Figure 2.1-2 through 2.1-9 in the EIR). A more in-depth analysis of wind data would be necessary to determine the best monitor locations, but it is suggested that monitor A would be better located if it were north of the mine waste disposal facility since winds from the south were recorded quite frequently at the project site. Better justification for the locations of the proposed monitors should be provided.

Page 15, Second Paragraph - It is stated that TSP (total suspended particulate) will be monitored at all sampling locations and that the samplers used will be able to distinguish particles larger and smaller than 10 microns in diameter. Does this mean that each TSP sample will actually be collected as two separate samples, one with particles greater than 10 microns in diameter and one with particles less than 10 microns in diameter? A more detailed explanation is in order here.

The dust from the MWDF could contain high levels of sulfides. The total particulates should be analyzed for sulfur to determine possible acid generation in adjacent surface waters, i.e., Duck, Deep Hole, and Little Sand Lakes.

Terrestrial Ecology

How will wildlife activity be monitored in the vicinity of the mining site?

Section B, Item 2

Neither self-bonding nor a demonstration of net worth are acceptable methods of satisfying the financial responsibility requirements of the applicable law or code. Section 144.86(1), Stats., specifies a bond furnished by a surety company licensed to do business in Wisconsin, cash deposit, certificate of deposit or government securities as the acceptable methods of meeting the financial responsibility provisions. Does Exxon plan on submitting a bond to cover reclamation of the entire site or will the bond be updated annually according to the amount of surface disturbance? If the latter method is preferred a detailed schedule showing the disturbance which will take place every year over the life of the project is required.

Section C

For the record it should be noted that the fee ($10,000) will be adjusted to reflect the actual cost of evaluation.

Section D - Mine Plan

General - Exxon refers to a number of state and federal regulations which must be complied with during the course of the project. However, Exxon does not reference the specific Administrative Code or federal rule which must be complied with. Examples of this occur in the following locations in the mining plan:

page 2-11 - sec. 2.1.2.1.2
page 2-12 - par. 1 and 2
page 2-33 - sec 2.4.5
page 2-34 - sec. 2.4.8
page 2-35 - sec. 2.4.9
page 2-40 - last par.
page 3-8 - first par.

These and any other vague references to compliance with codes or rules should be made more specific.

Section 2 (general) - The approximate dimensions and physical appearance of all surface facilities mentioned in this section or shown on the diagrams (Figures 2.1-5, 2.2-5 and 2.4-1) should be presented. No mention is made of the reclamation material storage area, solid waste storage area or the means of limiting access to the site.

Section 2.0, Description of Facilities - How much area included in the permitted mining site will actually be disturbed?

Section 2.1.1, Mine Surface Facilities - The surface facilities associated with the air compressors, mine air heaters and the mine vent exhaust fans should be discussed more thoroughly.

Section 2.1.1.1, Headframe - The external appearance of the headframe should be more thoroughly discussed.

* Section 2.1.2.1, Main Shaft - Paragraph 2 discusses pumping construction mine water to the surface. The last sentence should not be left open ended. Where on the "surface" will that water go?

* Section 2.1.2.2., Ventilation Shafts - Describe the shaft surface discharge structures, fan size, noise suppression, and air quality controls.

* Section 2.1.2.3, Drifts - Describe in detail the mining plan as it relates to the control of surface subsidence.

* Section 2.1.2.10, Ore Transport Facilities - The dust control system on the primary crusher and related ore handling facilities is not adequately described. Where will the ducts and dust collection hoods duct to?

* Section 2.1.2.12, Sanitation Facilities - Describe waste preservation chemicals and discuss the compatibility of chemically treated waste with the surface septic system.

Section 2.1.2.14, Fuel Handling and Storage - Will the floors of the fuel spill retention areas be made up of bedrock or a prepared material such as concrete or asphalt?

* Section 2.1.2.16, Mine Drainage - Describe in detail the physical aspects of the Case I and Case II mine drainage scenarios. How will the interceptor system water be protected from contamination? Could the interceptor system water be directly discharged with little or no treatment?

* Provide additional details or diagrams to illustrate the groundwater interception system to verify why water intercepted within the bedrock, even though at a shallow depth in the bedrock, can be considered to be clean. Also, some minimum detail should be included on groundwater collection sumps within the mine and disposition of the settled solids removed from the sumps.

Paragraphs 1 and 2 discuss mitigative actions to be taken to reduce groundwater flow into the mine. One measure discussed in paragraph 1 is to grout through surface drill holes. Is the 1,000 gpm of reduced flow into the mine referenced in the last sentence of this paragraph attributable to just these grouting measures or will part of this 1,000 gpm reduction occur as a result of the interceptor system discussed in paragraph 2? Our understanding of the system was that approximately 1,000 gpm of groundwater flow into the mine could be reduced by both grouting and the interceptor system. To cite 1,000 gpm for each mitigative action leaves the reader with the impression that 2,000 gpm of groundwater inflow will be prevented from entering the mine. Which is it?

Exxon should indicate where the water from the interceptor system and the contaminated mine drainage will be routed.

* Section 2.2.1, Ore Handling - Will there be any need for exterior ore surge piles in the event of system failure? Will there be any surface storage of low grade ores other than at the mine waste disposal facility?

* Are the wastewaters generated in the ore handling facility and the contaminated runoff generated on the preproduction ore and regular ore storage areas accounted for in the water balance? What will be the volume of runoff generated in a 10 year, 24 hour storm event? Show calculations.

Figure 2.2-1 - What is the shaded facility located just east of the water treatment plant? Also, the structures located on either side of this facility and the structure between the tailings thickeners are not identified on this figure or figures 2.1-5 or 2.4-1.

* Section 2.2.5, Reagent Storage and Mixing - Provide detailed plans and specifications for this facility and its equipment with emphasis on spill control, containment, and emission control. Describe the segregation of noncompatible reactive reagents, dusts, vapors, and gases.

Table 2.2-2 - This table describes "typical" reagents. A complete listing of all potentially utilized reagents should be provided.

* Tables 2.2.-2 and 2.2.-3 - Some of the reagents listed in these tables are not adequately described chemically so we do not know what they really are. In Table 2.2-2 these are xanthates and flocculants. In Table 2.2-3 they are flocculants, dewatering aid, and "other xanthates."

* Section 2.2.6, Concentrator Control Room - All remote environmental monitoring equipment should be described here or under other appropriate sections.

* Section 2.2.8 - Tailing Thickening - More detail and diagrams should be included to describe the equipment, overflow rates, separation efficiencies of sands and fines, and other items having to do with the thickening of the tailings.

* Section 2.2.9, Concentrate Handling and Loadout - Provide more details regarding the design of the covered rail cars and/or trucks to be used for concentrate shipping. This section specifies two day's production storage capacity while page 3-40 states that 10 days storage will be available. Please clarify this apparent discrepancy.

Section 2.2.11, Backfill Preparation Facility - Under what circumstances will crushed waste rock be utilized as backfill? The location of the waste rock crusher is not shown on Figure 2.2-1 as indicated in the text. The facilities for metering and mixing coarse tailings, waste rock and cement should be discussed more thoroughly.

* Section 2.2.12, Backfill, Transport, Storage, and Reclaim - Provide detailed plans and specifications for the backfill pond, including the bottom liner, water decant system, ancillary facilities, and backfill recovery equipment.

Will the pipeline between the backfill preparation plant and the backfill storage area be underground? The specifications and route for this pipeline should be presented.

* Section 2.2.13, Concrete Batch Plant - Describe plans for concrete preparation prior to completion of the permanent concrete batch plant. Further describe the quantity of aggregate needed during various construction and operation phases. Discuss the availability of suitable aggregate on site and off site. Will the batch plant include aggregate crushing, screening, and washing facilities? If so, describe the disposal of aggregate wash water.

* The concrete batch plant, liner batch plant, and soil processing plant are not adequately described anywhere in the application. Drawings of these plants and descriptions of the processes involved will be needed.

* Section 2.3, Mine Waste Disposal Facilities - What is the total proposed area of the MWDF as measured at the outer toe of the embankments?

* Section 2.3.1, Waste Rock Transport and Storage - During the construction phase, will surge piles be needed for waste rock and preproduction ore at the mine site? Will roads at the dump site contain high sulfide materials which could be released by traffic? Will the large diameter waste rock contain enough fines to adequately fill the voids between rocks and prevent piping of cover material into the pile? Will surface crushing of waste rock be required to provide riprap material during the construction phase?

* Section 2.3.2, Waste Rock Disposal and Preproduction Ore Temporary Storage - Additional detail is needed on how the preproduction ore will be separated from the waste rock. Such removal will have to be performed without damage to the liner. Also, describe how the waste rock will be placed on the liner and sand blanket without damaging the integrity of the liner. Will the preproduction ore be placed directly on the liner system or over a bed of waste rock?

* Section 2.3.3, Tailings Transport - Provide detailed plans and specifications for the construction, operation, and maintenance of the transport system. More detail is needed on the HDPE pipes and routing of the pipelines, including specifications (ASTM, etc.) which the candidate pipes should meet. Documentation should be included either in the text or in an appendix which addresses such items as resistance to crushing for a design overburden and live load, soil types used for trench and backfill, resistance to collapse in a vacuum situation, and ability to resist damage either from blockage by settled solids or by pipe freezing. Leak detection, containment and repair, necessity for redundant pipes, and storage or disposition of water drained from the pipe during normal pump maintenance or power loss should be addressed. Specify pump capacity for each pump on the three pipelines.

  Will there be any areas on the mining site where the pipelines will be on the surface? If so, these should be indicated on a diagram. What is the width of the proposed pipeline/haul road corridors?

* Section 2.3.4, Tailings Disposal - More detail should be provided on the carbonate sludge and the potential effect it will have when pumped to the tailings ponds. There is no additional detail contained in the feasibility study or contractor documents.

* Why does the Golder Report No. 11 (pages 7-19) recommend three feet of freeboard versus the five feet required in NR 182.11(1)(q)?

* The discussion of the MWDF location is not quite correct with regard to water users in that there are several users downgradient of the site at Rolling Stone Lake. Hemlock and Swamp Creeks are also downgradient of this facility and both drain to Rice Lake. Due to the unique nature of Rice Lake extra measures of protection may be required to maintain its water quality.

* Section 2.3.5, Water Treatment Waste Disposal - Greater detail should be provided on the effect of disposal of Na_2SO_4 sludge on the types of landfills available in Forest County. It is not likely that a typical town dump will be allowed to accept this material. If a large, engineered county landfill such as the Marathon County Landfill is suitable, that should be made explicit.

* Section 2.3.6, Reclaim Pond Sludge - Describe the method and frequency of sludge removal. Characterize sludge based on the analysis of sludge from similar operations.

* Section 2.4.1, Rail Spur - Discuss right-of-way maintenance as it relates to aesthetics, erosion control, and the prevention of railroad initiated wildfires.

* Section 2.4.2, Access Road - Describe the surface material to be used on this road.

* Section 2.4.6, Sanitary Waste Facilities - Discuss the anticipated volumes and frequency of sludge disposal. Greater detail should be provided as to how much area is needed annually for the disposal of septage. Given the climate in Forest County, there is potential that this material may have to be stored for a significant part of the cold winter months. Please estimate the land area needed and available for landspreading or the available treatment plants for treating this waste.

* Section 2.4.8, Fuel Storage and Distribution - Provide a map showing the location of fuel distribution pipelines. Provide specifications for pipeline construction, particularly in areas of potential earth settling or mine subsidence. Provide specifications and the anticipated life expectancy for buried fuel tanks. Provide plans for the containment dikes around surface fuel storage tanks and detail the storm water drainage from these containment structures.

* Will collection and treatment of runoff from the fuel oil storage area and the tank unloading area be provided? Please elaborate on the answer and indicate the type of treatment proposed, quantity of runoff, etc.

* Section 2.4.10, Potable Water Facilities - The discussion of the potable water supply system should be expanded to contain more detail on such things as well construction, the distribution system and any storage facilities. These questions and others will have to be addressed in detail in the high capacity well approval submittal.

* Section 2.4.11, Water Treatment Facilities - Details are needed of the water release pipeline similar to those for the tailings and reclaimed water pipelines addressed above.

* Section 2.4.12, Reclaim Water Ponds - The statement that "the reclaim ponds and the tailings ponds will provide surge capacity for the water management system" needs further clarification. The reclaim ponds apparently will be filled to capacity during normal operations and according to Knight and Piesold, it is desirable to reduce or eliminate any pond on the tailing surface in order to achieve drying and consolidation of the tailings. Under these conditions, how long could the mine or concentrator continue operation in the event of an extended water treatment plant shutdown?

* Section 2.4.14, Shop, Garage and Warehouses - Where will drainage of the southside unloading dock be routed?

* Section 2.4.15, Other Water Facilities - In addition to the fueling station drainage, what other waste streams will be routed to the oily water sewer system? What is the volume of water which will flow through the oily water sewer system? Overflow from the oily water sewer system should not be directed to the reclaim ponds unless it can be shown that the pond and mill treatment system can handle the wastes.

* Section 3.2, Facilities Construction (General) - The clearing of trees and shrubs during periods of snow cover is preferable because the wildfire hazard is minimized, salvage wood increases in volume and value because the logs are protected from dirt, and the lack of leaves reduces the slash volumes.

  Commercial whole tree chipping contractors and the sale of chips for fuel or pulp should be investigated as an alternative to burning. The burial of stumps under a one-time disposal permit may also be an alternative. DNR burning permits will be required for any burning during the fire season.

  Provide a grading plan for all disturbed areas showing interim and final grades, along with earth material balances. If negative balances are derived, specify the source of imported fill and/or topsoil. If positive balances are found, specify the use or disposal of surplus material. Include in the plans the specifics of the runoff and erosion control program and further describe the scheduling relationship between grading and runoff control. Calculate anticipated maximum runoff volumes from each storm water collection area and maximum flow rates in major collection ditches. Provide plans for all temporary and permanent storm water impoundments, specifying design capacity, retention times, control structures, overflow pipes, weirs, energy dissipaters, and surface stabilization material or methods. Define and differentiate between short-term and long-term erosion control measures (for example, the use of straw bales for periods of more than one year may aggravate siltation release problems because of the need for frequent maintenance with resulting disturbance to other stabilization materials).

  Section 3.2.1, Mine/Mill Site Preparation - What is the projected volume of wood waste which will have to be handled? Where will the mulched material be stockpiled?

* Section 3.2.2, Temporary Facilities - None of the existing on-site water wells were constructed or approved for potable water supply purposes. Modifications of previously granted high capacity well approvals will, therefore, be required prior to the use of existing wells for drinking water purposes. The use of several strategically located wells should be considered in order to minimize the need for tank trucks and potable water dispensers.

Where will the construction water well be located? Construction details, distribution system and storage facilities should be discussed.

* Section 3.2.3, Access Road Construction - Please discuss the road surfacing process.

What off-site landfill will be used for disposal of wood waste created by the construction of the access road corridor?

What will ultimately be done with the sediment that is collected in the temporary retention areas near the wetlands and behind the sheet piling at the stream crossings? How much peat is expected to be encountered in the wetland crossings?

* Section 3.2.4.2, Shafts and Collar - The discussion of shaft construction needs expansion. What type of brine will be used? How large will the holes be and how will they be constructed and spaced? How much area will be affected by the soil moisture freezing? How long will the "ice ring" be intact? What diameter will the total excavation for the main shaft be?

* Discuss brine containment and waste brine disposal.

The discussion of blasting should identify the magnitude of the blasts, types of explosives and demonstrate compliance with DILHR requirements.

* What is the projected volume of water that will be generated during the shaft construction (i.e, is 2,000 gpm the maximum to be reached 2-3 years after starting construction)?

* Section 3.2.4.3, Underground Development - The discussion of grouting the bedrock-overburden interface is inadequate. Details on the location of grouted sections, thickness of grout layers and total amount of grout to be injected must be presented along with a detailed plan of construction. A similar discussion of the specifications and construction of the groundwater interceptor system is also necessary. Diagrams and cross sections of these two systems would be extremely beneficial. What will the temporary water containment facilities consist of?

Section 3.2.6.1, MWDF and Reclaim Pond Site Preparation - The removal of wetland soils from below the MWDF may be necessary to stabilize the liner in dikes.

* Section 3.2.7, MWDF and Reclaim Pond Construction - The discussion of the batching and mixing plant and the screening plant could have been supplemented by reference to the INDECO Report. Unfortunately, this Report is very general with regard to the discussion of these plants and does not detail in any way possible water releases and quality control of the product. Details of both of these plants should be provided.

* This section discusses the retention basin for runoff from the waste rock storage area but does not include a description of details of construction of the ABC liner. These details are not included in the feasibility study and will have to be provided for Departmental review.

* Figs. 3.2-3 through 3.2-8 - These figures appear to be reductions of full size plan sheets. The full size plan sheets should be submitted to the Department to facilitate review and analysis of erosion control measures. The figures indicate that two tailings ponds will be under construction simultaneously while the project schedules show that only one pond will be constructed at a time. This apparent contradiction should be clarified.

* The route from the Woodlawn Siding should be indicated and the potential effects of heavy truck traffic on local roads should be addressed.

* Section 3.2.8, Pipeline Construction - Details of pipeline construction are needed with particular emphasis on jointing and changes in heading of the lines. Specifications and documentation demonstrating the life expectancy and durability of the pipeline material should be presented.

  Section 3.2.9, Railroad Construction - More detailed plans and discussion of the railroad spur construction, especially near the wetlands and Swamp Creek are needed. A diagram of the stream crossing and a cross section of the entire spur from the main line to the mine/mill site should be provided. If borrow or waste areas will be necessary, where will they be located?

* Section 3.2.11 Water Supply - The estimated peak demand for water of 45.3 m^3 day appears conservative. Provide data used for this estimate.

* Provide a plan for potable water supply testing and reaction to unsafe samples.

  Section 3.2.13, Sanitary Facilities - Please provide documentation justifying the estimated daily sanitary waste flow of 1,500 gpd.

  Section 3.2.15, Testing and Training Facility - Where will this facility be located and when will it be operated with respect to the overall mine/mill schedule? What will become of the facility once full scale operation begins?

  Where will reagents be stored during this time and what spill prevention/control measures will be followed? What will be the volumes and characteristics of the wastewater? Where and how will wastewater be treated?

  If a temporary storage facility is constructed, details of its construction and operation must be provided for Department review. The location of the temporary storage facility should be specified.

  Will any air pollution control equipment be utilized in conjunction with the testing and training facility?

* Section 3.3., Construction Schedule - According to Figure 3.3-1, the water treatment facility will not be completed until September 1987, approximately one year following commencement of main shaft and equipment air shaft construction. Reclaim Pond #1 should be completed within 3 months after start of the main shaft construction and 8 months after start of the air shaft construction and therefore could be used to store water from shaft construction. What will be done during the 3 and 8 month period when this pond is not in service? Waste rock and

preproduction ore storage runoff will also go to reclaim pond #1. Will the storage volume be sufficient to handle construction wastewater before the surface water treatment systems are completed? What is Exxon's contingency plan if the volume is not sufficient?

What area will be enclosed by the perimeter fence mentioned on Page 3-22?

A section similar to Section 1.3.3, Construction Operations, of the EIR should be included in the Mining Permit Application after the discussion of the Construction Schedule.

* Figure 3.4-1 - What is the area of "open water" shown in the northeast corner of this figure?

* Section 3.5.2.4, Mine and Backfill Dewatering - Provide details regarding the operation of the groundwater interception system and the plans for grouting the bedrock/drift interface.

* Section 3.5.2.5, Waste Rock - Provide additional detail regarding waste rock handling, use and disposal. Specifically, address the use of waste rock as riprap and as road surfacing material and provide estimates of the volume of waste rock which will be used for the various purposes and disposed of in the MWDF.

Section 3.5.2.6, Backfill Handling Underground - Under what conditions will it be necessary to supplement the coarse tailings with waste rock and glacial sand? Where will the backfill delivery boreholes be located?

* Which of the two options (adding cement to the backfill or leaving an ore wall) is actually being proposed? Whichever it is, a more detailed discussion is needed.

* Explain the kind and amount of cement which will be required to stabilize the backfilled stopes and what thicknesses of rock must be left on the sides and bottoms of each stope to assure safety and stability within the mine. Demonstrate that the cement of choice will work with an aggregate that may be predominantly sulfides.

* Section 3.5.2.7, Water Balance - What constitutes mine "process" water to be collected and discharged to the surface water treatment system? This is somewhat confusing in light of the discussion to recycle 200 gpm for mining processes. How much mine process water will be generated which will be transported to the surface? How is it accounted for in the 335 gpm value; of which 325 gpm is backfill water and 10 gpm is potable water?

* Section 3.5.3.3, Concentrate Handling and Shipping - The planned 10-day storage capacity for concentrate does not appear to allow much flexibility in the event of extended shipping or market problems. What alternatives are available other than mill shutdown?

What type of cover will be used on the rail cars transporting the concentrate?

* Section 3.5.3.4, Surface Backfill System - How will backfill in the temporary storage area be reslurried? All associated pipelines and the proposed routes must be presented on a diagram. What will the backfill storage area be lined with? Where will runoff be directed?

* Section 3.5.3.6, Water Balance - Figure 3.5-8 shows the water balance during full mill operation. Does this mean that this is the maximum amount of water and wastewater which will pass through each line shown? If not, please show the maximum amount expected.

* Section 3.5.3.10, Spills and Odors - Where will the spilled materials be disposed of if the material is not recycled?

* Section 3.5.4.2, Tailing Slurry and Water Transport Systems - As mentioned previously, the routes of all pipelines (buried and unburied) associated with the project should be shown on a figure or series of figures.

* Expand on the procedures and equipment which will be utilized to detect and repair leaks in the pipelines.

* Section 3.5.5.2, Water Treatment System - How long can the mine and mill continue in operation under the conditions described on the bottom of page 3-55?

  What standards will be used to determine whether or not the "uncontaminated" water from the mine requires treatment?

* Section 3.5.5.4, Water Treatment Wastes - Identify the prospective landfill site and delineate the 2-3 acre cell within the tailing pond area which could be used for disposal of the reverse osmosis sludge if the sludge is not marketed. Which of these options is actually being proposed?

* Section 3.5.6, Overall Water Balance - The overall water balance for "mature" operation has been presented. How will the water balance vary from start-up through shutdown?

  This section states that the average amount of water to be discharged is 1983 gpm yet Figure 3.5-16 indicates that this is the maximum value. Please clarify this discrepancy.

* Section 3.5.7.2, Treatment of Sanitary Wastes - Please explain how you arrived at an estimated average daily flow rate of 32 gpm.

  Final details of the septic system must be included in the mining permit application once they have been finalized.

  Indicate on a diagram where the soil absorption field is proposed to be located.

Section 3.5.7.3, Refuse - Where will the refuse (all types) be stored on the site prior to off-site disposal? What volume of each waste type is expected to be generated? The off-site disposal site for mill refuse will have to be specified.

Section 4.0, Environmental Protection - It should be stated in the mining plan what remedial actions will be taken if private water supply wells in the vicinity of the mine are adversely affected by the mining operation. Also, discuss what measures would be taken to reduce the effects of drawdown if mine inflow is much greater than anticipated.

Section 4.1, Air Quality Protection - Discuss the disposition of the dusts collected by the air pollution control devices.

The total pollutant emissions listed on page 4-1 are not correct. They were taken from Table 4.1-7, but the totals from that table do not agree with the totals from Tables 4.1-2, 4.1-4, and 4.1-6 which include all emissions from project operations. Table 4.1-7 does not include mobile source emissions during mill operations. The pollutant emission totals listed in this paragraph should be 118.0, 23.3, 167.9, 183.0, 15.7, and 0.9 respectively.

In addition, this project is not necessarily exempt from the requirement to obtain a PSD (prevention of significant deterioration) permit. This determination depends on the amount of pollutants emitted, and emissions from some potentially major sources associated with the project (see next comment).

Table 4.1-1 through 4.1-6 do not include emissions estimates for some air contaminant sources described or mentioned in the project description. Those sources not included are:

1) Existing gravel access roads

2) Temporary on-site diesel power generators

3) Burning of stumps and brush during site clearing

4) Wind erosion from MWDF stockpiles

5) Screening and stacking plant to produce MWDF liner and underdrain materials

6) Primary crusher and related ore handling facilities

7) Ore loading, hauling and dumping in the mine

8) Removal of rock from shaft during underground mine construction

9) Sulfur dioxide emissions from SO_2 scrubbing tower

10) Fugitive dust emissions from MWDF during operation

11) Burnt pebble lime facility

Section 4.2.2, Erosion and Drainage Control - Erosion control during construction of the proposed discharge structure on Swamp Creek should also be addressed in this section.

* Where will the mine water be routed prior to completion of the water treatment plant?

* Where will the "influent surge system" with a volume of 2.75 MG be located? What will this system consist of?

Discuss the expected water quality of the runoff collected from the waste rock storage area.

The "approved disposal area" for the oil waste should be specified. The oil-water separator (interceptor system) will require a Department review.

As stated previously, design details for all retention basins on the site must be provided.

Section 5.0, Risk Assessment (General) - As reflected in the following comments, some attempt should be made to present estimated frequencies of various occurrences. This information should be available since it is stated on page 5-2 that the risk assessment is based on historical data and semi-quantitative techniques. Further,the contingency measures for many of the potential incidents are not detailed as is required by s. NR 132.07(2)(i).

No risk scenarios were provided for the effect of reagent and fuel spills affecting the groundwater. Given the volume of materials that will be present at the mine/mill and previous groundwater contamination incidents in Wisconsin involving many of the same compounds, groundwater contamination is a real risk and should be addressed.

Section 5.2, Concentrate Spills - The discussion of concentrate spills considers airborne transport off-site as the only plausible consequence to the environment. Given the number of wetlands, lakes and streams in the vicinity of the mining site, isn't it also possible for a spill to occur in or near one of these water bodies? The effects of a concentrate spill in or near a surface water body should be discussed along with any clean-up procedures that would be used. Is there any historical data for the mining industry regarding the frequency of spills and derailments? What impacts have such spills created in the past?

It is stated on p. 5-6 that "Health effects caused by inhalation of particles in the respirable range are generally exhibited after long-term (chronic) exposure." However, short-term exposure can also cause health problems, especially in sensitive populations such as people with chronic respiratory ailments, children and older people. It is possible that short-term localized health problems could be caused by derailment of concentrate cars in a town under dry, windy weather conditions.

Section 5.3, Reagent Spills - Simply stating that the likelihood of reagent spills is negligible is insufficient. Some statistical information regarding reagent spills in the mining industry should be presented.

It is stated on p. 5-9 that sulfur dioxide, sodium cyanide, sodium dichromate, and sulfuric acid are the only reagents considered to present a potentially significant risk. The polypropylene glycol methyl ether, methyl isobutyl carbinol and possibly the aryldithiophosphoric acid could also present potentially significant risks.

Section 5.4, Fuel Spills - Why does this assessment focus only on small quantity spills and totally disregard larger scale spills such as rupture of a storage tank? How would large scale spills be handled?

What will be done with the contaminated soil that is removed from a spill site if the spill occurs during the construction period?

Section 5.5, Leachate Control System Failure - The discussion of the liner, cap and underdrain systems should include documentation of similar installations being used at other mill facilities or other industries along with an evaluation of their performance.

It is stated on page 5-18 that the long-term effect on groundwater is reversible. Please expand on this statement.

What measures will be taken if various degrees of failure or inadequate performance occur? Is pumping the only remedial action?

Section 5.6, Accidental Detonation of Surface Stored Explosives - There is no such agency as the Wisconsin Department of Industrial Health and Labor Relations as referenced on page 5-22. What is the expected frequency of accidental detonations based on historical data from the mining industry?

Section 5.7, Forest Fires - Discuss the measures that will be taken to prevent forest fires resulting from the controlled burning during the site preparation phase.

What is the expected frequency of on-site fires during construction and operation? How many incidents are projected to occur over the life of the project?

Discuss the potential for fires starting along the power line corridor and the railroad spur and also the prevention measures to be taken.

Secion 5.8, Mine Subsidence - Simply because mine subsidence does not represent a hazard to people off-site does not mean that it is not a credible source of risk. The evaluation of mine subsidence must be redone in much greater detail especially when one considers the fact that potential for significant surface subsidence is grounds for denial of the mining permit.

Section 5.9, Mine Fires - What is expected frequency of mine fires?

Section 5.10, Tailing Pipeline Failure - This section should discuss industry experience with HDPE pipelines. Exxon should expand on how leaks would be detected, repaired and cleaned up. Will there be a backup pipeline system if the tailing pipeline requires massive repair and is thus temporarily unusable?

Section 5.11, Pond Embankment Failure - Discuss the industry's experience with embankment failures (major and minor) and also specify the contingency measures to be implemented if failure does occur.

The possibility of failure of the liner and underdrain on the side slopes of the ponds, causing leakage into the dikes thus destabilizing the embankments, should be addressed.

How was the Probable Maximum Precipitation Event (PMP) calculated?

Section 5.12, Water Treatment System - Discuss the frequency of shutdown and need for maintenance of this type of system as experienced at other facilities.

How many days of water treatment plant outage can be tolerated by the system? Given the sophisticated nature of the equipment and technology to be used, it will probably take more than "several days" to put the water treatment plant back on line if certain pieces of the equipment (the VCE or RO units) need servicing. If the capacity of the reclaim ponds is exceeded due to extensive maintenance, where would the wastewater be routed?

The probability of, and potential impacts associated with surface water discharge pipeline failures, should also be addressed.

Contingency plans for the reclaim ponds are not discussed in this section. A contingency plan for these ponds might consist of taking one of the ponds off line and repairing the liner. Provide information on what effect this would have on the water treatment plant.

Section 5.13, Air Pollution Control Systems - Section NR 154.06(9) contains requirements for a malfunction prevention and abatement plan for air emission sources, and the plan should be included in this section.

Section 5.15.3, High Precipitation - Discuss the potential failure of the drainage and erosion control structures as a result of high precipitation, especially during construction. What remedial actions will be taken?

Section 5.18.1, Conclusions - The second to last line of this section should read "... pollution control ..." rather than "... population control ...".

Section 6.0, Emergency Notification Procedures - How will the Environmental Compliance Engineer (ECE) determine whether an incident presents a hazardous condition? How long will it take to implement the notification plan? What types of incidents will be channelled through Exxon Minerals Co. management before notifying the outside agencies?

A record of all incidents reported to the ECE should be kept and periodically submitted to the Department. If an incident requires corrective action, the Department should be notified, regardless of whether or not hazardous conditions exist.

The spill reporting measures, as outlined in various codes, should be included.

It should be stated in this section that Exxon is required by Section NR 154.06(2)(f) to report air pollution control equipment malfunctions to the DNR within eight hours of their occurrence.

Section 7.0, Geological/Geotechnical Investigations - As mentioned previously, the discussion of grouting the bedrock/overburden interface is inadequate. Exxon should expand the previous discussion of grouting in the mining plan so that this section could simply refer to that discussion. This section indicates that Exxon intends to conduct a pumping test over the ore body. The plans for this pumping test should be presented in detail and will require a high capacity well approval.

Isn't Exxon planning on doing any more "exploratory" drilling into the orebody? This is the type of drilling that the code is referring to, since these holes would be exempt from regulation under ch. NR 130 as long as the mining plan details the termination procedures to be used for the drilling sites.

Section 8.0, Pre-Blasting Survey - The pre-blasting survey is not optional or on an as-needed basis. The mining permit application must contain the plans (i.e., methodology) for the survey and the survey must be completed and submitted to the Department prior to blasting.

Volume II, Reclamation Plan

The reclamation plan as proposed is a good start towards completing the requirements of chapter NR 132, Wis. Adm. Code, but it is not considered complete at this time. Detailed comments follow which point out weaknesses in the plan, but a few general remarks are presented first.

Final Use

A basic weakness is that the final use of the mine site has not been discussed satisfactorily. Final use should be a unifying factor throughout reclamation planning, but is largely ignored in this document. Section 4.4.1 provides the general statement that the tailings area will be "reclaimed to a natural landscape in terms of vegetation and wildlife populations", but no attempt is made to provide a comprehensive plan that will assure such a result. Establishing a 500 acre black spruce and poplar forest (Appendix B, Mine Plan) is a return to neither natural conditions nor good wildlife habitat. An acceptable reclamation plan geared to wildlife habitat must include a comprehensive site map showing proposed plant communities that provide food and cover for the wildlife species of choice (in this case probably deer/grouse/woodcock).

Whether reclaiming for wildlife or some other use, the area would still require a greater diversity of species. Black spruce is adapted to wet areas, and the reclamation cap may be too droughty for optimal growth of this species. In addition, black spruce is very susceptible to windthrow. Tip ups can be expected to occur regardless of species planted, but covering a 500 acre plateau with this species seems especially risky.

It appears that reclamation of the tailings cap is not being approached from the correct perspective, that the wrong question is being answered. The question should be: How can the cap be designed to accommodate naturally invading species?, instead of: How can the vegetative cover be controlled to minimize damage to the cap as it is now proposed? A well thought out final use goal may provide direction in revising this plan.

Surface Drainage

Another topic deserving more attention is surface drainage/erosion control. Though erosion control is discussed in different sections throughout the report, no attempt has been made to quantify the potential runoff. This information is necessary for determining the size and location of retention basins and other erosion control structures. A comprehensive view of runoff control for the entire mine site should also be provided.

In Appendix B of the Mining plan (Volume I) there is a statement that sediment basins on the mine waste disposal facility will be designed for the 10-year, 24-hour storm. NR 182.11(1) 1 requires that they be designed for the 100-year, 24-hour rainfall event. This error suggests that all the sediment basins on the mine site are similarly designed, since no other guidelines are given. Therefore data must be supplied to support the design plans.

Topsoil Stockpiles

During departmental review of the reclamation plan it became evident there was some confusion about the disposition of salvaged topsoil. Clarification is needed regarding excavating, storing, and controlling erosion of the topsoil. The figures provided do not clearly show locations of storage or erosion control practices. It is also not clear in the report if glacial till being saved for reclamation is considered separately or not.

Details:

Section 2.4.2, Fertilizer Use - This section should state clearly that each site will be analyzed to determine the best fertilizing and seeding practices.

Section 2.4.3, Species Selection - This section implies that erosion control will not always be important during the period from October to May. On the contrary, erosion control is a must all year round. If barren soils are not stabilized in the fall, the frozen exposed ground is susceptible to spring rains and erosion. This section should be modified to show this.

Section 3.2.2, Site Preparation - 1) If trees and stumps are chipped and stockpiled, a location for the stockpile must be designated. A permit may be required for burning the stumps and brush. 2) Where is the outlet to the storm water drainage system? The mining plan shows (Fig. 3.2-1) a single runoff retention basin during construction. No indication is given as to how water will be directed to it. The reclamation plan shows (Fig. 3.3) four retention basins will be constructed during the first year of the construction phase. The mining plan has the four drainage basins (Fig. 3.2-2) appear after construction is completed. No contour lines are provided to substantiate the surface drainage plans.

Figures 3.2, 3.3, and 3.4 - Fig. 3.2 shows the topsoil stockpile location on the mine and mill site. Figs. 3.3 and 3.4 show that location as a vegetated erosion control dike. Are these structures one and the same? The area depicted in the different figures is not the same.

Figures 3.3, 3.4, 3.5 and 3.6 - Final paved areas are not clearly designated, especially around the tailings thickeners. The landscape phasing plan shows this area will be vegetated in construction year 5 (Fig. 3.5), but the erosion control plan for the operation phase (Fig. 3.4) specifically excludes vegetation from that area.

Section 3.2.3, Reclamation Phasing Plan - A report by the Sanborn Group, Inc. (1982) is cited as providing a comprehensive description of a typical landscape design. This document has been requested by the Department, but has not yet been received.

Section 3.2.3, Reclamation Phasing Plan - Two types of topsoil stockpiles are mentioned: temporary and permanent. These must be described in greater detail. How much salvageable topsoil is expected to be found? Will these stockpiles include the glacial till which will be substituted for topsoil during final reclamation?

Section 3.2.3.1, Year 1 Landscaping - More information is needed on the planting of native species in the retention basins and power line corridor. What species will be selected, and what is their source? Section 3.9.3.3 states that existing retention basins will be stabilized with vegetation when reclamation begins. How does this tie in with the native plantings already present?

Section 3.2.4.1, Plant Materials - A clearer description is needed of the source for transplanted native stock. Will the source be elsewhere on the mine site?

Section 3.2.5.2, Long-Term Maintenance - A description should be provided on the methods for maintaining clear zones (e.g. herbicide use, burning or mowing).

Section 3.3, Railroad Spur - A map showing the entire length of the railroad spur is needed. This figure should depict the erosion control practices along the route, especially of the Swamp Creek and wetland crossings.

Section 3.3.3, Erosion and Vegetation Maintenance - If herbicides are being considered for brush control their use should be discussed. Use of herbicides may be subject to Department approval.

Section 3.4.1, Construction Procedures and Erosion Control - In the final Reclamation Plan, when construction practices adjacent to navigable water are described, reference should be made to the appropriate Chapter 30 approval.

Section 3.5, Tailings Transport System - A map of the entire tailings transport corridor must be provided which shows specific erosion control measures to be used.

Section 3.6, Water Discharge System - The crossing of wetland areas and the development of a discharge structure on the bank of Swamp Creek should be discussed in this section.

Section 3.9.1, Removal of Facilities - 1) Reclamation of the access road must be addressed. A plan for reclaiming the road must be in place in the event a 'permanent need' has not been established for it during the mine operating period. 2) The plan should state that the railroad corridor will be reclaimed so as to blend in with the surrounding area, in terms of both grading and revegetating.

Figure 3.10, Final Landform Grades in Mine/Mill Area - This figure is far too site-specific. A map showing final grades for the entire mine site is needed to assess how the site will fit in to the surrounding area.

Section 3.9.3, Reclamation Grading and Soil Placement - The sources for borrow fill used in final grading are not adequately described. This section states that "most borrow fill will be acquired from the SE portion of the site..." Where is the remainder expected to come from?

Section 4.2.1, General Criteria - The glacial till excavated from the tailings disposal site is expected to be of adequate quality and quantity to build all embankments and complete the final cover. There must be a discussion of alternative sources in the event there is insufficient till available from the tailings area.

Section 4.2.3.4, Construction Support Area - Provide details on the design and construction of the runoff control structure. How will size be determined? To the extent possible the support area should be vegetated to prevent unnecessary runoff.

Fig. 4.14, Approximate Reclaimed Surface of Tailings Ponds - This figure must be combined with Figure 4.17 (Reclaim Ponds). Presented separately, these figures are not very useful, especially since they are drawn to different scales.

Section 4.4.4, Permanent Vegetation - This section must include a discussion on establishment of ground layer species.

Section 4.4.4.3, Species Selection - This section reports that final species selection will be determined by on-site testing of trees on pond T1 following completion of the tailings cap. No further mention is made of the proposed study. According to the Feasibility Report (p. 9-26) a final cover of black spruce and poplar will be established, with no indication that research may identify better suited species. The idea of a well planned study should be further developed. Details of this study must be included in the reclamation plan. A list of test species appears in Table 4.3. These species all have shallow root systems, but other types of root systems should also be examined in this experiment. If tree roots do penetrate the seal, this ought to be studied during operation because natural invasion cannot be completely prevented, and cap improvements are best made prior to final closure.

Section 5.1, Monitoring and Long-Term Maintenance - As written, this section is incomplete. Post-closure monitoring of vegetation must be described in detail. The monitoring will provide information on the relative success of the reclamation effort and highlight any problems that may arise.

Section 6.0, Reclamation Costs - The estimated reclamation costs must be supported with a more detailed cost breakdown.

Appendix 1.1A cites this section as fulfilling the requirements of ch. NR 182.08 (2)(j), which specified the need for an engineer's cost estimate for site closing. Such a report is missing from this section, but must be provided before the reclamation plan is considered complete.

Section 7.0, Notification - This section is supposed to provide the names of persons legally and operationally responsible for long-term maintenance (ch. NR 132.08(e)(2)). This section merely directs all questions to the unnamed Technical Services Manager. This does not meet the requirements of the code.

This letter together with our September 19, 1983 letter comprise the Department's comments on the Mining Permit application to date. As certain portions of the project become more well-defined or are revised, we expect additional review and comments by Department staff will be required.

If you have any questions regarding the two comment letters or in the development of your responses, please feel free to contact the Mine Reclamation Section.

Sincerely,
Bureau of Solid Waste Management

Gordon H. Reinke

Gordor H. Reinke, Chief
Mine Reclamation Section

Noted By:

Paul P. Didier 10/11/83

Paul P. Didier, P.E. Date
Director

GHR:mk/4124Y
cc: NDC
L.F. Wible - ADM/5
P. Didier - SW/3
H.S. Druckenmiller - BEI
C. Hammer - LEG/5
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State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Carroll D. Besadny
Secretary

BOX 7921
MADISON, WISCONSIN 53707

October 26, 1983

File Ref: 1630
(Exxon)

Mr. Leonard Swift
Charles M. White Memorial
Public Library
1325 Church St.
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Dear Librarian:

A copy of Exxon's response to our comments on Chapter 1 of their Environmental Impact Report (EIR) for the proposed Exxon Crandon mine is enclosed. Our initial detailed EIR review letter was sent to Exxon May 11, 1983.

Please place all of the enclosed information along with the other comments which are being kept with the Exxon EIR material.

In addition to the Chapter 1 response, Exxon also submitted a limited number of copies of the following support documents that relate to their Chapter 1 response. We are unable to send you these support documents at this time. However, we will do so in the future if we are able to obtain a sufficient number of copies.

1. CHAPTER 1.0, COMMENT NO. 39, ATTACHMENT NO. 1 - UTILITY PLOT PLAN
2. CHAPTER 1.0, COMMENT NO. 53, ATTACHMENT NO. 2 - PLOT PLAN FOR MINE/MILL FACILITIES
3. CHAPTER 1.0, COMMENT NO. 56, ATTACHMENT NO. 3 - DUST CONTROL SYSTEM FOR THE PRIMARY CRUSHER AND RELATED ORE HANDLING FACILITIES (5 drawings)
4. CHAPTER 1.0, COMMENT NO. 59, ATTACHMENT NO. 4 - PLOT PLAN FOR MINE/MILL SURFACE FACILITIES
5. CHAPTER 1.0, COMMENT NO. 59, ATTACHMENT NO. 5 - FUEL OIL STORAGE PLAN
6. CHAPTER 1.0, COMMENT NO. 70, ATTACHMENT NO. 6 - REAGENT STORAGE AND MIXING FACILITIES (2 drawings)
7. CHAPTER 1.0, COMMENT NO. 101, ATTACHMENT NO. 7 - GENERAL ARRANGEMENT OF THE ELECTRIC POWER SUBSTATIONS AND COMMUNICATIONS DUCT SYSTEM
8. CHAPTER 1.0, COMMENT NO. 109, ATTACHMENT NO. 8 - PRELIMINARY DESIGN FEATURES OF THE RECLAIM WATER PONDS, INCLUDING BASIC MATERIAL AND CONSTRUCTION SPECIFICATIONS (4 drawings)

9. CHAPTER 1.0, COMMENT .O. .25, ATTACHMENT NO. 9 - PAVING, GRADING AND DRAINAGE DETAILS IN THE MINE/MILL SITE (3 drawings)

10. CHAPTER 1.0, COMMENT NO. 129, ATTACHMENT NO. 10 - LOGS OF AUGER HOLES ALONG THE ACCESS ROAD AND RAILROAD SPUR. PRELIMINARY PLAN AND PROFILE DRAWINGS FOR THE ACCESS ROAD AND RAILROAD SPUR

11. CHAPTER 1.0, COMMENT NO. 131, ATTACHMENT NO. 11 - PRELIMINARY DESIGNS FOR THE CRANDON PROJECT SHAFT COLLARS (4 drawings)

12. CHAPTER 1.0, COMMENT NO. 139, ATTACHMENT NO. 12 - PROCEDURE FOR IN-SITU PERMEABILITY TESTING OF LANDFILL LINER/SEAL SOIL MATERIAL

13. CHAPTER 1.0, COMMENT NO. 143, ATTACHMENT NO. 13 - EXAMPLE OF PROCESS FLOWSHEETS AND DESCRIPTIONS FOR BATCHING AND MIXING OPERATIONS AND TYPE OF EQUIPMENT USED

14. CHAPTER 1.0, COMMENT NO. 145, ATTACHMENT NO. 14 - MINE WASTE DISPOSAL SYSTEM EROSION CONTROL - PHASES 1-6 (6 drawings)

15. CHAPTER 1.0, COMMENT NO. 176, ATTACHMENT NO. 15 - FINE ORE CRUSHING AND STORAGE CRUSHING AND SCREENING GENERAL ARRANGEMENT PLAN AND SECTIONS

16. CHAPTER 1.0, COMMENT NO. 179, ATTACHMENT NO. 16 - PROCESS FLOW DIAGRAM ILLUSTRATING THE METHOD OF STORING AND HANDLING CYCLONED SANDS FOR MINE BACKFILL

Thank you for your cooperation. If you have any questions, please contact me at (608) 267-7538.

Sincerely,
Bureau of Environmental Impact

Carol Nelson

Carol Nelson
Environmental Specialist

Encl.

CNpc/vw Chptllib

RESPONSES TO DNR COMMENTS ON CHAPTER 1
OF
THE ENVIRONMENTAL IMPACT REPORT

Exxon Minerals Company
Crandon Project

Chapter 1.0

SECTION 1.1 GENERAL DESCRIPTION

SECTION 1.1.1, ACTION REQUESTED OF THE DNR

Comment No. 1

Paragraph number 5) calls for the Department to coordinate with federal agencies to "insure" that the Department's EIS will be "responsible to the needs of the federal agencies". While we will continue to coordinate with the federal agencies and to be responsive to their needs, we cannot guarantee that our EIS will meet all those needs or that the EIS will necessarily satisfy all federal NEPA requirements. However, we have expressed our desire and willingness to incorporate federal agency NEPA concerns into the state EIS and thus avoid the necessity of a separate federal EIS. As of now, we see no reason that this goal cannot be met based on the discussions we have had with the involved federal agencies.

Response:

Comment acknowledged.

Comment No. 2

Paragraph 6) requests that the Department inform the Applicant after NR 150.10 interagency procedure has been completed. This procedure will be ongoing throughout the permitting process and will not be completed until after the master hearing.

Response:

While interagency coordination will be an on-going process and will not be completed until after the master hearing, the interagency coordination required to identify issues to be addressed by the DNR's draft EIS should terminate before the final EIS. The Applicant would like to receive notice of all agencies contacted prior to the draft EIS and whether the agency has agreed to let the Department's EIS fulfill any NEPA or WEPA EIS requirements the agency may have.

Comment No. 3

It should be made clear that the project sponsor for these permit applications is the Exxon Corporation and not the Exxon Minerals Company.

Response:

The permit applications do clearly state that the applicant is Exxon Corporation.

Comment No. 4

Review of the EIR and permit applications would be expedited by providing a contact person and telephone number of each of the consultants listed in Table 1.1-1 and by allowing direct and unencumbered communications between the Department and the consultants. Please let us know as soon as possible of your response to this suggestion.

Response:

In a meeting with the Bureau of Environmental Impact on June 21, 1983, Exxon agreed that free and open communication between Exxon and the DNR and, where appropriate, Exxon's consultants is a desirable goal. However, it is very important that Exxon remain the central focus of communications because the Crandon Project is an Exxon project and not a consultant's project. The testimony that is delivered at any hearings and the committments associated with it will be Exxon's and not the contractor's. For this reason, it is imperative that Exxon be completly informed and a part of communications between the DNR and the consultants.

Exxon has been and will continue to facilitate and consider any specific recommendations from the DNR regarding their understanding of the Crandon Project. For example, we will be pleased to arrange for any requested information requirements between the DNR and Exxon or its consultants regarding the Crandon Project. Exxon will also consider completely, any suggestions as to how the communications process might be improved.

SECTION 1.1.2, LOCATION OF PROPOSED ACTION

Comment No. 5

The land associated with the proposed surface water discharge pipeline corridor in Sections 32, 33, and 34 of T35N, R12E should be described as Exxon controlled land.

Response:

Comment acknowledged. In the revised EIR, the land area associated with the proposed surface water discharge pipeline corridor in Sections 32, 33, and 34 of T35N, R12E will be included in the description of land controlled by Exxon. This area which is under easement totals approximately 15 ha (37 acres).

Comment No. 6

Figure 1.1-2 should show the water discharge pipeline route, access road, and the rail spur as being within the Project site.

Response:

Comment acknowledged. In the revised EIR, Figure 1.1-2 will be modified to include the water discharge pipeline route, access road, and railroad spur within the Project site.

Comment No. 7

Figure 1.1-3 should specifically identify land ownership for the "small tract areas" surrounding Little Sand Lake and Deep Hole Lake.

Response:

Land ownership for the small tract areas surrounding Little Sand Lake and Deep Hole will be designated on a new figure that will be included in the revised EIR.

Comment No. 8

The lands identified on Figure 1.1-3 as owned by Connor under a mining lease east of the project area and lands owned by Mihalko under land purchase option in Langlade County should be addressed in terms of their relationships to the proposed project. What will be done with these lands if the project is permitted?

Response:

Exxon has under lease and option several parcels of land within Wisconsin. The EIR clearly identifies the lands within the Project site boundary and their ownership status. Typically, during exploration and project development, much more land is leased and optioned than ultimately is used for the project in operation. After the Crandon Project is in operation, parcels of land under lease or option will be reevaluated as to their continued use and/or disposition.

Comment No. 9

NR 182.07(1)(h) prohibits construction or operation of a mine waste disposal site within 200 feet of property lines. At least one non-Exxon owned parcel is within 200 feet of the proposed disposal area. Exxon should state their intent to purchase this parcel or request a variance from this locational criteria.

Response:

The land in question is under a mining lease and the need to convert part of the mining lease into fee ownership or apply for a variance will be decided in the future and prior to the Master Hearing notice period.

Comment No. 10

Figure 1.1-3 does not identify ownership of the NE NW, SW NW, W 1/2 SW of Section 2 and the NW NW, Section 11 of T34N, R12E, Langlade County. These are State of Wisconsin Trust Lands.

Response:

Comment acknowledged. Figure 1.1-3 of the EIR will be revised and ownership of the NE NW, SW NW, W 1/2 SW of Section 2 and the NW NW of Section 11, T34N, R12E, Langlade County will be designated as State of Wisconsin Trust Lands.

SECTION 1.1.3.1.3 USES AND OUTLOOK FOR RECOVERED METALS

Comment No. 11

The information detailing the U. S. metals production was derived from 1978 data. Statistics through 1981 are currently available in the Minerals Yearbook (Bureau of Mines, 1982) and should be used.

Response:

Subsection 1.1.3.1.3 will be revised in the EIR to comply with the request of providing currently available statistics:

Each of the economically recoverable metals in the Crandon ore is important to the economic viability of the Project. The metals, in order of importance, are zinc, copper, silver, lead, and gold. No other elements found in the ore are economic to recover; however, because of refining and environmental control practices, cadmium will also be recovered from zinc concentrate in the electrolytic smelting process. This smelting process will not be completed at the Crandon Project site.

The following subsections include a discussion of the benefits of recovery of each of the metals mentioned above, except cadmium. The primary sources of the information were Minerals Facts and Problems, Bureau of Mines (1980), and the 1981 Bureau of Mines Minerals Yearbook.

Zinc - Among nonferrous metals, zinc ranks third in domestic tonnage consumed, behind aluminum and copper. Its physical properties of corrosion resistance, machineability, relatively low melting point, and solubility in copper make it an important industrial metal for a number of applications. The primary markets for zinc and zinc components are in galvanizing, brass, die cast components for autos and appliances, batteries, and tire manufacture.

According to the latest available data of the U. S. Bureau of Mines, world zinc mine production in 1981 was 5.8 M t (6.4 million short tons). U.S. mine production was 312,000 t (344,000 short tons), some 5.3 percent of the total. The Crandon Project is expected to produce about 175,000 t (193,000 short tons) per year of zinc metal in concentrate form, making it one of the world's 10 largest mines in terms of annual zinc metal production. On world standards, however, the mine represents only a 3 percent expansion of production.

United States mine production of zinc covers only 30 percent of total U. S. demand. The remainder is covered by imports of zinc metal and concentrate, primarily from Canada, but also from Europe, Mexico and South America. The Crandon Project would directly or indirectly displace some of these imports, and thereby reduce U.S. foreign dependence for this important mineral.

The U.S. Bureau of Mines projects that U.S. demand for primary zinc will grow at a rate of about 1.6 percent per year through the year 2000. Such a growth rate would bring the demand to a level of 1.65 M t (1.82 million short tons) per year by the year 2000. At such a level, the Crandon Project would supply about 9 percent of total U.S. demand. Even though the U.S. zinc supply is substantial, there is a need for development of additional zinc mines in the U. S. to meet current and future needs.

Copper - Copper's physical properties, high electric and thermal conductivity, ability to be drawn into fine wires, malleability, high corrosion resistance, and appearance make it an important industrial metal. The principal end uses of copper are in electric wiring, telecommunications, plumbing and heating tubes, automotive radiators, valves and fittings, and household appliance components.

According to the U.S. Bureau of Mines, world mine production of copper in 1981 was approximately 8.2 M t (9.0 million short tons). The U.S. produced about 19 percent of the total, or 1.54 M t (1.70 million short tons). The Crandon Project is estimated to produce about 40,000 t/y (44,000 short tons per year) of copper metal when full production is achieved. As such, it represents about 3 percent of U.S. supplies and less than 1 percent of total world supply. While copper is an important source of revenue to the Project, the effect of the Project on the world market will be far smaller than for zinc.

According to the U. S. Bureau of Mines, in 1981 the U.S. imported about 20 percent of its primary copper needs in the form of metal or concentrates. The Project will help reduce this import dependence, directly or indirectly. While the tonnage impact is not as great as zinc, the monetary benefit to the U.S. balance of payments, attributed to Crandon's concentrate production, is approximately the same size.

The U.S. Bureau of Mines estimates that the demand for primary copper will grow at the rate of 2.4 percent per year through the year 2000. By then, demand should be 70 percent higher than in 1978. Clearly, considerable additional U.S. production capacity will have to be added if the country is to avoid increased dependence on imports of this important industrial commodity.

Silver - The pattern of consumptive use of silver has changed drastically since World War II. Whereas consumption for coinage has declined, the use of silver as an industrial commodity has increased. Silver continues to maintain its position as a precious metal used in jewelry and silverware. Progressively, silver has become a useful, if not critical, industrial product with the principal uses being in the electrical and electronics industries as a conductor, as a widely used constituent of brazing alloys in general industry, and in photographic and x-ray film.

Over half of world silver output is produced as a by-product of copper, lead, and zinc mining, with the remainder attributable to mines which principally produce silver metal. Total free world industrial consumption of silver in recent years has been 990 to 1050 M g (350 to 370 million ounces) per year, with corresponding production being 709 to 765 M g (250 to 270 million ounces). Accordingly, the typical short-fall in free world production of about 284 M g (100 million ounces) is from above ground stocks in the form of reprocessed film and coinage, investment bullion, jewelry, and silverware.

Mine production in the U.S. represents about 11 percent of western world consumption. In a typical year, the Crandon Project would produce approximately 6.8 M g (2.4 million ounces) of silver in all concentrates, most of which is ultimately recovered in smelting and refining.

Crandon represents an important source of newly mined silver in the U.S., amounting to about 6 percent of 1981 domestic mine production. Demand in the U.S. for primary silver according to the U.S. Bureau of Mines may more than double by the year 2000. Accordingly, the U.S. can support larger increases in silver production.

Lead - The major applications for lead are storage batteries, pigments and chemicals, as an anti-knock additive to gasoline (still widely used outside the U.S.), cable sheathing, and in materials for the construction and metal working industries.

According to the U.S. Bureau of Mines, world mine production of lead in 1981 was approximately 3.4 M t (3.7 million short tons). The U.S. produced about 13 percent of this total, or 446,000 t (491,000 short tons). The Project's anticipated lead production of 11,000 t/y (12,320 short tons per year) represents an increase of about 2 percent in U.S. mine production and far less than 1 percent in total world production. Lead does, however, contribute to Project economics.

Gold - The Crandon Project expects to produce in all concentrates about 2.6 percent of U.S. mine production of gold and less than 0.1 percent of world-wide mine production.

According to U.S. Bureau of Mines' figures, U.S. demand for fabricated gold from primary sources has varied in recent years, from 11.82 M g (3.8 million ounces) to 3.1 M g (1.0 million ounces). In 1981, demand was 3.73 M g (1.2 million ounces). U.S. mine production was about 3.11 M g (1.0 million ounces) annually between 1978 and 1980, then increased to 4.35 M g (1.4 million ounces) in 1981. The U.S. Bureau of Mines forecasts that demand will grow by about 75 percent by the year 2000, indicating that there is a need for major increases in U.S. gold production capacity.

Comment No. 12

Previous discussions with Exxon indicated that cadmium would be recovered as a smelting by-product. Is this no longer viable? Are there any other marketable smelting by-products besides gold and silver?

Response:

There are no other marketable smelting by-products besides silver and gold. The ore does not contain economic quantities of minor metals as is characteristic of some other base metal ores produced in the world. For example, there is no smelter recovery for antimony, arsenic, barium, tin, or tellurium.

Comment No. 13

The description of the relative importance of the various metals obtained from this mine should be clarified with a tabular display of relative abundance and relative economic worth of each metal.

Response:

The attached table compares the relative abundance and economic worth of the various metals from the Crandon Project. The market value column reflects the market price applied to the total production. It does not reflect the costs of producing the product or any costs for smelting or refining. Therefore, these values in no way indicate profit or profitability to the Project.

Comment No. 14

It is possible that the Crandon project could displace some marginal U.S. zinc production rather than reduce imports. Also, the U.S. has considerable unused copper capacity now. The need for a strong domestic mining industry, the uncertainties of foreign supplies, and the length of time required to develop new mines could be cited as reasons for the Crandon project.

Response:

Crandon Project production is expected to contribute to help meet an increase in U.S. demand when the Project begins operation. Since the U.S. is a net importer of a major portion of its zinc consumption, any incremental production will potentially reduce the effects of dependence on imports. A marginal U.S. producer will survive or fail depending on their ability to compete in a world market rather than with any particular increment of production such as from the Crandon Project.

Crandon concentrates will compete with other domestic concentrates for existing U.S. smelter capacity on a ton for ton basis. Whereas there is no assurance that any specific U.S. zinc smelter will remain operating by the year 1990, it is reasonable to assume that the following plants will continue in operation.

Company	Zinc Refinery Location
ASARCO	Texas
AMAX	Illinois
Jersey-Miniere	Kentucky
St. Joe	Pennsylvania

Table for Response to Comment No. 13

RELATIVE ECONOMIC IMPORTANCE OF METALS FOR THE CRANDON PROJECT (Typical Year of Operation)

Metal	Units	Metal Recovered Into Respective Concentrate	Smelter[a] Primary Recovery %	Smelter[a] Primary Recovery lbs(k) or oz.	1982 Chase Econometrics Metal Price	1982 k$ Market Value	% Market Value of Each Metal
Zinc	k lbs.	376,119	96	361,074	.356 $/lb.	128,542	56.2
Copper	k lbs.	93,307	98	91,440	.705 $/lb.	64,465	28.2
Lead	k lbs.	17,083	93	15,887	.267 $/lb.	4,241	1.9
Silver	oz	2,405,000[b]	90	2,165,000	7.608 $/oz.	16,471	7.2
Gold	oz	36,000[b]	90	32,000	445. $/oz.	14,240	6.2

[a] Does not include secondary smelter recoverable, such as recovery of cadmium in zinc concentrate from zinc refinery sludge.

[b] Contained metal in all concentrates.

Assuming zinc concentrates will be available from other mines in the U.S. at a level consistent with that of the last 3 years, there should be sufficient U.S. facilities for treating Crandon concentrates, as well as that from other U.S. producers, without a negative effect upon existing marginal U.S. production.

Much of the U.S. zinc concentrate production has a relatively high zinc content compared with many other world-wide sources. For example, most Tennessee mines produce a zinc concentrate averaging 65 percent zinc, whereas Crandon's averages 55 percent zinc. Accordingly, they should be competitive in vying to fill the domestic zinc refinery capacity.

The need for a strong domestic mining industry is pointed out by the recent Presidential Commission to Establish a Domestic Mining Policy. See response to comment No. 11 for metal production, consumption and import/export statistics. These data indicate the need for a domestic mining project such as Crandon.

SECTION 1.1.3.2, STATUTORY OBLIGATIONS

Comment No. 15

The WPDES Permit Application was not submitted with the EIR and has not been submitted as of this date. Also, preliminary wastewater treatment engineering plans have not yet been provided. Plans for the reclaim water ponds must be included in both of these submittals.

Response:

The WPDES Permit Application was submitted to the DNR in September 1983. Plans for the wastewater treatment plant will be submitted at a later date. Plans for the reclaim water ponds are included with this submittal.

Comment No. 16

Table 1.1-2 has the following errors or deficiencies:

Federal Obligations - Only two federal permits are listed. Please provide a comprehensive list of all federally required actions in this section regardless of the agency or objective of the regulation. Also, the "operating license" listed for 33 U.S.C. 1344 reads "Dredge or fill permits for activities in or impacting navigable streams or wetlands". This authority actually addresses discharge of dredged or fill material.

Response:

The following is a supplemental list of potential federal permits required to begin construction:

STATUTORY OBLIGATION	ADMINISTERING AGENCY	ACTIVITY	ACTION
42 USC 300 h et seq	EPA	Possible well injection of ground water, placement of backfill sands below groundwater aquifer.	Issue Class V permit

33 USC 1321	EPA	Spill prevention control and counter measure plan (40 CFR 1127)	Have plan on file before operations begin.
49 USC 1348	FAA	Registration with FAA of a structure that will exceed 200 feet above ground level	Determine that headframe is not an air navagational obstruction.
16 USC 470F	Advisory Council on Historic Preservation	Monitors actions of federal government which may involve sites having buildings, structures, or objects eligible for inclusion in the National Register.	Coordinate with U.S. Army Corps of Engineers
18 USC 843	Bureau of Alcohol, Tobacco and Firearms	Explosives user permit.	Issue permit

Many federal programs that would otherwise be applicable are administered by the state. It is assumed that the state will remain or become qualified to administer the following federal programs: National Pollution Discharge Elimination System; Resource Conservation and Recovery Act Solid Waste Disposal programs; Clean Air Act -- non-PSD aspects; and Safe Drinking Water Act.

Comment No. 17

Non-DNR Related Wisconsin Statutory Obligations - The requirement to obtain plan approval by DILHR for the private sewage system is the only non-DNR state obligation listed. The statutory citation for this approval is erroneously characterized as s. 144.20, Wis. Stats. The correct citation is s. 145.20, Wis. Stats. Also, s. 147.02 Wis. Stats., is cited as a statutory obligation and DNR is listed as an administering agency. While DNR will coordinate with DILHR on the sewage system plans, no DNR permit is required and DNR is not an administering agency.

Response:

Comment acknowledged. The permit requirements are initially established in s. 145.19, and the EIR will be revised accordingly.

Comment No. 18

Other non-DNR related state statutory obligations certainly exist. Please provide a comprehensive list of non-DNR Wisconsin statutory actions, including PSC approval of power supply facilities.

Response:

See the attached table for Wisconsin Department of Industry, Labor and Human Relations actions. A similar list will be prepared for the Department of Health and Social Services and the Department of Transportation. The Department of Industry, Labor and Human Relations currently has under review the attached list of possible regulations applicable to the Crandon Project.

Comment No. 19

DNR-Related Statutory Obligations - The authority governing placement of structures on the bed of navigable waters is cited as s. 30.12(2)(a), Wis. Stats. This section has recently been revised by the Wisconsin Legislature and the appropriate citation is now s. 30.12, Wis. Stats.

Response:

Comment acknowledged and the EIR will be revised accordingly.

Comment No. 20

For placement of riprap, s. 31.12(2)(d), Wis. Stats. is cited. This apparently was intended to cite s. 30.12(2)(d). As mentioned above, this section has recently been revised and the appropriate citation for a riprap permit is s. 30.12(3), Wis. Stats.

Response:

Comment acknowledged and the EIR will be revised accordingly.

Comment No. 21

Plan approval for the wastewater treatment system under s. 144.04, Wis. Stats., will also encompass the water reclaim ponds.

Response:

Comment acknowleged and the EIR will be revised accordingly.

Comment No. 22

As indicated above, the reference to a s. 147.02, Wis. Stats, permit for the private sewerage system is erroneous.

Response:

Comment acknowledged and the EIR will be revised accordingly.

Comment No. 23

Under air emission, s. 144.392, Wis. Stats. is cited. Both s. 144.391 and s 144.392 should be cited.

Response:

Comment acknowledged and the EIR will be revised accordingly.

(TABLE FOR RESPONSE TO COMMENT NO. 18)

PERMITS REQUIRED TO BEGIN CONSTRUCTION OF THE CRANDON PROJECT

Statutory Obligation	Administering Agency	Activity	Action
FEDERAL			
33 U.S.C. 1344	U.S. Army Corps of Engineers	Dredge or fill permits for activities in or impacting navigable streams or wetlands	Permit issuance
30 U.S.C. 801 et seq	Dept. of Labor Mine Safety & Health Administration	File legal identity report	
42 U.S.C. 300 h et seq	EPA	Possible well injection of ground water, placement of backfill sands below groundwater aquifer.	Issue Class V permit
33 U.S.C. 1321	EPA	Spill prevention control and counter measure plan (40 CFR 112.7)	Have plan on file before operations begin
49 U.S.C. 1348	FAA	Registration with FAA of a structure that will exceed 200 feet above ground level	Determine that head-frame is not an air navagational obstruction
16 U.S.C. 470F	Advisory Counsel on Historic Preservation	Monitors actions of federal government which may involve sites having buildings, structures, or objects eligible for inclusion in the National Register	Coordinate with U. S. Army Corps of Engineers

(TABLE FOR RESPONSE TO COMMENT NO. 18)

PERMITS REQUIRED TO BEGIN CONSTRUCTION OF THE CRANDON PROJECT

Statutory Obligation	Administering Agency	Activity	Action
18 U.S.C. 843	Bureau of Alcohol, Tobacco and Firearms	Explosives user permit	Permit issuance

Many federal programs that would otherwise be applicable are administered by the state. It is assumed that the state will remain or become qualified to administer the following federal programs: National Pollution Discharge Elimination System; Resource Conservation and Recovery Act Solid Waste Disposal programs; Clean Air Act -- non-PSD aspects; Safe Drinking Water Act.

STATE

Wis. Stat. 23.11	DNR	EIR submittal	Determine adequacy
Wis. Stat. 30.12	DNR	Placement of structures	Permit issuance
Wis. Stat. 30.12	DNR	Pacement of riprap	Permit issuance
Wis. Stat. 144.855(2)	DNR	Diversion of surface water	Permit issuance
Wis. Stat. 30.19(1)(c)	DNR	Grading of banks	Permit issuance
Wis. Stat. 30.20(1)	DNR	Dredging	Permit issuance
Wis. Stat. 31.23	DNR	Bridges	Permit issuance
Wis. Stat. 86.07	Dept. of Transportation	Permit to connect mine access road to State Highway 55 and to run water discharge pipeline underneath Highway 55	Permit issuance

(TABLE FOR RESPONSE TO COMMENT NO. 18)

PERMITS REQUIRED TO BEGIN CONSTRUCTION OF THE CRANDON PROJECT

Statutory Obligation	Administering Agency	Activity	Action
Wis. Stat. 28.11(11)	DNR - Forest County	Withdrawal of land within project site boundary from County forest status	Approval of withdrawal application filed on December 2, 1980 with DNR
Wis. Stat. 101.15	DILHR	Mine Shaft sinking, hoisting and ventilation of underground workings	Review mining activities and issue all applicable permits (see letters dated May 3, 1983 and August 30,1983 between DILRHR and Exxon for a more specific listing of required approvals
Wis. Stat. 101.12	DILHR	Surface Building plans, blasting procedures	Review and approve applicable construction procedures and building plans and issue applicable permits
Wis. Stat. 145.02	DILHR	Plumbing and fire protection	Review and approve plans and issue applicable permits
Wis. Stat. 144.025(2)(e)	DNR	High capacity wells	Permit issuance
Wis. Stat. 144.04	DNR	Waste water treatment system	Plan approval

(TABLE FOR RESPONSE TO COMMENT NO. 18)

PERMITS REQUIRED TO BEGIN CONSTRUCTION OF THE CRANDON PROJECT

Statutory Obligation	Administering Agency	Activity	Action
Wis. Stat. 145.19, 145.20, 147.02	DILHR, Forest County and DNR	Private sewage system	Permit issuance (county) and review and approve final plans (DILHR DNR)
Wis. Stat. 144.392, 144.391	DNR	Air emission	Permit issuance
Wis. Stat. 144.44, 144.46	DNR	Mine Waste Feasibility Report, Plan of Operation	Approval
Wis. Stat. 144.85	DNR	Mining	Permit issuance
Wis. Stat. 59.971	Forest County, DNR	Placement of mining structures in shoreland/ wetland zoning districts	Adopt Shoreland zoning ordinances in accordance with NR115; approve the placement of such structures in the zoning districts
Wis. Stat. Chap. 147	DNR	Water discharge	Permit issuance
Wis. Stat. Chap. 162	DNR	Potable water supply	Review and approve final plans

LOCAL

The Town of Lincoln has a zoning ordinance. It is expected that the Town of Nashville will have an ordinance relating to mining.

Comment No. 24

For the mine waste feasibility report and plan of operation s. 144.44, Wis. Stats. is cited. Since it may be necessary to obtain a waiver under s. 144.44, from separation distance requirements, this should include a reference to s. 144.46, Wis. Stats., to recognize the availabiity of such variances.

Response:

Comment acknowledged and the EIR will be revised accordingly.

Comment No. 25

When citing s. 144.85, Wis. Stats., Exxon indicates the administering agency as "DNR-Mining Permit", with blanks under the "Activity" heading and the "Action" heading. Under the "Administering Agency" heading, only DNR should be listed. Under the "Activity" heading "Mining" should be listed. Under the "Action" heading, we presume the request to be for "permit issuance".

Response:

Comment acknowledged and the EIR will be revised accordingly.

Comment No. 26

The reference to DNR and Forest County action regarding shoreland and flood plain zoning contains a number of errors. Section 54.471, Wis. Stats., is an erroneous citation and should read s. 59.971. Section 144.46, Wis. Stats., refers to separation distances of solid waste disposal facilities from navigable waters, and does not apply to the pipeline route. This reference should be dropped. Also, the shoreland (not shoreline) and flood plain zoning activity is local in nature and should not reference the DNR as an administering agency. Finally, the "Activity" and "Action" items appear to be transposed. The requested action is apparently the obtaining of necessary zoning and permits.

Response:

Comment acknowledged and Table 1.1-2 of the EIR will be amended as regards Shoreland and Flood Plain zoning as follows:

STATUTORY OBLIGATION	ADMINISTERING AGENCY	ACTIVITY	ACTION
59.971	Forest County	Placement of mining structures in shore-land/wetland zoning districts.	Adopt Shoreland zoning ordinances in accordance with NR 115; approve the placement of such structures in the zoning districts.

Comment No. 27

In addition to the mining permit under s. 144.85, Wis. Stats., Exxon must also receive formal authorization to commence mining under s. 144.86(3), Wis. Stats. Also, Exxon may need to acquire approvals for one-time disposal of wood ash, construction debris and waste wood. If arrangements cannot be made to dispose of mill refuse and other nontailings wastes in an existing landfill, it may also be necessary to pursue development and Department approval of a solid waste landfill pursuant to s. 144.44 Wis. Stats.

Response:

Comment acknowledged.

Comment No. 28

Local Obligations - In addition to the town ordinances governing activities within the town boundaries, Exxon will have to comply with certain County ordinances. As mentioned above, the pipeline will have to conform with all Forest County shoreland and flood plain ordinances or be granted variances from incompatible restrictions. The outfall structure and all stream crossings would also be subject to these ordinances. In addition, we expect that delineation of the ordinary high water marks of Duck Lake, Deep Hole Lake, Skunk Lake, and Little Sand Lake may place other project facilities within the 1,000 foot shoreland zoned area.

Response:

Comment acknowledged. Also, see response to comment No. 26.

SECTION 1.1.3.3, PROJECT SCHEDULES

Comment No. 29

The present schedule fails to consider activities which must occur or be initiated prior to the start of construction. A pre-construction plan and schedule must be provided to identify those activities and to establish a more realistic time frame for the start of construction. This plan and schedule should include but not be limited to the following items:

1. Implementation of the various monitoring plans.

2. Corporate analysis of permit conditions and decision to proceed with a project.

3. Completion of required land acquisition including county forest lands.

4. Satisfactory legal and physical resolution of predicted private water supply problems.

5. Compliance with other post-permitting regulatory requirements, and as requirements for environmental mitigation.

Response:

1) A discussion of the monitoring programs for ground water, surface water, aquatic ecology, air quality and terrestrial ecology is presented in the Mine Permit Application, Section A-Item 15. The schedule for implementation of the monitoring program and the frequency of sample collection and the locations to be sampled are also discussed. The monitoring programs for the above disciplines will be initiated approximately 6 to 12 months prior to construction.

2) The Corporate analysis of permit conditions and evaluation of the decision to proceed with the Project is an ongoing process. The proposed DNR permit conditions will be known during the Master Hearing.

   The Corporate analysis will remain current throughout the Master Hearing process.

3) Land required to proceed with the Project not already owned by Exxon is currently under option. The options can be exercised and title transferred to Exxon within 90 days of notice of exercise of the option. Construction can begin immediately upon permit issuance on land already under lease or owned by Exxon.

4) The legal-statutory framework to satisfactorily resolve water supply problems is in-place. Monitoring of water wells that may be impacted by mine related activities will begin at least one year before construction.

5) Scheduling of post-permitting activities will be described in greater detail as the operation phase of the mine draws to a close.

Comment No. 30

Figure 1.1-4 which indicates projected peak manpower requirements, must be supported by detailed employment needs by job category in Sections 1.3.3.1 and 1.4.2. Manpower requirements must be broken down by year, and must be accompanied by the assumptions and data used to derive the projections.

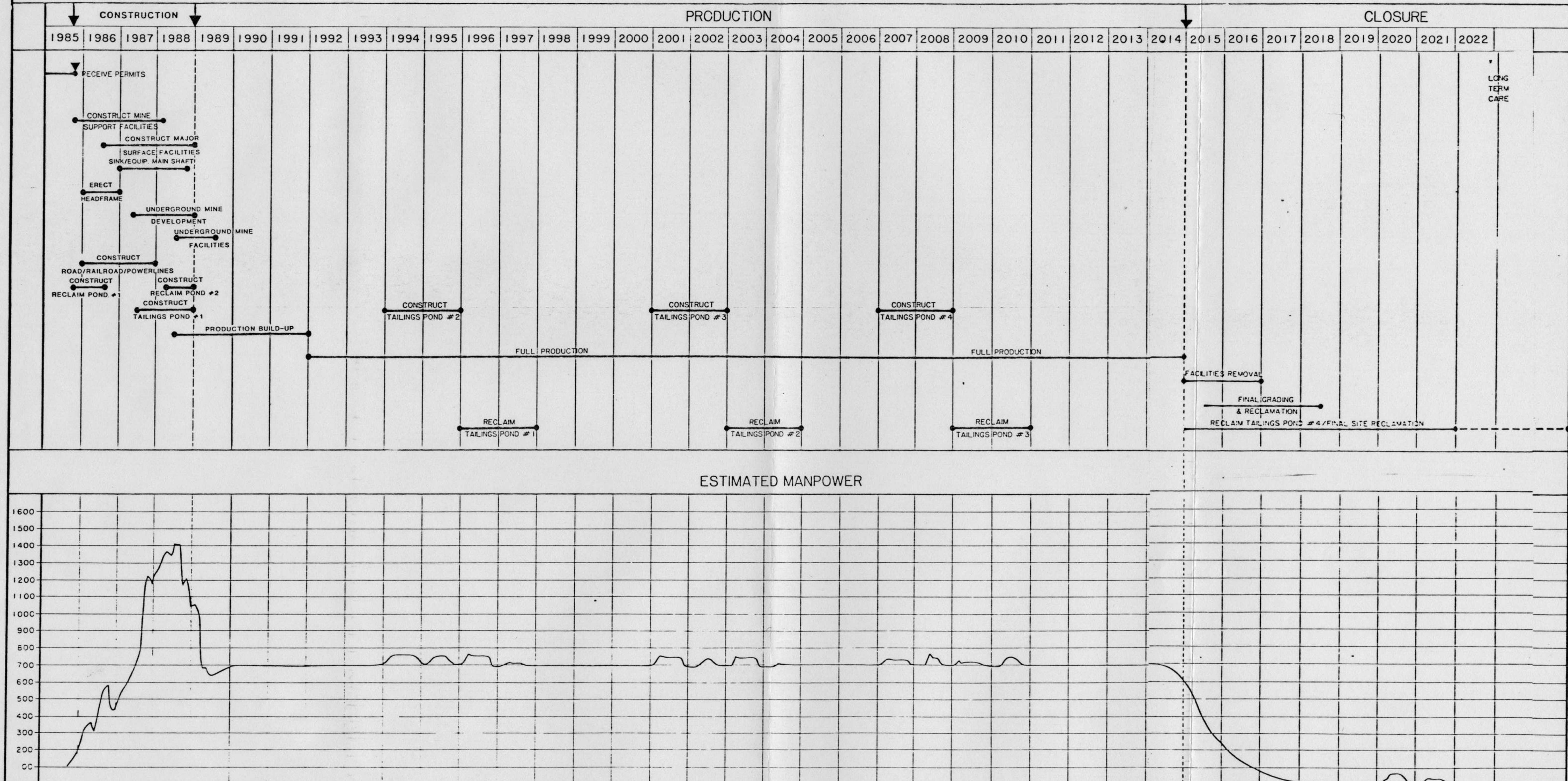
Response:

Exxon's new manpower projections consistent with the current execution philosophy are reflected in the attached Project schedule. Response to comments No. 30, 31, and 154 are based upon these new projections shown in Figures 1.1-4, Revision 1 (attached) and figures accompanying response to comment No. 154. The new information reflects current planning; however, it is subject to changes in their inherent dependency on market conditions, permitting factors, and Exxon's corporate decision process.

Exxon has determined that the time to develop the main shaft and install the hoisting equipment can be shortened by 6 months.

Current execution philosophy takes advantage of a "run of mine" production period (12 months) prior to completion of the underground primary crusher. Two stopes will be operated during this time with uncrushed ore hoisted from

EXXON MINERALS COMPANY
CRANDON PROJECT
SCHEDULE



	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
PEAK	200	592	1224	1417	1070	703	703	703	703	780	780	785	722	703	703	703	785	770	770	715
AVG.	140	414	857	992	749	615	615	615	615	753	720	698	682	615	615	615	698	740	740	625

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022		
PEAK	703	703	758	785	722	780	703	703	703	703	600	250	80	25	25	78	58	1	1	1
AVG.	615	615	640	698	630	642	615	615	615	641	325	165	55	25	25	39	18	1	1	1

NOTE:
THE CONSTRUCTION STARTING DATE IS BASED UPON THE EXPECTED DATE OF PERMIT ISSUANCE AND THE DURATION OF SCHEDULED ACTIVITIES MAY VARY. THE ACTUAL CONSTRUCTION START DATE WILL VARY DEPENDING UPON PERMIT ISSUANCE AND ECONOMIC CONDITIONS.

REVISION	DATE	BY	DESCRIPTION
1	9-83	CS	GENERAL

EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE: PROJECT SCHEDULE

SCALE: NONE | STATE: WISCONSIN | COUNTY: FOREST
DRAWN BY: R.C. DIETZ | DATE: 10/82 | DATE: 11/29/82

FIGURE 1.1-4 | SHEET 1

(FIGURE FOR RESPONSE TO COMMENT NO. 30)

the ventilation air intake shaft and from a temporary skip loading station in the main production shaft located above the crusher station.

This ore will be stockpiled on surface until operation of the concentrator starts. This moves the start-up of mill facilities ahead by 6 months, giving a total Project schedule shortening of 1 year from the schedule previously submitted.

A condensed schedule for the Crandon Project is presented in Figure 1.1-4, Revision 1. This schedule illustrates schedule durations and interrelationships of major activities. The estimated manpower requirements required for each Project phase are presented, with further detail of employment needs given in subsections 1.3.3.1 and 1.4.2. Please refer to the response to comment No. 154 for these figures, the detailed manpower projections and the basis for development of these figures.

Comment No. 31

The EIR seems to indicate three different levels of manpower requirements. Figure 1.1-4 indicates a maximum of less than 1,450 workers. In comparison, for the most likely scenario in Table 4.2-25 in 1989, there would be 1,080 construction workers and 580 operations workers for a total of 1,660 employees. Figure 1.3-15 apparently shows a maximum of about 1,450 construction workers for 1989 which would indicate a total work force for that year of over 2,000. Justification of these critical projections is essential since review of the literature relevant to large growth projects shows that estimates of manpower requirements are often too low ("Social Economic Impacts of Power Plants", Denver Research Institute and Brown, Bortz and Coddington prepared for the Electric Power Research Institute, Palo Alto, California, 1982, and "Chronic Under Projecting of Work Forces at Nuclear Power Plants", Robert B. Braid, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 1980).

Response:

Figure 1.1-4, Revision 1 (attached to the response to comment No. 30) is a condensed verison of information presented in response to comment No. 154. This curve indicates a maximum peak of 1,417 workers occurring in July 1988. The composition of the peak work force is 126 workers employed in construction of the shaft and underground facilities, 466 Exxon employees, and 825 workers engaged in construction of the surface facilities. Detailed breakdowns by job category also are presented in the response to comment No. 154 for the figures. The Exxon employees constitute operations, maintenance, technical, administration, and construction management for the mine and surface facilities. Therefore, the peak manpower of 1,417 reflects construction workers and operations personnel.

The projections for Exxon employees are based on current organization charts and job classification requirements throughout Project life. The figures reflect the combined needs of the construction phase and build-up of operations personnel. They have been checked for consistency and reasonableness with actual personnel requirements for other mining industry operations and other Exxon projects.

The build-up of the construction work force for shaft, underground, and surface facilities is based upon the Project schedule, required crew mixes for construction tasks, and a detailed calculation of estimated manhours. This estimate has been developed using historical Exxon information. They reflect Exxon's philosophy of project execution and required manning levels. This is an important aspect as we traditionally impose rigorous standards upon contractors for the maintenance of safety, quality, and cost/schedule control which typically increases their staffs. Only by reflecting our own historical information can this concept be interjected into our manpower projections and thereby reflect realistic personnel requirements.

SECTION 1.1.3.4, PROJECT FACILITIES AND EQUIPMENT COSTS

Comment No. 32

Table 1.1-3 should be significantly expanded to cover construction and operation costs of major project components. This includes individual cost estimates for mine equipment, mill equipment, and for major elements of the pollution control facilities (tailings pond liner, reclaimed ponds, water treatment units, etc.). Cost figures of all taxable capital equipment and improvements are also necessary. Justification or documentation for cost estimates must be provided.

Response:

The disclosure of all the cost data covering the construction and operation of the Project components would require a degree of disclosure that could work to its economic disadvantage and that of the Company. Exxon is willing to discuss with the DNR those specific areas in which additional cost information may be required by either Wisconsin Statutes or regulation.

SECTION 1.1.3.5, RELATED GOVERNMENTAL PLANS AND GOALS

Comment No. 33

This section must address the relationship of the proposal to lands entered under various governmental programs such as County Forest lands, Forest Crop Law lands, and Woodland Tax Law lands.

Response:

State, county, city, town or village public lands in the environmental study area are shown on Figure 2.9-7 in EIR Section 2.9. Lands in the environmental study area entered into the Woodland Tax Law and the Forest Crop Law programs are identified in Section 2.9, Figure 2.9-2. County Forest lands associated with Project facilities will be acquired by Exxon by exercising land purchase options. These include Forest County lands in Sections 29 and 30, T35N, R13E (EIR Figure 1.1-3).

Lands entered under the Forest Crop Law that were purchased by Exxon have been withdrawn from the provisions of this law. Any additional lands under Forest Crop Law contract that are acquired by Exxon for the Project will be removed from the provisions of this contract. This includes the Forest County lands in Sections 29 and 30, T35N, R13E which are under an Exxon land purchase option (EIR Figure 1.1-3).

There are no Woodland Tax Law lands associated with the proposed Project facilities.

Comment No. 34

Describe development, recreation, transportation, resource, and educational plans for Antigo, Rhinelander, Oneida and Langlade Counties, the Nicolet National Forest, and the three local Native American communities.

Response:

The following statements will be incorporated into the revised EIR subsection 1.1.3.5:
The Langlade County development plan in the City of Antigo Comprehensive Plan (NCWRPC, final draft, August 1983) contains statements regarding the proposed Project. Discussion with local governmental agencies indicates the following developments or development plans:

Recreation:

Langlade County has a 5-year recreational program. This program is currently devoted to improvement of the Langlade County Fairgrounds. Outdoor recreational activities are being evaluated and expanded as necessary through local governments in cooperation with the private sector (K. Given, Antigo area Chamber of Commerce).

Transportation:

Highway "A" the main route from Antigo to SH 55 near the Project, will be maintained and reconstructed during the next few years. Highway "55" is considered a "scenic route" through Langlade County and the Wisconsin Department of Transportation indicates that this road will not be rebuilt or upgraded until demand exists.

The Langlade County Airport is in a 6-year development plan. Currently the Airport Commission is attempting to acquire land for a cross-wind runway extension of an existing runway. Construction will not be considered until needs justify the expansion.

The recently abandoned Chicago and Northwestern Railroad right-of-way is under study for potential use as a long-term utility development corridor by the City of Antigo.

Resources:

Langlade County and Antigo are in a reforestation program to establish 7500 trees on a 4-ha (10-acre) tract on the site of the former landfill.

The Antigo Waste Processing and Recycling Center is now completed and accepting waste products from Langlade and parts of Shawano and Marathon counties.

Education:

The Antigo Board of Education Capital Improvement Plan includes the construction of a high school auditorium on current school acreage followed by a multi-year program which includes complete remodeling of the existing high school facilities.

The Oneida County Long-Range Plan (NCWRPC, in revision), the Rhinelander Comprehensive Development Plan (Rhinelander Mining Impact Committee, in final draft), and the Downtown Rhinelander Improvement Association Development Plan (J. Allen, in final draft) each present goals related to the proposed Project:

Recreation:

The Oneida County Forestry and Outdoor Recreation Committee has developed long-range plans which include expansion of outdoor recreational activities on Oneida County Forest lands.

The Wisconsin Northwoods Tourism Region 2 recently announced the establishment of an annual Snowmobile Festival to be held in January of each year.

Transportation:

The downtown Rhinelander traffic pattern will be improved by the development of the abandoned Chicago and Northwestern Railway corridor which was recently purchased by the City of Rhinelander.

A long-range proposal to provide a Highway 8 by-pass around Rhinelander will ultimatly affect traffic in the Rhinelander-southern Oneida County area.

Current plans are to improve the taxiway at the Rhinelander-Oneida County Airport.

Resources:

The Oneida County Forestry and Outdoor Recreation Committee long-range plans include timber sales and reforestation for total resource management. The same type of long-range management plan is in effect for the Northern Highland and American Legion forests in Oneida County.

Education:

The Rhinelander K-12 School District has developed a 5-year capital expenditure plan which provides improvement to all schools in the district including the construction of a new K-6 or double K-6 school in the Town of Pelican.

The Nicolet National Forest Land Use Plan is mentioned on EIR page 1.1-20. The plan will not be available in 1983.

The two Native American Communities in the Project area have each submitted OEDP plans and updates annually. Discussions with the two communities do not indicate major developments during the short-term. The Mole Lake Chippewa Community continues to develop a shopping complex on the reservation and the Forest County Potawatomi recently received approval to develop a heavy construction trades program for their community.

Comment No. 35

Describe the 1981 State Comprehensive Outdoor Recreation Plan for Region 2 supply-demand-needs assessment of outdoor activities and the issues developed for Region 2. Discuss tourism activities, goals and objectives established for the area by the Department of Development-Division of Tourism, and Governor's Council of Tourism Reports.

Response:

A review of the 1981 State Comprehensive Outdoor Recreation Plan supply-demand-needs assessment for outdoor recreational activities indicates that for all activities, only a minor percentage of the state-wide need occurs in Region 2. Data developed in the course of preparing the Exxon Minerals' Socioeconomic Report entitled, "Current Conditions Report," confirm the basic needs assessment for outdoor activities identified in the 1981 State plan. Discussions with the Forest, Langlade and Oneida County Chambers of Commerce indicate that the responsibility for meeting the recreational needs has been a primary function of each local governmental jurisdiction in cooperation with the local private sector. Also, in Region 2 many outdoor recreational activities are preferred to be in undeveloped or in the lesser developed areas.

Tourism goals and objectives have been established for Region 2 by the Wisconsin Department of Development (Wisconsin Tourism Industry Study, [March 1983]) and the Governor's Blue Ribbon Task Force on Tourism (final report, 1982). These studies are more recent than the 1981 Comprehensive Outdoor Recreational Plan cited by the DNR. Recommendations based on the Wisconsin Tourism Industry Study by the Department of Development apply equally to Region 2. The study contained recommended action on several levels:

1) Information: Facilities availability; sight-seeing opportunities;

2) Lake Access: Better public access for water related activities;

3) Financing: State funding availability to local tourism areas;

4) Marketing: Maintenance of existing markets and attraction of untapped markets; and

5) Education: Providing operators with information on which to make decisions related to facilities improvement.

SECTION 1.1.3.6, REQUIREMENTS FOR GOVERNMENT SERVICES

Comment No. 36

Governmental workloads have been or will be increased in areas such as job service, facility inspection, environmental inspection, revenue, employee training, planning, and impact funding.

Response:

As noted in the EIR, operations of the Crandon mine/mill facilities will require minimal additional services. The following comments will be added to the end of subsection 1.1.3.6 in the revised EIR:

At the State level, governmental service requirements in the areas of facility inspection (DILHR, DHSS, DNR) and environmental inspections (DNR) will be increased to the extent required to meet current laws and administrative regulations. However, it is anticipated that the types of inspections necessary will not increase the overall workload or require additional staff.

The decision to treat the Project property as "Manufacturing" for assessment purposes has not required the Department of Revenue's Bureau of Property Tax to increase the manpower required for proper evaluation and tax computation. Under current conditions, any anticipated workload increase should not have a major effect on the overall manpower of the Bureau of Property Tax. Other Department of Revenue Bureaus may also experience brief increases in administrative effort due to the Project; however, no shift in the total workload is expected.

State planning agencies (i.e., DOE, DOA, DOR) have had to consider the potential of mining in the development of near-term and long-range plans. Because these plans were being developed for numerous other purposes, the mining aspects have added only minimal amounts of effort. If the Project proceeds into the construction phase, State agencies may be required to provide a limited increase in manpower assigned to the planning effort for the Crandon Project and its effect on the long-range plans.

The Mining Investment and Local Impact Fund Board, created as a result of the 1977 tax laws, has continued to require one full time staff person. Manpower levels for planning administrative requirements should not increase as a result of the development of the Project, according to discussions with Elizabeth Kohl, Executive Secretary of the Board.

According to Eugene Voss, Director of the Job Service Office in Rhinelander, current administrative functions utilizing computerized data availability will enable the Job Service to handle any Project development with a minimal increase of staff time.

With the exception of possible DILHR involvement on a minimal scale, governmental services for employee training will not be necessary under current plans. Exxon Minerals Company will conduct or retain outside contractors for all training required for permanent staff.

Comment No. 37

There is no sludge disposal site in Forest County at this time. The disposal site for sludge must be identified and described to assess potential demands on government services.

Response:

The sewage treatment system was designed in accordance with Wisconsin Administrative Code Section ILHR 83 as well as U.S. Department of Health, Education, and Welfare "Manual of Septic Tank Practice." The total liquid capacity of the septic tank is 223.3 m^3 (59,000 gallons). This will provide one-day liquid retention time and allow for 49.2 m^3 (13,000 gallons) of sludge storage. This system will require sludge removal once or twice a year. It is anticipated that sludge removal and disposal will be handled by a licensed private contractor.

Comment No. 38

Disposal of refuse in a landfill in the Town of Nashville may be a significant service demand on the township. At this time, there appear to be no sites of sufficient capacity for the disposal of these wastes. Also, preliminary discussions with Town officials indicate that they may not accept Exxon refuse at the Town landfill. A new site in the Town of Nashville would take several years to develop and be approved. Exxon must describe the additional waste loading expected from the mine, mill and increased local population and must specifically identify and describe the disposal area. These comments also apply to the one-time disposal of ash, wood waste and construction debris.

Response:

Plans for the exact disposal area or areas for refuse from the Crandon Project have not been finalized. The potential for disposal in sites in the Town of Nashville is still being evaluated. However, if the volume of Project wastes cannot be handled by local township landfill operations, either more distant landfills (Antigo, Oneida), private contract landfills or a landfill at the Project site will have to be used.

Estimates of the amount of refuse generated during construction are provided under the heading "Solid Wastes" in EIR subsection 1.3.5.1. The highest estimate of 9.1 t (10 short tons) per week was during the summer of construction phase years 3 and 4. Salvageable material would consist of shipping containers, scrap metal, wood framing, wire spools, and other such material, some of which would be returned to suppliers. That which cannot be salvaged or returned, plus administration office and labor force wastes (paper, boxes, lunch bags), will be disposed in a landfill.

Slash and unmerchantable timber will be burned or disposed at an on-site or off-site landfill facility.

Refuse generated during operation is characterized in EIR subsection 1.4.8.3, under the heading "Refuse." Estimates of the percentage of various waste categories are as follows:

Waste Type	Volume Percentage
Paper and garbage	75
Plastic	5
Wood	5
Metal	10
Miscellaneous	5
	100

Based on evaluations of similar industrial operations, we estimate the total volume of unsalvageable waste during operation to be approximately 2.3 t (2.5 short tons) per year per employee. Assuming 800 employees, the estimated annual waste generated would be approximately 1815 t (2000 short tons).

The increase in the local population as well as the estimate of resultant refuse generated from this increase is not available at this time.

Comment No. 39

Details on the available on-site fire suppression equipment, the manpower training proposal, and anticipated needs for fire protection must be provided along with existing fire fighting capability of nearby municipalities in order to adequately evaluate the total fire suppression capability. Also, the Soo Line Railroad is responsible for 4-5 fires per year in the area. How many additional fires would be expected annually from the increased rail traffic associated with the mine operation?

Response:

Fire protection will be provided to meet all pertinent codes and regulations. The degree of protection provided in any facility area will be based on its occupancy and its content of combustibles. Individual systems design and the selection of specific equipment items will be addressed during the detailed engineering phase.

At this time, the conceptual design provides for a fire-water tank with a capacity of 1,900 m^3 (500,000 gallons). This tank will be located on the north side of the mine/mill site approximately 200 m (656 feet) east of the mill building. The water source for the fire-water system is assumed to be either treated water from the treatment plant, uncontaminated mine water or well water. The fire-water tank will be full at all times.

Two fire-water pumps (one electric and one emergency diesel) for supply and a jockey-pressurizing pump will be provided to distribute fire water through a pipe loop (see Attachment No. 1 [Drawing DBM-1-C-001]). This loop passes in close proximity to all principal surface facilities. A second, subsidiary loop will surround the concentrator building. Fire hydrants will be provided at close intervals, either mounted directly on the loop or on short branch lines. The emergency diesel pump will be activated in the event of a power outage at the pump station.

Automatic fire and/or smoke detection and alarm equipment will be installed in all facilities. A fire truck will be garaged in the northwest corner of the services building. Hand-held and Halon 1211-type fire extinguishers will be located where needed. Every vehicle will carry at least one dry chemical unit.

Apart from the handling of flammable fuels and certain reagents, the operations of crushing, concentrating and product load-out are not potential fire risks. This is particularly true in the concentrator building where all processes are wet with the exception of fine ore crushing.

Information on fire protection capability of nearby municipalities is presented in EIR subsection 2.10.4.2 (pp. 2.10-118 and 2.10-119; Table 2.10-71). More detailed information on fire protection facilities, equipment and vehicles, number of firemen, salary and operating expenditures, key fire insurance ratings, service area and planned modifications for the local cities and service centers, where available, is given in EIR Appendix 2.10A, Table 2.10A-5.

We are not able to respond to the question concerning estimates of additional fires associated with increased rail traffic. This question should be addressed by the Soo Line Railroad. However, the only additional rail traffic will be from the main track to the mine/mill site. The frequency of rail traffic on the existing main rail line is not expected to increase.

Comment No. 40

Why is it anticipated that outside law enforcement assistance would be required? The level of law enforcement assistance required by the project must be described along with the capabilities of nearby law enforcement units and any additional equipment or manpower needs.

Response:

Subsection 1.1.3.6, Requirements for Governmental Services - The statement questioned in the DNR's comment appeared in this subsection. Inadvertently the word not was omitted. Therefore, the EIR will be revised to state: It is not anticipated that outside law enforcement assistance would be required.

Comment No. 41

Please discuss the need for upgrading town or county roads for use prior to the completion of the access road or during the mine operation.

Response:

The revised construction schedule (to be included in the revised EIR) indicates completion of the access road within the first year of construction. The railroad will be completed within 15 months from start of construction so that heavy loads can be delivered by rail. Therefore, Exxon does not anticipate the need to upgrade (enlarge or expand) the existing local roads.

SECTION 1.1.3.7, PROPOSED CHANGES IN LAND CLASSIFICATION

Comment No. 42

Forest County - Forest County shoreland zoning permits and/or approvals may be required for the proposed access road and railroad crossings, the discharge structure, and other facilities located within 1,000 feet of a lake's ordinary high water mark. Specific plans should be provided to the Forest County Zoning Administrator for determinations of necessary permits and approvals.

Response:

Comment acknowledged and the EIR will be revised accordingly. Also see response to comment No. 26.

Comment No. 43

Forest County is also in the process of developing and adopting a county flood plain ordinance. Upon adoption of the ordinance, additional county zoning permits and/or approvals may be required.

Response:

Comment acknowledged. Also see response to comment No. 26.

Comment No. 44

Town of Lincoln - The Town of Lincoln has recently adopted a town zoning ordinance. Under this ordinance, the mine/mill site, tailings ponds, and a portion of the reclaimed water ponds are located in areas that are zoned "forestry". A zoning change to "mining" would be required prior to development of any facilities at proposed locations in the Town of Lincoln.

Response:

Comment acknowledged and the EIR will be revised accordingly.

Comment No. 45

Town of Nashville - The Town of Nashville is in the process of adopting a town zoning ordinance. Exxon should identify any necessary zoning changes required if and when an ordinance is adopted.

Response:

Comment acknowledged.

SECTION 1.1.3.8, RELATIONSHIP OF THE PROPOSED PROJECT TO OTHER SIMILAR PROJECTS

Comment No. 46

Please discuss the potential for processing ore from other deposits at the Crandon mill, and the general legal requirements which would apply if other ore was processed. Describe the effect implementation of the proposal would have on the technical and economic feasibility of the development of other ore bodies in the region.

Response:

As stated in the EIR, the Project is designed to process only the ores which are known to occur in the Crandon deposit.

Recent reports in the press have indicated the existence of other mineral occurrences in the region. Exxon is in no position to judge as to whether any of these occurrences are economic to mine or whether they are compatible with the facilities designed for the Crandon Project. Further, the intentions of the owners of these mineral rights are unknown.

Comment No. 47

This section should also indicate that this would be the first mine in Wisconsin to be initiated under the existing regulations and the first sulfide ore body developed.

Response:

Comment acknowledged and the EIR will be revised to include the statement: The Crandon Project will be the first massive sulfide mine developed in Wisconsin under the existing state regulations.

SECTION 1.2, DESCRIPTION OF FACILITIES

Comment No. 48

Neither this section of the EIR or the Mining Permit Application contains the requisite level of engineering detail necessary for an adequate environmental and regulatory review. The two volumes of the Ralph M. Parson Report approached the level of detail which will be required. Unfortunately, the Parson's Report only covered portions of the complex and was outdated at the time of its transmittal to the Department. Mr. Hansen's letter of November 18, 1981 assured us that "an additional phase of engineering studies is presently being planned." The results of those studies are necessary for our evaluation.

Response:

The level of engineering detail contained in the EIR and the Mine Permit Application are generally felt to be adequate to allow the DNR to assess the Crandon Project impacts. In some design aspects, a total release of engineering detail could jeopardize Exxon's competitiveness in the minerals business. However, Exxon will continue to respond to specific questions and areas of concern -- (see also response to comment No. 4).

Comment No. 49

This section should include a small scale map or scale drawing showing all of the major Project facilities. A base map such as USGS Planimetric Quadrangle sheet could be used.

Response:

A small scale figure showing all the Project facilities is attached.

Comment No. 50

Include a description of the proposed pilot plant in this and subsequent sections.

Response:

A pilot plant has been proposed as a means of training mill personnel and determining optimum operating and control parameters for the full scale plant. This pilot plant has not yet been designed; however, it would essentially be a very small version of the full scale plant and would process one to two tons of ore per hour when operating.

The current plans are to house the pilot plant in a portion of the core storage building. The current estimated building area requirement is 372 m^2 (4000 square feet). Tailings from the pilot plant would be retained temporarily in a small lined pond. Sometime after startup of the full scale plant and the establishment of a permanent tailings pond,

(FIGURE FOR RESPONSE TO COMMENT NO. 49)

the lined tailings storage pond for the pilot plant would no longer be needed and the existing contents would be moved by truck to the permanent location. The small pond would then be reclaimed. A small water reclaim pond will also be provided and would be removed once the operation of the pilot plant ceases.

This pilot plant would be run intermittently prior to and during the startup of the full scale plant and as needed thereafter.

Comment No. 51

This section also lacks any description of the aesthetics features of the surface facilities.

Response:

The discussion of aesthetic features of the surface facilities for the Crandon Project are provided in EIR subsection 4.2.9.2, Aesthetics, and the reports referenced in this subsection. This subsection provides an evaluation of the visibility of Project facilities from local vantage points as well as a discussion of mitigative options available to reduce visual impacts.

Comment No. 52

The acreage cited for the area of the surface facilities should include the railroad, access road and discharge pipeline corridors.

Response:

The following surface areas for the facilities will be included in Chapter 4.0, Table 4.0-1 of the revised EIR:

Facility	Corridor Width		Construction Limits Width (Avg.)		Corridor Area		Construction Area	
	m	feet	m	feet	ha	acres	ha	acres
Access Road	60*	200	30	100	30	74	15	37
Railroad Spur	60	200	30	100	26	64	18	45
Rock Haul Road/ Slurry Transport/ Reclaim Water	60	200	40	131	6	15	4	10
Excess Water Discharge Line	15	50	6	20	15	37	6	15

*Includes 30 m (100 feet) for road and 30 m (100 feet) for powerline.

SECTION 1.2.2, VENTILATION SHAFTS

Comment No. 53

Describe the shaft surface discharge structure, fan size, noise suppression, air quality controls, and access roads. Exxon had previously indicated that the fans would be located underground in order to reduce ambient noise levels. Why were the fans moved to the surface?

Response:

Fans will be located on the surface of the east and west exhaust shafts. Preliminary design includes a 90° elbow at the shaft collar, with a horizontally mounted fan or fans attached to another 90° elbow, which is directly coupled to a vertical evase for ultimate discharge to the atmosphere. Physical dimensions of the discharge evases can be found in Table C-1 of the "Air Permit Application Appendices." Fan sizes were addressed in subsection 1.4.2.3, Ventilation and Mine Air Heating of the EIR. Present design indicates that each discharge shaft fan installation will convey approximately 350 m^3/s (.75 M cfm) of air.

Noise suppression at each of these installations was determined unnecessary by modeling (see EIR Section 4.2). However, to mitigate any undesirable noise emanations and possible resultant impacts, the discharges will be directed vertically to achieve maximum dampening and dispersion. .

Description of air quality controls can be found in the Air Permit Application, subsection 2.2.1, Mine-Construction and Operation. Location and routing of access roads to and from each exhaust shaft are presented in Attachment No. 2 (Plot Plan drawing No. 051-1-G-001).

Location of mine exhaust fan installations at the surface is necessary to assure maximum reliability and operability of essential switchgear and electronic components. The Mine Safety and Health Administration (MSHA) recommends location of main fans on the surface and addresses that issue in draft proposal 30 CFR 58-21, Subsection 58.21-2 (U) Mine Categories. Therefore, surface main fan installations were designed for maximum assurance of a safe and reliable ventilation system for those working underground. Also, for reasons described earlier, minimum impact to surrounding communities will remain a high priority during final design and equipment acquisition.

SECTION 1.2.1.2.3, DRIFTS

Comment No. 54

Describe in detail the mining plan as it relates to the control of surface subsidence. Describe controls to prevent the piping of overburden materials into the mine.

Response:

The mining methods and stope sequences planned for extraction of the Crandon orebody were selected to control mine area rock mass stability and preclude surface subsidence. A permanent bridge or "crown pillar" of bedrock directly beneath the glacial overburden will be purposely excluded from mining activity. This bedrock barrier will maintain surface stability and prevent piping of overburden materials into active mine workings.

Beneath the orebody crown pillar, stoping methods and sequences will be arranged to maintain local rock mass integrity and avoid disturbance of the crown pillar. All mining methods planned (refer to EIR subsection 1.4.2.1) provide for backfilling of stopes immediately following ore extraction. Depletion of reserves will generally proceed from depth and the orebody extremities toward the surface, with mining directly below the permanent crown pillar planned for the final third of the mine life. These practices, combined with the fact that approximately 8 percent of the mineable ore will be left in place as pillars throughout the mine, will assure perpetual stability of the mine area bedrock surface and glacial overburden (refer to EIR subsection 1.5.1).

SECTION 1.2.1.2.9, MINING EQUIPMENT

Comment No. 55

How will large equipment be taken underground?

Response:

All mine structural materials, machinery, and mobile equipment will enter the mine through the main production/service shaft. The service hoist and cage are designed to accommodate the heaviest and largest mechanical components required to construct and operate the mine. A load of 28,100 kg (31 tons) can be suspended from the drawbar inside the cage, in a free space 7.9 m (26 feet) high, 2.7 m (9 feet) wide, and 5.3 m (17 feet) long. The larger mobile mining vehicles will, for example, be separated at the center articulation joint for transport underground.

SECTION 1.2.1.2.10, ORE TRANSPORT FACILITY

Comment No. 56

The dust control system on the primary crusher and related ore handling facilities is not adequately described. Where will the ducts and dust collection hoods duct to? A drawing showing the crusher, dust collection system and any other control devices should be included.

Response:

The dust collection system consists of ducting from the throat of the gyratory crusher, from the discharge of the vibratory feeder, from the discharge of the picking belt conveyor, and from the discharge of the crusher delivery conveyor to a multiple installation of bag type dust collectors, as shown schematically in a J. S. Redpath drawing No.

050.2.113.M.051 contained in Attachment No. 3. The system is powered by a 50 hp exhaust fan moving 7.27 m^3/s (15,400 cubic feet per minute) at 12 1/2 inches WG. This fan will discharge air into the exhaust air system of the mine. Dust from the collectors will be transported by a screw conveyor to a closed container, which can then be transported to the top of a backfill stope for disposal or, alternatively, emptied into the loading pocket. Drawings No. 050.2.111.S.007, 008 and 009 in Attachment No. 3 show the equipment in detail.

Water mists at each of the feeders above the crusher, above the crusher throat, at the discharge of the feeder below the crusher, at the discharge of the picking belt conveyor, and at the discharge of the crusher delivery conveyor will suppress potentially fugitive dust at these points. This system, together with a conveyor belt fire suppression system, is shown schematically on drawing No. 050.2.113.M.050 in Attachment No. 3.

SECTION 1.2.1.2.12, SANITATION FACILITIES

Comment No. 57

Provide further details on the underground sanitation facilities including the ventilation, transportation, and disposal of sanitary waste. Discuss any waste preservation chemicals which would be used and the compatibility of chemically treated waste with the surface septic system.

Response:

Mine sanitation facilities will be provided in the vicinity of shops and other permanent installations, and within walking distance of active areas on the mining levels. Rock wall cut-outs in well ventilated drifts will be bulkheaded for privacy. Chemical toilets typical of those used at surface construction sites or large public events will be installed on a prepared floor. The sanitation stations will be equipped with permanent lighting, wash water, and required supplies.

Sanitation units will be serviced as demanded by local use frequency. Containerized waste will be transported to surface in the mine cage for disposal in the plant septic system. The formaldehyde and perfume used in the chemical toilet control solutions will be in dilute concentrations compatible with the septic treatment system.

SECTION: 1.2.1.2.13, WATER SUPPLY

Comment No. 58

Provide a plan for potable water supply testing and reaction to unsafe samples.

Response:

Most of the potable water will come from a fresh water well and should not require pretreatment. The testing program has not been developed, but will comply as appropriate with Chapters NR 108 and 109. The testing scheme will be provided to the DNR prior to construction.

SECTION 1.2.1.2.14, FUEL HANDLING AND STORAGE

Comment No. 59

Describe the surface handling facilities for the fuel pipelines running to underground fuel storage tanks and any spill contingency plans.

Response:

Fuel oil to supply the needs of surface and underground vehicles, the emergency power generators, and other plant equipment will be delivered to the mine/mill site by tank truck. Fuel will be off-loaded through a pumphouse adjacent to the two 60 m^3 (15,000 gallons) bulk fuel oil storage tanks. These tanks will be located within dikes sized to contain the fuel oil in the event of a spill, tank leakage, or rupture. The attached plot plan and fuel oil storage plan (Attachments No. 4 and 5, respectively) from work recently completed by Raymond Kaiser Engineers show the arrangement of these facilities. Final engineering work may provide some additional refinement or optimization to this arrangement and/or some of the details, but basic concepts are not expected to change.

Fuel oil will be distributed from the bulk storage pumphouse by buried pipelines to surface use locations. Fuel allocated for underground use will first be pumped to a pair of 12-m^3 (3,000-gallon) capacity measuring tanks on surface adjacent to the underground delivery borehole (also shown on Attachments No. 4 and 5). These tanks will be contained by a dike with sufficient capacity to contain the contents of the tanks. Valves controlling the filling and emptying of these tanks will be interlocked with the receiving tanks in the underground fuel stations. Filling will not be possible unless the borehole delivery valve is closed. Discharge from the measuring tanks will only be possible when an underground receiving tank of greater capacity is empty (refer to EIR subsection 1.2.1.2.14, Fuel Handling and Storage).

Both the bulk fuel oil storage and underground delivery measuring tank facilities will be constructed and operated in accordance with the Wisconsin Administrative Codes. Spill prevention, countermeasure and control plans will be provided prior to construction and issuance of permits.

SECTION 1.2.1.2.16, MINE DRAINAGE

Comment No. 60

Considerably more detail is necessary for the mine inflow control systems. Describe the grouting proposal including methods, number and location of surface boreholes, and documentation of the effectiveness of this measure. Provide an analysis of the economic and technical considerations which will control the extent of grouting. When does Exxon intend to decide if grouting is economically and technically feasible and therefore part of the proposed mine operation?

Response:

Site geohydrologic conditions will limit the flow of ground water into the Crandon mine to a steady state rate of approximately 0.118 m^3/s (1870 gallons per minute) as documented in the Prickett Associates' report entitled "Ground Water Inflow Model for the Proposed Crandon Mine," December 1982 (previously provided to the DNR). A layer of relatively impermeable glacial till and/or clay-rich weathered bedrock retards ground water entry over much of the mine area. The inflows forecast to occur will be primarily in areas where overburden aquifer sands are in contact with porous weathered rock at the orebody subcrop. The ground water impact modeling presented in EIR Appendix 4.1A reflects these flow mechanics of the site geohydrology, in that only partial desaturation of the aquifer above the mine is forecast.

Any artificial controls applied to reduce the inflow would, of course, lessen environmental effects and reduce mine drainage and water treatment and discharge costs. Potential mine inflow control techniques were investigated by Klohn Leonoff Consulting Engineers as described in their June 1982 report entitled" Crandon Project Mine Water Control Plan - Alternative Evaluation and Preliminary Engineering" (previously provided to the DNR). Although site geotechnical programs and hydrologic computer modeling were incomplete at the time of this study, the regime flow mechanisms had been identified.

The Crandon site geohydrologic regime is relatively simple, predictable, and easily monitored. Saturated glacial overburden with definitive surface water discharge boundaries constitutes the aquifer, exclusively recharged by infiltrating precipitation. In the absence of pumping stress, the bedrock is functionally excluded from the ground water system. Development of the mine will, however, induce flow from the overburden aquifer through weathered bedrock courses not throttled by impermeable materials at the orebody subcrop. With this simple source - throttle - receptor type of geohydrologic regime in mind, two basic inflow control strategies were evaluated by Klohn Leonoff:

1) Reduction of source ground water over the mine area.

2) Alteration of mine inflow path permeability.

Ground water source reduction techniques studied included surface well field overburden dewatering, underground drainage gallery overburden dewatering, and aquifer flow restriction methods like slurry trenching and vertical grout curtains. The overburden dewatering methods would require removal of more than twice as much ground water to achieve a marginal reduction of the mine inflow, and were therefore rejected on the basis of increased environmental effects. Aquifer flow restriction methods are impractical at the Crandon site due to the extensive overburden depth. Method details and cost estimates are presented in the Klohn Leonoff report.

Mine inflow path permeability reduction methods evaluated included primarily cement and bentonite grouting techniques. Chemical grouting was eliminated as environmentally unsound, and long-term freezing of the saturated overburden was shown uneconomical. Of the grouting methods described by Klohn Leonoff, the plan to place bentonite grout in the high inflow areas of the orebody subcrop was most practical and potentially effective. In essence, this plan artificially creates flow resistant material similar to that which occurs over most of the mine area. Preliminary engineering plans and a cost estimate for this subcrop grouting plan are presented in the Klohn Leonoff report.

During mine final engineering, further site tests can be conducted to confirm active steady state mine inflow courses and verify the proposed bentonite grouting technique. The extent of any inflow control program instituted will be determined by the potential for lessened environmental effects in balance with reduced mine drainage and water treatment and discharge costs.

Comment No. 61

Provide additional details including cross-sections and drawings of the groundwater interceptor system. Discuss why water intercepted within the bedrock, even though at a shallow depth, can be considered "clean." The mine dewatering will create a drawdown of the aquifer in the area, thus introducing oxygen to a previously anaerobic environment. This may substantially change the chemical characteristics of the groundwater. How will the interceptor system water be protected from contamination?

Response:

Ground water inflow to the Crandon mine will be localized (see response to comment No. 60 with respect to Prickett Associates' study), occurring predominantly where weathered bedrock water courses are in contact with the overburden aquifer at the subcrop. The intensity and lateral extent of the bedrock weathering diminishes with depth. Initial mine production has been planned for the 230 to 350 m stope horizon, a position that is below the majority of the weathered zones. Thus, ground water inflows to mine workings during the early years of the mine life are expected to be very localized.

Exploratory diamond drilling techniques will be employed to identify active water courses prior to advance of the mine face. Flows encountered on the uppermost mine level will be captured in interceptor drill holes and contained to avoid contamination by the mining processes at levels below. Mine water control drifts will be developed ahead of production entry in the upper mine areas to maintain the ability to intercept ground water prior to contamination. Ultimately the ground water interceptor system would function as shown on the conceptual Mine Inflow Control cross-section (see attached figure). Cement rock grouting may be used for local inflow control or diversion.

As the mine progresses upward from the initial 230 m level entry position, the required mine water control drifts will simply be normal production access drifts developed prematurely and dedicated for exploration and interception of ground water. The exploration diamond drill holes in fact become part of the ground water interception system. As is common practice in other mines, the diamond drill hole collars will be packed and fitted with pipe connections.

Ground water collected from exploration drilling, or other drill holes placed specifically for inflow interception, will be piped directly to a clean water sump and pump station near the main shaft on the 230 m mine level. With the exception of ground water inflow diverted for mine utility water use, discharge from this segregated ground water system will be pumped to surface through a separate pipe column in the main shaft.

Mine inflow intercepted, contained, and discharged by this system is expected to remain near ambient ground water quality, except for possible transient effects during orebody storage depletion and initial flushing pore volumes. In the steady state, partially saturated flow conditions will exist in the weathered bedrock water courses. Some oxygen may then be introduced to this previously anaerobic environment, but its effects are expected to be minor. The oxidation and leaching potential of the water courses is already limited by the extensive pre-glaciation weathering, and the residence time for further ground water flow will be of a duration which can be measured in hours or days.

Comment No. 62

Describe contingency measures available for mine inflows in excess of 2,000 gallons per minute.

Response:

The predicted steady state rate of uncontrolled ground water inflow to the proposed Crandon mine is 0.118 m^3/s (1870 gallons per minute) (see response to comment No. 60 with respect to Prickett Associates' study). For the purposes of site area impact modeling, a stress of 0.126 m^3/s (2,000 gallons per minute) was employed, representing a contingency of 7 percent. Since, during mine development and operation, all practical efforts will be made to control and reduce this rate of ground water inflow, it is highly unlikely that flows in excess of 0.126 m^3/s (2,000 gallons per minute) will ever be experienced.

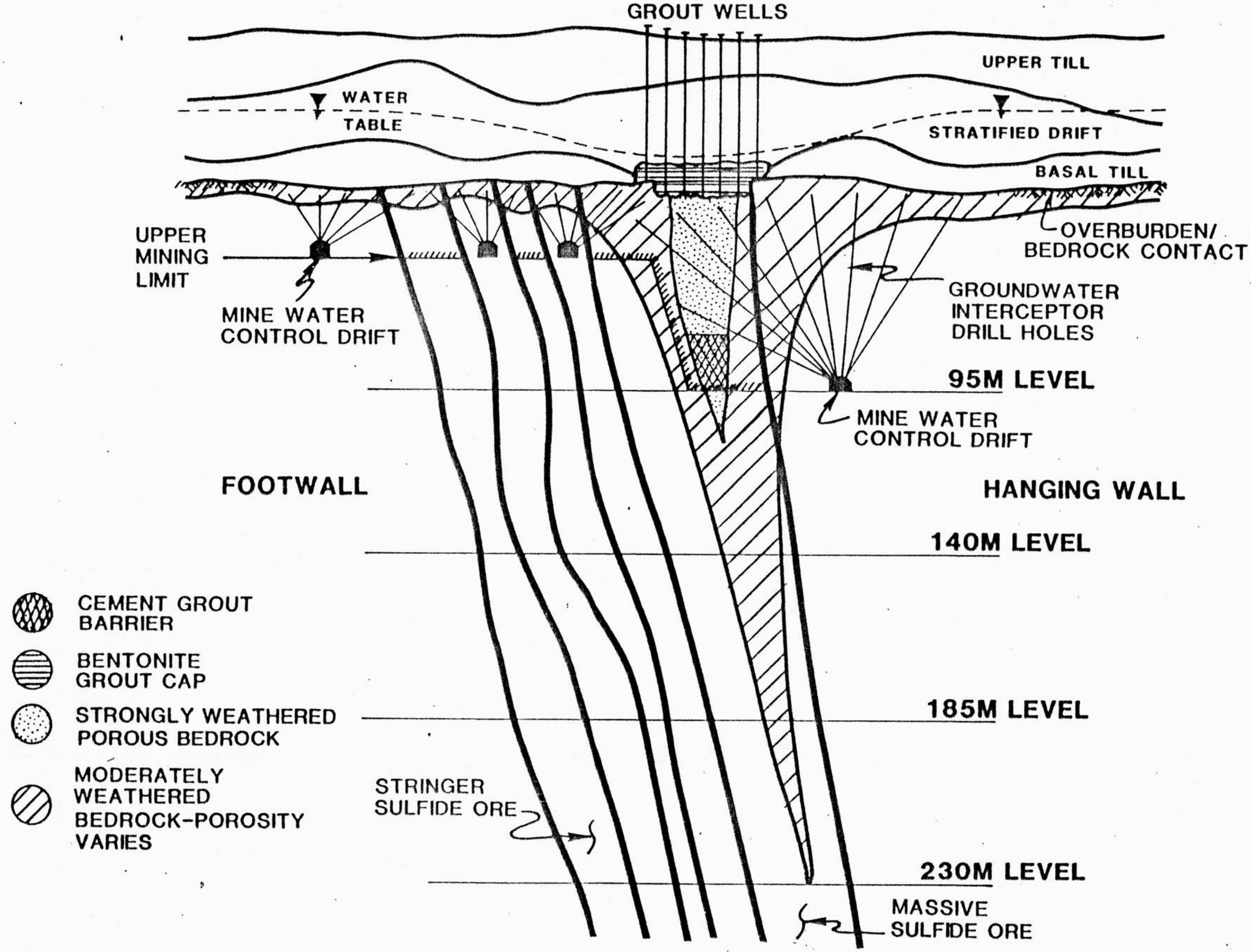
However, the disruptive effects of excess mine water are well known and prudent mine plans will therefore include contingency measures. For the Crandon mine there will be several excess inflow contingency options.

(FIGURE FOR RESPONSE TO COMMENT NO. 61)

EXXON MINERALS CO.
CRANDON PROJECT

MINE INFLOW CONTROL METHODS

(CONCEPTUAL X-SECTION)



First, the excess inflow could be controlled by surface source pumping or inflow path grouting as described in the Klohn Leonoff mine water control methods study (see response to comment No. 60). Secondly, mine pumping systems have been designed for the conservative maximum inflow of 0.126 m^3/s (2,000 gallons per minute) employed for site impact modeling, including pumps and shaft columns. Surface surge storage capacity will exist in the reclaim and tailing ponds for temporary handling of excess inflow. The total freeboard volume in reclaim pond R1 alone, for example, is 309,000 m^3 (250 acre-feet), or enough for surge of 0.063 m^3/s (1,000 gallons per minute) excess mine pumpage and discharge for over 50 days.

Comment No. 63

This section implies that grouting could reduce inflow by 1,000 gallons per minute and that the groundwater interceptor system would also collect 1,000 gallons per minute. What is the theoretical maximum effectiveness of both systems?

Response:

Mine inflow control grouting and uncontaminated ground water interception methods will be employed to the limit of technical achievability and economic feasibility. EIR subsection 1.2.1.2.16 suggests that the practical limits may approach 50 percent for inflow control, and a 50 percent interception rate in the absence of inflow control. Theoretically, inflow control by grouting could be 100 percent effective with application of unlimited resources, and similarly ground water interception success could be greater than stated in the EIR.

Given the geotechnical uncertainties which will remain until mine development begins, a non-numerical statement of intent may be best. There is environmental and economic motivation to reduce the inflow of ground water to the mine, and to avoid mine contamination of as much of the uncontrolled mine inflow as possible.

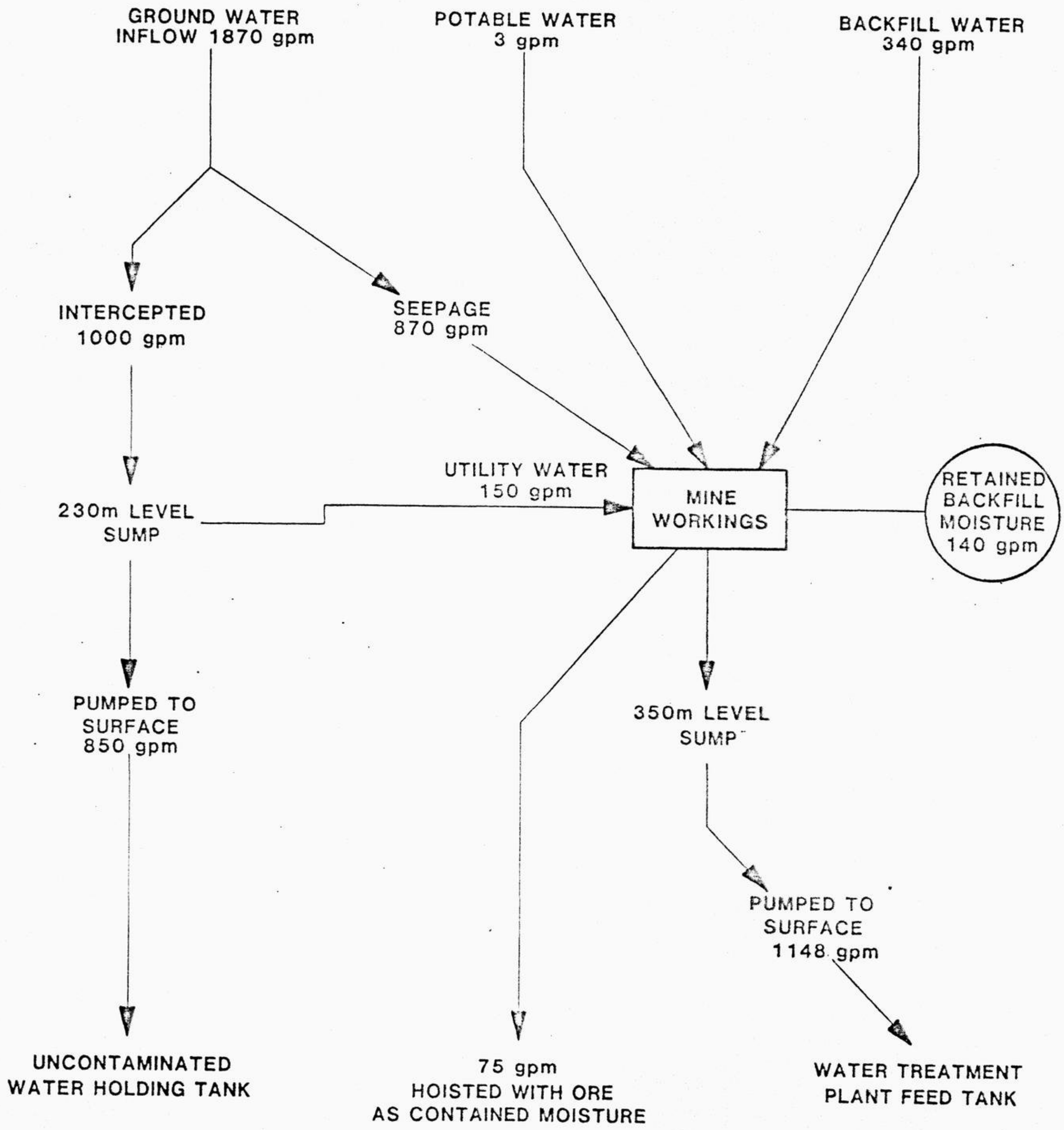
The measurable effectiveness of one system may very well depend upon the success of the other. Reduced mine inflow by grouting might, for example, eliminate flow in a water course amenable to interception. Environmental protection and mine operability will be best served by a practical combination of these proposed techniques.

Comment No. 64

This section should indicate where water from the two collection systems will be routed.

Response:

Discharge from the totally segregated ground water interceptor and mine operations drainage systems will exit the mine in separate main shaft pump columns (see attached figure). The uncontaminated ground water will be directed to a surface storage tank prior to discharge or, if needed, used as mill process make-up water. Mine drainage effluent will be routed to the water treatment plant feed tank for treatment prior to discharge.



EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE: MINE DRAINAGE SCHEMATIC

SCALE: NONE	STATE: WISCONSIN	COUNTY: FOREST
DRAWN BY: DR SPRINGBORN	DATE: 9/83	CHECKED BY:
APPROVED BY:	DATE:	APPROVED BY:
APPROVED BY:	DATE:	EXXON:
DRAWING NO.	SHEET: OF	REVISION NO.

(FIGURE FOR RESPONSE TO COMMENT NO. 64)

Comment No. 65

Describe the groundwater collection sumps within the mine and disposition of the settled solids removed from the sump.

Response:

Ground water inflow to the proposed Crandon Mine will be collected in two separate systems. First, an uncontaminated ground water interceptor system will be installed on the uppermost mine level (see also response to comment No. 134)

Ground water seepage that is not contained by the interceptor system will infiltrate the mine workings and ultimately be recovered in the normal mine local level drainage system sumps and piped or drained to the main mine water sumps. These main mine water sumps and pump stations will be located near the main shaft on the 350 m and 780 m levels, and will also receive backfill seepage and used mine utility water.

Normal mine drainage collection will begin on each mine level where flows will be directed to small local sumps excavated in the drift wall. Decant water from the local mine level sumps will be piped or drained through boreholes to the main 350 m or 780 m level sumps. The main sumps will consist of downgrade excavations in the wallrock adjacent to the pump stations. A bulkhead containing the pump station suction pipes will be constructed at the sump outlet.

Since the normal local level mine drainage system pumps will be specified for "dirty" water, the main level sumps will function primarily as pumping reservoirs. However, some settling of solids is expected in the local level and main mine drainage sumps. For this reason, pairs of sumps with front-end loader access will be provided at each mine level transfer point and at the main mine drainage facilities. One sump at each location will then be operated while the other is cleaned. Sump solids will be transported to mined stopes and combined with regular stope backfill.

In the event that additional settling capability is required, a segment of the mine area adjacent to each normal local level mine drainage pump room will be reserved for excavation of a vertical cone settler. Solids discharged from the base of the conical settler would be similarly transported to depleted stopes as backfill.

SECTION 1.2.2, MILL

Comment No. 66

Provide plans and specifications for any equipment used for the storage or distribution of hazardous materials including spill detection and control facilities.

Response:

The plans and specifications for equipment, storage and distribution of hazardous materials, including spill detection and control, will be completed during final engineering. See response to comment No. 70 for available details on design of reagent handling and mixing facilities.

SECTION 1.2.2.1, ORE HANDLING

Comment No. 67

Will there be any need for exterior ore surge piles in the event of system failure? Will there be any surface storage of low grade ores other than at the mine waste disposal facility? How will the preproduction ore laydown area be prepared?

Response:

Study of alternatives for preproduction ore storage has continued since submittal of the EIR. While the EIR proposed preproduction ore storage in the mine waste disposal facility, the current plan proposes storage at the north edge of the mine/mill area. Additional planning of the management of the mine backfill sands has eliminated the need for a temporary backfill sands storage facility allowing the preproduction ore storage area to be located in its place. This ore storage facility would be lined, and drainage will be collected and transported to the plant water treatment system. The liner would be protected either through a separate cover or through careful placement of the initial cover of preproduction ore. Recovery of ore would be managed to leave this protective cover in place throughout the life of the facility.

While this storage facility is planned for the preproduction ore, it could also be maintained (or reactivated) and used as an ore surge storage area.

Comment No. 68

Are the waste waters generated in the ore handling facility and the contaminated runoff generated on the preproduction ore and waste rock storage areas accounted for in the water balance? Provide calculations showing the volume of runoff generated in the 10-year, 24-hour storm event.

Response:

The entire ore handling facility from the mine headframe through coarse ore storage, crushing, fine ore storage, and grinding is completely covered. All conveyor galleries are covered. There will be no contaminated water runoff from the ore handling facility. Any drainage water collected in the coarse ore storage facility will be pumped to the grinding circuits.

The preproduction ore storage area is now planned for the 3.2-ha (8-acre) area just north of the rail tracks (previous backfill storage area). Surface water runoff from this ore storage area will be collected in a 5600-m^3 (1,479,520-gallon) sump designed to accommmodate the precipitation volume in the area from a 25-year, 24-hour storm event. Water that accumulates in this sump will be pumped to the water treatment plant feed tank.

A 15.6-ha (38.6-acre) area will be allocated in the MWDF area to hold waste rock. A sump will be provided to collect runoff from this area; it will be sized to accommodate a 10-year, 24-hour storm event in addition to one years worth of average net precipitation gain. If necessary, water from this sump will be pumped to reclaim pond R1. The sump will be designed for a capacity of 40,000-m^3 (10.6-million gallons).

Calculations

a) Preproduction Ore Storage; 8-acre; 25-year, 24-hour storm event; 4.2 inches (0.35 ft) of rain

$$8\text{-acre} \times \frac{43{,}560\ ft^2}{acre} \times 0.35\ ft \times \frac{7.48\ gal}{ft^3} = 912{,}321\ gal$$

Therefore, the sump near the preproduction ore pile will be sized for 5600-m^3 (1,479,520-gallon) capacity which is more than adequate. This water could be pumped to the treatment plant over a 2-week period at a rate of 10.3 m^3/h (45 gallons per minute).

b) Waste Rock Storage; 38.6-acre; 10-year, 24-hour storm event, 3.6 inches (0.30 ft) of rain

$$38.6\text{-acre} \times \frac{43{,}560\ ft^2}{acre} \times 0.30\ ft \times \frac{7.48\ gal}{ft^3} = 3{,}773{,}098\ gal$$

Allowance for 1-year of average net gain in precipitation over evaporation (7.41 inches or 0.62 ft)

$$38.6\text{-acre} \times \frac{43{,}560\ ft^2}{acre} \times 0.62\ ft \times \frac{7.48\ gal}{ft^3} = 7{,}797{,}735\ gal$$

Total requirement of 11.6 million gallons.

The sump near the waste rock storage area will be sized for approximately 40,000 m^3 (10.6 million gallon) capacity which is close to the total calculated requirement of 43,800 m^3 (11.6 million gallons). This water will be pumped, as necessary, to reclaim pond R1 which has a design volume of 898,938 m^3 (237,500,000 gallons), including 308,856 m^3 (81,600,000 gallons) of freeboard volume.

SECTION 1.2.2.4, ORE TREATMENT

Comment No. 69

The discussion of the dewatering and storage of thickened concentrate needs elaboration. There is some potential for SO_2 formation and emission from the concentrates during storage. In addition, sulfide mineral concentrates have potential for spontaneous combustion which requires some residual moisture content and control. Please clarify if the concentrates will be stored and located as a filter cake or in some other form.

Response:

The final flotation concentrates produced in the concentrating process will contain 25 to 35 percent solids by weight (i.e., 75 to 65 percent by weight water). These slurries will be pumped to respective concentrate thickeners as the first step in the dewatering process. Overflow from the zinc concentrate thickener will be sent to a tank for direct recycle to zinc flotation. Overflow from the copper concentrate thickener will be sent to the reclaim pond. Overflow from the lead concentrate thickener will be sent to the tailing thickener to take advantage of the added lime for metal precipitation. The thickened underflows from each concentrate thickener will contain 55 to 60 percent solids by weight and will be further dewatered using semi-continuous pressure filters. Laboratory tests on pilot plant concentrates have shown that these types of filters can produce concentrate filter cakes with residual moisture levels of 8 to 12 percent by weight. Filtrate from the filters will be recycled to the concentrate thickeners. Moisture levels much below 8 percent cannot be achieved by filtration. There will be no drying of concentrates using gas-fired kilns.

The cake discharge from the filters is friable, can be transported on a conveyor, and is non-dusting in nature. The filter cake will be loaded directly into railcars or can be stored beneath the filters, if required. At moisture levels of 8 percent, the concentrates will not undergo spontaneous combustion to yield sulfur dioxide.

SECTION 1.2.2.5, REAGENT STORAGE AND MIXING

Comment No. 70

Provide detailed plans and specifications for this facility and its equipment with an emphasis on spill control, containment and emission control. Describe the segregation of noncompatible reactive reagents, dusts, vapors, and gases.

Response:

Detailed design of the reagent storage and mixing facilities will be completed during final engineering. Preliminary drawings of these facilities are presented in Attachment No. 6 (Drawings No. 051-6-G-008 and 051-6-G-009). These facilities are described as follows:

Reagent Facilities Description

The reagents are received by either truck or railcar; there are three unloading areas:

1) Lime, soda ash, and sulfuric acid will be received on the inside plant track immediately north of the filter area shown on drawing No. 051-6-G-009, which will also be used intermittently to handle lead concentrate cars. These reagents are used in the water treatment plant and the track and storage tanks for lime and soda ash are shown on drawing No. 051-6-G-008.

2) Sulfur dioxide, frothers, and sodium dichromate will be received on a railroad spur entering the center of the mill building (drawing No. 051-6-G-009). Sulfur dioxide is used directly in the process and there is no intermediate storage. The frothers and sodium dichromate storage tanks are contained in a bermed area with blind sumps which may be used to return spillage to the respective tank by pump. The frothers and sodium dichromate are pumped from the storage tanks to intermediate mix tanks in the reagent preparation building (drawing No. 051-6-G-009). From the mix tanks, these reagents and most others are pumped to the day tanks above the control room. The reagent preparation tanks are isolated by berms and blind sumps. Overflows and the floor drains for the day tanks drain to the reagent preparation area blind sumps.

3) Drums, bags, and returnable bins will be delivered by truck at a loading dock at the front of the reagent storage building. These bagged and drummed reagents will be mixed to make solutions in the reagent preparation area using the mix tanks. The solutions will then be pumped to the respective day tank.

The berms that are shown in the reagent storage, mixing, and day tank areas are provided to isolate noncompatible or dissimilar reagents. Similar reagents such as all xanthates will be contained together since they are chemically and functionally compatible. Noncompatible reagents will be isolated spatially as well as with berms. Sodium cyanide is therefore not unloaded or stored near acids nor will acids be stored near strong caustics. The berms will be designed to contain a total spill from a single tank of similar reagents. The blind sumps will generally be used to return spilled reagents to their respective tank.

Dusts will be minimal in the reagent preparation building. Personal breathing protection will be provided as needed for workers in these areas. The reagent dusts encountered will primarily be in the lime and soda ash unloading, slaking and mixing areas. Drawing No. 051-6-G-008 shows this area and indicates the dust collectors used. There is an insertable dust collector provided with the unloading and storage silos in both cases.

Gases will be removed from the enclosed reagent preparation area by a ventilation system. The reagent preparation area and the day tank area will be equipped with alarms for hydrogen sulfide and hydrogen cyanide.

The reagents which are particularly noncompatible include sulfur dioxide, sodium cyanide and sodium sulfide. To avoid the mixing of sulfurous acid (results when SO_2 contacts water) with these or other reagents, SO_2 will be stored outside the concentrator building in two tanks. The liquid SO_2 will then be piped into the SO_2 distribution system.

Frother compounds that have fairly high vapor pressure (e.g., MIBC) will be stored in a tank outside and pumped in as needed for mixing.

Special Criteria

The attached table shows storage capacities, shipping mode, and other reagent receiving and storage data. The following criteria will be included in the reagent area design.

- o Adequate ventilation.
- o Sodium cyanide will be received in 1362 kg (3000 pound) Flo-Bins™ which are returnable.
- o Storage and mixing requirements for each reagent have been determined. Where feasible, the preferred system will be a mixing tank and a day tank. The day tanks merely store mixed reagents for distribution to the flotation circuit. Suggested capacity of the day tank is 32 hours of operation.
- o Maximum storage for xanthate solutions is 4 days. All xanthate mixing and storage tanks will have sloping bottoms with drains for cleaning at the low point. Solution removal for process use will be at a height of 15.2 cm (6 inches) above the point where the sloping bottom begins.
- o Xanthate tanks will have a forced air exhaust to remove any carbon disulfide.
- o All reagents received in solid form will have mixing and storage tanks designed like xanthate tanks.
- o Explosion-proof motors, light fixtures and conduit will be used.
- o Emergency eye wash, shower facilities, and other necessary first aid equipment will be included in the reagent area design.
- o Special consideration will be given to materials selection for each reagent system to guard against corrosion.

(Table for response to comment No. 70.)

REAGENT RECEIVING AND STORAGE DATA

Chemical	Receive By	Monthly Consumption (Pounds)	Shipment Size	Unit Size	Form	Storage Capacity
Sulfur Dioxide SO_2	Tank car	205,000	60,000 or 100,000 lb	30 ton	Liquid	150,000 lb
Copper Sulfate $CuSO_4 \cdot 5H_2O$	Railcar	216,300	100,000 lb minimum	100 lb bag	Granular	300,000 lb
Sodium Cyanide NaCN	Truck	13,200	36,000 lb	3,000 lb	Briquette	36,000 lb
Dowfroth 250	Truck	18,100	40,000 lb	Truck	Liquid	50,000 lb
Sodium Sulfide $Na_2S \cdot 9H_2O$	Railcar	150,200	80,000 lb minimum	400 lb drum	60% Flake	230,000 lb
Xanthates	Truck	42,100	40,000 lb	300 lb drum	Pellet	63,000 lb
Zinc Sulfate $ZnSO_4 \cdot 7H_2O$	Truck	36,000	24,000 lb minimum	50 lb bag	Granular	54,000 lb
CMC-7LT	Truck	16,900	25,200 lb minimum	50 lb bag	Powder	30,000 lb
Sodium Dichromate $Na_2Cr_2O_7 \cdot H_2O$	Truck Tank car	30,100 (8000 gal)	78,000 lb minimum	8000 gal	Liquid	12,000 gal

Note: Ton in this table is short ton (2000 lb).

(Table for response to comment No. 70 [continued].)

Chemical	Receive By	Monthly Consumption (Pounds)	Shipment Size	Unit Size	Form	Storage Capacity
Sodium Silicate Na_2SiO_3	Tank car	90,100	117,000 lb (10,000 gal)	10,000 gal	Liquid	15,000 gal (175,500 lb)
Carbon	Railcar	48,100	24,000 lb minimum	50 lb bag	Powder	75,000 lb
MIBX	Tank car	24,100	40,000 lb minimum 6,000 gal	6000 gal	Liquid	12,000 gal
Lime CaO	Rail	1,100,000	190,000 lb minimum	Railcar	Pebble	2,640,000 lb
Soda Ash Na_2CO_3	Railcar	523,000	200,000 lb minimum	Railcar	Powder	750,000 lb
Sulfuric Acid H_2SO_4	Truck	76,300	45,000 lb	Tanker	Liquid	67,500 lb
HMP	Truck	6.500	No minimum	100 lb bag	Granular	7,000 lb
Flocculant	Truck	31,200	34,000 lb minimum	Tanker	Liquid	40,000 lb

Note: Ton in this table is short ton (2000 lb).

- o Sodium dichromate will be received by tanker truck in a saturated liquid form (69 percent sodium dichromate by weight). Adequate inline heating will be provided to prevent freezing in winter conditions. Sodium dichromate could also be received in solid form if necessary.

- o In addition, the reagent distribution to the plant processes has been described in the response to comment No. 183. Further information concerning the nature of these reagents is provided in response to comment No. 186 and the responses to comments No. 71 and 72.

Comment No. 71

Many of the reagents will be hazardous materials. Exxon will be required to comply with NR 181 and RCRA in regards to storage and disposal of these materials. How long will storage of chemicals and reagents not meeting specifications be necessary before disposal? The facility may require a hazardous waste storage license. Please provide a mass balance study to indicate the reagents used and their expected concentrations in the various waste systems.

Response:

Reagent handling and storage will meet MSHA and other appropriate regulations. Reagent storage is discussed in more detail in EIR subsection 1.4.3.7, Reagent Receiving, Storage, and Use, and in the response to comment No. 70.

Chemicals or reagents that do not meet specifications will be returned to the vendor if they cannot be used in the mill. A list of expected mill reagents is presented in EIR Table 1.2-5, in subsection 1.2.2.5. The expected concentration of reagents in the streams exiting the mill cannot be calculated because of the following:

1) Reagents will chemically interact among themselves and with the ore slurry, and thus will be precipitated, adsorbed on ore surfaces, or chemically altered. For example, copper sulfate is added to activate the surface of the zinc sulfide mineral, sphalerite, by formation of copper sulfide. Thus free or elemental copper is no longer present in solution.

2) Most flotation reagents, except lime and sulfuric acid which are used for pH control, are added at "starvation" concentrations. This is not done just to be economical, but to achieve the desired selectivity in the preferential flotation of one sulfide mineral versus another. The net result of this is that very little reagent that is initially added in a particular mill circuit is left in solution.

3) Different reagents are added to different circuits within the mill, as indicated in Figure 4 in Section VII, "Crandon Water Balance" from the CH2M Hill Phase III Water Management Study Report, December 1982 (previously provided to the DNR). There is also extensive recycle internal to mill circuits and between mill circuits. This makes reagent mass balance and concentration calculations nearly impossible.

However, to put the concentration of reagents in the streams exiting the mill into perspective, keeping fully in mind the above mentioned severe limitations, let us consider the mill as a single big mixing tank. Water, 1,340 m^3/h (5900 gallons per minute); ore, 398 t/h (439 short tons per hour); and all the reagents are being added together, enabling one to mathematically calculate the average concentration in the water/slurry streams exiting the mill. Four different streams exit the mill as depicted in EIR Figure 1.4-18, "Overall Water Balance - Mature Operations"; copper concentrate thickener overflow, 66 m^3/h (290 gallons per minute); lead concentrate thickener overflow 13 m^3/h (57 gallons per minute); lead feed thickener overflow 13.5 m^3/h (59 gallons per minute); and zinc tailings 1,169 m^3/h (5146 gallons per minute). All of these streams directly or indirectly (via tailings pond) go to the reclaim pond.

Reagent consumption as kilograms per tonne of mill feed is given in Table 3.17 "Reagent Types and Estimated Quantities for Use in Production of Concentrate" in the Mine Waste Disposal Facility Feasibility Report, page 3-35. The water to ore ratio as feed to the mill is 1340 m^3/h (5900 gallons per minute) to 398 t/h (439 short tons per hour) or 3.36 m^3 (806 gallons per short ton) of water per tonne of ore. Thus for each 1.0 kg of reagent per tonne of mill feed (2.2 pounds per short ton), the streams exiting the mill will on the average contain 0.3 kg/m^3 or 300 mg/l (ppm) of reagent assuming no adsorption of reagents on mineral surfaces.

To illustrate this further, bearing in mind the above mentioned limitations of this approach, for example, sodium ethyl xanthate is added at a dosage rate of 0.03 kg/t (0.06 pounds per short ton). Thus the mill effluent would on the average contain 0.01 kg/m^3 or 10 ppm as a maximum concentration assuming no interaction with the ore slurry. Zinc is added as zinc sulfate hydrate, $ZnSO_4 \cdot 7H_2O$, at the rate of 0.06 kg/t (0.12 pounds per short ton). Thus the effluent would contain 20 ppm of zinc sulfate hydrate, which equates to 4 ppm of zinc (again, assuming no other interactions take place).

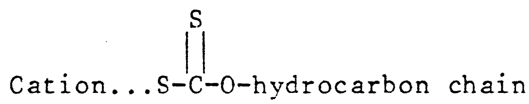
Comment No. 72

Table 1.2-5 describes "typical" reagents. Will other unlisted reagents be required? Some of the reagents listed in Tables 1.2-5 and 1.2-6 are not adequately described chemically. Please define xanthates, flocculents, dewatering aid, and "other xanthates."

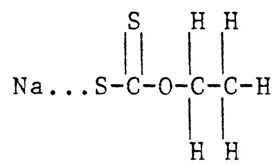
Response:

The reagents shown in Tables 1.2-5 and 1.2-6 of the EIR are essentially the reagents that have been used in the process development testing for the Crandon Project. These reagents are "typical" in the sense that they are commonly used in the treatment of ores of this type. If pilot plant and actual plant testing shows other reagents to be more beneficial to the process, they might be incorporated into the process.

The xanthates are a group of flotation collectors which have the following general chemical structure:



For example, sodium ethyl xanthate is one of the xanthates used for Crandon ore:



Xanthates with different hydrocarbon chains that might be used include potassium amyl-xanthate and sodium isopropyl xanthate. "Other xanthates" which have commonly been used in treating similar ores might be tested in the pilot plant and ultimately used in the flotation process.

Flocculents are generally organic polymers which are commonly used to flocculate fine suspended ore particles so that they settle faster in thickeners and thus enhance clarity in the thickener overflow. They are generally used in extremely low dosages, typically 15 to 50 g/t (0.03 to 0.1 pound per short ton of ore). Although a particular polymer has not been identified for use at Crandon, the polymer used would be one of the flocculents in general use by mining and other industries. A typical polymer is a polyacrylamide.

Dewatering aids are chemicals usually used to lower the surface tension of water and/or flocculate mineral particles so that they can be filtered more easily. The mining industry uses these chemicals to aid in filtration of concentrates. They are generally similar chemically to those reagents used by car washes during rinse cycles to prevent hard water spots. A particular dewatering agent has not been identified for Crandon, nor has the absolute need for a dewatering aid been established.

SECTION 1.2.2.6, CONCENTRATOR CONTROL ROOM

Comment No. 73

All remote environmental monitoring equipment should be described here or under the appropriate section.

Responses:

The concentrator control room will not have any connections to remote environmental monitoring equipment. Any such equipment will be monitored in the environmental laboratory in the concentrator building. The specifics of any such design will be related to the Monitoring and Quality Assurance Plan and completed with final design engineering.

The response to comment No. 96 provides additional information about the environmental laboratory facilities.

SECTION 1.2.2.8, TAILING THICKENING

Comment No. 74

Provide details and diagrams describing the equipment, overflow rates, separation efficiences, etc.

Response:

Thickeners are basically sedimentation or settling devices. A dilute slurry is fed at the center feed well of a large circular vessel. The solids settle towards the bottom while clear water overflows along the periphery of the vessel. The settled solids are withdrawn from the bottom of the vessel as a thick slurry. The feed rate, diameter of the vessel, and flocculents, if used, are all factors that affect the performance of the thickener. Generally, thickeners are easy to operate and are not mechanically complex.

For the Crandon Project, we estimate the feed stream will contain an average of 3667 t/d (4043 short tons per day) of solids with a total pulp volume of 1993 m^3/h (8777 gallons per minute). The solids content in the feed slurry will be 7.3 percent by weight. After settling, we estimate the thickener underflow to contain 55 percent solids by weight at a flow rate of 172 m^3/h (756 gallons per minute). The thickener underflow is collected in a sump and transported by pipeline to the MWDF.

The thickener overflow at 1822 m^3/h (8022 gallons per minute) contains a small amount of solids, approximately 100-1000 ppm by weight. A portion of this water is recycled to the backfill cyclone process directly (as make-up water) and the remainder is recycled via the reclaim ponds.

SECTION 1.2.2.9, CONCENTRATE HANDLING AND LOAD OUT

Comment No. 75

Provide information regarding the design of the covered railcars and/or trucks to be used for concentrate shipping.

Response:

The railcars to be used to transport concentrate are open top, rectangular cars commonly called gondola cars. They have a steel bed and sides which will completely contain the concentrate without spillage. After loading, the cars will be covered with a plastic cover made especially for this application. These covers are commonly used for this application. Trucks will not normally be used; however, if they are required, they probably would be 18.1-t (20-short ton) semi-trailer type dump trucks covered with plastic similar to that mentioned above.

Comment No. 76

Approximately eight days production storage for each concentrate is specified here while on page 1.4-5 and in Table 1.4-2, ten-day storage is indicated. Which figure is correct? The planned eight- or ten-day storage capacity does not allow much flexibility in the event of extended storage transportation or market problems. What alternatives are available other than mill shutdown?

Response:

The correct figure is 2 days storage for copper and zinc and 10 days for lead concentrate and the EIR will be revised accordingly. Earlier plans called for a total of 10 days storage with 2 days in bins and 8 days on the floor beneath the bins.

Discussions with officials from the Soo Line Railroad indicate that the history of rail service in the area has been extremely reliable. Therefore, the probability of an extended transportation problem occurring is low. The 2-days storage capacity available for copper and zinc concentrates along with storage capacity in available railcars should be adequate to prevent shutdown of the plant during the day or two that the railroad cannot supply cars due to a weather-related problem. Currently, there is an oversupply of gondola cars and this situation is not expected to change in the near future.

Severe market problems would likely force a temporary shutdown of the Project regardless of the amount of storage capacity available.

If railcar availability were to become a problem and the planned concentrate storage capacity was inadequate, more covered storage area would be planned and a permit application for the Project site would be made.

SECTION 1.2.2.10, SPILL CONTROL FACILITIES

Comment No. 77

Where could recovered reagents be disposed?

Response:

There should be no disposal of reagents. Recovered reagents will be collected in such a manner to assure that they can still be used as intended. Reagent storage and preparation facilities will be designed with the criteria that any spills are to be contained for recovery and use.

SECTION 1.2.2.12, BACKFILL TRANSPORT, STORAGE AND RECLAIM

Comment No. 78/79

Provide detailed plans and specifications for the backfill storage area, including the bottom liner, water decant system, ancillary facility, and backfill recovery equipment. Construction of the storage area will also need to be addressed. Describe how backfill sands will be reslurried, how the liner will be protected, and how the equipment listed on Table 1.2-4 will be used.

Will surge tanks be provided for containing the contaminated run-off prior to use in the backfill preparation facility? If not, run-off could become highly contaminated while residing in the backfill pile. Would this affect its use in backfill preparation?

Response:

It was originally the intention to store a total of approximately 150,000 t (168,000 short tons) of cycloned tailings sands on a pad located immediately north of the mine/mill site. Cyclone sandfill material would be routed to this storage area when the mine is unable to accept backfill for any reason. Sands would be reclaimed from the storage area as stopes become available for backfilling.

A reappraisal of the mine plan and the stope development sequence has indicated that there is no longer a need to provide large volume surge storage capacity for backfill sands. As a result, this facility has been eliminated and all backfill material handling will be totally within the confines of the concentrator building.

Under the present concept, cycloned tailing sands produced continuously during the milling operation will be mixed with a cement slurry and pumped directly into the mine. Storage capacity for a total of approximately 18,000 t (20,000 short tons) of backfill sands will be provided in concrete storage bunkers. Reclaim from the bunkers will be by monitor jets which will wash the sands into a pump sump. A pump will transfer the sand-slurry to a repulping tank for settling, adjustment of percent solids, and direct transfer to the mine. Decant water from the repulping tanks will be pumped to the monitor jets providing a totally closed no-loss system.

It is now the intention to utilize the area previously designated for storage of backfill sands as an area for storage of preproduction ore. During the 18-month period prior to mill start-up, a maximum of 1,000,000 t (1,120,000 short tons) of uncrushed ore will be accumulated in the storage area. This material will be fully consumed during the early years of mill operation.

The storage area will be cleared and grubbed and then rough graded to provide drainage toward the northwest. The area will be lined with a bentonite modified soil mixture protected by a layer of crushed waste rock.

A ditch will be provided to collect rainwater runoff from the stockpile and to conduct the water to a concrete sump. The ditch and sump will be sized to provide sufficient storage capacity to retain the full storm runoff, based upon a one in 25-year storm developing 106.7 mm (4.2 inches) of rainfall in 24 hours. A pump will return the runoff water to the plant process water system or to the water treatment plant as appropriate.

SECTION 1.2.2.13, CONCRETE BATCH PLANT

Comment No. 80

Describe plans for concrete preparation prior to completion of the permanent batch plant. Discuss the quantity of aggregate needed during various construction and operation phases and the availability of suitable aggregate on-site and off-site. Could waste rock or reclaimed cobbles be used? Will the batch plant include aggregate crushing, screening and washing facilities? If so, describe the disposal of aggregate wash water. Why will the batch plant be needed after the mill is constructed?

Response:

Preliminary studies have indicated that concrete requirements during the construction phase will probably be obtained through a local supplier who would erect a temporary batch plant within the confines of the mine/mill site. Aggregate supply for the concrete would be the responsibility of the concrete supplier. Based on the quantities of aggregate required, the supplier would probably set up a gravel plant as close to the mine/mill site as he could arrange.

During the construction phase a total of approximately 38,000 m^3 (50,000 cubic yards) of concrete will be poured. This volume of concrete will require an almost similar quantity of aggregates. A peak daily rate of approximately 600 m^3/d (783 cubic yards per day) is estimated for a limited period in 1987.

During operations the requirements for concrete decrease to approximately 1700 m^3/y (2,200 cubic yards per year) and a maximum daily requirement of approximately 23 m^3/d (30 cubic yards per day). It is now anticipated that no permanent batch plant will be required and concrete will be trucked from an off-site supplier.

SECTION 1.2.3, WASTE DISPOSAL FACILITY

Comment No. 81

The feasibility report states that the waste disposal facilities will cover 500 acres including the embankments while this section indicates that the four tailing ponds will have a total surface area of 500 acres inside the pond crests. What is the total area of the ponds as measured from the outside toe of the dikes?

Response:

The total surface area of the four tailing ponds within their crests is approximately 161.2 ha (403 acres). The total area of the ponds to the outside toe of the dikes is approximately 202.2 ha (505 acres).

SECTION 1.2.3.1, WASTE ROCK TRANSPORT AND STORAGE

Comment No. 82

Will surge piles be needed for waste rock and preproduction ore during the construction phase? Will roads at the dump sites contain high sulfide materials which could be released by traffic? Will the large diameter waste rock contain enough fines to adequately fill the voids between rocks and prevent piping of cover material in the pile? Will surface crushing of waste rocks be required to provide riprap material during the construction phase? Will the haul road be directly on top of the liner?

Response:

Surge piles will not be required for either waste rock or preproduction ore in the MWDF. Waste rock will be delivered and placed directly into the storage area at the MWDF. Preproduction ore will be stockpiled at the mine/mill site.

Haul roads at the dump sites (MWDF) will be constructed from crushed rock product obtained from an off-site supplier and will not contain high sulfide concentrations.

Large diameter waste rock up to 0.6 m (2 feet) in diameter will only be produced during the first 3 years of mine development after which time underground crushing will be employed, limiting maximum waste rock size to 152 mm (6 inches) in diameter or less. The larger diameter waste rock will be placed at the base of the waste rock disposal area and subsequently overlain with the finer crushed waste rock. The predicted waste rock gradation when compared to the average gradation of the local till is such that a piping ratio of less than five can be calculated. The piping ratio is

$$\frac{D_{15}\ \text{(filter)}}{D_{85}\ \text{(protected soil)}}$$

where D_{15} is the sieve size opening in mm which 15 percent of the mass of the filter (waste rock) passes through and D_{85} is the sieve size opening which 85 percent of the mass (till) passes in a standard gradation test (Cedergren, H.R., 1977, Seepage, Drainage and Flow Nets, John Wiley and Sons, p. 181). Large hydraulic gradients within the till cover are not anticipated; consequently, piping should not be a problem.

Surface crushing of waste rock will not be required to produce rip-rap during construction. Rip-rap will be developed from uncrushed waste rock.

Haul roads will not be constructed directly on top of liners. All liner areas in the MWDF will be suitably protected by the overlying drainage blanket layer and till filter zone.

SECTION 1.2.3.2, WASTE ROCK DISPOSAL AND PREPRODUCTION OR TEMPORARY STORAGE

Comment No. 83

Specifically discuss how the integrity of the liner will be protected during placement and reclamation of materials. How will the preproduction ore be separated from the waste rock and removed without damage to the liner?

Response:

Placement of waste rock in the MWDF will be on a prepared surface composed of the underdrain system and liner. Rock placement should not affect the liner which will be adequately protected by the overlying drainage and filter zones.

Waste rock to be temporarily stored in the MWDF will be in the upper portions of the pile as shown on Figure 1.2-10 of the EIR and should not impact the liner during waste rock recovery.

Continuing study of mine/mill operations has eliminated the need for mine backfill stockpiling. Preproduction ore will now be stockpiled in the mine/mill area rather than the MWDF.

SECTION 1.2.3.3, TAILING TRANSPORT

Comment No. 84

Provide detailed plans and specifications for the construction, operation, and maintenance of the transport system. (1)Describe the specifications (ASTM, etc.) which the High Density Polyethylene (HDPE) pipes should meet. (2)Indicate the types of pipe strength and pressure ratings which will be selected and (3)what types of trenching or backfill conditions will be used. Describe items such as resistance to crushing for a design overburden and live load, soil types used for trench and backfill, (4)resistance to collapse in a vacuum situation, and (5)ability to resist damage either from blockage by settled solids or by pipe freezing. (6)Discuss the pipeline installation, leak detection and repair, necessity for redundant pipe, and storage or disposition of water drained from the pipe during normal pump maintenance or loss. (7)Describe measures which will be taken to prevent groundwater contamination in the event of a pipeline failure. (8)Specify capacity for each pump for each of three pipeline systems.

Response:

(1) The pipe will be fabricated from an extra-high molecular weight high density polyethylene. This material has been selected on the basis of its resistance to abrasion and corrosion. It is not attacked by chemicals in the soil and it does not support the growth of, and is not affected by, algae, bacteria and fungi.

Typically, for the HDPE pipe envisaged, the physical properties of the material would be tested according to the following ASTM procedures:

Density: ASTM D 1505
Tensile Strength: ASTM D 638
Impact Strength: ASTM D 256
Hardness: ASTM D 2240
Long-Term Strength: ASTM D 2837
Stress Life Testing: ASTM 1598

(2) The pipe material will be high density polyethylene rated for 1725 kpa (250 psi) internal design pressure. In drawing No. 051-1-PSI-002, (see report "Tailing Slurry and Solution Transport Pipeline Systems" by Pipeline Systems Incorporated 1982; previously provided to the DNR), the hydraulic gradients proposed for the system are identified. It can be seen, especially in the case of the tailing transport line that the rated allowable pressure is well above the expected pipeline pressures. For the tailings line, it is proposed to use a wall thickness of 36.8 mm (1.45 inches) and an internal diameter of 199 mm (7.85 inches).

Inspection of the hydraulic gradient data for the other pipe systems shows that, in each case, the pipe is specified to sustain an operating pressure considerably in excess of the expected pressure.

(3) Tailings pipelines and other pipes handling process water will be buried at a depth of 1.83 m, (6 feet) below ground to avoid damage by freezing or external hazards.

The trench will be generally as shown in the pipeline installation sketch shown in the report by PSI, Inc. The trench will be over-excavated by 150 mm (6 inches). The trench volume below the pipes will be backfilled with sand, gravel or other select material to support the pipe. Generally, the pipe bed material will be free of rock greater than 12 mm (0.5 inch) in size and will contain no jagged or soft rock.

After the pipe has been laid, it will be surrounded with compacted sand, gravel, or other select material and then backfilled with glacial till derived from trench excavation. Backfill will be compacted to about 85 percent Proctor density (ASTM 698).

When a pipe is buried, it is subjected to external loads such as soil pressure and the pressure of surface loads. The performance limits due to internal pressure are related simply to hoop tension in the pipe wall. The performance limit due to external pressure could be wall crushing, wall buckling, or ring deformation depending on the applied loads, and the phyical properties of the soil and the pipe. These aspects of pipe design will be considered in final engineering.

Instrument cable will be buried with the pipe. The cable will be used as a metal source for pipeline locating instruments.

(4) Because the tailings ponds embankment berms are at a higher elevation than the pumping station and the discharge of tailings to the lower depths of the ponds could create a vacuum in the tailings line, a vacuum breaker will be installed at the high point of the pipeline on the tailings pond berm.

(5) Because the pipeline is buried it will not be vulnerable to deliberate or accidental damage from humans, vehicles or machines. The depth of burial below the frost-line excludes the possibility of freezing. Rodent attack is unlikely at the 1.83 m (6 feet) depth.

Slurry characteristics determined by laboratory penetrometer testwork show that the solids are "soft-settling." In this test procedure a sample of tailing solids and water is prepared and allowed to settle for 24 hours. A penetrometer is placed on the solid-liquid interface. Weights are added to the penetrometer until the tip penetrates the solids and reaches the bottom of the containing vessel. The weight required to achieve penetration under standard conditions is a measure of the resistance of the settled solids to re-slurrying after a pipeline shutdown.

The results of the tests indicated that if the pipeline is shutdown during an emergency, the solids are soft-settling and can reslurry when the pipeline is restarted. During scheduled shutdowns of the pipeline, the solids will be flushed out with water prior to shutdown.

In the event of a sudden blockage of the pipeline, the slurry pumps will not be able to develop the pressure required to rupture the line. The increase in pipeline pressure and decreasing flowrate would activate alarms and the pipeline would be shutdown.

(6,7) The pipe will be received in 11.6 m (38 feet) lengths. All pipe will be inspected for damage on site. Sections of pipe with cuts or gouges will be cut out and rejected.

Each piece of pipe will be fusion butt welded to form a continuous pipeline from the pumping station in the mine/mill site to the discharge point.

Butt fusion welding involves heating both ends of the pipes to be joined, making contact between the two molten ends and joining them together under pressure. The operation is performed using commercially available equipment designed for this purpose. The equipment is easily transported and may be used at any point along the pipeline during the installation of new pipe or the repair of old pipe. The joint which is formed is stronger than the pipes it joins.

A similar technique will be used to install the reclaim water, thickener overflow water, and decant water pipelines from the tailings ponds.

Buried pipelines are inherently safer than pipelines laid on the surface. They are silent in operation and not visible. Typically, vegetation covers the trenched area within 2 years.

In the event of a pipeline breakage, flowrate monitoring equipment would warn the operator to shutdown the pipeline system. Such an event could be cause for a complete plant shutdown. For the case of a pipeline break at the lowest elevation in the pipeline route the contents of the pipe would drain to the low point. The contents of about a 650 m (2133 feet) length of line would leak from the pipeline. This is equal to a volume of 20.3 m^3 (5363 gallons) of slurry. Because of the low elevation heads, the rate of leakage would be low and little solid material would escape.

Clean-up would require excavation around the leak and the water and tailings would be pumped to the MWDF. Repair would involve the removal of the damaged pipe and welding in new pipe using portable butt welding equipment. The repaired pipeline would be leak tested using water before backfilling and returning the pipeline to normal service.

Spare plastic pipe would be retained in storage for repair purposes.

Pipeline leaks in conventional flanged or mechanically coupled pipelines typically occur at the flanges or in areas of the pipe where sudden changes in direction are necessary. The use of welded plastic pipe eliminates the flange or other connections and reduces the possibility of leakage. Typically, HDPE pipe can be cold bent to a minimum radius of 25 times the pipe diameter. This allows gradual direction changes to be made and reduces the possibility of pipe wall erosion and minimizes the potential for leaks.

(8) The current anticipated capacities of the pumps are as follows:

Tailings slurry pumps	185.2 m^3/h* (815 gallons per minute)
Reclaim water pumps	1153 m^3/h (5,077 gallons per minute)
Thickener overflow pumps	1030 m^3/h (4,535 gallons per minute)

*Includes gland seal water

SECTION 1.2.3.4, TAILINGS DISPOSAL

Comment No. 85

Waste Volumes - More detail is needed on the carbonate sludge and the potential effect it will have when pumped to the tailings ponds. Will the calcium carbonate fines occupy 1 million m^3 or will it fill voids which exist in the tailings? Also, why does the Golder Report No. 11 recommend 3 feet of freeboard versus the 5 feet required in the NR 182.11(1)(q)?

Response:

The carbonate sludge is a very fine flocculant precipitate and will have no adverse effect when pumped with the tailings to the ponds. The most recent estimate of calcium carbonate sludge is 250,000 m^3 (327,000 cubic yards) as presented in Table 3.1 of the Mine Waste Disposal Facility Feasibility Report. It is expected that the sludge will fill some of the existing voids in the tailings and their actual required storage volume would be somewhat less. However, a conservative estimate of 1 million m^3 (800 acre-feet) was used to assure adequate disposal design volume for the MWDF for the carbonate sludge and also for the lesser volume of reclaim pond sludge to be disposed in the tailings pond at completion of operations.

NR 182.11 (1)(q) states that "Sufficient freeboard measured from the...crest shall...contain the 100-year, 24-hour rainfall event... or a minimum of 5 feet...". Golder Report No. 11 calculated the 100-year, 24-hour rainfall event and maximum wind generated waves expected for the ponds. These calculations indicated that a 0.9 m (3-foot) freeboard was sufficient to prevent overtopping of waves for the 100-year, 24-hour rainfall event and accompanying high winds. As such, their recommendation meets the requirements of NR 182.11 (1) (q). However, regardless of the regulation interpretation, based on the normal maximum tailings pond water levels, freeboard ranges from 2.35 to 3.65 m (7.7 to 12.6 feet).

Comment No. 86

Mine Waste Disposal Facility Location - The discussion of the MWDF location is not correct with regard to water users. There are several users downgradient of the disposal site.

Response:

There are approximately 25 private water wells and 21 Exxon owned residential water wells with the area of hydrological influence from the Crandon Project. Since the MWDF is located over a ground water high, all of these wells would be downgradient from the MWDF. However, all of them lie outside of the compliance boundary and should not be impacted by the MWDF. (See EIR Chapter 4.0, Sections 4.2 and 4.3 and Appendix 4.1A).

Comment No. 87

Soil attenuation should be addressed in greater detail by describing the contaminants likely to be found in the tailings and those which are likely to be attenuated.

Response:

Soil attenuation is specifically addressed in D'Appolonia's Soil Attentuation Study - Final Report, November 1982 (previously provided to the DNR). This report includes information on the attenuation of chemical constituents in tailings leachate from Crandon pilot plant tailings with Crandon site till and drift soils. The tailings leachate composition is given in Table A-3 "Projected MWDF Tailings Pond Seepage Chemistry" in Appendix 4.1A of the EIR. This table is based on the results summarized in Table 3.5-"Summary of pH 2 Leachate, Spiked, Target, Predicted MWDF Tailings Leachate Chemistry, Drinking Water Standards" of the D'Appolonia Soil Attenuation Study. A discussion of tailings leachate preparation was presented in Section 3.2 "Leachate Synthesis, Testing, and Stability," pages 3.9 through 3.15.

The extent to which chemical constituents present in tailings leachate are attenuated is summarized in D'Appolonia's Soil Attenuation Study. Table EX.1 "General Mobility of Leachate Constituents," Page EX.7 of Volume 1. More detailed information is also presented in Table 3.20 "Comparison of Retardation Factors (Rd) Determined by Constant pH Sorption and pH Controlled Permeate Column Tests" of the above mentioned report.

The impact of tailings seepage to ground water is modeled and discussed in subsection 6.6.1, "Groundwater Impacts", pages A58 through A68 of Appendix 4.1A of the EIR. The conclusion of this study was that sulfate was the only chemical constituent of concern because of its relatively high initial concentration in the tailings pond, 2000 ppm, (in chemical equilibrium with gypsum in tailings) and little expected retardation. All other chemical constituents in the tailings leachate were not of concern because of relatively low concentrations (near or below EPA drinking water standards, and/or high retardation factors).

Contaminant transport modeling would indicate that sulfate may enter the stratified drift and move laterally with the ground water after several hundred years, but the average steady state concentration along the compliance boundary is anticipated to be less than the EPA drinking water standards for sulfate or any other chemical constituent.

Comment No. 88

Why does the MWDF design call for 4:1 inside slopes and 3:1 outside slopes when the outside slopes will have to remain stable over a longer period of time?

Response:

The 3:1 outside slopes of the MWDF are conservatively flat for stability and for maintainability. The glacial till soils to be used in the embankments are excellent construction soils and could be placed at steeper slopes if desired. The 3:1 outside slopes were chosen with aesthetic consideration for the reclaimed facility. The 4:1 inside slopes have been chosen primarily for construction considerations of the bentonite-modified soil liner and other seepage control system layers. With these flat slopes, conventional equipment can construct the seepage control system readily and meet required quality control objectives.

Comment No. 89

Provide more detail on the accesses to the MWDF from both the mill and the Woodlawn Siding.

Response:

The attached figures depict the routes from the Woodlawn Siding area to the MWDF and from the mine/mill area to the MWDF.

Comment No. 90

<u>Seepage Control System</u> - As we have indicated to you in the past, we have a number of concerns regarding the feasibility, reliability, and effectiveness of your proposed seepage control system. These issues will be discussed further in the review of your Mine Waste Disposal Facility Feasibility Report.

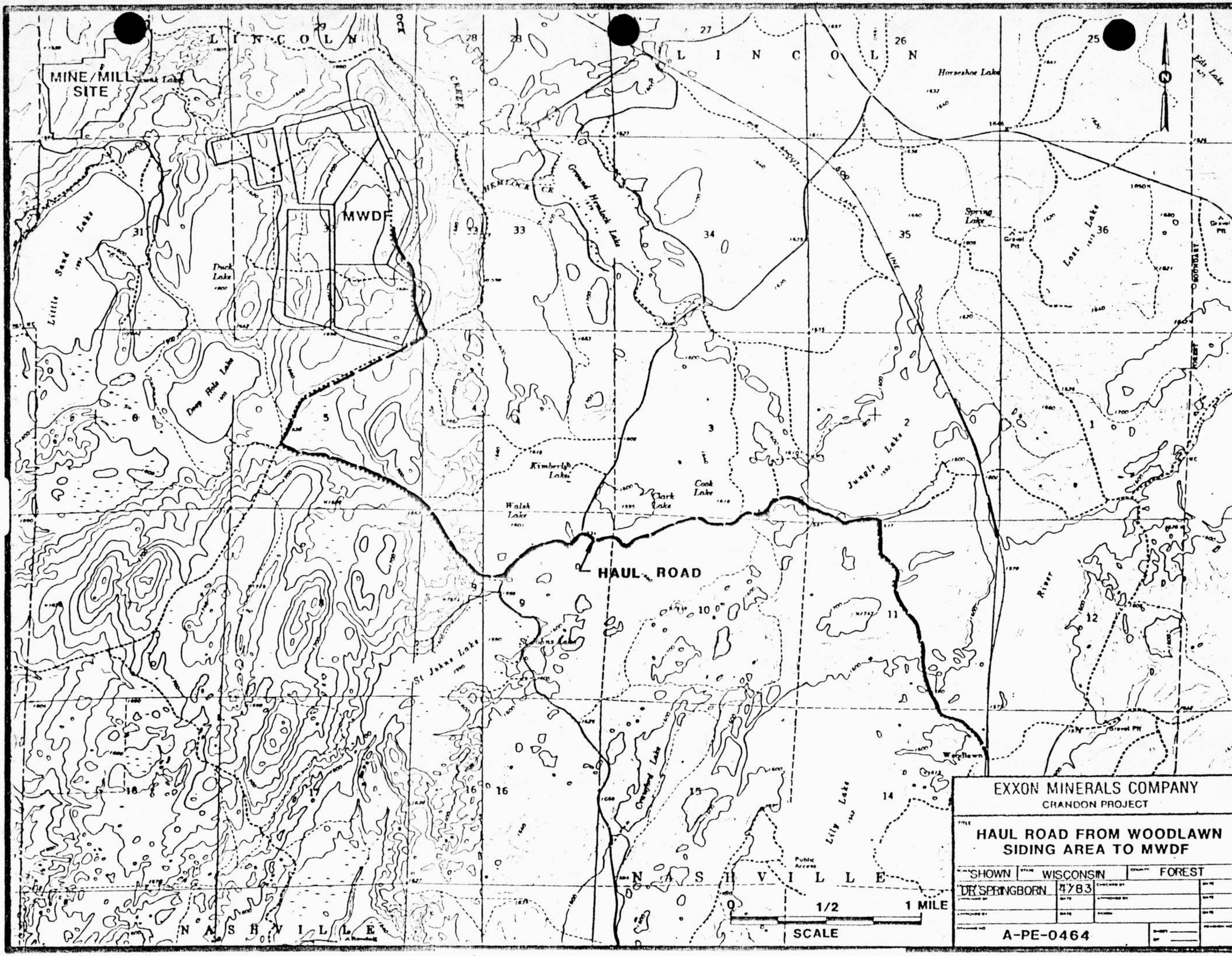
Response:

Comment acknowledged.

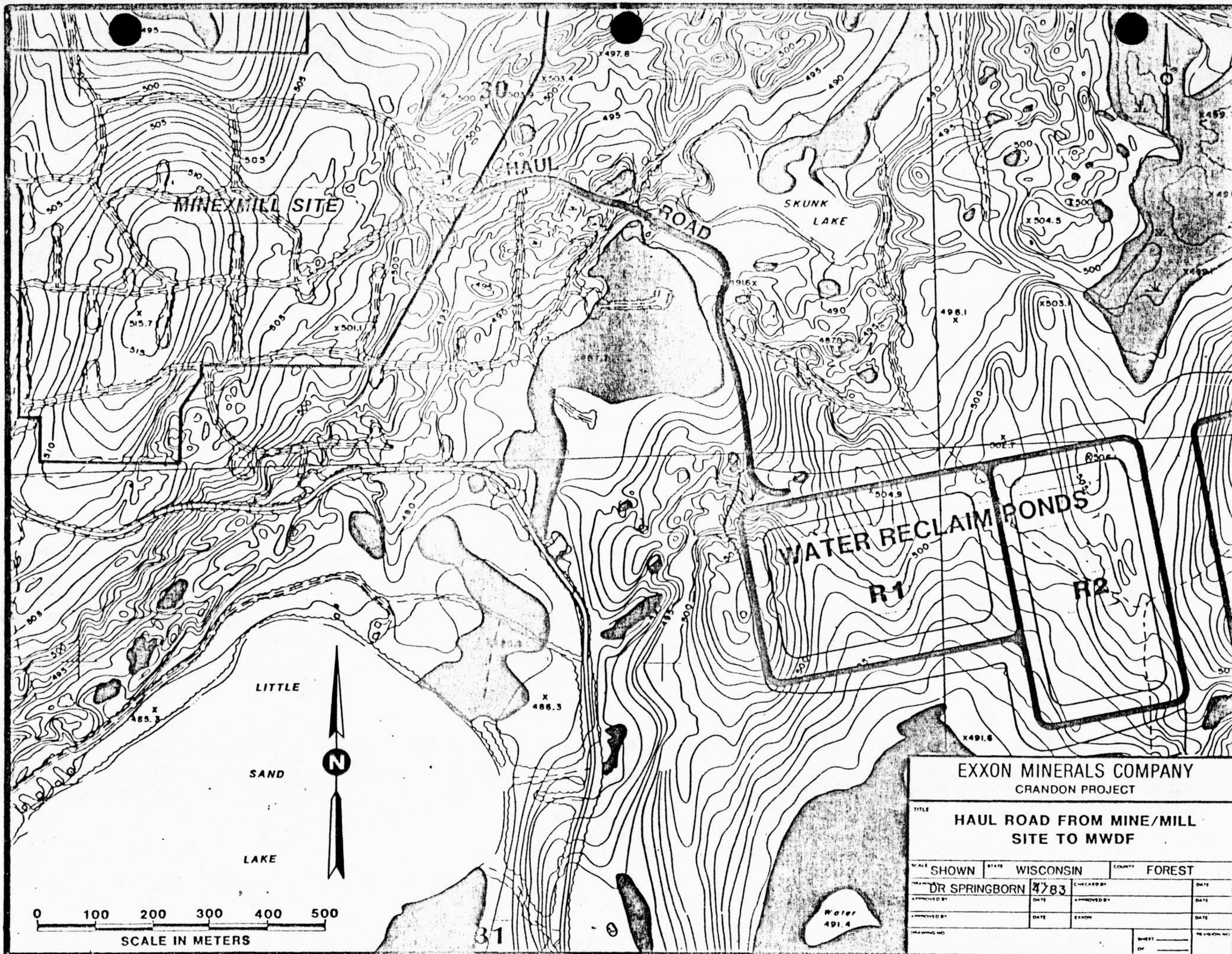
SECTION 1.2.3.5, WATER TREATMENT WASTE DISPOSAL

Comment No. 91

What are the potential market locations for the sodium sulfate? How and with what frequency would it be transported to its destination? Where would the sodium sulfate be disposed if a suitable market is not available?



(FIGURE FOR RESPONSE TO COMMENT NO. 89)



(FIGURE FOR RESPONSE TO COMMENT NO. 89)

A-PE-0470

Response:

Sodium sulfate, or salt cake as it is commercially known, is consumed by Kraft pulp and paper mills. Wisconsin has three Kraft pulp mills which consume a total of 29 t/d (32 short tons per day) of salt cake, based on a telephone survey.

Wisconsin Kraft Pulp Mills

Company	Location	Salt Cake Consumption (t/d)
Mosinee	Mosinee	3
Nekoosa	Nekoosa	4
Thilmany	Kaukauna	22*

* 27 t/d (30 short tons per day) of Copeland sulfate (80% Na_2SO_4, 20% Na_2CO_3) equivalent to 22 t/d (24 short tons per day) of pure Na_2SO_4.

An additional 20 t/d (22 short tons per day) of salt cake is projected to be consumed by the states of Minnesota and Michigan, and the Canadian provinces of Manitoba and Ontario.

The production of crystallized sodium sulfate from the water treatment plant will range from 0 to 14 t/d (0 to 15.4 short tons per day) depending on the percentage of water being treated by the reverse osmosis/vapor compression evaporation (RO/VCE) units. The frequency of transportation of salt cake to Kraft pulp mills would depend upon the mode of transportation and location of the mill. Assuming approximate 23 t (25 short ton)-shipments, then approximately semi-weekly shipments would be required.

Prior to sodium sulfate crystallization (removal of soluble impurities), the nearly saturated sulfate solution exiting the VCE unit is lime neutralized and then clarified to remove insoluble impurities (heavy metals). This post treatment of the VCE brine ensures a marketable salt cake or a non-hazardous secure landfill disposal option.

SECTION 1.2.3.6, RECLAIM POND SLUDGE

Comment No. 92

Describe the method and frequency of sludge removal. Discuss the effect of sludge removal on the reclaim pond liner. Specifically characterize the reclaim pond sludge composition. Discuss the effect of disposing the sludge in the top layers of the tailings ponds and the effects this will have upon placement of final cover.

Response:

A conservative projection of 100,000 m^3 (131,000 cubic yards) of reclaim pond sludge has been made for the life of the Project. This estimate is based on the water flow rate passing through the two pond system, the suspended solids in the water, the total Project time, and a sludge density. This volume of sludge can be held in the system with no effect on the operation of the reclaim ponds. Overall it is approximately 8.5 percent of the total operating volume. Divided evenly between the two ponds it would amount to approximately 0.6 m (2 feet) of sediment on the pond bottom.

There will be some difference in the sludges between the two ponds. Reclaim pond R2, the first pond to receive the tailings pond decant and underdrain water, will have sludge predominately of tailings and $CaCO_3$ precipitates, while reclaim pond R1 will have a predominance of gypsum precipitates from the pH adjustment step between the two ponds. There may also be some metal hydroxide precipitates in pond R1 from pH adjustment.

Aside from the conservative sludge estimates, the operation of the tailings pond decant system offers a degree of control on the clarity of the water returned to the reclaim ponds. Some additional ponding with increased retention time in the tailing ponds could reduce suspended solids in the decant water.

If it would ever be necessary, there are suitable sludge removal methods that would not damage the pond liner while still allowing continued pond operation. A small floating suction dredge with depth control on the suction head could be used. In practice, a small depth of sludge (0.3 m [1.0 foot]) would not be removed to maintain an additional layer over the liner. Specific disposal details for the sludge have not been determined, but are not expected to present any problems. If the estimated 100,000 m^3 (131,000 cubic yards) of sludge were distributed evenly over the final tailings surface of pond T4, the depth of sludge would be approximately 0.25 m (0.8 foot). Since there are no crucial timing constraints on reclamation of pond T4, there will be ample time for proper management of the sludge through drying or blending with tailings or cover soil. The sludge could also be incorporated into the thick till grading layer planned as the first step in reclamation of the tailings pond.

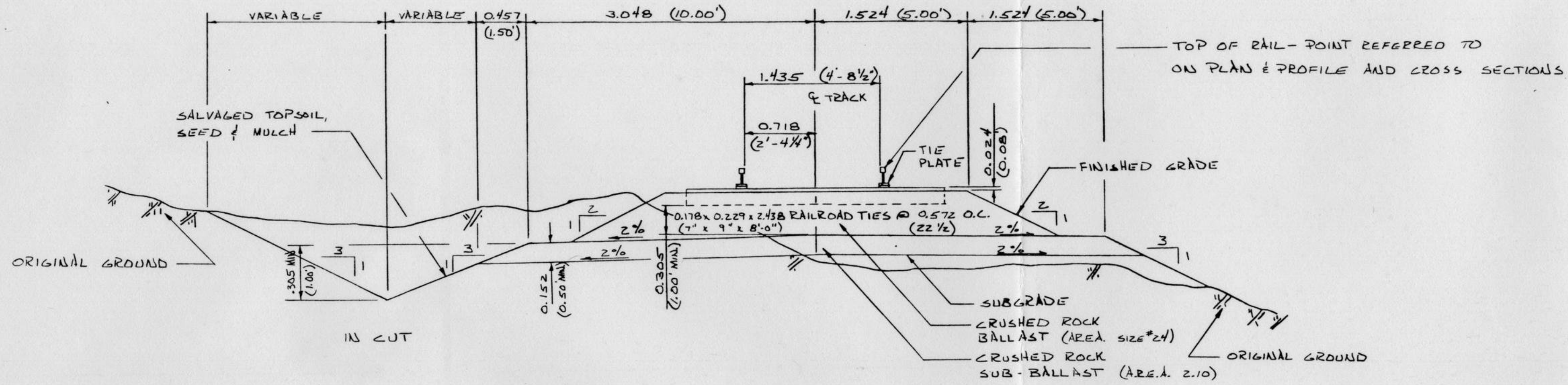
SECTION 1.2.4.1, RAIL SPUR

Comment No. 93

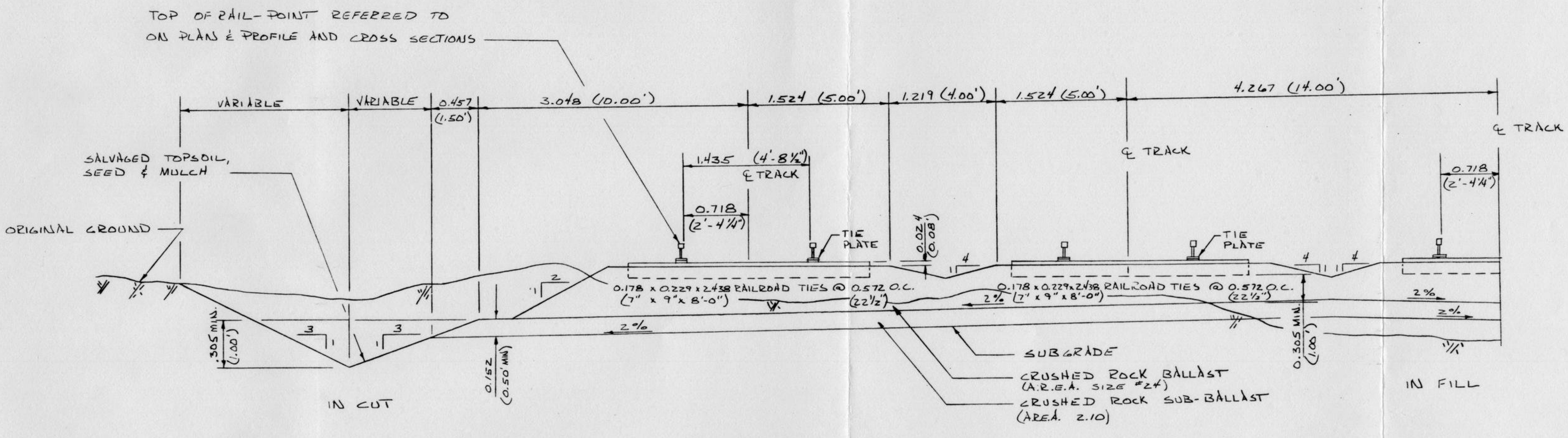
Discuss right-of-way maintenance as it relates to aesthetics, erosion control, and the prevention of railroad initiated fires. Provide cross-sectional design drawings detailing the physical dimensions of the right-of-way and proposed rail structures.

Response:

The attached drawings, taken from the set of preliminary engineering drawings for the railroad spur, provide details of the railroad cross-section and the structure crossing Swamp Creek.



SINGLE TRACK SECTION



MULTI - TRACK SECTION

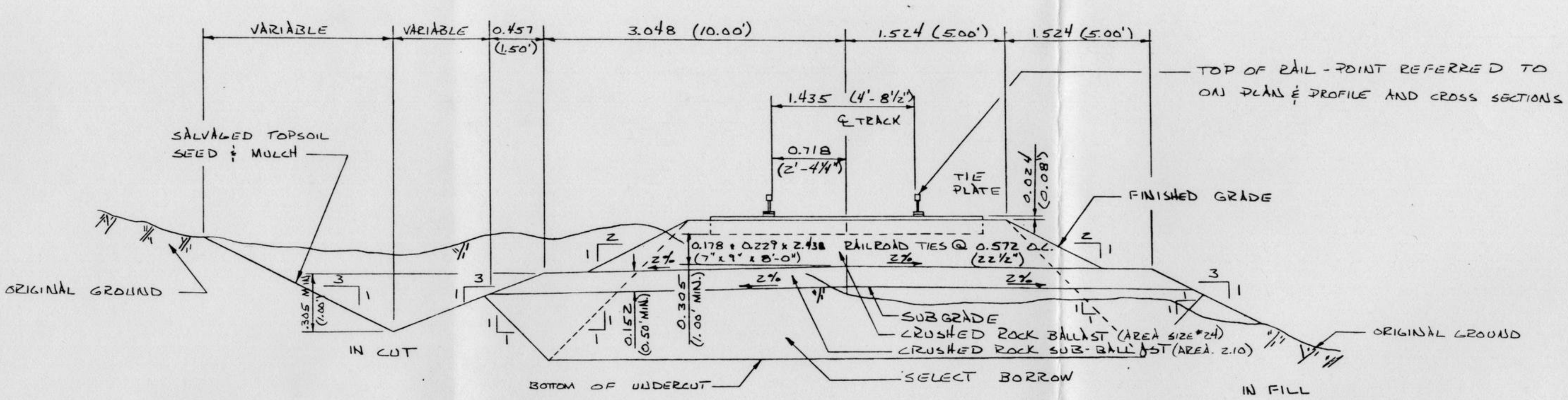
(FIGURE FOR RESPONSE TO COMMENT NO. 93)

EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE: TYPICAL SECTIONS

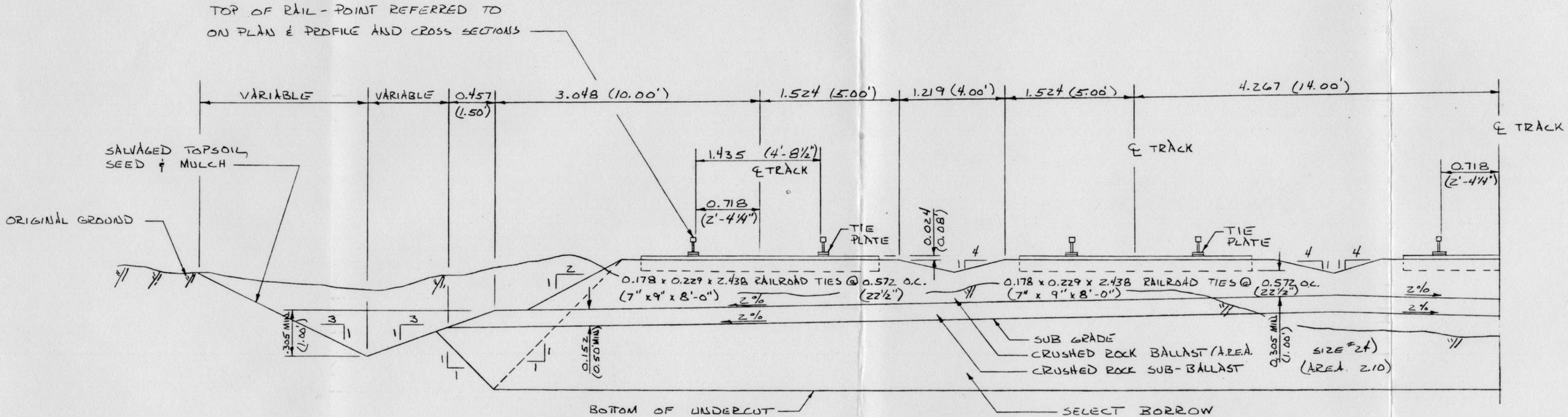
SCALE: NONE | STATE: WISCONSIN | COUNTY: FOREST
DRAWN BY: M. J. O. | DATE: 9-9-81 | CHECKED BY: J. M. M., D.R.W. | DATE: 12-81
APPROVED BY: D.R.W. | DATE: 12-81 | APPROVED BY: T.J.J. | DATE: 12-81
APPROVED BY: | DATE: | EXXON | DATE:
DRAWING NO: B-PE-0314 | SHEET | OF | REVISION NO

REVISED	DATE	BY	DESCRIPTION



SINGLE TRACK SECTION UNDERCUT (E.B.S.)

NOTE: DEPTH OF UNDERCUT IS EQUAL TO 60% OF THE MAXIMUM DEPTH OF FROST PENETRATION (1.20m OR 3.90' BELOW SUBGRADE) OR ACTUAL DEPTH OF FROST SUSCEPTIBLE SOILS WHICHEVER IS LESS, IN BOTH SINGLE AND MULTI-TRACK SECTIONS.



MULTI-TRACK SECTION UNDERCUT (E.B.S.)

(FIGURE FOR RESPONSE TO COMMENT NO. 93)

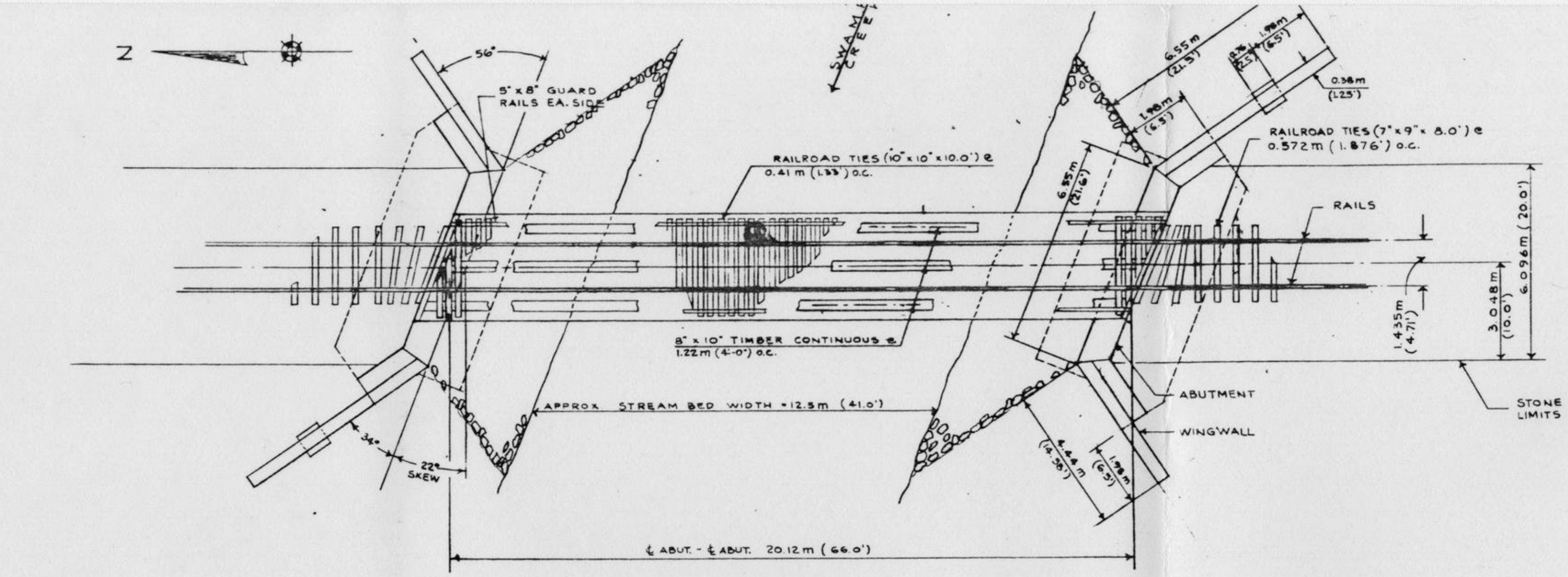
REVISED	DATE	BY	DESCRIPTION

EXXON PROPRIETARY

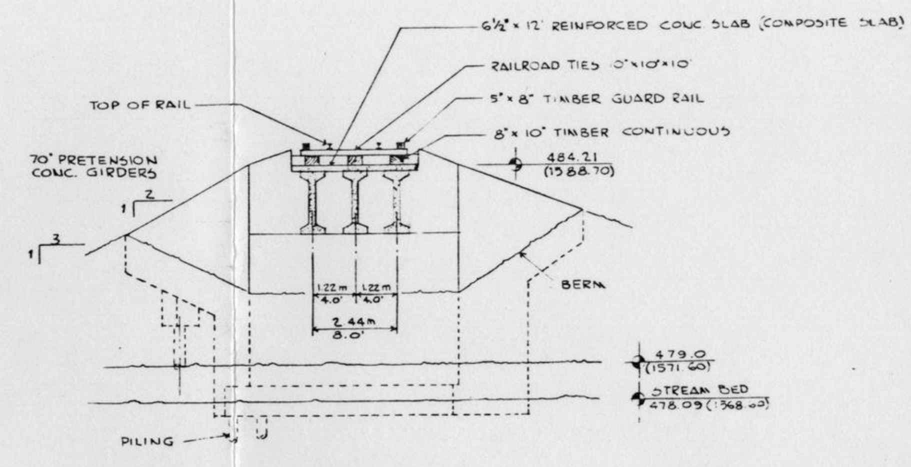
EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE: TYPICAL SECTIONS

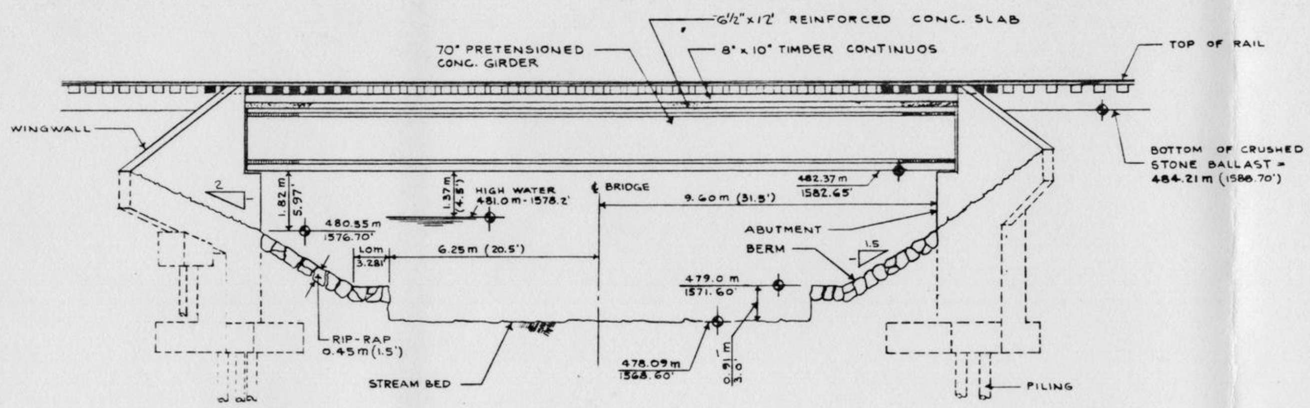
SCALE: NONE	STATE: WISCONSIN	COUNTY: FOREST	
DRAWN BY: M.J.O.	DATE: 9-30-81	CHECKED BY: J.M.M., DRW	DATE: 12-81
APPROVED BY: DRW	DATE: 12-81	APPROVED BY: TJ	DATE: 12-81
APPROVED BY:	DATE:	EXXON	DATE:
DRAWING NO: B-PE-0315	SHEET: OF		REVISION NO:



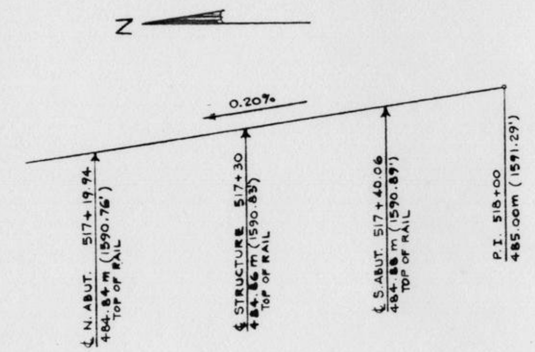
PLAN
1:100
1 CM = 1 METER



TYPICAL SECTION
1:100
1 CM = 1 METER



ELEVATION
1:100
1 CM = 1 METER



PROFILE GRADE LINE

(FIGURE FOR RESPONSE TO COMMENT NO. 93)

REVISED	DATE	BY	DESCRIPTION

EXXON PROPRIETARY

EXXON MINERALS COMPANY CRANDON PROJECT			
TITLE GENERAL PLAN SWAMP CREEK BRIDGE			
SCALE AS SHOWN	STATE WISCONSIN	COUNTY FOREST	
DRAWN BY H.W	DATE 11-81	CHECKED BY W.L.Y., K.A.E.	DATE 12-81
APPROVED BY K.A.E.	DATE 12-81	APPROVED BY	DATE
APPROVED BY	DATE	EXXON	DATE
DRAWING NO B-PE-0331		SHEET OF	REVISION NO

GBB 5/1981

Normal railroad maintenance practices will be followed for the railroad spur line. Because the spur line will be new and will receive relatively little use, maintenance will primarily relate to control of vegetation in the right-of-way. The ballast section will be kept free of vegetation altogether, either through use of approved chemical herbicides or other means. Undesirable weeds or brush within other areas of the right-of-way will be controlled by mowing or through use of approved chemical herbicides or other means.

Comment No. 94

Figure 3.4-7 does not show the proposed siding location as indicated in this section.

Response:

The reference to the figure showing the railroad siding locations should have been Chapter 3, Figure 3.4-8 instead of Chapter 3, Figure 3.4-7.

SECTION 1.2.4.2, ACCESS ROAD

Comment No. 95

Provide cross-sectional design drawings detailing the right-of-way and structures. Describe the road surface material. Will there be any limitations of access to this road by the general public and/or adjacent landowners?

Response:

The attached drawings, taken from the set of preliminary engineering drawings for the access road, provide details of the road cross-section and the structure crossing Swamp Creek. As the cross-section indicates, bituminous concrete is planned for the road pavement. The agreements with the landowners from whom right-of-way was secured are not uniform with regard to road access. Some agreements contain access rights, while others do not. The access road will be posted as a private road leading to the Exxon mine; however, no gates or guards are planned at the State Highway 55 intersection.

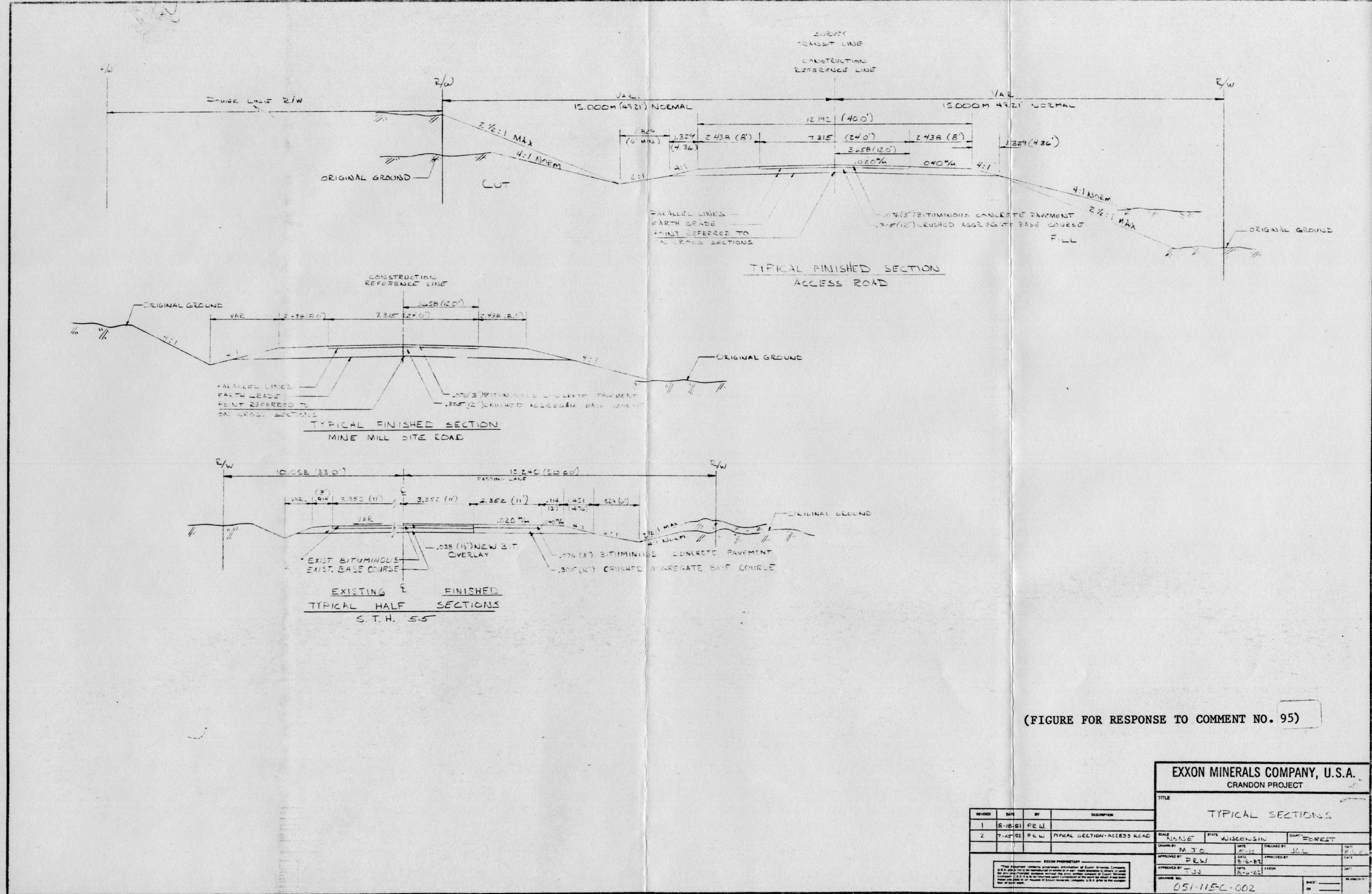
SECTION 1.2.4.4, ADMINISTRATION BUILDING

Comment No. 96

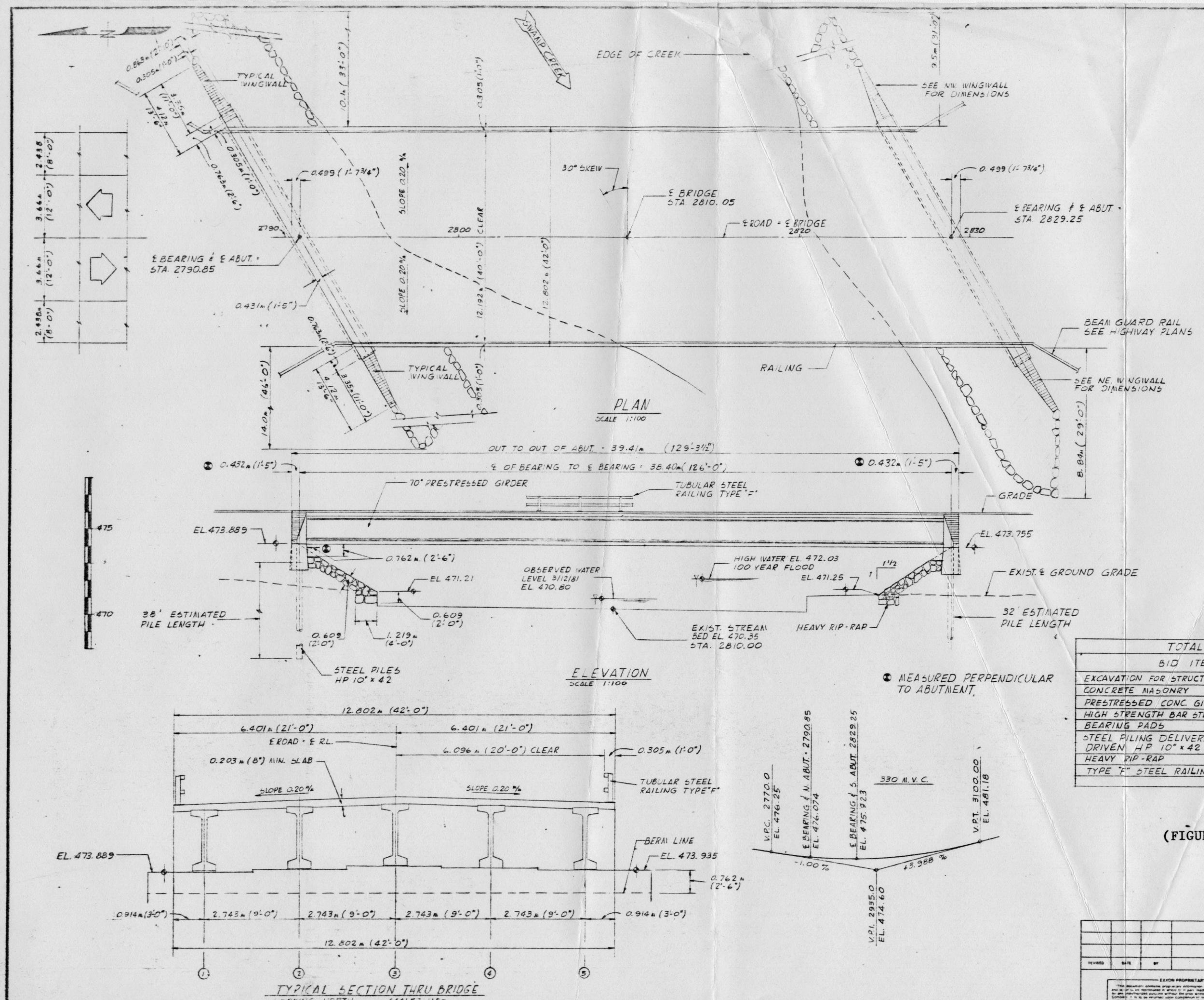
Will a separate environmental laboratory be provided?

Response:

The main environmental laboratory will be located in the concentrator building. Environmental analyses related to monitoring programs will be performed in this laboratory or by outside laboratories under contract.



(FIGURE FOR RESPONSE TO COMMENT NO. 95)



TOTAL ESTIMATED QUANTITIES					
BID ITEMS	UNIT	N ABUT.	S ABUT.	SUPER	TOTAL
EXCAVATION FOR STRUCTURES	L.S.				
CONCRETE MASONRY	C.M.(C.Y.)	92.8(56)	92.8(56)	161.5(211)	246.9(323)
PRESTRESSED CONC. GIRDER 70"	L.M.(L.F.)	—	—	193.5(635)	193.5(635)
HIGH STRENGTH BAR STEEL REINFG.	L.B.S.	(BY FINAL DESIGN)			
BEARING PADS	L.S.				
STEEL PILING DELIVERED AND DRIVEN HP 10" x 42 ; 32'	L.M.(L.F.)	115.8(380)	97.5(320)	—	213.3(700)
HEAVY RIP-RAP	C.M.(C.Y.)			—	206.4(270)
TYPE "F" STEEL RAILING	L.M.(L.F.)	—	—	78.6(258)	78.6(258)

(FIGURE FOR RESPONSE TO COMMENT NO. 95)

EXXON MINERALS COMPANY CRANDON PROJECT	
TITLE: SWAMP CREEK BRIDGE GENERAL PLAN	
SCALE: AS SHOWN	STATE: WISCONSIN — COUNTY: FOREST
DRAWN BY: W.L.Y. — DATE: 7/82	CHECKED BY: J.G.L. — DATE: 8-6-82
APPROVED BY: PRW — DATE: 8-6-82	APPROVED BY: K.A.E. — DATE: 8-6-82
APPROVED BY: TJJ — DATE: 8-6-82	EXXON: — DATE:
DRAWING NO: 051-115-C-017	SHEET: OF: — REVISION NO:

SECTION 1.2.4.5, COMBUSTIBLE STORAGE BUILDINGS

Comment No. 97

Construction, operation, safety and fire protection of the combustible storage building will also have to meet federal, state and local requirements.

Response:

Comment acknowledged and a statement will be added to subsection 1.2.4.5 of the revised EIR that the construction, operation, safety and fire protection of the combustible storage building will meet federal, state and local requirements.

SECTION 1.2.4.6, SANITARY WASTE FACILITIES

Comment No. 98

What will the peak flow to the sanitary treatment system be? What is the basis for the 31.9 gallons per minute average flow value? Provide documentation for these figures.

Response:

A peak hourly flow rate of 14.5 m^3/h (64 gallons per minute) has been estimated. Estimates for sanitary wastewater flows are developed in the Phase III Water Management Study by CH2M Hill (previously provided to the DNR).

Comment No. 99

Discuss the effect of having drainage from the absorption field in close proximity to the mine. Estimate the land area needed and available for land spreading of sludge. Discuss the availability of a commercial sludge disposal facility and the anticipated volumes and frequency of sludge disposal. Discuss the potential for needing sludge storage during winter months. Describe the separation of laboratory and other chemical wastes from this system.

Response:

There should be no effect of having the absorption field in close proximity to the mine. The mine workings closest to the surface will be over 100 m (328 feet) below ground level.

As stated in the response to comment No. 37, the sewage treatment system will have 49.2 m^3 (13,000 gallons) of sludge storage capacity and will require sludge removal once or twice per year. However, if the entire septic tank of approximately 223.3 m^3 (59,000 gallons), which includes 49.2 m^3 (13,000 gallons) of sludge, is emptied, the sludge field required is less than 2 ha (5 acres), assuming an application rate of 0.11 m^3/9.3 m^2 (30 gallons per 100 square feet). Although land area is available for on-site disposal, Exxon does not currently plan to develop such an area. These volumes will be handled by a licensed private contractor.

Initially, pumping might be more frequent to avoid winter sludge disposal problems (if winter disposal is prohibitive for the private contractor); however, with some operating experience a sludge pumping schedule could be established to avoid winter disposal.

Drainage from all laboratory and mill facilities, with the exception of sanitary wastes, will flow to the reclaim pond as shown on EIR Figure 1.4-18 and will not be mixed with sanitary sewer waste.

Comment No. 100

Describe the size and location of the sludge absorption field.

Response:

There is no sludge absorption or disposal field planned for the Project. A soil absorption field to dispose of the septic tank effluent is proposed. The size of the field will depend upon siting location and field percolation rates; however, it will be in the range of 0.4 to 1.2 ha (1 to 3 acres). Additional details of the sanitary wastewater system are included in the Phase III Water Management Study by CH2M Hill (previously provided to the DNR). Further studies have been completed to prepare permit applications for a soil absorption field; this permit was submitted to DILHR in September 1983.

SECTION 1.2.4.7, POWER SUPPLY FACILITIES

Comment No. 101

Please provide plans for the substation which detail measures taken to suppress transformer and emergency generator noise. Describe the location and construction techniques for site underground and above-ground distribution system. Describe the above ground structures which will be utilized.

Response:

The substation area is shown on drawing No. 051-1-E-002 in Attachment No. 7. This drawing is a general arrangement indicating relative space allocations. A detailed drawing will not be available until final engineering is complete.

No special noise suppression measures have been taken to alleviate noise from transformers or generator sets. The noise emitted is well within the EPA guidance limits at the property boundary. All transformers are manufactured in compliance with NEMA standards and will comply with the 77 dBa at 1 m (3.3 feet) OA/FA operation maximum of the NEMA standard.

The two 2500 kW generators and one 1000 kW generator are housed in a concrete block building and after the powerhouse is installed will operate only in an emergency. The two large generators will produce 103 dBa at 1 m (3.3 feet). The smaller generator will produce 95 dBa at 1 m (3.3 feet). The building will absorb some of the sound transmitted from the generators. Ear protection will be required within the generator station as a safety requirement. The generators will be fitted with spark arresting silencers on the exhaust.

At the center of the substation area a point source noise will be less than the 96 dBa that was used in the noise model which indicated levels at the Project boundary were within EPA guidance limits. Therefore, no abatement procedures are required.

Drawing No. 051-1-E-002 also indicates the relative locations for all major substations in the surface facilities, except for the substations associated with the headframe and hoist drive system which are located on the lower floor of the headframe. The outdoor substations consist of a high voltage switch, mineral oil filled power transformers, and secondary main circuit breakers. The secondary circuit breakers in turn feed the appropriate motor control centers located in the process areas. The outdoor substations will be mounted on concrete pads. The areas will be fenced as required by code.

Power is supplied from the main substation through an underground electrical duct system buried within 1.2 m (4 feet) of the ground surface with manholes at points required for pulling cables. The power for the MWDF is also supplied underground to the edge of the facility boundary where it is converted to an overhead 13.8-kV powerline. This powerline transverses the pipeline route to the MWDF and then around the facility to supply power for the pumps.

A communications duct system is also shown on drawing No. 051-1-E-002. This system provides telecommunication, data, and intercom routes throughout the Project surface facilities.

The static VAR compensator is located adjacent to the compressor house. This compensator is required for production hoist operation. It consists of capacitor banks, reactors, and transformers required to adjust for VAR differences during hoist cycling.

SECTION 1.2.4.8, FUEL STORAGE DISTRIBUTION

Comment No. 102

Will the area within containment dikes be lined or paved to prevent spills from reaching groundwater? Will collection and treatment of runoff from the fuel oil storage area and the tank loading area be provided? Describe the quantity of runoff and the type of treatment proposed. Provide a map showing the location of on-site fuel distribution pipelines. Provide specifications for pipeline construction, particularly in areas of potential earth settling or mine subsidence.

Response:

The area within the containment dikes surrounding the bulk fuel storage facility will be lined with an elastomeric membrane to prevent spills and contaminated runoff from reaching ground water. Any minor spills, washdown or runoff from this area will be transferred to the industrial wastewater sewage system. (This system also collects washdown and runoff from around the shops and other areas of potential oil/grit contamination.) Precipitation collected within the containment berms would not normally be contaminated in any way since the fuel storage and handling systems are totally enclosed and sealed. In such case the precipitation would simply be permitted to flow off into the surrounding area.

The design of the industrial wastewater sewage system will be finalized during detailed engineering. The system will be provided with an oil/water separator to remove oily contaminants. This contaminant material will be transferred to a holding tank for eventual removal from the site. The clear water will be pumped to the reclaim pond.

Sufficient surge capacity will be provided within the system for storage of total storm runoff for eventual treatment, based upon a one in 25-year storm developing 106.7 mm (4.2 inches) of rainfall in 24 hours and a 'C' factor (runoff/rainfall) of 0.90. The surge capacity may be provided in sumps or in holding tanks.

The fuel distribution system is confined to a single line, approximately 200 m (656 feet) long, from the bulk fuel storage tanks to the fuel tanks located at the fuel delivery borehole to the mine. No settlement is expected along this pipeline route. The pipeline specification would be C.S. Sch. 40 welded at joints.

SECTION 1.2.4.10, POTABLE WATER FACILITIES

Comment No. 103

The Department has not yet received an application for a high capacity well approval. This application will need to include all proposed groundwater withdrawals on the property.

Response:

Comment acknowledged. Applications for high capacity well permits will be filed in 1983.

Comment No. 104

The EIR indicates that a chlorinator treatment system will be provided if necessary. We recommend that such a system be installed on a standby basis. It would have to be approved by the Public Water Supply Section. Chemical treatment or additions to the well or the total water supply pumped from the well for the purpose of quality control, when the additions are made ahead of the pressure tank or reservoir, will require approval from the Department.

Response:

Comments acknowledged and recommendations will be followed.

Comment No. 105

The potable water well and distribution piping must be in compliance with NR 112 and H62, respectively. If the mine is approved and a potable water distribution system is constructed, we recommend that Exxon periodically inspect cross-connections and sample the distribution system and wells for bacteriological quality.

Response:

Comments acknowledged and recommendations will be followed.

SECTION 1.2.4.11, WATER TREATMENT FACILITIES

Comment No. 106

Provide details of the surge tank for the "uncontaminated" water. Discuss the monitoring program and how the necessary treatment will be determined.

Response:

The maximum volume of uncontaminated mine water is expected to be about 227.1 m^3/h (1000 gallons per minute). The tank that will receive this water will have a capacity of 1,893 m^3 (500,000 gallons).

As water is pumped from this tank to the excess water discharge tank, it will be continuously monitored for pH, turbidity, and conductivity. Although details of the monitoring program are not yet developed, periodic samples of this water will be obtained for chemical analyses.

If this water is intercepted at ground water quality (see EIR Table 2.3-8), it should not require treatment. However, if it is determined that the quality of the intercepted ground water is such that the total effluent being discharged to Swamp Creek will not meet WPDES effluent limits on a long-term basis, appropriate treatment technology will be used.

Comment No. 107

Provide the details of the water discharge pipeline as requested under Section 1.2.3.3 for the tailings transport pipeline.

Response:

At the current stage of project engineering the water discharge pipeline is expected to be constructed of 0.36 m (14-inch) diameter high density polyethylene (HDPE) pipe and buried a minimum of 1.5 m (5 feet) below ground to beneath the frost line. The exact size and wall thickness of the pipeline will be determined later.

Because the depth of the trench will be excavated in glacial till, blasting will not be required and all excavation can be by backhoe or trenching machine. The trench volume in the pipeline zone will be backfilled with sand or gravel or other select material and the remaining trench volume will be backfilled with till. During construction, exposed areas with potential for runoff of sediments will be controlled with straw bale sediment traps. Seeding and reestablishment of vegetation will follow shortly after trench backfilling.

General HDPE pipe characteristics are discussed in the response to comment No. 84. Current engineering calculations show that HDPE pipe rated at 250 psi internal design pressure would be well above expected pipeline pressures.

The water discharge pipeline should not experience vacuum conditions because vacuum breakers will be installed prior to operation.

Blockage of the pipeline due to settled solids will not be a problem because solids in the discharge water will normally be less than 20 mg/l. Settling due to periodic pipeline shutdown will be flushed out with start-up.

The depth that the pipeline will be buried will preclude pipeline freezing.

The pipe will be received in 11.6 m (38 feet) lengths. All pipe will be inspected for damage on-site. Sections of pipe with cuts or gouges will be removed and rejected.

Each piece of pipe will be fusion butt welded to form a continuous pipeline from the pumping station on the mine/mill site to the discharge point.

Butt fusion welding involves heating both ends of the pipes to be joined, making contact between the two molten ends and joining them together under pressure. The operation is performed using commercially available equipment designed for this purpose. The equipment is easily transported and may be used at any point along the pipeline during the installation of new pipe or the repair of old pipe. The joint which is formed is stronger than the pipe it joins.

Buried pipelines are inherently safer than pipelines laid on the surface. They are silent in operation and not visible. Typically, vegetation covers the trenched area within 2 years.

In the event of a pipeline breakage, flowrate monitoring equipment would warn the operator to shutdown the pipeline system.

Clean-up and removal of spilled water will not be necessary due to the good quality of the treated discharge. Repair of the pipeline will involve the removal of the damaged pipe and welding in new pipe using portable butt-welding equipment. The repaired pipeline would be leak tested using water before backfilling and returning the pipeline to normal service.

Spare plastic pipe will be stocked for repair purposes.

Pipeline leaks in conventional flanged or mechanically coupled pipelines typically occur at the flanges or in areas of the pipe where sudden changes in direction are necessary. The use of welded plastic pipe eliminates the flange or other connections and reduces the possibility of leakage. Typically, HDPE pipe can be cold bent to a minimum radius of 25 times the the pipe diameter. This allows gradual direction changes to be made and minimizes the possibility of leaks.

Current plans call for use of three pumps in the system. Two 110 hp pumps and one 170 hp pump. During normal operation (discharge less than 2,000 gallons per minute) one of the 110 hp pumps will be used with the other for standby operation. During maximum discharge (3,000 gallons per minute), all three pumps would be used.

Comment No. 108

What is the estimated scale of Figure 1.2-18? Indicate a "low water" level on the section drawing and define high and low levels.

Response:

EIR Figure 1.2-18 is a conceptual drawing and is not to scale. A detailed drawing has been provided with the water regulatory permit submitted to the DNR for the discharge structure. "High Water Level" and "Normal Water Level" have been estimated on the drawings. The high water elevation was identified by debris on the bank or change in vegetation and represents the elevation where the water level was for a sufficient period of time to leave a discernible mark. We did not estimate the low water elevation in the permit application, but that information will be added as a response to DNR comments on the application.

<u>SECTION 1.2.4.12, RECLAIM WATER PONDS</u>

Comment No. 109

Provide engineering plans and specifications for these ponds and ancillary facilities.

Response:

Additional detail of the preliminary design of the reclaim water ponds is presented in Chapter 9 of the "System Development" report by Golder Associates (previously provided to the DNR). Full size copies of the drawings from the report are included in Attachment No. 8. Basic material and construction specifications are included as notes on the drawings.

Comment No. 110

Specify the thickness of the synthetic liner and discuss the compatibility of the liner with the wastewater. Provide evidence to that this wastewater will not degrade the membrane. Discuss potential ice and frost damage to the pond liner, dams, and ancillary facilities. Discuss potential gas formation below the membrane liner. Provide details of the discharge and pump points to assure that movement of water will not erode the blanket or expose and rip the liner.

Response:

At the current stage of design, the synthetic liner has been described as a 0.091-mm (36-mil) thick Hypalon or HDPE (High Density Polyethylene). A comprehensive data compilation on a variety of liner types including discussions on chemical compatibily with stored wastes is provided in "Evaluation of Prospective Common Liners, Crandon Project, Waste Disposal System, Project Report 6.2" dated December 1981 prepared by Golder Associates (previously provided to the DNR).

The entire synthetic liner will be covered by a 0.46-m (1.5-foot) protective cushion of sand, and along the slope in the water edge zone an additional 0.30 m (1.0 foot) of till transition material and 0.91 m (3.0 feet) of rock slope protection will be provided. For an estimated freezing index at the Project site of 1500 degree-days, a maximum depth of frost penetration of 1.4 m (4.6 feet) was determined (Corps of Engineers EM-1110-345-306). Consequently, frost penetration to the liner is not anticipated. Frost effects on the outer shell and crest of the embankments will not affect embankment performance. Final design of the water reclaim system will have protection against ice damage.

The sand cushion specified to underlie the synthetic liner will be carbonate free. The underlying bentonite modified till underliner may be composed of carbonate tills. However, leakage through the synthetic liner is expected to be minimal. This combined with the low permeability of the bentonite modified till should minimize the potential for gas development. In the event gas does develop, a venting system to relieve gas pressure could be installed into the underlying sand cushion.

Comment No. 111

Explain why a double-liner system is needed. The design illustrated seems inconsistent with published geomembrane liner design guidelines as it includes no provision for leak detection or collection of the liquid that leaks through the membrane and collects on the soil bentonite liner. If the second liner has the capacity to collect liquids, there should be some mechanism to either remove them or at least detect their presence.

Response:

A double liner system concept has been developed as a precautionary safety feature. In the unlikely event the primary synthetic liner system develops a leak, the backup underliner (bentonite modified till liner) will impede leakage towards the underlying aquifer. Potential leakage through a properly installed synthetic liner is anticipated to be relatively small, thereby imposing minimal head on the underliner and consequently minimal seepage loss through the total system.

A leak detection system or collection system for potential leakage has not been considered at this time because of: (1) the minimal quantity of leakage anticipated and (2) the limited impact this leakage would have if in fact it could penetrate the underliner.

Consideration will be given during final design to incorporate a leakage detection and removal system.

Comment No. 112

Provide the rationale for the location of the reclaim ponds, and discuss the factors influencing the ponds' siting. Is there an advantage to placing the ponds such that water may flow back to the mill under gravity flow? The reclaim water pond combined with the mine waste disposal facility appear to significantly reduce Duck Lake watershed. The resultant loss of water flow through the lake and wetland complex must be thoroughly addressed in Section 4.1.4.1.2.

Response:

Throughout the extended siting study, the reclaim water ponds were considered along with the MWDF tailings ponds. Various MWDF and reclaim pond layouts were reviewed including some layouts with separated reclaim and tailings ponds. As a result of the studies, it was concluded that separated facilities probably would lead to overall greater impacts. Since the reclaim ponds have to be shallow compared to the tailings ponds, a relatively flat ground area was preferred for their location, design, and construction. In Site 41, the area north of Duck Lake met that criterion. Another factor considered was the purpose of the reclaim ponds as water holding and transfer ponds between the MWDF and the mill. A location between the two facilities would minimize the water handling systems. However, unless the reclaim ponds are very close to the mill area, the available elevation differentials are not great enough to overcome pipe friction flow losses. If gravity flow were to be utilized in one direction, it would mean higher differential elevation heads in the other direction. Although the overall system would be simpler, total power requirements and energy use would be similar. Therefore, considering the available topography and siting considerations, there is no advantage to relocating the reclaim ponds to facilitate gravity flow to the mill.

Resulting impacts from the siting of the reclaim ponds north of Duck Lake are addressed in Chapter 4 of the EIR.

Comment No. 113

Provide detailed information on the mechanisms by which the reclaim ponds will function in the treatment of organics, thiosulfates, and polythionates. Give examples of the concentrations of these chemicals and breakdown products. Include analytical work conducted at other mining installations which utilize reclaim ponds for water treatment purposes. Discuss the potential of deeper portions of the reclaim pond becoming anaerobic and resulting in reducing conditions and the generation of hydrogen sulfide and the effect this would have on treatment of water and generation of noxious odors.

Response:

The reclaim ponds serve three main functions:

1) Settling and retention of fine particulates from water decanted from the tailings pond and the tailings thickener overflow;

2) Provides surge capacity for the water management system; and

3) Promotes oxidation, evaporation and degradation of:
   a. thiosulfates and other polythionates,
   b. organic compounds; such as residual collectors and frothers, and
   c. cyanide (see also response to comment No. 191)

Operationally, the first two are the most important. Oxidation, evaporation, and degradation efficiency of thiosalts and organic compounds is seasonal. In the winter months the rate of these processes is reduced but not eliminated. The tailings pond with a shorter retention time also allows similar oxidation, evaporation, and degradation for approximately 10 percent of the total mill water that is sent to the reclaim pond.

Summarized in the attached table is information concerning expected operation of the Crandon reclaim ponds and what has been observed at other mines. Thiosalts are generated during the milling of pyritic ore by the interaction of air, metal sulfides and SO_2, a reagent added during the milling.

For the Crandon Project, water from the reclaim pond is recycled to the mill, 90 percent being returned directly, the remainder being treated essentially for sulfate removal to control gypsum scaling in the mill. None of the reclaim pond water will be routinely discharged to the environment.

Contaminated mine water does not initially contain thiosalts. Once backfilling has started, water seeping from the stopes may eventually contribute as much as 25-30 percent of the contaminated water being pumped from the mine.

(Table For Response To Comment No. 113)

RECLAIM POND OPERATION

CHEMICALS	INFLUENT CONCENTRATION (ppm)	BREAKDOWN PRODUCTS	DOMINANT MECHANISM OF REMOVAL
Thiosalts	<300	$SO_4^{=}$	Biological oxidation
$S_2O_3^{=}$, $S_3O_6^{=}$, $S_4O_6^{=}$			
Cyanide	<0.1	SCN^-, CNO^-, CO_2	Photodecomposition (UV), Evaporation (Volatilization)
Organic			
o Collectors Xanthates $R-O-CS_2M$	<1	$(ROCS_2)_2$	Photodecomposition (UV), Evaporation (Volatilization)
o Frothers MIBC $(CH_3)_2CHCH_2CH(OH)CH_3$	<10	$(CH_3)CHCH_2C(O)CH_3$ CO_2	Evaporation
Fine Particulates	<100	Not applicable	Sedimentation

The reclaim ponds were designed for oxidation and thus have an average depth of less than 6 m (20 feet). It is unlikely that the deeper portions of the pond will go anaerobic.

In the unlikely event that hydrogen sulfide is generated at depth, it would not get to the surface of the pond before reacting with polythionates and being oxidized to thiosulfates.

$$2H_2S + 4S_4O_6^{=} + 3H_2O \text{---}> 9S_2O_3^{=} + 10H^+$$

The unlikely presence of trace concentrations of hydrogen sulfide in recycled reclaim pond water would not be detrimental to the water treatment process, because it would be oxidized during the lime/soda ash treatment.

Comment No. 114

Discuss the pond's fertility and the potential for algae and weed growth with resulting operational and sludge disposal problems. Describe the effect of extremely cold temperatures on the treatment efficiency.

Response:

There will be a potential for algae and weed growth in the reclaim ponds. However, this is considered in the design of the mill water treatment system.

Reclaim pond treatment efficiency will be reduced during winter conditions. This will primarily be reflected in a decrease in the pond's ability to allow oxidation of thiosulfate and other polythionates to sulfate. However, this also is accounted for in the design of the mill water treatment system, and like algae, will not reduce the plant's capability to sufficiently treat the process water.

Comment No. 115

What is meant by adequate retention time in the reclaim ponds? How will this be achieved if one of the ponds is taken out of service? Please explain why the storage volumes for each pond are the same but the dimensions of the ponds are different.

Response:

On the basis of fine particulate sedimentation and surge capacity, any reclaim pond retention time in excess of a week should be adequate. Organic and thiosalt removal requires more time and is dramatically affected by seasonal temperature changes. If one reclaim pond is temporarily removed from service, reducing the retention time from approximately 44 to 22 days, there should be no long-term detrimental effect.

The operating storage volume of the two reclaim ponds is similar, but the total volume of reclaim pond R1 is greater because of a greater overall pond depth which provides additional freeboard in the pond.

Comment No. 116

Provide information on how "the reclaim ponds and the tailings ponds will provide surge capacity for the water management system." The reclaim ponds will apparently be filled to capacity during normal operation. Describe the effect of surge water storage on consolidation of tailings, operation of the underdrain system and stability of the dikes. How long could the mine or mill continue operation in the event of an extended water treatment plant shutdown?

Response:

When the water level in the reclaim ponds is at the maximum normal operating level, there is water surge (storage) capacity in the ponds in the pond freeboard depth. Reclaim ponds R1 and R2 have a design freeboard of 2.59 m (8.5 feet) and 0.91 m (3.0 feet), respectively, above maximum operating water level. Approximately 1.55 m (5.1 feet) of the freeboard in reclaim pond R1 will hold 14 days of water flow at a rate of 0.158 m^3/s (2500 gallons per minute). The reclaim ponds freeboard is designed to contain the volume of the probable maximum precipitation (PMP) event including the water from the largest tailing pond (T4). The preferred operating practice will be to keep the water level in the pond below the maximum level so that surge capacity is available without infringing on the freeboard allowance. In Section 3.0 of the "Miscellaneous Details and Analyses" report by Golder Associates, additional pond freeboard information is presented.

The surge capacity in each of the tailing ponds, above highest normal water levels, is in all cases greater than required from a storm and wave run-up standpoint. In an emergency, if the surge capacity in the reclaim ponds was not sufficient, the tailing ponds could be used to store water.

To use the tailing ponds storage capacity and maintain low seepage rates, pumping of the underdrains would continue with underdrain water circulated back to the tailing ponds. Then, depending upon the rate of decant water pumping, water level in a tailings pond could be increased to accommodate surge storage requirements. As the ponded water depth is increased there is an increase in the underdrain flow rate, but it can be accommodated as a result of the design of the underdrain pumping system. If the underdrains were not pumped, they would flood; while this would temporarily increase seepage, it would not affect the integrity of the facility, nor change the stability analysis of the embankments.

Tailings deposited underwater would have a slightly lower density (approximately 10 percent less) than the previously deposited tailings. However, the overall tailings volume change within the pond would be negligible.

Tailing pond T1 has the smallest surge capacity of the four ponds. Its lowest surge capacity (at completion of tails deposition) is approximately 660,000 m^3 (535 acre-feet) from the tailings surface to a level surface 0.91 m (3 feet) below the pond crest. Surge capacity within the 0.91 m (3 feet) freeboard height is approximately 300,000 m^3 (244 acre-feet). At a water flow rate of 0.158 m^3/s (2500 gpm), these volumes represent 48 and 22 days of surge capacity, respectively. The total minimum surge capacity (i.e., tailings pond T1 and reclaim pond R1 water storage) would be approximately 84 days at a 0.158 m^3/s (2500 gallons per minute) flow rate.

Comment No. 117

Provide details on the removal of the reclaim pond sludge and liner protection. Describe a contingency plan in the event of liner failure and discuss the feasibility of repairing Hypalon after vulcanization.

Please provide adequate documentation for the above discussions.

Response:

The response to comment No. 92 provides information on the build-up of sludge in the water reclaim ponds and the proposed one-time handling of it at the completion of the Project. As noted in that response, although not anticipated for the Crandon Project, there are methods of sludge removal that could be used in an operating pond that would not damage the liner.

As noted in response No. 111, the bentonite modified till underliner, although it is part of the pond design, is a precautionary or contingency measure against leakage from the primary synthetic liner system.

In addition to the seepage control system design, the basic contingency measure available for repair to the water reclaim ponds would be to drain the pond and perform the necessary liner repairs. There is flexibility in the water management system to allow operations to continue with one water reclaim pond.

Although it is not envisioned that any other contingency measure would be necessary, it would be possible to apply some of the same contingency measures suggested for the tailings ponds, such as pumping of the ground water system, to the water reclaim ponds.

The engineering study and water reclaim pond design work to date has identified two potential membrane liners for the ponds. Chlorosulfonated polyethylene (CSPE) (more commonly known by DuPont's tradename "Hypalon") and high density polyethylene (HDPE) have been suggested as potential liners. The liner choice will be made during the final engineering effort based on additional study and the latest available information. Suggested repair procedures would be considered in the choice of liner, but if repairs are completed in an empty pond, no difficulty would be expected for either type of liner.

SECTION 1.2.4.14, SHOP, GARAGE, WAREHOUSES

Comment No. 118

Where will drainage of the southside unloading dock be routed?

Response:

The revised design incorporates the shops, garage, warehouse, offices and change rooms into a single building known as the Services Building (see Attachment No. 4). This building is located in the same general area as were the shops and warehouse in previous layouts shown in the EIR. The off-loading and outside areas adjacent to the shops are located to the north and northwest of this building. Spills, grit or other contamination which might occur in these areas will be routed and handled through the industrial wastewater treatment system (see also response to comment No. 102).

SECTION 1.2.4.15, OTHER WATER FACILITIES

Comment No. 119

In addition to the fueling station drainage, what other waste streams will be routed to the oil water sewer system? What is the volume of water which will flow through the oily water sewer system. Discuss the compatibility of the oil water waste stream with the reclaim ponds and water treatment systems.

Response:

The 1 ha (2.48 acre) area in front of the shops and warehouse and the 0.25 ha (0.62 acre) equipment and material laydown area southeast of the headframe will also drain into the oily water sewer system. The volume of water which will flow through the oily water sewer system is only that from precipitation runoff. For a 1.25 ha (3.1 acre) area this is approximately an annual average of 1.1 m^3/h (5 gallons per minute). The oily water sewer system is designed to separate the immiscible oil from water. Once separated, the oil-free water stream then flows to the reclaim pond. There is no incompatibility of this 1.1 m^3/h (5 gallons per minute) oil-free water stream with the 1135+ m^3/h (5000+ gallons per minute) water feeding the reclaim ponds or the mill process recycle water treatment system.

Comment No. 120

What approved off-site disposal area will be used for oil particle disposal? What is the estimated volume which would be produced? How will the oil be removed and stored prior to disposal? Describe the methods and frequency of waste oil transportation. If the oil particles have a flashpoint under 140°F, they are classified as hazardous waste and would need to be disposed of at an approved hazardous waste site.

Response:

Subsection 1.2.4.15 in the EIR will be revised to state that waste oil will be collected and shipped with other waste lubricants to a reprocessing facility. The estimate of the volume of waste oil is not currently available and, therefore, frequency of shipment to reprocessing facilities is unknown. However, we anticipate collecting waste oil in oil/water separators and storing waste oil in drums until transported off-site by contractor to a reprocessing facility. We do not anticipate having waste oil with a flashpoint under 140°F.

SECTION 1.3, CONSTRUCTION

Comment No. 121

In this section, Exxon states that "the construction sequence is realistic for this stage of planning. The actual sequence is subject to optimization along with equipment and techniques, during final engineering." This statement illustrates the tentative nature of the construction schedule and the general lack of engineering and scheduling details presented in this chapter. The further statement that "the schedule for construction will be . . . sequenced to assure the availability of all environmental protection systems well in advance of the need date" does not satisfy our need for a critical review prior to action on the mining permit application.

Response:

The construction sequence submitted identifies the approximate durations and sequencing of only the principal construction activities since the present level of engineering does not enable development of a fully detailed control schedule. The final schedule to be used for field control during the construction phase cannot be completed prior to completing detailed or final engineering.

In all scheduling activities, time has been provided to sequence the construction and installation of environmental protection systems and/or devices so that these facilities will be ready and operational as needed.

Some of the more important facilities are as follows:

1) Necessary portions of the water treatment facility will be completed prior to the completion of shaft sinking (after shaft collar construction).

2) Construction of impoundments and reclaim ponds to capture potentially contaminated surface water drainage from temporary construction service areas.

3) Completion of the sewage treatment facility prior to main mine/mill facilities (i.e., within first year).

4) Early completion of the services building (offices), and warehouse (shops) to minimize the need for temporary contractor facilities.

5) Early completion of the railroad spur to permit delivery of bulk and heavy equipment items to the mine/mill site with minimum impact on highway traffic.

6) Installation of dust collectors, noise suppressors and similar devices prior to systems testing, and full startup operation.

Comment No. 122

This section also states that the construction technologies are " . . . well established and readily quantifiable." Please provide documentation and quantification of the technologies to be employed in constructing the tailings ponds' and reclaim ponds' liners.

Response:

Throughout the preliminary design of the MWDF, consideration has been given to the constructability of the MWDF. This is reflected in various features such as the embankment slopes, the slope benches, and the layer thickness for the seepage control system. As the preliminary engineering neared completion, Johnson Brothers Corporation (through INDECO) of Minneapolis, Minnesota prepared construction methods and planning studies for the proposed design. Johnson Brothers is a large contractor with an extensive background in heavy civil construction. They are experienced in construction of these types of facilities and offered valuable input in finalizing the preliminary design. Results of their construction planning studies are presented in the "Construction of Waste Disposal Facilities" report by INDECO (previously provided to the DNR). Additional general quality control considerations for the MWDF are presented in the Exxon paper "Construction Aspects" (also previously provided to the DNR).

SECTION 1.3.1.1, MINE/MILL SITE PREPARATION

Comment No. 123

The clearing of trees and shrubs during periods of snow cover is preferable because the wildfire hazard is minimized, salvage wood increases in volume and value because logs are protected from dirt, and the lack of leaves reduces the slash volume.

Response:

Comment acknowledged.

Comment No. 124

Commercial whole tree chipping contractors and the sale of chips for fuel or pulp should be investigated as an alternative to burning. The burial of stumps under a one-time disposal permit may also be an alternative. A license for a wood burning site from the Department may be necessary.

Response:

Comment acknowledged.

Comment No. 125

Please provide a grading plan for all disturbed areas showing interim and final grades along with earth material balances. If negative balances are derived, specify the source of imported fill and/or topsoil. If positive balances are found, specify the use or disposal of surplus material.

Include in the plans the specifics of the runoff and erosion control program and further describe the scheduling relationship between grading and runoff control. Calculate anticipated maximum runoff volumes from each stormwater collection area and maximum flow rates in major collection ditches. Provide plans for all temporary and permanent stormwater impoundments, specifying design capacity, detention times, control structures, overflow pipes, weirs, energy dissipators, and surface stabilization materials or methods. Define and differentiate between short-term and long-term erosion control measures. Use of short-term measures for a long period of time may actually aggravate erosion due to the need for frequent maintenance.

Response:

The three attached civil drawings (Attachment No. 9) indicate the grading plans for final grades superimposed on existing topography in the site area.

As described in the EIR, the site will be cleared, grubbed, and rough graded as necessary which will be one of the initial activities in the construction schedule. Since there is no phasing to this work, there will be no interim conditions for any length of time.

The storage area for the salvaged topsoil, (estimated at 53,500 m^3 [70,000 cubic yards]), is shown on the east side of the mine/mill area. Earthwork calculations for the mine/mill area indicate a net excess of 70,700 m^3 (92,400 cubic yards) of material in addition to the topsoil stockpile. This excess material will be utilized in the construction of the MWDF.

Erosion control will be developed as necessary with the rough grading. To the extent possible, the two permanent surface drainage basins will be used for runoff control (see drawings No. 051-1-C-001 and 051-1-G-002 in Attachment No. 9). The basin areas will be excavated first with grading work generally progressing outward from the basins. Where portions of the storm drainage system are not installed concurrently with the rough grading, separate provision for runoff and erosion control will be made. These provisions will consist of temporary siltation basins or hay or straw bale ditch retention checks.

Graded areas not scheduled for immediate development would be revegetated with a temporary ground cover following the grading work to reduce siltation from runoff erosion. As an area is subsequently developed, any portions of the final storm drainage system not installed with the initial site work would first be installed for the area before beginning other construction. At that point, runoff would be controlled by the final system, although some hay or straw bale ditch checks might still be used to prevent downstream siltation of the system. Development of the site in this manner will reduce the need for short-term temporary erosion control measures. The long-term control will be through the final surface water drainage system.

The three civil drawings include a culvert schedule which presents the water flow rates in the ditches and culverts, for a 10-year, 24-hour storm. Runoff coefficients and tributary areas are included with the other drawing data.

Except for two small extremities of the mine/mill area (the road to the underground fuel delivery borehole at the southwest and the explosive storage area at the northeast), all surface water will be directed to surface drainage basins No. 1 and No. 2. The drainage basins are sized for a 25-year, 24-hour storm, with pond depth allowance for sediment accumulation and maintenance of freeboard. Runoff in the preproduction ore storage area, which is now located where the backfill sands were originally designated to be stored, is collected and pumped as needed to the water treatment plant feed tank. As shown on the drawing, drainage is also collected separately from three other small areas in the central portion of the mine/mill site. This water is directed to the reclaim pond.

Typical drainage inlets for paved areas and for ditches, and details of the surface drainage basins are included with the drawings.

Comment No. 126

Would upgrading existing roads involve partial filling of wetlands along the right-of-way of the Little Sand Lake Road? If so, would the extent of filling be the same as those used for the calculations in Table 3.4-3 for road access alternate E?

Response:

Upgrading Little Sand Lake Road to approximately the same standards as the new proposed access road would require partial removal and filling of wetlands along the route. Assuming right-of-way for widening could be obtained, and assuming the existing roadway centerline location in the wetlands areas was maintained, then approximately 0.5 ha (1.2 acres) of existing wetland would be removed and filled, assuming a construction limit width of 27.4 m (90 feet). If the upgraded roadway was realigned to keep the widened area to one side then the required wetland area could be reduced.

SECTION 1.3.1.2, TEMPORARY FACILITIES

Comment No. 127

Modifications of previously granted high capacity well approvals will be required prior to the use of existing wells for drinking water purposes. The use of several strategically located wells should be considered in order to minimize the need for tank trucks and potable water dispensers.

Response:

Comment acknowledged. A high capacity well application(s) will be filed in 1983. The suggestion of using multiple wells will be considered.

Comment No. 128

Describe the existing electrical power transmission lines and discuss the extent to which the existing system could be modified and used to reduce the need for on-site power generation.

Response:

As stated in the CPCN application to construct the Venus to Exxon Line X-76, a 24.9 kv power transmission line is currently located along Sand Lake Road adjacent to the Exxon mine/mill site. This powerline would be able to provide service to the construction phase of the Project for less than 6 months. After this time period, requirements indicate a need for supplemental electrical power. After the 18th month of the construction phase even a separate 24.9 kv powerline from the Venus substation to the mine/mill site is insufficient for the load. The cost of a separate 24.9 kv line to the mine/mill site would be prohibitive when there is no apparent need for the power after 18 months.

To eliminate the need for on-site power generation, Exxon is working with Wisconsin Public Service Corporation on a plan to accelerate approval of the CPCN application so that construction of the 115 kv powerline can begin upon issuance of mining and other DNR-approved permits.

SECTION 1.3.1.3, ACCESS ROAD CONSTRUCTION

Comment No. 129

Please provide a summary of organic deposits on the access road and railroad (Section 1.3.1.9) corridors along with estimates of the total amounts of marsh materials to be excavated. What is the estimated volume of waste wood and the likely destination for off-site disposal.

Response:

As part of the preliminary engineering work completed for the access road and the railroad spur, soil samples were collected along the centerlines at 30 m (98 feet) intervals. Material logs of these auger holes are attached (Attachment No. 10). The plan and profile sheets from the preliminary engineering drawings for the road and railroad are also included in Attachment No. 10. The auger sample locations are shown on these plan and profile sheets. Material quantities were also estimated by Foth and Van Dyke as a part of their engineering work. Marsh excavation for the access road is estimated to be approximately 4800 m^3 (6275 cubic yards) while for the railroad spur it is estimated to be approximately 12,700 m^3 (16,700 cubic yards).

A Forest Inventory and Timber Appraisal Study for the Crandon Project by Edward F. Steigerwaldt and Sons estimated timber resources recoverable during access road and railroad spur construction (report previously provided to DNR). By adjusting their estimates to include cleared areas for the access road and spur, and applying percentage waste factors, the amount of wood wastes from timber harvesting were estimated. Using a factor

(TABLE FOR RESPONSE TO COMMENT NO. 129)

WASTE WOOD FROM ROAD AND RAILROAD CLEARING
STEIGERWALDT DATA

Access Road

Acres	Cords	Board Feet
75	550	12,157
(Revise cleared area to 37 acres)		
37/75	272	5,997
Air dry tons	476	11.2
Waste at 65%*	309	7
Total: 316 Tons		

Railroad Spur

Acres	Cords	Board Feet
74	676	40,709
(Revise cleared area to 45 acres)		
45/74	411	24,755
Air dry tons	719	46.4
Waste at 65%*	467	30
Total: 497 Tons		

Notes: Cord - 128 ft^3
Wood Volume - 80 ft^3
Air dry weight (hardwoods) - 3500 lbs/cord (1.75 tons per cord)
Air dry weight (hardwoods) - 45 lbs/ft^3 (0.0225 $tons/ft^3$)

* Contained in a Dames and Moore Study for WPSC on wood availability in this area of Wisconsin. (65% represents culls, branches, and tops normally left in the field after harvest - stumps would increase the percentage.)

of 65 percent waste (culls, branches, and tops) on an air dry weight basis, the following approximate waste quantities were estimated:

Access road - 320 tons
Railroad spur - 500 tons

The calculations leading to these totals are presented in the attached table. Stumps removed during grubbing would increase these totals.

The disposal options of burning, chipping, and burial (landfill), as suggested in the EIR, are still considered appropriate.

Comment No. 130

Please describe the road surfacing process and material. Specify the total amount of road base material which will be brought in.

Response:

The proposed access road consists of a 0.076-m (3-inch) bituminous concrete pavement underlain by a 0.305-m (12-inch) crushed aggregate base. An estimated quantity of 56,700 t (62,500 short tons) of crushed aggregate base material is required for the access road.

SECTION 1.3.1.4.2, SHAFTS AND COLLAR

Comment No. 131

Provide details on the soil freezing process including well design, brine containment, and waste brine disposal. What type of brine will be used? How large will the holes be and how will they be spaced? How much area will be affected by the soil moisture freezing? What diameter will the total excavation actually be?

Response:

The plan for development of the Crandon Mine includes construction of four vertical shafts:

1) Main production and service shaft - 7.3 m (24 feet) finished diameter;

2) Intake air shaft - 5.5 m (18 feet) finished diameter;

3) East exhaust air raise - 6.1 m (20 feet) finished diameter; and

4) West exhaust air raise - 6.1 m (20 feet) finished diameter.

Each shaft will have a concrete lined collar through the glacial overburden and weathered subcrop rock. Collar construction will include stabilization and hydraulic control by ground freezing, followed by excavation and concrete lining within the protective frozen soil cylinder.

The stabilized ice wall is formed by closed circuit circulation of a cooling fluid (calcium chloride brine) through a circular pattern of vertical pressure-tested steel cased boreholes (114-152 mm [4 1/2 - 6 inches] diameter) containing inner 38-mm (1 1/2-inch) down-flow tubes. Monitor boreholes are also provided to measure ground water levels, ground temperatures, and for detection of brine leakage. With this temporary ground stabilization method no foreign materials are introduced to the ground water regime or surrounding soils.

Freezing system design, e.g., number of freeze holes, hole spacing, and required ice wall thickness, is contingent upon the geohydrologic conditions of each site. Preliminary designs for the Crandon shaft collars have been prepared by Ground/Water Technology, Inc. of Denville, New Jersey. Site design details are shown on the four figures included in Attachment No. 11.

Once excavation and lining of the shaft collars is complete, the protective ice walls and the surrounding soils will be allowed to thaw. Abandonment of the freeze pipes will include:

1) Removal of brine for off-site disposal by the freezing contractor;

2) Clean water flushing of freeze pipes;

3) Mechanical perforation of freeze pipe casings at the soil-rock interface and at the hole bottom; and

4) Displacement of freeze pipe flushing water with 1:1 neat cement grout delivered from the surface.

Ground freezing is an established shaft collar construction technique for sites with saturated or unstable soils. For additional technique and application details the reader is referred to:

1. Sanger, F. J. 1968, Ground Freezing in Construction. - Journal of the Soil Mechanics and Foundations Division, A. S. C. E. Vol. 94, No. SMI. Proc. Paper 5743. January, 1968.

2. Sanger, F. J. and Sayles, F. H. 1978, Thermal and Rheological Computations for Artificially Frozen Ground Construction. - International Symposium on Ground Freezing. March, 1978. Bochum.

3. Maishman, D. 1982, Ground and Water Control by Freezing - The Application in Shaft Construction. - University of Wisconsin, Extension Course on Shaft Design and Construction. January, 1982.

Comment No. 132

What is the projected volume of water that will be generated during the shaft construction? The water treatment facility will not be completed until approximately one year following commencement of main shaft and air shaft construction. Waste rock and preproduction ore storage runoff will also go to reclaim pond No. 1. While reclaim pond No. 1 should be completed within three months after the start of the main shaft and eight months after the start of the air shaft construction, where will the water be stored during the three- and eight-month period when this pond is not in service?

Response:

During development of the main production and intake air shafts, water will enter the excavations from three sources: 1) Precipitation; 2) Ground water seepage; and 3) Utility water supply.

All shaft drainage will be pumped to surface storage ponds prior to treatment and discharge as required.

Precipitation gains over the total area of the shafts will be less than 0.07 m^3/h (0.3 gallons per minute). Construction plans provide for control of surface runoff around the shaft excavations. Therefore, the effects of precipitation drainage on shaft development are negligible.

Ground water seepage into the shaft excavations will vary from 0 to 3.4 m^3/h (0 to 15 gallons per minute) in each shaft, and is estimated to average 0.9 m^3/h (4 gallons per minute) (Dames and Moore, April 19, 1978, pumping tests of shaft pilot hole No. 155). During collar excavation and lining, the freezewall methods to be employed will negate ground water influx. When sinking begins in bedrock, ground water quantity will vary with depth, fracture intensity, and reservoir source (overburden aquifer or connate bedrock water). Shaft construction specifications will require rock grouting any time ground water inflow to the excavation exceeds 3.4 m^3/h (15 gallons per minute) in sections not yet permanently lined with concrete.

Utility or process water consumption during shaft development will vary from zero to 1.4 m^3/h (0 to 6 gallons per minute) during different shaft sinking operations. The nominal average use is estimated to be 0.45 m^3/h (2 gallons per minute).

Once intake air shaft sinking is complete (EIR Figure 1.3-9, Construction Schedule) and mine level development begins, shaft drainage water will constitute only a small part of the estimated total mine inflow. Until that time, approximately 18 months after the start of shaft sinking, all mine water will be pumped to a surface sedimentation pond prior to treatment and discharge. During this 18-month period an estimated 18925 m^3 (5,000,000 gallons) of water will be pumped from the shaft excavations. Reclaim pond R1, and a small transfer pond at the construction site, will be available to receive the shaft construction water when sinking in bedrock begins (EIR Figure 1.3-9). Only 3.2 percent of reclaim pond

R1's 590,460 m^3 (156,000,000 gallons) normal operating capacity will be required to store the estimated 18925 m^3 (5,000,000 gallons) of shaft excavation drainage, discounting any treatment and discharge which will be available as an option 10 months after shaft construction begins.

Comment No. 133

Provide calculations showing that the storage volume will be adequate to handle construction wastewater before the surface water treatment systems are completed. What contingency measures are available if the volume is not sufficient?

Response:

Reclaim pond R1 has a volume of 590,460 m^3 (156,000,000 gallons) to the normal water level (NWL). Also, the pond has 2.6 m (8.5 feet) of freeboard above the NWL which could hold 309,000 m^3 (81,600,000 gallons) if necessary. This volume of storage capacity is far in excess of the estimated necessary storage capacity prior to completion of the required portions of the wastewater treatment and excess water discharge system.

Until the treatment plant and discharge system are ready, an approximate total volume of only 18,925 m^3 (5,000,000 gallons) of mine associated water will have been stored in reclaim pond R1.

The only other water that requires storage or treatment during that period is runoff from the waste rock storage pad. The waste rock area has its own temporary retention pond with one year of storage capacity (39,000 m^3 [10,300,000 gallons]). This temporary pond will be pumped as necessary to reclaim pond R1 prior to completion of tailing pond T1. It will have less than one year of use prior to completion of the necessary water treatment and discharge facilities. All other construction wastewater is uncontaminated surface runoff and will be directed through silt control retention basins or ditches for direct discharge to existing surface water drainage.

With this degree of excess capacity in reclaim pond R1, there are no additional contingency storage measures planned.

SECTION 1.3.1.4.3, UNDERGROUND DEVELOPMENT

Comment No. 134

Describe in detail the construction of the groundwater interceptor system. Describe the temporary water containment and pumping facilities.

Response:

Subsequent to any mine inflow controls which may be applied, a residual ground water seepage interception program will be instituted. Its purpose will be to intercept and contain ground water inflow before any contamination by exposure to mine operations is possible. To accomplish this, interception must occur above the active mine workings.

Initial mine production has been planned for the 230 to 350 m stope horizon, a position at the base of the weathered bedrock ground water inflow courses. Thus, seepage into the mine workings during the early years of the mine is expected to be very localized. Exploratory diamond drilling techniques will be employed to identify active water courses prior to advance of the mine face.

The specific design of the ground water interceptor system will begin during preoperational underground exploration. Conceptually, water encountered on the uppermost mine level will, where possible, be captured in interceptor drill holes and contained to avoid contamination. In most cases, as the mine progresses upward from the initial 230 m level, access for interceptor drilling will be provided by premature development of production drifts temporarily dedicated for mine inflow control. Otherwise, specific mine water control drifts will be developed as required by identification of any area of concentrated seepage. Ultimately, the ground water interceptor system would function as shown on the conceptual Mine Inflow Control cross-section (figure attached). Cement rock grouting may be used for local inflow control or diversion.

Actual ground water collection will be from exploration or interception drill holes developed from the access and mine water control drifts. These holes will be typically arranged in a conical fan above the drifts, increasing the effective radius of the adit as a line sink drain. As is common mine practice, each water producing hole collar will be sealed and equipped with a pipe manifold.

Collected ground water from the interceptor drill holes will be piped through the drifts to the separate clean water sump and pump station. This facility will be located on the 230 m mine level near the main shaft, and will be developed at the start of mining prior to interception of potential ore deposit weathered zone water courses.

The clean water surge sumps on the 230 m level will consist of downgrade excavations in the wallrock adjacent to the pump station. A bulkhead containing the pump station suction pipes will be constructed at the outlet of the sumps. Twin sumps will be provided for ease of maintenance and reserve capacity.

Clean water sump discharge will be pumped up the main shaft in a dedicated pipeline. A bank of stand-by pumps and a second main shaft discharge pipeline will be provided to avoid system interruption. At the surface, the intercepted ground water pipeline will be routed directly to the uncontaminated water holding tank.

Comment No. 135

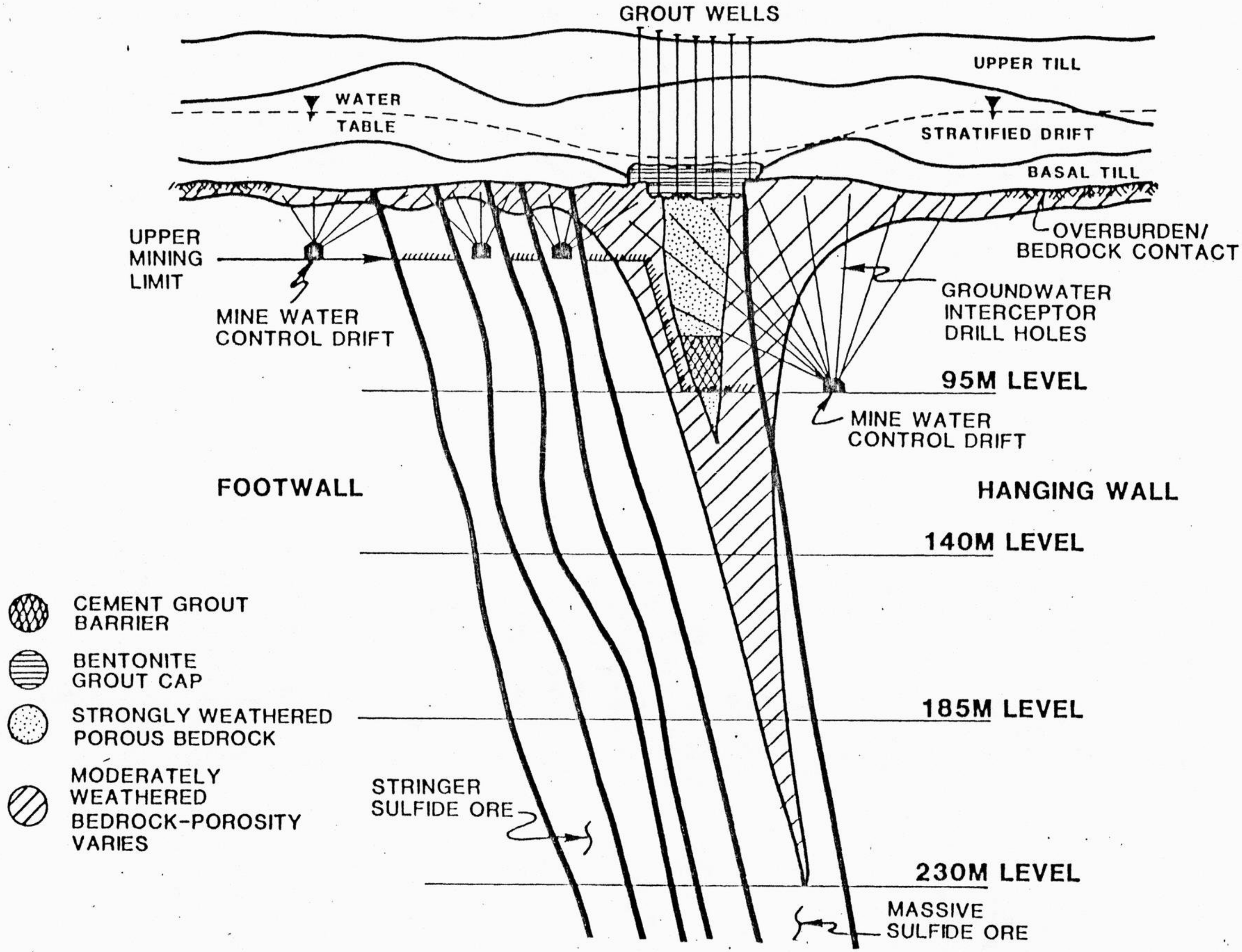
Describe in detail the placement of the grouting and indicate approximately how much of the ore body-unconsolidated deposits interface would be grouted.

(FIGURE FOR RESPONSE TO COMMENT NO. 134)

EXXON MINERALS CO.
CRANDON PROJECT

MINE INFLOW CONTROL METHODS

(CONCEPTUAL X-SECTION)



Response:

The extent to which bentonite grouting from surface or underground cement grouting will be applied is dependent upon technical achievability and economic considerations. Actual grout placement locations will be determined during the mine final engineering and initial mine development periods as additional geotechnical investigations are completed. Potential mine inflow control methods, and related technical references, are described in the response to comment No. 61.

Comment No. 136

Discuss contingency measures for inflows of more than 2,000 gallons per minute during construction.

Response:

Ground water inflow to the mine will not occur in major quantities until mine level development intersects the orebody weathered zones (Prickett, December 1982). Mining plans provide for construction of the intercepted ground water and normal mine drainage sumps and pump stations at the very start of underground development. These facilities are located near the main shaft, exterior to the orebody weathered zones. They will, therefore, be available for full capacity duty prior to mining entry into any areas of potential ground water seepage.

Consequently, the contingency measures described in the response to comment No. 62 will apply throughout the mine construction and operations periods.

SECTION: 1.3.1.4.4, WASTE ROCK AND PREPRODUCTION ORE

Comment No. 137

Discuss the affect of operating the equipment transporting waste rock and preproduction ore on the liner integrity.

Response:

Waste rock haulage to the MWDF will be performed using end dump trucks in the 35-ton size range. Spreading and grading would be by tractor (i.e., CAT D-7). The operation of either of these types of equipment on the 0.92 m (3 feet) thickness of drain and filter material overlying the liner will not jeopardize liner integrity or performance capability.

Truck tire pressures of 70 psi acting at the filter layer surface should be reduced to less than 10 percent at the level of the liner. Track pressures of a typical D-7 would only be 10 psi and be similarly reduced at the liner depth. Consequently, traffic during waste rock placement should have no effect on the liner. In practice, the traffic areas will also receive a layer of rock to provide yet another protective layer which would further reduce effects at the liner level.

Preproduction ore will not be stockpiled in the MWDF. An area at the mine/mill site is now designated for stockpile of preproduction ore.

SECTION 1.3.1.6, MINE WASTE DISPOSAL FACILITY AND RECLAIM POND SITE PREPARATION

Comment No. 138

What characteristics will determine if topsoil is "suitable"? Provide descriptions of topsoil stockpiling quantities, location and method of protection.

Response:

Throughout the EIR, for all construction areas where earthwork or grading is required, the general statement has been made ". . . where suitable topsoil is encountered it will be salvaged, stockpiled, and reused." Suitable topsoil is meant to include easily distinguishable humus-bearing soils suitable to the sustenance of plant life.

After clearing and grubbing operations, suitable topsoils will be identified during initial earthwork operations. Guidelines, procedures, and specifications will be developed by Exxon and its consultants to allow field personnel and equipment operators to make judgments as to what topsoils are worth saving. The guidelines and judgments will account for soil quality, depth, and areal extent. General specifications used by the Wisconsin Department of Transportation for topsoil salvage and reuse will be tailored to the Crandon Project. Experienced field personnel will be utilized who can make these judgments, because it is not the type of procedure which can be rigidly defined.

Based on experience to date, from development of drill site areas and other minor site work, there is limited suitable topsoil in the area. After clearing and grubbing operations are completed, there may not be major quantities of topsoil available to salvage.

It would not be cost-effective to stockpile and handle the topsoils twice if they are only marginally better soils than subsoils. However, if the timing and scheduling of operations allow (such as the stripping materials of one area going directly to the reclamation of another), then even the marginally better topsoils could be reused.

Stockpile storage volumes and area are addressed in the INDECO report "Construction of Waste Disposal Facilities" (previously provided to the DNR). While these estimates are total volumes, if some topsoils were segregated, overall area requirements would remain essentially the same. Runoff from stockpile areas will be controlled and directed to sedimentation ponds or through straw bales and no other protection is anticipated to be necessary. However, if a stockpile was to remain over an extended period and there was a potential for erosion, temporary vegetation would be established.

SECTION 1.3.1.7, MINE WASTE DISPOSAL FACILITY AND RECLAIM POND CONSTRUCTION

Comment No. 139

Considerably more information is needed on the construction techniques and the quality assurance and quality control measures referred to for construction of the liners and underdrain system. It has not yet been demonstrated that the tailings pond liner, drainage layer, and filter layer, as a total structure, will work. All Exxon-sponsored studies related to the liner systems should be submitted to the Department for evaluation. Also, please provide documentation from other facilities which have successfully used these or similar construction procedures.

Response:

As proposed, the liner will be developed from processed till (soil material larger than 3/4 inches removed) mixed with bentonite. This mixture would be "blended" and moisture conditioned to a uniform consistency using a batch system similar to that used in the concrete industry; transported to the liner construction area by truck; dumped, spread and compacted. However, further study is planned for other methods of liner construction including in-situ mixing techniques to assess facility performance variability.

An example of one method of quality control to evaluate as constructed field permeability is provided in Attachment No. 12. A high degree of quality control, as far as constant mixture of liner components (i.e., till, bentonite and water), can easily be provided using the automated batching system proposed.

Techniques for spreading a processed aggregate in constructing the underdrain layer would be similar to those used in highway construction with special considerations developed to protect the underlying liner. Grade control and soil material quality assurance methods are well established. Drainage performance characteristics of the underdrain system can be established either in large scale laboratory tests or from in-situ field measurement (i.e., determination of the in-situ permeability of base and subbase soil materials; Report No. FHWA-RD-79-88 May, 1979).

The combination of liner, drainage and filter layers is not new technology and has been successfully used in landfill site development. The following list includes several sites where either similar concepts, in part or in total, have been implemented, are under construction, or have recently been designed:

SITE	LOCATION	TYPE OF WASTE	STATUS
Oaks Sanitary Landfill	Montgomery Co., MD	Municipal waste	Under construction
Key Lake	North Saskatchewan	Uranium tailings	Construction complete, operations just beginning
Crystal Lake Landfill	McHenry Co., IL	Municipal waste	Operating
Landfill No. 2	Virginia Beach, VA	Municipal waste	Under construction
Hawkins Point	Baltimore, MD	Hazardous waste	Designed
Loudoun Co. Landfill	Loudoun Co., VA	Municipal waste	Designed

To date, all Exxon sponsored studies related to the underdrain system have been submitted to the DNR including:

1) General Properties of Common Liners, Crandon Project, Project Report 6.1, Golder Associates, December 1981.

2) Evaluation of Prospective Common Liners, Crandon Project, Waste Disposal System, Project Report 6.2, Golder Associates, December 1981.

3) Geotechnical Review, Crandon Project Waste Disposal System, Project Report 2, Vols. 1-3, Golder Associates, October 1981.

4) Parametric Seepage Rate Estimates, Crandon Project, Waste Disposal System, Project Report 3.1, Golder Associates, March 1982.

5) Underdrain Review, Crandon Project, Waste Disposal System, Project Report 3.2, Golder Associates, March 1982.

6) Laboratory Testing Programs, Crandon Project, Waste Disposal System, Project Report 5, Golder Associates, May 1982.

Comment No. 140

How long will it take to actually put a liner in place? How will the earliest constructed areas be protected from erosion and any other potentially damaging forces? How will a uniform 6-inch layer of bentonite modified soil be placed and held on slopes?

Response:

A final detailed construction schedule for facility development has not been prepared for either the reclaim or tailing ponds. That effort would be part of the Plan of Operations. The report by INDECO, "Construction of Waste Disposal Facilities" (previously provided to the DNR), included an estimated schedule for installation of the liner in each pond. These timeframes were based on processing equipment capacities and placement rates and the appropriate manpower to complete construction.

Liner construction in the reclaim ponds, including the bentonite modified till underliner, lower cushion, synthetic liner and overlying protective cushion, was estimated at approximately 4 months for each pond.

Liner construction for each of the tailing ponds will occur in 3 or 4 stages with each stage being completed ahead of the pond filling rate. The benches on the inside pond embankment were included in the design to accommodate this staged construction. However, in the INDECO study it was assumed that the entire liner for each pond would be installed at one time. For the tailing ponds this period ranged from 4 to 6 months including installation of the liner, underdrain, filter, and rock protection of the inside embankments.

To avoid environmental or other damage to the liner or underdrain, the seepage control system will be developed sequentially within the pond area as opposed to constructing the entire liner, then underdrain, then filter.

Construction areas developed initially will be subject to environmental effects including erosion. Precautions to protect the surrounding environment will include proper routing of potential surface water drainage and location of siltation ponds. Any damage to the previously constructed segments as a result of erosion and other potentially damaging forces will require repair and/or reconstruction. In almost all cases it is expected that any damage which would occur, would be to the top filter and repairs would be no different than any other construction that might require some interim regrading.

Bentonite modified soil will be placed and compacted on proposed 4H:1V pond side slopes using conventional construction techniques such as scrapers or belly dump trucks. The soil will be spread to a uniform thickness using tractors or motorgraders prior to compaction in order to provide the proper final design thickness of 0.15 m (0.5 feet). Stability during and after placement is not perceived to be a problem.

Comment No. 141

When will the bentonite modified soil be hydrated? Is the 6-inch thickness wet or dry? How will the liner be protected from dehydration? What particle size of bentonite will be used?

Response:

It is planned to partially hydrate the till soil prior to mixing with the bentonite. Additional water may be added during mixing (i.e., pugmill-batch process) to bring the soil to or slightly above optimum moisture content. A final hydration step will be performed in the field after the underdrain layer is placed over the liner. Water percolating from the construction of the underdrain and filter layers and normal infiltration will prevent liner dehydration. The detail of these steps will be provided in the Plan of Operations for the MWDF.

The 6-inch thickness defined for the liner is a compacted layer thickness at a moisture content between optimum and 2 percent above optimum. At this time, a bentonite product similar to Volclay-Saline Seal 100 manufactured by American Colloid Company has been assumed for preliminary design. American Colloid suggests a dry fineness for this product with 90 percent minimum passing a No. 12 mesh and 18 percent maximum passing a No. 200 mesh.

Comment No. 142

Will the wetlands under the MWDF be excavated during construction. What affect will leaving the wetland soils in place have upon the liner construction and stability and the dike integrity? How will excavated organic soils be disposed?

Response:

All wetland deposits (peats, mucks, and other organics) will be removed from the MWDF area. Most of the deposits are in the pond bottom areas and are 5 to 10 m (16 to 33 feet) higher in elevation than the bottom grade of the pond and would be removed in pond excavation. Those wetlands in the embankment areas would also be removed completely, down to firm subsoils prior to any embankment construction.

Based on estimated wetland material depths and areas, an approximate volume of 253,000 m^3 (331,000 cubic yards) of material would be removed. Of the total estimated excavation for the MWDF (13,600,000 m^3 [17,800,000 cubic yards]), this wetland material represents about 2 percent. The excavated organic materials will be used as top dressing on embankments and other areas where vegetation is to be established.

Comment No. 143

Provide drawings and describe the batching and mixing plant and the screening plant including processes, quality control, and waste products.

Response:

The construction methods study and planning by INDECO (see response to comment No. 122) included a review of material processing requirements. Basic process descriptions and equipment requirements are included in the INDECO report "Construction of Waste Disposal Facilities" (previously provided to the DNR). During the course of INDECO's study, various equipment manufacturers were contacted to provide assurance that proposed processes could be efficiently accomplished. The attached process flowsheets (Attachment No. 13) from Universal Engineering Corporation depict an equipment set capable of providing all required soil materials by processing of the glacial till. Equivalent systems could be provided by other manufacturers.

In Universal Engineering Corporations system, flowsheets No. 1 and No. 2 are dry processes to prepare liner material and cushion material. The only water used is in flowsheet No. 3 showing the process to prepare the underdrain material. Brief process descriptions are included with the flowsheets.

Water requirements in flowsheet No. 3, for the underdrain material preparation are primarily related to the volume rate of material handled and its fines content. The necessary rate of material handled depends on the scheduled need for facilities. The total water requirement is expected to be in the 0.25 - 0.38 m^3/s (4000 - 6000 gallons per minute) range. Actual makeup water is only in the range of 0.03 - 0.04 m^3/s (400 - 600 gallons per minute) to account for water loss with the materials removed from the process. There would be a settling pond associated with the process, however, small high capacity clarifiers would be used first to keep the pond size to a minimum. The clarifiers and settling pond would remove the finest material (-200 mesh size), with the clarifier underflow pumped to the pond. After completion of a construction phase the fines would be removed from the pond and used in the liner mix or another appropriate use. The first phase of construction (preparing the waste rock storage area) will determine much of the system sizing requirements because there will be less opportunity to spread out the material processing during that phase. Based on these needs a settling pond to contain all the fines (-200 mesh) removed during the first phase of construction would be in the range of 0.8 to 1.6 ha (2 to 4 acres) with a depth of 3 to 4.6 m (10 to 15 feet). In this underdrain material preparation process the -40 mesh fraction of till is removed but does not have to be wasted, as it can be used in place of straight till in other applications. As indicated above, with the reuse of the settled fines, there are no unused materials produced from the classifying or processing operations.

The batching and mixing operations are also accomplished through the use of conventional equipment. The attached manufacturers' data (Attachment No. 13) are typical of the type of equipment that would be used to first batch the bentonite clay with the glacial till and then mix the fractions.

Quality control procedures will be planned in detail for the Plan of Operations; however, general quality control aspects for this type of procedure are included in the Exxon paper "Construction Aspects" (previously provided to the DNR).

Comment No. 144

Describe the route for hauling bentonite from the Woodlawn Siding and the need for new road construction and/or upgrading. What, if any, modifications will be necessary for the existing Woodlawn siding facility?

Response:

The figure provided with the response to comment No. 89 shows the bentonite haul route from the Woodlawn Siding facility to the MWDF.

In developing the Construction Plan, INDECO reviewed necessary upgrading for the siding and haul route. Grading only will be required at the siding while approximately 4.8 km (3 miles) of the route (of a 9.6 km [6-mile] total) will require grading and compaction. The upgrading would be accomplished in approximately one week.

Comment No. 145

Figures 1.3-3 through 1.3-8 indicate that two tailings ponds will be under construction simultaneously while the project schedules show that only one pond will be constructed at a time. This contradiction should be clarified. Please provide full size plan sheets of these figures.

Response:

EIR Figures 1.3-3 through 1.3-8 are simplified figures of the MWDF configuration at each of the six main construction stages. The ponds are constructed sequentially and each stage is from 2-4 years in duration. The next pond in sequence is constructed early in its stage and the previous pond is reclaimed in the latter part of the stage. The detail of this scheduling is presented in the INDECO report "Construction of Waste Disposal Facilities" (previously provided to the DNR). Full size drawings from that report, which were used to prepare the EIR figures, are included in Attachment No. 14.

Comment No. 146

Additional comments and questions on the reclaim ponds and tailings ponds construction were forwarded to you under the respective permit reviews.

Response:

Comment acknowledged.

SECTION 1.3.1.8, PIPELINE CONSTRUCTION

Comment No. 147

Provide construction and design details for all pipelines. Indicate where and why the tailings and reclaim ponds pipelines will be buried. Describe installation of any monitoring systems designed to detect pipeline leaks or failures.

Response:

The reasons for burying the tailings and reclaim ponds pipelines are included in the response to comment No. 84. The monitoring system proposed to be installed to detect pipeline leaks or failures is shown in the process flow diagrams in the report by PSI, Inc. The pipeline route has been identified in EIR Figure 1.2-13, "Waste Disposal Facility Pipeline Route and Haul Road" and is further described in the report by PSI, Inc. Construction and design details have also been described in the response to comment No. 84. See the response to comments No. 84, 107 and 188 for further details.

SECTION 1.3.1.33, WATER SUPPLY

Comment No. 148

Please indicate the location and construction details of the water supply well(s). As noted earlier, any well which is used as a potable water supply must be in conformance with NR 112. We recommend a regular program for testing the bacteriological quality of the wells, tank trucks, and work area water dispensers. Due to the possibility of contaminated backflow through the temporary construction water system, we also recommend that a distinction be made between construction water and potable water wells.

Response:

The proposed location of the water supply well is approximately 250 m (820 feet) due west of the southwest corner of the mine/mill site. Construction of the potable water supply well will be in accordance with NR 112 requirements. Other comments regarding testing and construction details are acknowledged and will be incorporated into our planning.

Details of well construction will be included in the high capacity well permit applications which will be submitted in 1983. The general well construction presented below is proposed:

The well will be cased and screened with continuous slot, pipe size, stainless steel screen. The amount of screen and casing in the well and their relative position will depend upon the formations encountered in the drilling. A gravel pack will be placed around the screen and continued for the entire saturated thickness of the aquifer above the screen. Above the gravel pack a top seal of cement grout will extend to the surface. After placing the gravel pack, the well will be pumped, surged and otherwise developed until it is essentially a sand free well.

Comment No. 149

The estimated peak demand for water of 45.3 cubic meters per day appears conservative. Please provide the data used for this estimate.

Response:

Earlier estimates of a peak demand for water of 45.3 m^3/d (12,000 gallons per day) were too conservative. Water use will peak during the first year of construction and will be used for supplying human needs, sprinkling of site roads as required, compaction for fill and for use in concrete production. The heaviest water use will occur from June to November 1986, with an estimated peak demand of 326 m^3 (86,129 gallons) per day. This peak consumption is estimated as follows:

	m^3/day	(gallons per day)
Compaction	225	59,445
Batch Plant	60	15,852
Road Sprinkling	40	10,568
Human consumption	1	264
Total	326	86,129

Average water demand for the first year will be less, depending on the amount of rainfall, moisture content of the soil being compacted, and the rate of concrete production. Water use during the remainder of the construction phase will be considerably less than the peak demand that occurs during the first year.

SECTION 1.3.1.13, SANITARY FACILITIES

Comment No. 150

This section states the sewage treatment facilities will be completed during the first year of construction; Figure 1.3-9 shows the facilities as scheduled for completion during construction year 2. Please indicate the actual expected completion date. Provide calculations and estimated flows for both the chemical toilets and the temporary septic tank systems before and after completion of the permanent treatment facilities. Describe the volumes, method and frequency of transportation, and the likely disposition of sewage hauled off-site. Provide a description of the temporary septic tank. Is Exxon proposing a holding tank or a septic tank and drainage field.

Response:

The permanent septic tank and soil absorption field will be installed as soon as possible and should be available within 6 months after start of Project construction. Portable toilets will be used throughout the site from initial construction until sewer lines and permanent restrooms are constructed. If Exxon or a contractor utilizes a restroom/shower trailer, a temporary sewage holding tank will be used for that facility.

A licensed septic tank pumping contractor will be used to service the portable toilets (and the holding tank if there is one) as necessary. Prior to installation of the permanent septic tank and soil absorption field, the licensed contractor will haul the sewage off-site for disposal. After installation, he will transfer sewage to the permanent facilities.

With portable toilets there is approximately 0.015 m^3 (4 gallons) of sewage generated per person per week. With a restroom/shower trailer approximately 0.19 m^3 (50 gallons) of sewage is generated per person per day. During the first 6 months of construction, assuming a peak work force of 400 people with 50 having access to a restroom shower trailer, approximately 53 m^3 (14,000 gallons) of sewage would be generated weekly.

Assurances have been received from licensed septic tank pumping contractors that this type of arrangement and their service would be satisfactory. We have not attempted to determine where they have sewage disposal capabilities.

SECTION 1.3.2, CONSTRUCTION SCHEDULE

Comment No. 151

As mentioned under Section 1.1.3.3, a preconstruction schedule is needed which would include the mitigation or resolution of impacts to private water supplies. Other impacts of construction which could be reduced by revising the construction schedule include the following:

1. Reduce damage to town roads by the completion of permanent rail and road facilities prior to the start of major on-site activities.

2. Phase the construction schedule to eliminate the need for on-site electrical generation.

3. Reduce impacts to wetlands and surface waters by the early completion, stabilization, and revegetation of key erosion and runoff control facilities. This may take as much as two growing seasons to accomplish depending on the stabilization techniques used.

4. Reduce activities during high seasonal population periods by placing more emphasis on winter activities.

Please provide discussions of these and other mitigative measures in the appropriate sections of Chapter 3.

Response:

1) Exxon plans to begin construction of the permanent access road and railroad spur into the Project site as early as possible after receipt of permits and Exxon Corporation's approval to proceed with the Project. We do not plan to complete the road and railroad before beginning site clearing, grading and construction of permanent facilities. Delaying construction of the permanent facilities would be impractical and result in a 12-18 month lengthening of the construction schedule. We plan to complete the road and railroad as soon as possible to allow access of construction personnel and material and equipment deliveries.

2) Exxon currently plans to complete the installation of permanent electric power facilities as soon as practical after powerline right-of-way and permit approvals. The current schedule shows permanent power available within months after the start of Project surface facilities construction. This greatly reduces the need for temporary power generators thereby reducing on-site noise and air emissions.

3) Exxon's site clearing and grading plans include the building of water runoff and control facilities to minimize the amount of suspended solids reaching the existing surface waters and wetlands. We also plan to revegetate cleared areas immediately to minimize erosion and control runoff. We believe that the majority of this revegetation will need only one growing season to adequately control soil erosion. See Section 2.0 in Attachment D (Reclamation Plan) to the Mining Permit Application for further details.

4) Exxon's construction plan includes performing construction activities throughout the calendar year, including the winter months. This minimizes the total construction period thereby reducing the duration of any construction-related environmental and social impacts. However, certain activities like surface grading, excavation and concrete placement will be hampered by the cold and snow. This requires construction of as many as possible of the temporary and permanent buildings during the first year to allow mostly inside activities to progress during the second and third winter seasons.

The construction schedule outlined in the above comments represent our current plan. While the basic philosophy of the construction plan (see response to comment No. 121) is not expected to change, details of the plan are likely to change as additional engineering is completed.

Comment No.: 152

Please list and discuss factors which could extend the construction period and describe the likelihood of delays. These factors should include inclement weather, labor problems, unavailability of required equipment and supplies, design or engineering modifications, and other factors you may identify.

Response:

Many factors have potential for extending the construction schedule. These factors include: inclement weather, labor problems, equipment/material deliveries, design modifications, approval of construction by the regulatory agencies, and higher mine water inflows than anticipated.

Inclement weather may cause problems and schedule delays only during the first winter. We will have most work areas under temporary or permanent cover by the second winter which will allow the inside work of equipment and material installation to proceed without delay.

Labor availability, strikes or disruptions may impact construction activities and schedule. To overcome this problem we intend to utilize local subcontractors to the maximum extent possible. We will expect all contractors to have well defined personnel recruiting and retention programs in advance of construction to hire and retain competent workers. We also plan to provide contractor coordination services to minimize jurisdictional disputes.

Equipment and material deliveries may delay installation and thereby extend the schedule. We will have in place a well defined procurement and expediting plan which will minimize delays in ordering and securing delivery of equipment and materials. We will identify those pieces of equipment which have long delivery times and will place the purchase orders well in advance to avoid schedule impacts.

Design modifications will occur as construction progresses. We will minimize delays by having an engineering office on-site to make field changes to construction drawings.

Approval of facilities design and construction by the regulatory agencies could delay construction activities. We plan to work closely with the appropriate agencies, keeping them informed in advance, to minimize schedule changes.

Higher mine water inflows than anticipated may impact the mine development schedule. We will constantly monitor the mine water inflow and probe ahead of development headings to identify sources of excess water flow. If excess water flows are identified, we will inject cement grout to seal the leaking areas ahead of excavation. These plans are discussed in the response to comments No. 134 through 136.

Comment No. 153

Please describe the construction schedule for the backfill sand storage area, pilot plant and training facility, and the water discharge pipeline and outlet structure.

Response:

Exxon's current Project plan has eliminated the backfill sand storage area. We now plan to have a few days of storage in reclaim tanks and sand storage bunkers within the mill building.

We plan to erect the pilot plant and training facility early in the construction period to verify process metallurgy, train concentrator operations personnel, and continue early development of control systems. This facility should be operational before construction of the concentrator begins.

We plan to construct the water discharge pipeline and outlet structure while erecting the first section of the water treatment plant and reclaim pond R1. This will allow treatment and discharge of water before the mine shaft sinking reaches subsurface levels containing potentially contaminated water.

SECTION 1.3.3.1, MANPOWER

Comment No. 154

As previously indicated, projected manpower requirements must be accompanied by detailed employment needs by job category over the construction period. The data and assumptions used as a basis for Figure 1.3-15 are needed.

Response:

A composite curve illustrating total manpower requirements during construction and into the production phase is given in Figure 154-1 (attached). This curve depicts manpower requirements for three major areas: shaft and underground facilities, Exxon permanent employees, and surface facilities. Figure 154-2 (attached) presents the total manpower requirements for each area by month. Assumptions used for the development of each major area follows:

1) Contractor Construction Manpower - the detailed construction manpower requirements by craft for the shaft and underground facilities are shown on Figure 154-3 (attached). Activities include sinking the main and ventilation shafts, headframe erection, development of the rail haulage drift, and development of the underground crushing station including equipment installation. Manpower assessments were developed for each activity based upon contractor estimates for construction of the headframe, main shaft sinking, and intake air shaft sinking. These estimates evaluate crew sizes based upon shift requirements and schedule demands. The remainder of the activities are developed similarly through analysis of each construction task, determination of required equipment and materials, and development of crews for each task.

2) Exxon Permanent Employees (see Figure 154-4 [attached]). Exxon permanent employees who will be involved in operations, maintenance, and technical support for the mine and mill facilities are included in Figure 154-4. These personnel will be engaged in underground mine development work and prestart-up of the surface production facilities. They will also fulfill construction management requirements for administration of various contracts for surface and underground work prior to mine and mill start-up. During start-up many of these people will assume their permanent positions as operations, maintenance, and technical support staff. Positions were first identified on an overall Crandon Project organization chart. All positions were then staged through the construction phase, and into the production phase, to meet schedule demands for mine/mill start-up, construction management requirements, and reasonable rates for effective employee assimilation and training.

3. Contractor Construction Manpower - Surface Facilities (see Figure 1.3-15 Revised [attached]). Contractor manpower will be engaged in the construction of the railroad, access roads, tailing pond T1, reclaim ponds R1 and R2, and all other surface facilities. These include coarse ore storage, fine ore crushing, concentrator building and all facilities therein, services building, water treatment plant, plant water systems,

Response:

1) A discussion of the monitoring programs for ground water, surface water, aquatic ecology, air quality and terrestrial ecology is presented in the Mine Permit Application, Section A-Item 15. The schedule for implementation of the monitoring program and the frequency of sample collection and the locations to be sampled are also discussed. The monitoring programs for the above disciplines will be initiated approximately 6 to 12 months prior to construction.

2) The Corporate analysis of permit conditions and evaluation of the decision to proceed with the Project is an ongoing process. The proposed DNR permit conditions will be known during the Master Hearing.

   The Corporate analysis will remain current throughout the Master Hearing process.

3) Land required to proceed with the Project not already owned by Exxon is currently under option. The options can be exercised and title transferred to Exxon within 90 days of notice of exercise of the option. Construction can begin immediately upon permit issuance on land already under lease or owned by Exxon.

4) The legal-statutory framework to satisfactorily resolve water supply problems is in-place. Monitoring of water wells that may be impacted by mine related activities will begin at least one year before construction.

5) Scheduling of post-permitting activities will be described in greater detail as the operation phase of the mine draws to a close.

Comment No. 30

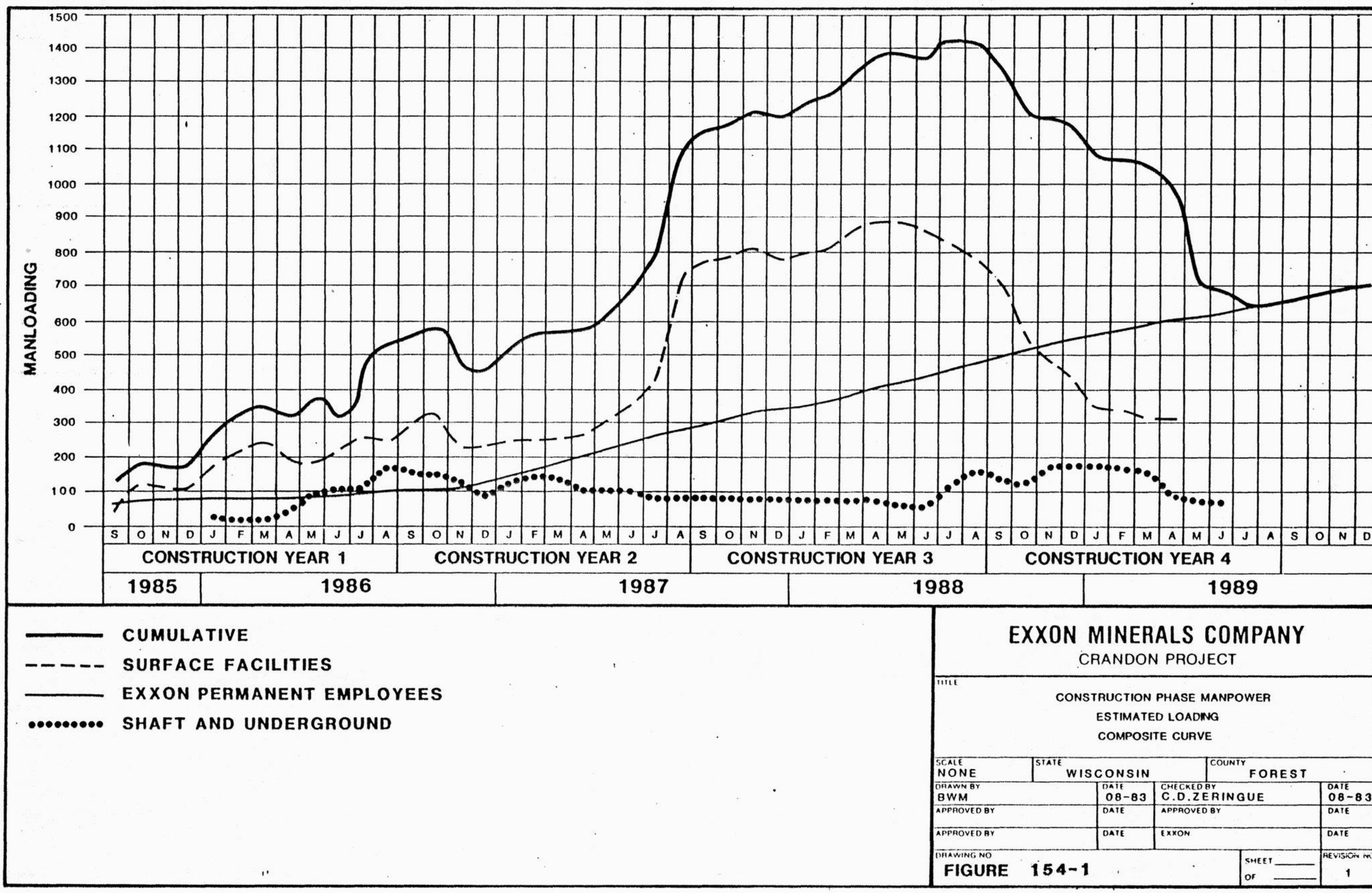
Figure 1.1-4 which indicates projected peak manpower requirements, must be supported by detailed employment needs by job category in Sections 1.3.3.1 and 1.4.2. Manpower requirements must be broken down by year, and must be accompanied by the assumptions and data used to derive the projections.

Response:

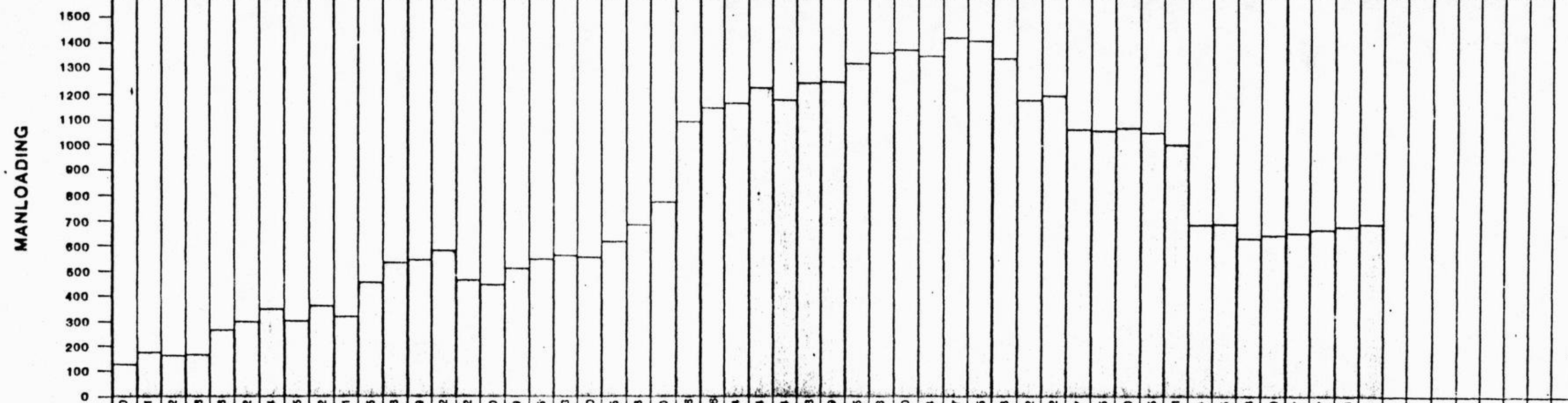
Exxon's new manpower projections consistent with the current execution philosophy are reflected in the attached Project schedule. Response to comments No. 30, 31, and 154 are based upon these new projections shown in Figures 1.1-4, Revision 1 (attached) and figures accompanying response to comment No. 154. The new information reflects current planning; however, it is subject to changes in their inherent dependency on market conditions, permitting factors, and Exxon's corporate decision process.

Exxon has determined that the time to develop the main shaft and install the hoisting equipment can be shortened by 6 months.

Current execution philosophy takes advantage of a "run of mine" production period (12 months) prior to completion of the underground primary crusher. Two stopes will be operated during this time with uncrushed ore hoisted from



(FIGURE FOR RESPONSE TO COMMENT NO. 154.)



1985 — 1986 — 1987 — 1988 — 1989 — 1990

CONSTRUCTION YEAR 1

	S	O	N	D	J	F	M	A	M	J	J	A
Total	120	191	182	186	286	312	354	315	372	321	465	533
CONSTRUCTION CONTRACTORS SHAFT & UNDERGROUND					30	20	17	42	98	106	112	174
EXXON PERMANENT EMPLOYEES	65	71	77	81	81	82	82	83	89	90	93	104
CONSTRUCTION CONTRACTORS SURFACE FACILITIES	55	120	105	105	175	210	255	190	185	225	260	255

CONSTRUCTION YEAR 2

	S	O	N	D	J	F	M	A	M	J	J	A
Total	549	592	472	450	529	565	573	580	625	698	780	1116
CONSTRUCTION CONTRACTORS SHAFT & UNDERGROUND	152	149	126	93	132	145	134	104	104	98	84	92
EXXON PERMANENT EMPLOYEES	107	113	121	127	142	165	184	206	221	250	271	284
CONSTRUCTION CONTRACTORS SURFACE FACILITIES	290	330	225	230	255	255	255	270	300	350	425	740

CONSTRUCTION YEAR 3

	S	O	N	D	J	F	M	A	M	J	J	A
Total	1166	1174	1224	1194	1243	1249	1325	1373	1380	1384	1417	1415
CONSTRUCTION CONTRACTORS SHAFT & UNDERGROUND	94	84	79	77	79	76	76	76	69	61	126	154
EXXON PERMANENT EMPLOYEES	297	315	335	342	364	368	389	412	426	448	466	471
CONSTRUCTION CONTRACTORS SURFACE FACILITIES	775	775	810	775	800	805	860	885	885	855	825	790

CONSTRUCTION YEAR 4

	S	O	N	D	J	F	M	A	M	J	J	A
Total	1348	1192	1202	1167	1065	1070	1055	1011	694	695	638	650
CONSTRUCTION CONTRACTORS SHAFT & UNDERGROUND	135	124	180	180	159	159	162	93	79	67		
EXXON PERMANENT EMPLOYEES	493	513	537	552	566	571	593	608	615	628	638	650
CONSTRUCTION CONTRACTORS SURFACE FACILITIES	720	555	485	435	340	340	310	310				

CONSTRUCTION YEAR 5

	S	O	N	D	J	F	M	A	M	J	J	A	Total
Total	657	677	689	694									41294
CONSTRUCTION CONTRACTORS SHAFT & UNDERGROUND													4391
EXXON PERMANENT EMPLOYEES	657	677	689	694									17503
CONSTRUCTION CONTRACTORS SURFACE FACILITIES													19400

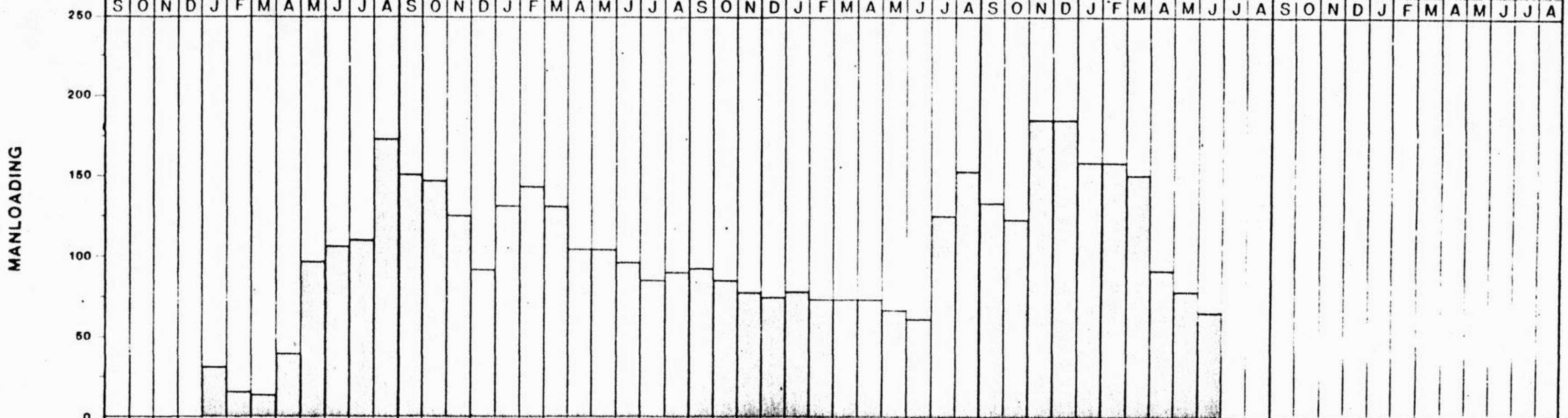
EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE: CONSTRUCTION PHASE MANPOWER
COMPOSITE HISTOGRAM
ESTIMATED LOADING

SCALE NONE	STATE WISCONSIN	COUNTY FOREST	
DRAWN BY BWM	DATE 08-83	CHECKED BY C.D.ZERINGUE	DATE 08-83
APPROVED BY	DATE	APPROVED BY	DATE
APPROVED BY	DATE	EXXON	DATE
DRAWING NO FIGURE 154-2		SHEET ___ OF ___	REVISION NO 1

(FIGURE FOR RESPONSE TO COMMENT NO. 154.)

1985 — 1986 — 1987 — 1988 — 1989 — 1990



CONSTRUCTION YEAR 1

	S	O	N	D	J	F	M	A	M	J	J	A
(Total)					30	20	17	42	98	106	112	174
ROCK DRILLERS					12						6	
PIPEFITTERS/WELDERS						6						4
ELECTRICIANS						3	1	1	2	5	2	3
MILLWRIGHTS												
MECHANICS						3	2	2	3	7	3	4
EQUIPMENT OPERATORS					6	2	8	9	13	15	12	25
IRONWORKERS								6	6	6		
CARPENTERS											4	6
LABORERS					8	3	3	4	10	10	13	33
CEMENT MASONS								3	15	12	9	18
SHAFT & DRIFT MINERS								8	28	28	34	40
HOISTMEN									1	1	4	12
SURVEYORS								1	4	4	3	2
SUPERVISION/ENGINEERS					4	3	3	8	16	18	22	27

CONSTRUCTION YEAR 2

	S	O	N	D	J	F	M	A	M	J	J	A
(Total)	152	149	126	93	132	145	134	104	104	98	84	92
ROCK DRILLERS			6								6	6
PIPEFITTERS/WELDERS	2	2	1	4	2	2	1					1
ELECTRICIANS	3	3	2	2	3	3	3	2	2	5	6	6
MILLWRIGHTS									2	2	2	2
MECHANICS	7	6	3	3	6	6	6	3	5	9	9	9
EQUIPMENT OPERATORS	22	22	16	14	22	22	22	16	14	10	10	11
IRONWORKERS	6	6	6		6	3			2	2	2	8
CARPENTERS	4	4	4		1	4	4	4	4	1		
LABORERS	14	14	11	3	8	14	9	6	11	11	5	5
CEMENT MASONS	11	11	5		6	11	10	4	5	5		
SHAFT & DRIFT MINERS	46	46	40	40	46	46	46	40	28	25	22	22
HOISTMEN	8	8	8	6	8	8	8	8	8	8	3	3
SURVEYORS	3	3	2	2	3	3	3	2	2	1	1	1
SUPERVISION/ENGINEERS	27	24	22	19	21	23	22	19	21	19	18	18

CONSTRUCTION YEAR 3

	S	O	N	D	J	F	M	A	M	J	J	A
(Total)	94	84	79	77	79	76	76	76	69	61	126	154
ROCK DRILLERS	6	6	6	6	15	15	15	15	15	15	21	21
PIPEFITTERS/WELDERS			4	4							1	1
ELECTRICIANS	6	6	6	5	4	4	4	4	2	1	3	5
MILLWRIGHTS	2	2										2
MECHANICS	7	9	7	7	5	5	5	5	5	5	14	18
EQUIPMENT OPERATORS	10	10	10	10	10	9	9	9	6	5	8	10
IRONWORKERS	5				12	12	12	12	12	10	6	6
CARPENTERS	6										1	
LABORERS	5	5	3	3	4	4	4	4	3	1	2	9
CEMENT MASONS											5	
SHAFT & DRIFT MINERS	22	22	22	22	6	6	6	6	6	6	33	51
HOISTMEN	4	5	3	3	3	3	3	3	3	3	11	3
SURVEYORS	1	1	1	1	1	1	1	1	1	1	2	3
SUPERVISION/ENGINEERS	20	18	17	16	19	17	17	17	16	14	19	25

CONSTRUCTION YEAR 4

	S	O	N	D	J	F	M	A	M	J	J	A
(Total)	135	124	180	180	159	159	152	93	79	67		
ROCK DRILLERS	21	21	27	25	6	6	6	6	6	6		
PIPEFITTERS/WELDERS												
ELECTRICIANS	5	3	3	3	1	1	1	1	1	1		
MILLWRIGHTS									6	3		
MECHANICS	18	14	24	24	21	21	21	21	15	12		
EQUIPMENT OPERATORS	9	8	8	8	8	8	8	6	6	6		
IRONWORKERS			12	12	12	12	12	5				
CARPENTERS												
LABORERS	4	3	3	3	3	3	3	3	3	3		
CEMENT MASONS			6	6	6	6	6	3				
SHAFT & DRIFT MINERS	51	51	75	77	81	81	75	30	24	18		
HOISTMEN	3	3	3	3	3	3	3	3	3	3		
SURVEYORS	3	3	3	3	3	3	3	3	3	3		
SUPERVISION/ENGINEERS	21	18	16	16	15	15	14	12	12	12		

CONSTRUCTION YEAR 5

	S	O	N	D	J	F	M	A	M	J	J	A	Total
(Total)													4391
ROCK DRILLERS													322
PIPEFITTERS/WELDERS													35
ELECTRICIANS													126
MILLWRIGHTS													23
MECHANICS													379
EQUIPMENT OPERATORS													472
IRONWORKERS													211
CARPENTERS													47
LABORERS													273
CEMENT MASONS													163
SHAFT & DRIFT MINERS													1356
HOISTMEN													179
SURVEYORS													85
SUPERVISION/ENGINEERS													720

EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE: CONSTRUCTION PHASE MANPOWER
CONSTRUCTION CONTRACTORS
SHAFT & UNDERGROUND FACILITIES

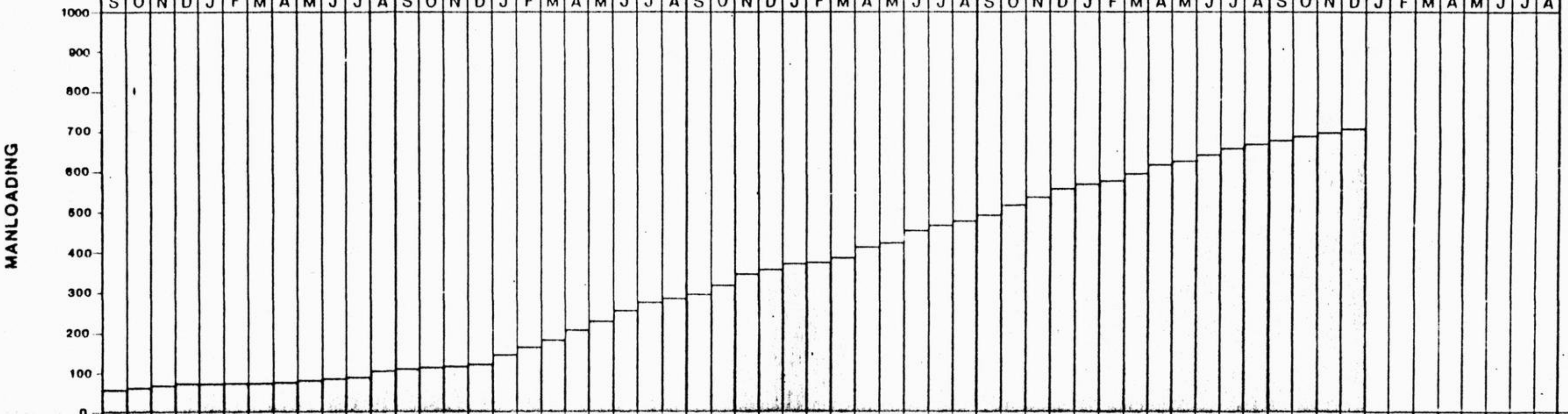
SCALE	STATE	COUNTY
NONE	WISCONSIN	FOREST

DRAWN BY	DATE	CHECKED BY	DATE
BWM	08-83	C.D. ZERINGUE	08-83
APPROVED BY	DATE	APPROVED BY	DATE
APPROVED BY	DATE	EXXON	DATE

DRAWING NO. **FIGURE 154-3** SHEET ___ OF ___ REVISION NO. 1

(FIGURE FOR RESPONSE TO COMMENT NO. 154.)

1985 — 1986 — 1987 — 1988 — 1989 — 1990



CONSTRUCTION YEAR 1

	S	O	N	D	J	F	M	A	M	J	J	A
TOTAL	65	71	77	81	81	82	82	83	89	90	93	104
ADMINSTRATION	24	24	25	25	25	25	25	25	29	29	29	31
MINE TECH	17	18	18	18	18	18	18	18	18	18	18	18
MINE OPERATION						1	1	1	2	2	2	2
MINE MAINTENANCE												
MILL OPERATIONS	1	1	1	1	1	1	1	1	1	1	1	1
MILL TECHNICAL	3	3	3	3	3	3	3	3	3	3	3	3
MILL MAINTENANCE												
CENTRAL MAINTENANCE									1	2	5	11
CONSTRUCTION MGMT.	20	25	30	34	34	34	34	35	35	35	35	38

CONSTRUCTION YEAR 2

	S	O	N	D	J	F	M	A	M	J	J	A
TOTAL	107	113	121	127	142	165	184	206	221	250	271	284
ADMINSTRATION	31	34	40	41	44	48	49	51	51	57	57	57
MINE TECH	18	18	18	18	18	18	18	18	18	18	21	21
MINE OPERATION	3	3	4	4	10	22	34	48	54	67	80	90
MINE MAINTENANCE					6	11	16	21	26	31	33	37
MILL OPERATIONS	1	1	1	1	1	1	1	1	1	1	2	2
MILL TECHNICAL	4	4	4	4	4	4	4	4	7	7	7	7
MILL MAINTENANCE	1	1	1	2	2	2	2	2	2	4	4	4
CENTRAL MAINTENANCE	11	14	15	17	17	19	20	21	22	25	27	28
CONSTRUCTION MGMT.	38	38	38	40	40	40	40	40	40	40	40	38

CONSTRUCTION YEAR 3

	S	O	N	D	J	F	M	A	M	J	J	A
TOTAL	297	315	335	342	364	368	389	412	426	448	466	471
ADMINSTRATION	57	57	57	57	60	60	60	64	64	64	65	67
MINE TECH	21	22	22	22	22	24	24	24	25	27	27	27
MINE OPERATION	101	112	122	130	142	142	154	166	172	183	198	198
MINE MAINTENANCE	39	40	47	50	53	53	54	54	57	59	59	59
MILL OPERATIONS	2	2	2	7	5	5	5	5	5	8	8	8
MILL TECHNICAL	7	9	9	9	9	9	12	12	12	12	15	15
MILL MAINTENANCE	4	4	7	7	7	7	7	12	12	15	15	15
CENTRAL MAINTENANCE	28	31	31	31	32	34	39	41	45	46	47	48
CONSTRUCTION MGMT.	38	38	38	34	34	34	34	34	34	34	34	34

CONSTRUCTION YEAR 4

	S	O	N	D	J	F	M	A	M	J	J	A
TOTAL	493	513	537	552	568	571	593	608	615	628	638	650
ADMINSTRATION	69	72	72	75	75	75	77	77	78	78	78	82
MINE TECH	27	30	30	30	31	31	31	34	34	34	34	34
MINE OPERATION	210	219	232	238	241	241	250	257	257	260	260	264
MINE MAINTENANCE	60	60	64	65	65	65	70	73	76	79	80	80
MILL OPERATIONS	9	11	14	16	20	25	26	26	28	31	38	42
MILL TECHNICAL	15	18	18	18	23	23	26	26	26	29	29	29
MILL MAINTENANCE	22	22	25	27	27	27	27	27	27	27	28	28
CENTRAL MAINTENANCE	49	49	50	51	52	52	54	56	57	60	61	61
CONSTRUCTION MGMT.	32	32	32	32	32	32	32	32	32	30	30	30

CONSTRUCTION YEAR 5

	S	O	N	D	J	F	M	A	M	J	J	A	Total
TOTAL	657	677	689	694									17603
ADMINSTRATION	82	85	86	86									2855
MINE TECH	35	35	35	35									1244
MINE OPERATION	264	270	275	278									6261
MINE MAINTENANCE	81	84	85	85									1977
MILL OPERATIONS	49	55	58	60									591
MILL TECHNICAL	29	31	31	31									628
MILL MAINTENANCE	28	28	28	28									565
CENTRAL MAINTENANCE	63	63	65	68									1619
CONSTRUCTION MGMT.	26	26	26	26									1763

EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE: CONSTRUCTION PHASE MANPOWER ESTIMATED LOADING EXXON PERMANENT EMPLOYEES

SCALE: NONE	STATE: WISCONSIN	COUNTY: FOREST	
DRAWN BY: BWM	DATE: 08-83	CHECKED BY: C.D. ZERINGUE	DATE: 08-83
APPROVED BY	DATE	APPROVED BY	DATE
APPROVED BY	DATE	EXXON	DATE
DRAWING NO: FIGURE 154-4		SHEET ___ OF ___	REVISION NO: 1

(FIGURE FOR RESPONSE TO COMMENT NO. 154.)

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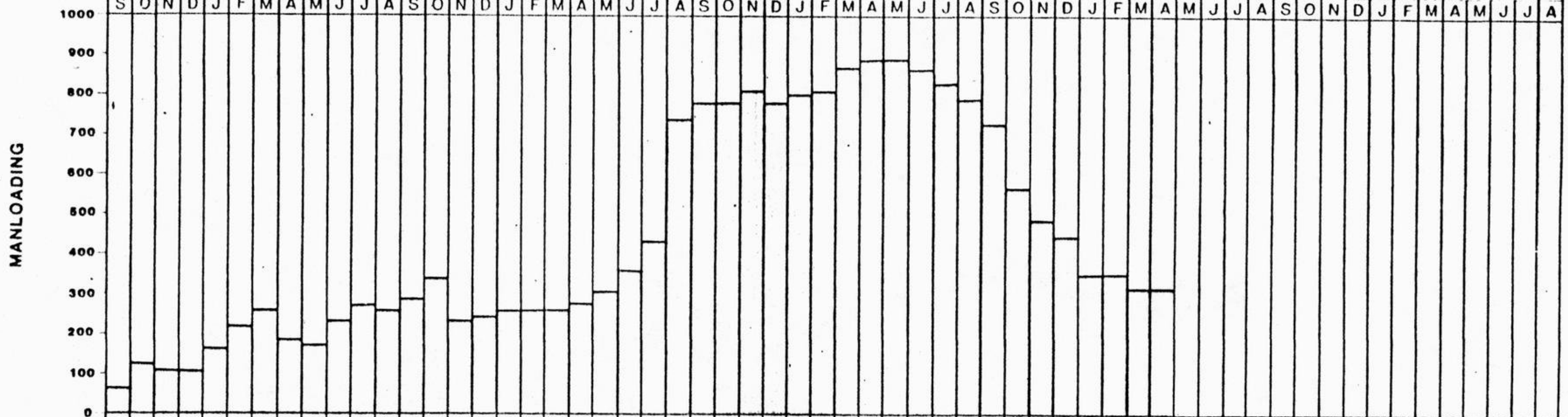


CONSTRUCTION YEAR 1

	S	O	N	D	J	F	M	A	M	J	J	A
	55	120	105	105	175	210	255	190	185	225	260	255
BOILER MAKERS												
CARPENTERS		5								5	5	10
ELECTRICIANS												
LABORERS	10	15	15	15	30	60	85	60	55	45	70	70
OPERATING ENGINEERS	30	70	70	70	65	80	95	70	70	95	115	100
MILLWRIGHTS												2
PAINTERS												
PIPEFITTERS												3
IRONWORKERS		5								1	5	5
TEAMSTERS/MECHANICS	5	5	5	5	35	40	30	30	30	39	25	25
CEMENT MASONS		5										
RODMEN										5	3	3
FINISHERS										5	2	2
SUPERVISION	10	15	15	15	25	30	45	30	30	30	35	35

CONSTRUCTION YEAR 2

	S	O	N	D	J	F	M	A	M	J	J	A
	290	330	225	230	255	255	255	270	300	350	425	740
BOILER MAKERS	5	5	5		5	5	5	5	5	10	10	10
CARPENTERS	20	45	65	65	65	65	65	65	75	105	110	130
ELECTRICIANS		5	5		5	5	5	5	15	20	30	40
LABORERS	85	85	60	50	50	50	50	55	55	50	60	75
OPERATING ENGINEERS	95	65	40	60	40	40	40	45	50	45	50	135
MILLWRIGHTS	1	2	5	5	10	10	10	10	10	25	30	35
PAINTERS										5		
PIPEFITTERS	4	8	5								5	10
IRONWORKERS	15	35	5	10	35	35	35	35	35	40	60	180
TEAMSTERS/MECHANICS	25	30	5	5	5	5	5	10	10	5	10	10
CEMENT MASONS				5	5	5	5					5
RODMEN												
FINISHERS												
SUPERVISION	40	50	30	30	35	35	35	40	45	45	60	110

CONSTRUCTION YEAR 3

	S	O	N	D	J	F	M	A	M	J	J	A
	775	775	810	775	800	805	860	885	885	855	825	790
BOILER MAKERS	5				20	20	50	50	80	80	80	90
CARPENTERS	160	155	135	120	120	120	120	120	120	100	80	35
ELECTRICIANS	40	50	45	55	75	90	120	120	120	100	100	100
LABORERS	65	70	100	95	125	145	140	120	120	120	95	95
OPERATING ENGINEERS	115	145	130	120	125	115	90	70	70	80	85	80
MILLWRIGHTS	45	30	25	20	15	5	25	30	30	30	40	60
PAINTERS	5	5	5	10	10	5	5	5	5	5		10
PIPEFITTERS	25	20	40	45	5	80	100	120	100	100	100	110
IRONWORKERS	190	175	200	195	170	100	90	100	70	70	70	40
TEAMSTERS/MECHANICS	15	15	20	5	10	5		20	30	35	35	35
CEMENT MASONS	5							10	15	15	20	20
RODMEN												
FINISHERS												
SUPERVISION	105	110	110	110	125	120	120	120	125	120	120	115

CONSTRUCTION YEAR 4

	S	O	N	D	J	F	M	A	M	J	J	A
	720	555	485	435	340	340	310	310				
BOILER MAKERS	90	80	70	70	50	50	50	50				
CARPENTERS	50	30	25	25	15	15	15	15				
ELECTRICIANS	90	90	80	80	60	60	50	50				
LABORERS	75	55	55	55	35	35	25	25				
OPERATING ENGINEERS	60	25	25	20	20	20	15	15				
MILLWRIGHTS	50	30	30	25	25	25	25	25				
PAINTERS	10	10	15									
PIPEFITTERS	110	110	80	80	70	70	70	70				
IRONWORKERS	40	30	30	20	15	15	15	15				
TEAMSTERS/MECHANICS	30	5	5									
CEMENT MASONS	15	10										
RODMEN												
FINISHERS												
SUPERVISION	100	80	70	60	50	50	45	45				

CONSTRUCTION YEAR 5

	S	O	N	D	J	F	M	A	M	J	J	A	Total
													19400
BOILER MAKERS													1055
CARPENTERS													2475
ELECTRICIANS													1710
LABORERS													2905
OPERATING ENGINEERS													3080
MILLWRIGHTS													745
PAINTERS													110
PIPEFITTERS													1540
IRONWORKERS													2186
TEAMSTERS/MECHANICS													664
CEMENT MASONS													140
RODMEN													11
FINISHERS													9
SUPERVISION													2770

EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE: CONSTRUCTION PHASE MANPOWER
CONSTRUCTION CONTRACTORS
SURFACE FACILITIES

SCALE: NONE	STATE: WISCONSIN	COUNTY: FOREST	
DRAWN BY: BWM	DATE: 08-83	CHECKED BY: C.D.ZERINGUE	DATE: 08-83
APPROVED BY	DATE	APPROVED BY	DATE
APPROVED BY	DATE	EXXON	DATE
DRAWING NO: FIGURE 1.3-15	SHEET ___ OF ___	REVISION NO: 1	

(FIGURE FOR RESPONSE TO COMMENT NO. 154.)

main substation and electrical distribution, yard piping systems, all in-plant roads and parking areas, and all other ancillary surface facilities.

Material requirements were prepared from conceptual engineering drawings for such items as excavation, concrete, structural steel, piping, and painting, etc., and used to derive the estimated field manhours. Equipment installation manhour estimates were obtained from the vendors with manhour estimates and costs for field representation during installation and startup. A productivity adjustment was included to account for Crandon Project specifics and to reflect actual manhours to be expended on-site. An analysis was then completed for the areas of construction, the construction schedule, and the Project contracting plan. A determination of equipment and materials necessary for each task was generated, and manpower curves, developed for each skill classification. These curves were checked against historical curves for peak manpower requirements, duration of peak, phased entry into the Project and total scheduled duration.

The contractor estimates, organization charts, and engineering drawings are based on preliminary engineering which inherently lacks the degree of detail necessary for precise construction material quantity determinations. As these quantities govern the manpower computations, it is anticipated actual manpower requirements during construction will deviate from our present projections. This is particularly true with respect to any one specific craft or in any one specific area. However, in the aggregate we expect the overall manning requirements will track the present curve within acceptable limits. We believe the location of the manpower peaks and valleys can be predicted with reasonable accuracy.

SECTION 1.3.3.3, FUEL AND ENERGY

Comment No. 155

What are the multiplier units on the yearly use figures in Table 1.3-5? How will fuel be stored on-site prior to completion of the bulk fuel storage area?

Response:

The average yearly use of diesel fuel, gasoline, and natural gas presented in Table 1.3-5 should be multiplied by 1,000. The estimates for electrical power are correct as shown. A new table will be included in the revised EIR.

During the construction phase, before the bulk fuel storage area is completed, any on-site fuel storage will be in the tanker trailers in which the fuel is delivered to the site.

SECTION 1.3.3.4, FUEL AND ENERGY

Comment No. 156

What are the units of numbers in the table presented in the text of this section? What assumptions were used to derive these numbers?

Response:

The units in the table are number of vehicles making a round trip to the Project site per day. The employee automobiles were estimated by assuming 2.6 people traveling together in a car and that 80 percent of the workforce would travel by private automobile. In developing the estimate, it was assumed that a bus transportation system would develop and that 20 percent of the workforce would use the bus service. With 20 to 30 people per bus, approximately 10 buses would be used for the peak travel periods. Buses, in addition to the private autos, account for all transportation of the workforce.

Staff automobiles are for Exxon and contractor construction management personnel and were estimated at 1.0 person per car. The service trucks and delivery trucks are estimates based on the size and type of the project. These estimates were developed by Exxon with input from various contractors regarding employee levels and automobile occupancy.

Additional construction planning and scheduling work may require an adjustment in these estimates. However, the methodology used to generate the numbers would not be changed.

SECTION 1.3.4, LANDSCAPE PLAN

Comment No. 157

Figures 1.3-16 and 17 should include the backfill sands and explosives storage areas along with the tailings slurry and haul road corridor.

Response:

Comment acknowledged. EIR Figures 1.3-16 and 1.3-17 will be revised to include all Project facilities north of the main mine/mill complex. Facilities in this area that will be included in the landscape plan and the phasing of this plan are the preproduction ore storage area (formerly the mine backfill storage area) and associated road, explosives storage area and associated road, and the north sediment retention basin.

The portion of the slurry pipeline and haul road corridor not developed for Project facilities will be seeded with grasses and/or legumes following year 2 of the construction phase. With the exception of periodic maintenance in the corridor to minimize invasion of trees and shrubs, no additional landscape treatments are proposed for this area. Therefore, these facilities have not been included in the landscape plan for the mine/mill site.

Comment No. 158

Please provide a discussion of the screening process used to select suitable plantings. Birch and balsam fir may not be appropriate species because of high incidence of disease and insect problems.

Response:

The following criteria were employed in the screening and selection of suitable plantings for application in the mine/mill site landscape plan:

1) Woody species selected had to be indigenous to the site area and compatible with the final reclamation plan.

2) Herbaceous species used to provide rapid stabilization of slopes and prevention of erosion could be either indigenous or nonindigenous to the site area.

3) Plant species for specific areas in the mine/mill site were selected based on their ecological characteristics and known adaptability to the projected environmental conditions, such as slope, exposure, soil type and soil moisture, that will be created at the completion of Project construction.

Comment acknowledged and we will re-evaluate the use of birch and balsam fir as species for inclusion in the landscape plan.

Comment No. 159

What is the "open water" indicated in the northeast corner of the mill site?

Response:

The open water area in the northeast corner of the mine/mill site is a deciduous swamp having some open water. This wetland is less than 0.1 ha (0.25 acre) in size and is located approximately 152 m (500 feet) northwest of wetland F116. This wetland is designated but not numbered on Figure 4.3-1E of the August 1982 Wetlands Assessment Report prepared by Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc (previously provided to the DNR).

SECTION 1.3.5.1, MINE/MILL SITE, RECLAIM PONDS AND MINE WASTE DISPOSAL FACILITY DEVELOPMENT; AIR EMISSIONS

Comment No. 160

This section should include estimates of emissions from mine construction. Also, estimates of emissions from several air contaminant sources previously mentioned are not included in Tables 1.3.6 and 7. Provide estimates for: 1) the-burning of stumps and brush, 2) a temporary on-site diesel powered generator, 3) the existing gravel access roads, 4) wind erosion from the mine waste disposal facility stockpiles, and 5) the screening and stacking plant used to produce materials for the liner and underdrain.

Comment No. 162

Solid Wastes - It appears the solid waste disposal facility in the Town of Nashville will have to be upgraded to handle the amount of waste projected to be generated from the site construction. Please provide more detail on the types of wastes expected to be generated along with estimates of the amount of each type of waste.

Response:

See response to comment No. 38.

Comment No. 163

Erosion Control - Include a discusson of the water discharge pipeline corridor. Describe the handling, treatment and discharge of contaminated water during the construction period. What water treatment equipment will be required during the construction period? Describe the locations, dimensions, construction schedules, and specifications for the "influent surge system". Describe the specifications and duration of use of the temporary lined holding pond and include it on Figures 1.3-10 through 14. Describe the chemical characteristics of the contaminated water.

Response:

The water discharge pipeline corridor is shown on EIR Figure 1.1-2. The corridor is approximately 9.8 km (6.1 miles) long and has a nominal width of 15.0 m (49.2 feet). The actual width of the corridor that will be disturbed during pipeline installation is estimated to be 6.0 m (19.7 feet) which results in a total estimated disturbed area of 5.9 ha (14.5 acres). Approximately 75 percent of the route length is across high ground which will present no special construction difficulties. Trench excavaton, pipe laying, and backfilling will be completed in sections to avoid having open trenchs for extended periods.

Installation of pipe through the wetland areas will require additional precautions. Muck and organic soil conditions as well as season of the year will determine the most effective equipment to use. To the extent possible, the wetland mucks will be kept separate from the subsoils as they are excavated and placed along the trench. The soils will be backfilled later in the original sequence, i.e., subsoils will be backfilled before the mucks. In areas where there is potential for erosion, the materials will be contained with silt fences (filter fabrics) or other equivalent methods. Because of the nature of wetland soils, wider disturbed areas will result in the wetlands. Lighter equipment and swamp mats will probably be used unless a winter time construction schedule is determined to be beneficial. Selection of a contracor with appropriate experience and prior satisfactory results on other similar projects will be an important criterion.

During construction, four sources of contaminated water are currently identified: (1) the mine including ground water inflow and utility water, (2) surface water runoff from a 1.45-ha (3.6-acre) equipment laydown area near the main mine shaft, (3) surface water runoff from a 3.24-ha (8.0-acre) preproduction ore storage area located on the north edge of the mine/mill area (previous backfill sands storage area), and (4) surface water runoff from an 15.6-ha (38.6-acre) waste rock storage area in the MWDF.

For the first one-third of the construction phase (approximately 18 months), there will be no contaminated water from mine shaft sinking because there will not be any contact with mineralized rock. Through this first phase, waters from the mine shaft and the equipment laydown area will be routed through sedimentation ponds for discharge as surface water drainage. The sedimentation ponds will either be temporary or possibly one or two of the ponds will be used which will become a part of the mine/mill area final surface water drainage system.

Runoff from the waste rock storage area at the MWDF is handled in a temporary, membrane lined pond located on the west side of the waste rock area. This temporary pond is sized to hold the volume of one years net precipation gain plus one 10-year, 24-hour storm. If the temporary pond approaches its capacity, the water will be pumped to reclaim pond R1.

After there is contact with mineralized rock, the mine and equipment laydown area waters are transported to water reclaim pond R1. As the required portions of the water treatment plant are completed, the water in reclaim pond R1 will be treated and discharged as necessary. Water from the preproduction ore storage area will be transported to the water treatment plant feed tank. The portion of the plant required for treatment of this water will include lime precipitation, filtration and pH adjustment. The capacity of the water treatment plant feed tank is approximately 3800 m^3 (1,000,000 gallons). The EIR figures, showing this tank being completed in construction year 2 are correct.

The temporary pond in the MWDF area is described more fully in the INDECO report "Construction of Waste Disposal Facilities" (previously provided to the DNR).

See Appendix B (Design Criteria-Water Management Program) of Appendix F of CH2M Hill's Phase III Water Management Study (previously provided to the DNR) for mine and surface drainage water quality.

Comment No. 164

How can the maximum effluent flow rate during the third year of construction be 2,000 gallons per minute when the mine water inflow alone is estimated at 2,000 gallons per minute at this time?

Response:

The unmitigated steady state rate of ground water inflow to the proposed Crandon Mine is estimated to be 0.118 m^3/s (1870 gallons per minute) (Prickett, December 1982). During the third year of mine construction the mine drainage rate may approach 0.126 m^3/s (2,000 gallons per minute) for several months because of the combined effects of unmitigated inflow and depletion of water stored in the orebody weathered zones. This depletion of stored water is non-repetitive and will be of short duration.

Any excess mine drainage effluent experienced at this time would be stored in the surface reclaim ponds prior to eventual mill use or treatment and discharge. Pond design has included capacity specifications which will allow management of the mine/mill water balance and control of the surface water discharge rate.

As described in the response to comment No. 62, it is unlikely that ground water inflow, even in combination with the orebody depletion of storage water will ever exceed 0.126 m^3/s (2,000 gallons per minute) because of the inflow rate limiting control techniques proposed for application during Project development (see the response to comment No. 61).

Comment No. 165

Describe the discharge location from sedimentation ponds and the use of other sediment traps such as silt fences made of geotextiles.

Response:

Sedimentation ponds will be used to collect surface water runoff from areas with high erosion potential, including the mine/mill site and MWDF. Any discharge from these facilities will be to surface drainages. Release points from MWDF ponds are shown on EIR Figures 1.3-3 through 1.3-8. Ponds associated with the mine/mill site are shown on Figure 3.3 of the Mine Permit Application, Section D, Reclamation Plan. Refinements to the mine/mill site are in progress and these refinements will be shown on a subsequent revision to EIR Figure 1.3-10. This figure will show the location and discharge points of mine/mill site sedimentation ponds.

Silt fences (i.e., geotextiles, cloth, straw bales) will be used, as needed, on cut and fill slopes with a high erosion potential and which do not respond to conventional erosion control practices and slope stabilization. This would primarily be channels subject to high flow velocities where conventional hay and straw mulching fails to stabilize the soil long enough for vegetation to reestablish.

Comment No. 166

Include the temporary pond used to store runoff from the waste rock embankment on the appropriate figures. Provide the dimensions and design critera for this pond. What figures were used to derive the net annual precipitation gain estimate of 7 inches? What will the chemical characteristics of this contaminated runoff be? Discuss the effect of the contaminated water and bacterial activity on the liner's integrity.

Response:

The temporary pond used to store surface water runoff from the waste rock storage area will be identified on EIR Figure 1.3-3. The pond is presently shown on EIR Appendix 1.2A, Figure 9-5. Final design details are not available at this stage of Project development; however, pond layout and preliminary design data are included in the Indeco report "Construction of Waste Disposal Facilities" (previously provided to the DNR). Design criteria are also provided in subsections 9.1.4, and 9.2.2 of EIR Appendix 1.2A.

The estimated net annual precipitation gain of 7 inches was derived by subtracting the average yearly lake evaporation rate from the average yearly precipitation. Since this temporary pond will be lined, infiltration was assumed to be negligible. The closest location to the Project site area for which long-term evaporation rates are available is the station at Rainbow Reservoir in north-central Oneida County. Data from this station indicate an average pan evaporation rate from May through October of 608.6 mm (23.96 inches). To extrapolate these data to an annual lake evaporation rate, CH2M HILL examined the Climatic Atlas of the United States, published by the National Oceanic and Atmosphere Administration of the U.S. Department of Commerce. This reference indicates that for the regional area of the Project, May to October evaporation is approximately 80 percent of the annual total. It also indicates that, for this same regional area, lake evaporation is 78 percent of pan evaporation. Therefore,

$\frac{608.6}{0.80} \times 0.78 = 593.4$ millimeters = average annual lake evaporation

$\frac{23.96}{0.80} \times 0.78 = 23.36$ inches = average annual lake evaporation

Annual rainfall is estimated at 781.56 mm (30.77 inches). Subtraction of evaporation gives 188.2 mm (7.41 inches) of net precipitation. For general Project design this was assumed to be 7 inches.

The exact chemical characteristics of surface water runoff from the waste rock can not be determined until operation. However, based on leach tests conducted on waste rocks, a water quality projection was made. This is shown in Appendix C of "Design Criteria - Water Management Program" contained in Appendix F, Volume 3, "Phase III Water Management Study," CH2M Hill, 1982. Data presented in EIR Appendix 1.2A, Table 3.4 show that waste rocks are not classified as hazardous waste according to U.S. EPA extraction procedure tests.

As stated in EIR Appendix 1.2A, this pond is temporary and will only be used for 3 years. The exact type of liner to be used will be determined during final design. Use of the proper liner can virtually eliminate microbiological attack and be resistant to inorganic chemicals. The choice of liner will be based on manufacturers' recommendations for containment of wastes with the composition expected in surface water runoff from the waste rock storage area.

SECTION 1.4.1, SCHEDULE

Comment No. 167

This section describes a steady state production phase of 26 years. Please provide a discussion of temporary mine shutdowns (both short and long-term), the potential causes of shutdown, and the ramifications of these shutdowns on schedules, operations and pollution control facilities.

Response:

Temporary mine/mill shutdowns should be defined as those periods during which actual mine and/or surface plant operations cease, but all facilities are maintained in start-up readiness. During such periods mine water pumping, water treatment, MWDF underdrain pumping and reclamation, and similar activities would be uninterrupted. The mine life would simply be extended in real time by an amount equal to the length of the temporary shutdown.

A variety of events and situations could lead to the temporary suspension of operations for durations of from one day to several years. Short shutdowns, (i.e., one month or less) might be caused by weather extremes, equipment failure, or planned facilities maintenance or modification. A cessation of up to 3 to 6 months might result from a labor dispute, either local or by an essential supplier or carrier. Suspension of operations for periods greater than 6 months would most likely be caused by economic conditions such as severely depressed metal prices. Necessary pollution control and monitoring equipment would be operated during these periods to assure compliance with all applicable permit conditions. The ultimate ramification of such events is the extension in time of mine and facility operations and reclamation.

Comment No. 168

Please provide the actual design capacity for concentrate storage and contingency plans should additional storage be necessary.

Response:

Refer to the response to comment No. 76.

SECTION 1.4.2.4, MINE AND BACKFILL DEWATERING

Comment No. 169

Provide all data, methods and assumptions used to calculate groundwater seepage into the mine. Describe in detail the operation of the groundwater interceptor system and the continuing grouting of the ore body and the interface with the unconsolidated deposits.

Response:

Data, methods and assumptions used to calculate ground water seepage into the mine are presented in the "Ground Water Inflow Model for the Proposed Crandon Mine" (Chapter 3.0, subsection 3.1.5, pp. 16 and 17 and subsection 3.2.2, pp. 18 through 35), prepared by Thomas A. Prickett and Associates and Appendix 4.1A, "Hydrologic Impact Assessment" (Chapter 3.0, pp. A-12 through A-23 and Chapter 4.0, pp. A-24 through A-37), prepared by D'Appolonia, Inc. Both of these reports were submitted to the DNR.

The mine water interceptor system is described in the response to comment No. 134.

Comment No. 170

Describe contingency plans for inflows in excess of 2,000 gallons per minute.

Response:

The excess inflow contingency measures applicable during the mine operating life are described in the response to comment No. 62.

SECTION 1.4.2.5, WASTE ROCK

Comment No. 171

Describe the continued use of waste rock as riprap on the sides of the tailings ponds. Provide estimates of the quantities of waste rock for each destination.

Response:

Use of waste rock as MWDF embankment slope facing is described in subsection 1.2.3.2 of the EIR. Additional details are presented with the preliminary engineering drawings accompanying the MWDF Feasibility Report. Of the total waste rock disposed at the MWDF, approximately 897,000 m^3 (1,173,000 cubic yards) are used as slope protection. This volume is used in the four tailing ponds and two water reclaim ponds. The estimated rock quantity per pond is included on Plan Sheet 4 of the MWDF Feasibility Report.

SECTION 1.4.2.6, BACKFILL HANDLING UNDERGROUND

Comment No. 172

Please explain why backfill may have to be supplemented by glacial sand and why tailings fines cannot be used in its place. Golder Report 11 indicates that fines from the soil screening process may be disposed of within the mine as backfill. If soil fines can be used, why aren't tailings fines suitable? If glacial sands are required, what would be the source of the material?

Response:

Backfill which is placed hydraulically must be free draining to prevent a buildup of hydrostatic head which would present a serious safety hazard. Laboratory testing of Crandon coarse tailings has shown that backfill possessing this free draining characteristic can contain only a small percentage of -20 μm particles. The exact percentage that can be tolerated is a function of rate of placement, slurry density, and stope size, as well as the size distribution of the +20 μm fraction.

When the tailings have been classified to remove the fine fraction, a projected deficit of approximately 300 t/d (331 short tons per day) of backfill will exist. This deficit will, in general, be made up from waste rock coming from development drifts in the mine, thus eliminating the need to hoist this fraction of the waste to the surface. Glacial sands will not be used based on current plans.

Comment No. 173

Discuss the kind and amount of cement required to stabilize the backfilled stopes and the thickness of rock which will be left on the sides and bottoms for each stope. Discuss the sulfide resistance of the cement and how the cement will function with a predominantly sulfide aggregate.

Response:

Cement is sometimes added to the backfill to provide stability so that it will stand unsupported to enable removal of the ore in the adjacent stope. On average, the ratio of cement to tailings sand will be about 1:15. Ratios as rich as 1:5 may be used in specific situations where higher structural strength is desired, such as the formation of a floor of fill on which to operate mobile equipment.

As an alternative to making the fill in a stope self-supporting by adding cement, the fill may be retained in place by leaving a rib pillar of rock between the fill and the adjacent stope. This pillar would have a minimum thickness of 10 percent of the hanging wall to footwall width of the stope, or 3 m (10 feet), whichever is greater. The decision to add cement or to leave a pillar of rock will be based on economics, considering the value of the ore and the cost of cement. It is expected that about one-third of the total fill placed in the mine will contain cement.

Laboratory testing of backfill samples using both normal and sulfate-resistant Portland cement showed no strength differences over the periods of up to 90 days the samples were allowed to cure. Further testing will be conducted in the underground mine when more tailings are available from plant operation. Long-term cement deterioration is not expected to be a problem. If cement deterioration is found to be an important factor in a fill's self-support capability, the economic decision will be made to use additional cement, change the type of cement, or delete cement and retain an ore pillar.

Comment No. 174

Discuss the sizes of waste rock hauled directly from headings to stopes and the possibility of voids in the backfill.

Response:

Waste rock from development headings will be within a size range from sand grains to 600 mm (24 inches) pieces. Two-thirds to three-quarters will probably be in the range of 150 to 450 mm (6 to 18 inches). When this material is used as stope backfill, it will be placed before or during the placement of hydraulic tailings fill. The hydraulically placed fill will flow into and fill the interstices between the rock fragments.

It is also common practice to place coarse sand in the throat of each stope drawpoint, just behind the fill bulkhead to act as a filter and prevent the finer tailings sand from plugging the filter cloth on the bulkhead. This sand could be supplied by local sand and gravel operations or from the processing plant to produce the underdrain material for the MWDF.

SECTION 1.4.2.7, WATER BALANCE

Comment No. 175

Please define what constitutes mine "process" water which will be collected and discharged to the surface water treatment system. How much mine process water will be generated and transported to the surface? Are the 200 gallons per minute of processed water accounted for in the maximum mine pumping rate?

Response:

As stated in subsection 1.4.2.7 of the EIR, mine "process" water is simply water used for drilling and dust suppression. The source of this water is is the uncontaminated mine seepage sumps. After use, this "process" water drains to the contaminated water collection sumps. (This is what is meant by being used in closed circuit.) This water is, of course, accounted for in the water pumped from the mine.

SECTION 1.4.3.1, COARSE ORE TRANSPORT AND FINE CRUSHING

Comment No. 176

Provide plan and elevation drawings of the crushing circuits (secondary and tertiary) showing the configurations of crushing and conveying equipment, dust collection points, duct and air pollution control equipment.

Response:

See drawing No. 051-5-G-005 in Attachment No. 15.

SECTION 1.4.3.2, GRINDING AND FLOTATION

Comment No. 177

Provide additional discussion on the grinding and floating processes with diagrams and photographs. Discuss in general terms the use of reagents such as frothers and collectors.

Response:

A concentrator is a facility in which ore is separated into concentrates and tailings. Concentrates contain the valuable minerals that were in the ore, and tailings are the materials rejected after the valuable minerals have been removed.

To produce concentrates, it is necessary to liberate the various minerals from the host rock and from each other so that the valuable minerals can be separated from the waste components. Liberation will be achieved by crushing and grinding the ore to a size at which the valuable minerals will be discrete particles which can be separated from each other.

The sulfide mineral particles will be separated from the ore slurry by a selective flotation process. Selective flotation is the process in which specific sulfide mineral particles adhere to air bubbles, float to the surface of the ore slurry and form a froth which collects on the top of the slurry. The froth is then removed from the slurry.

By the use of various reagents, the mineral may be made either to adhere to an air bubble or to remain in the water. The use of these chemical reagents permits the separation and recovery of the zinc, copper, and lead sulfides as separate concentrates from the gangue minerals. Figure 1 (attached) is an illustration derived from a high speed photograph showing mineral adhering to air bubbles.

Collectors and frothers used in each of the flotation circuits are generally added ahead of the first stages of flotation and as needed in subsequent stages of flotation. Collectors are those reagents added to the ore-water slurry that attach to the desired mineral particles thereby imparting a hydrophobic, or air-avid, surface to the mineral particles. These particles then attach to air bubbles and rise to the top of the flotation cell to form a froth. Frothers are added for the purpose of altering the surface tension of the slurry such that stable, mineralized froths can form on the top of the flotation cell and be removed.

The flotation process will be performed in flotation machines similar to that shown in Figure 2 (attached). The ground ore, in a slurry with water, comes from the grinding circuit. Reagents will be added and the slurry passes into the first cell of the flotation machine.

In the flotation machine, air will be introduced into the bottom through an impeller. The very fine air bubbles will be distributed thoroughly through the slurry of ore and water. When an air bubble encounters a mineral particle that has been treated with the proper reagent, that particle adheres to the bubble and will be transported with the froth to the top of

(FIGURE FOR RESPONSE TO COMMENT NO. 177.)

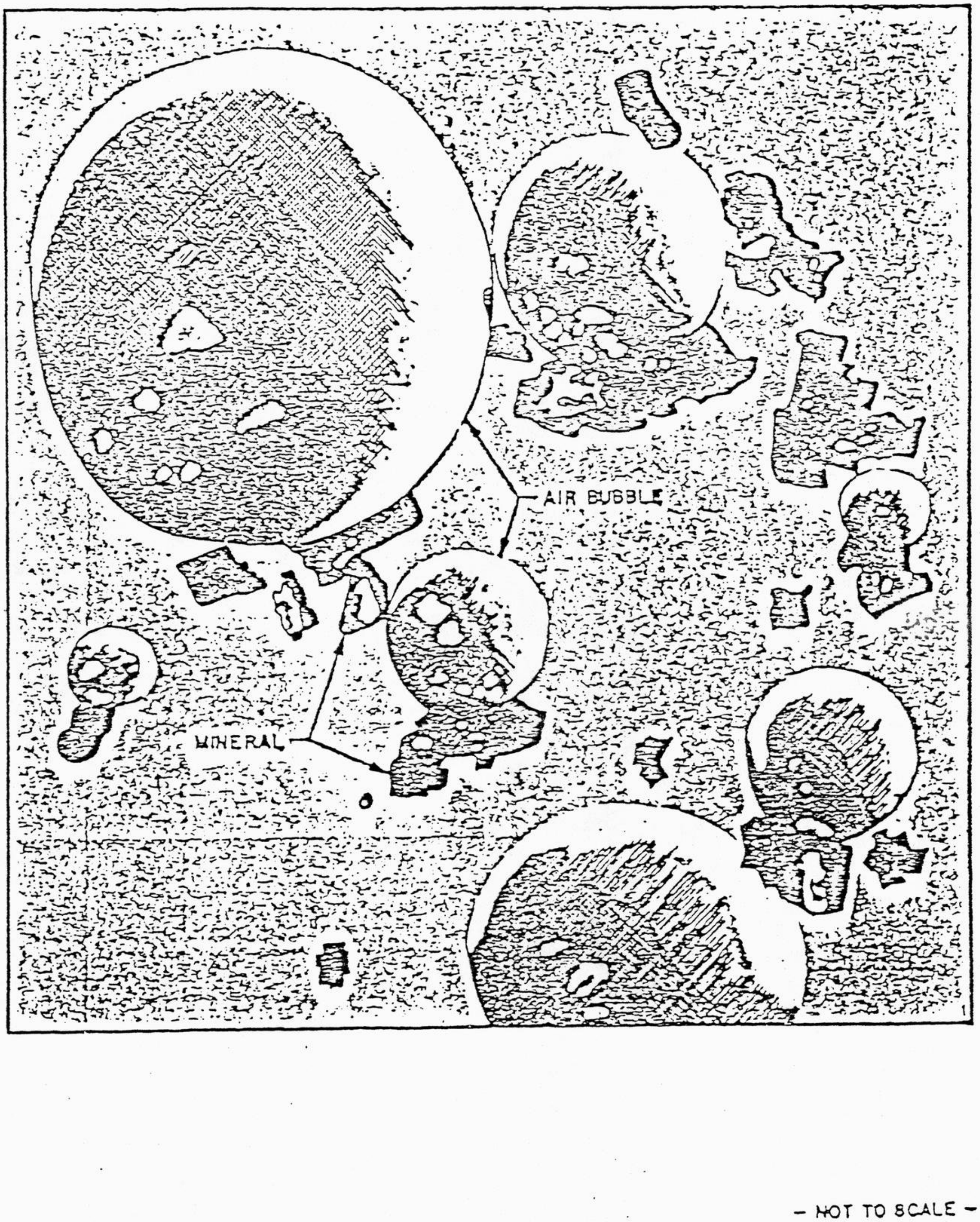


FIGURE 1 -- High speed photograph of mineral particles adhering to air bubbles.

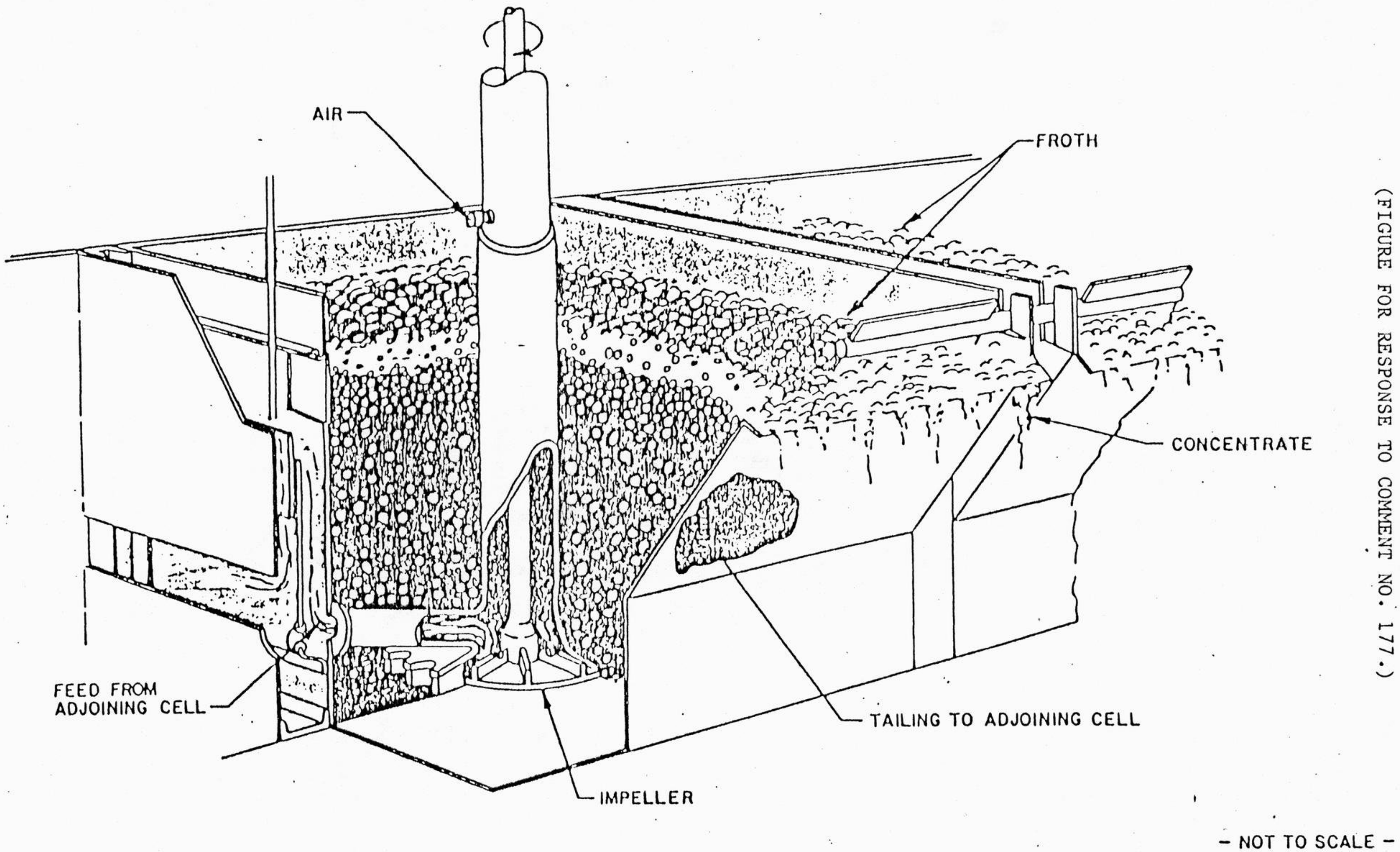


FIGURE 2 -- Flotation cell mechanism showing slurry feed to the cell, mineral laden froth (concentrate), and tailing product.

(FIGURE FOR RESPONSE TO COMMENT NO. 177.)

the machine. A particle that has not adsorbed the proper reagent will not adhere to an air bubble. This particle then remains in the water and will be carried out with the water and form the tailing. The mineral collecting with the froth will form the concentrate.

By use of proper reagents and the appropriate arrangement of the flotation machines, separations will be made between the various sulfide minerals and tailings. This results in the production of concentrates of zinc, copper, and lead, and a tailings waste product.

In the process of liberation and separation of minerals from the ore, the mill/concentrator will include the following activities:

1) Crushing and ore storage;

2) Grinding and classification;

3) Flotation;

4) Concentrate handling;

5) Mine backfill preparation;

6) Tailings disposal;

7) Reagent preparation; and

8) Process control.

Crushing and Ore Storage

The first stage of crushing, to nominally minus 150 mm (6 inches) will be done underground in the mine. The ore will be hoisted to the surface. The mine will produce two ores: a zinc-copper-lead ore (massive) and a copper-zinc ore (stringer). The hoisted ore will be delivered by feeders from an ore bin in the headframe to a conveyor belt which will deliver the ore to the coarse ore storage facility, where the two ores will be stored separately.

The purpose of the coarse ore storage building is to provide surge capacity between the mine and the concentrator, and to provide a supply of ore for the operation of the concentrator over the 2 days of the week during which ore is not hoisted from the mine.

Coarse ore will be reclaimed through a series of feeders onto conveyor belts which will transport the ore to the fine crushing plant. A schematic flowsheet of the crushing and ore storage system for the proposed Crandon concentrator is presented in Figure 3 (attached).

Crushing will occur in three stages. Each stage will be equipped with a machine suitable for crushing a particular size of rock. As mentioned earlier, the first stage of crushing will occur underground in a gyratory crusher. Gyratory crushers are effective in crushing ore from several feet in diameter to approximately 150 mm (6 inches) or less. The next stage

(FIGURE FOR RESPONSE TO COMMENT NO. 177.)

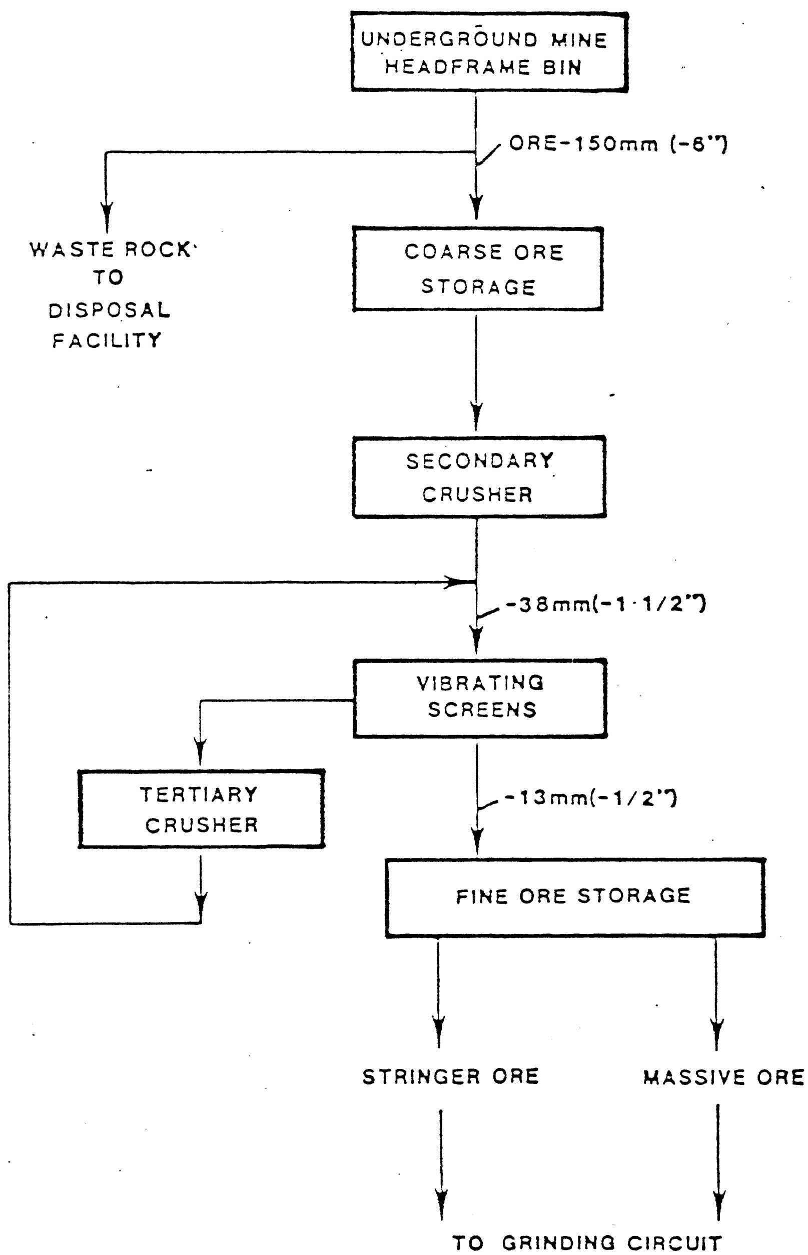


FIGURE 3 -- Schematic flowsheet of the crushing and ore storage system for the proposed Crandon concentrator.

requires a cone crusher, which will crush from approximately 150 mm (6 inches) to about 38 mm (1.5 inches). The final stage involves a shorthead cone crusher which crushes from 38 mm (1.5 inches) to about 13 mm (0.5 inches). A vibrating screen will be placed between the second and third stage of crushing to remove the fine ore. This will allow the third stage crusher to operate more efficiently. Figure 4 (attached) is a cutaway view of a cone crusher.

The crushed and screened ore will be conveyed to one of two sets of fine ore bins. Massive and stringer ores will be crushed and stored separately, and will be processed individually.

Grinding and Classification

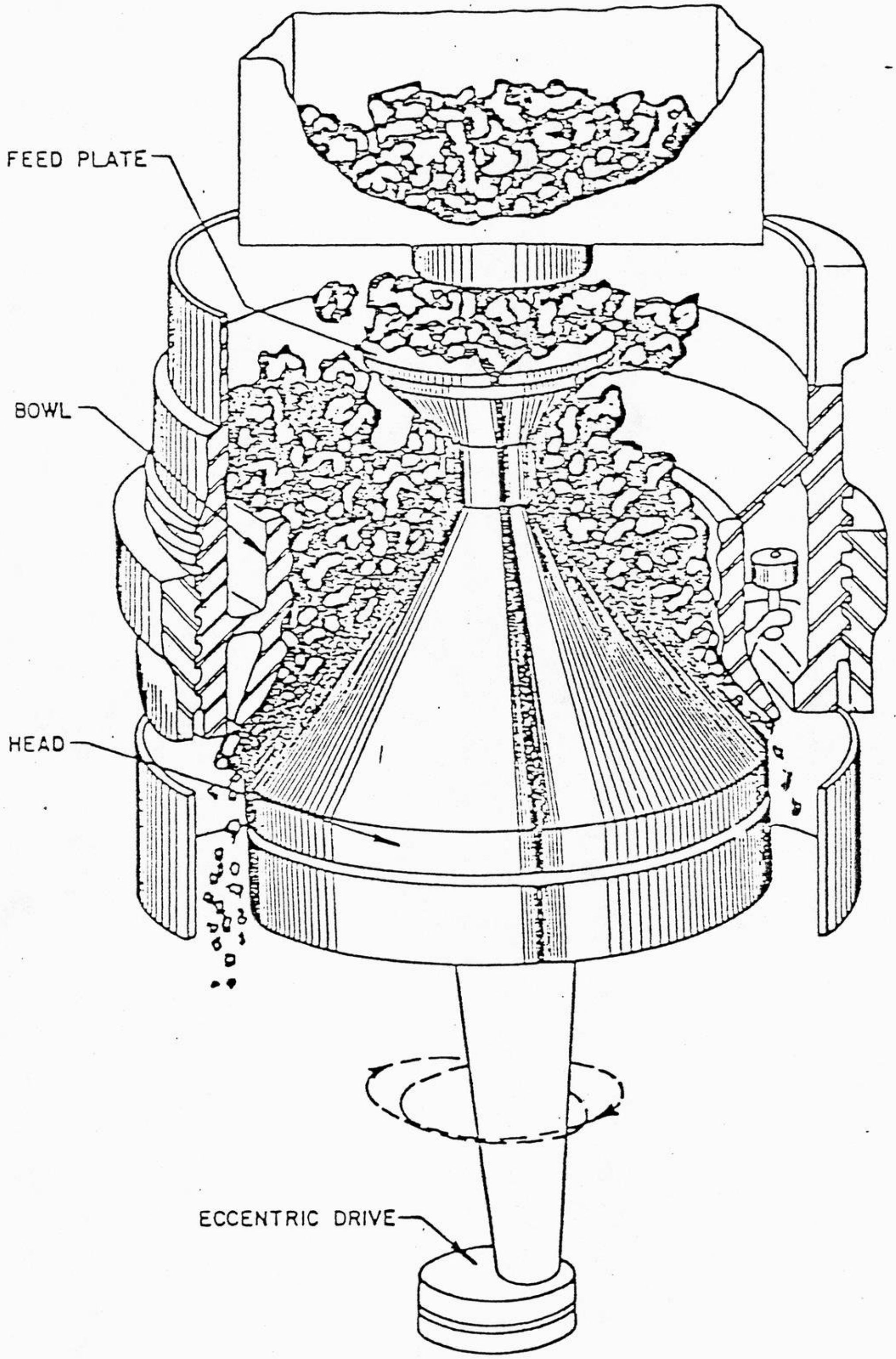
The two ores will be crushed separately and placed in separate fine ore bins for storage ahead of fine grinding. The finely crushed ore will be removed from each fine ore bin and sent to a separate grinding circuit for each ore type. Figure 5 (attached) contains a schematic flowsheet of the proposed concentrator and includes all the unit operations that will take place in the concentrator.

The operation of the grinding circuits will be identical for each ore. The crushed ore will be fed by a conveyor belt into a rod mill where water will be added and the ore will be ground. A rod mill is a large horizontal cylinder lined with heavy steel liners and filled with grinding rods approximately 51 to 76 mm (2 to 3 inches) in diameter and slightly shorter than the length of the mill. The mill will be rotated by means of an electric motor and the rods tumble as the mill rotates. As the ore and water pass through the mill, the ore will be crushed between the tumbling rods to a particle size approximatly the consistency of coarse sand. Because rod mills will not efficiently grind the ore to the necessary particle size for complete mineral liberation, an additional stage of grinding will be required.

The rod mill discharge will be pumped to a cyclone classifier in the ball mill grinding circuit. A cyclone classifier separates particles based on their size. The ore slurry will be pumped into the cyclone under pressure which causes the mineral slurry to rotate and the coarse particles will pass to the outside of the cyclone and will be collected at the bottom, while the finer particles will tend to collect towards the center and pass through the top of the cyclone. Figure 6 (attached) contains a cutaway drawing of a cyclone. The coarse particles from the bottom of the cyclone will be directed to a ball mill for further grinding.

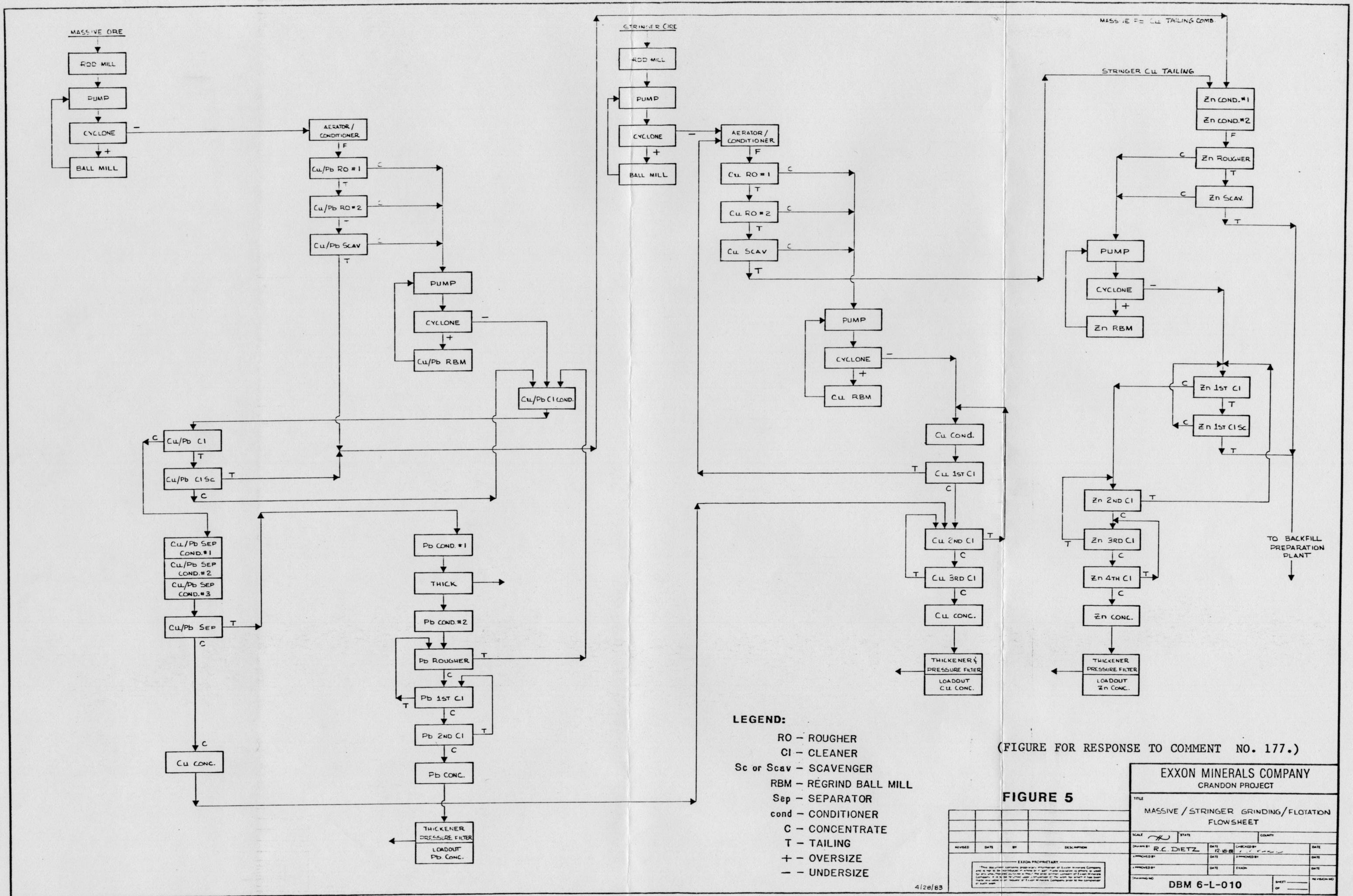
The slurry containing the coarse particles from the cyclone classifier will be ground in a ball mill. A ball mill is very much like a rod mill in that it is a horizontal rotating cylinder lined with heavy steel liners and rotated by an electrical motor. The ball mill will be filled with alloy steel balls ranging in size from approximately 6 mm (0.25 inch) in diameter to a maximum of about 51 mm (2 inches). As the mill rotates and the slurry of ore and water passes through the mill, the impact and abrasion of the

(FIGURE FOR RESPONSE TO COMMENT NO. 177.)



– NOT TO SCALE –

FIGURE 4 -- Cut-away view of a cone crusher.



(FIGURE FOR RESPONSE TO COMMENT NO. 177.)

FIGURE 5

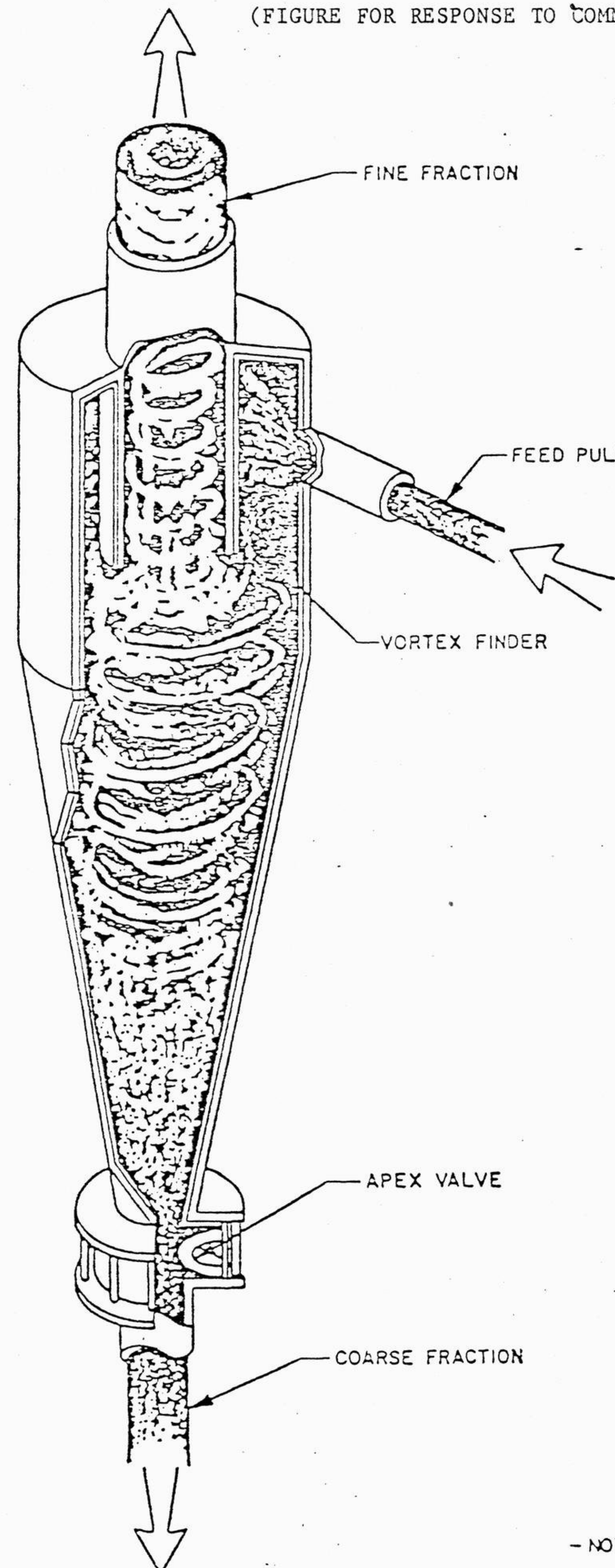


FIGURE 6 -- Cut-away view of a cyclone classifier.

balls falling on the mineral particles will cause them to break and result in ore size reduction and liberation. The discharge from the ball mill also will be pumped to the cyclone classifier, where the fine particles will be removed and the coarse particles recycled to the ball mill.

Flotation

The slurry from the cyclone overflow will pass to an aeration step in which the slurry will be conditioned with reagents and air to prepare it for the flotation of the sulfide minerals. The aerators will consist of large slurry tanks containing agitator mechanisms which serve to dispense air into the slurry. Products from the aerator will be fed to the respective flotation circuits. The aerator for the massive ore will precede the bulk copper-lead flotation of the massive ore, and the stringer aerator will precede the copper flotation of the stringer ore.

- Copper-Lead, and Lead Flotation Circuits

  After grinding, aeration, and conditioning with reagents, the massive ore slurry will be fed into the distributor feeding several banks of flotation machines. This flotation step will produce copper-lead rougher concentrate which requires further processing. The tailings from the copper-lead rougher flotation will pass to a scavenger flotation step in which additional copper and lead minerals will be recovered by flotation. The tailings from the copper-lead scavenger circuit will contain zinc from the massive ore and will be pumped to the zinc circuit.

  The copper-lead rougher and scavenger concentrate will be pumped to a regrind circuit containing a ball mill and cyclone classifier. Upon regrinding of the concentrate, the copper minerals will be separated from the lead minerals by another step of flotation. The copper concentrate will then be pumped to the combined copper cleaning circuit for the stringer ore. The lead tailing will then be pumped to a lead circuit to produce a lead concentrate.

- Copper Flotation

  After grinding, aeration, and conditioning with reagents, the stringer ore will be subjected to flotation for the production of a copper concentrate and a tailing containing recoverable zinc. The copper flotation circuit will be similar to the massive copper-lead circuit containing roughing and scavenger steps.

  The copper rougher and scavenger concentrate will be reground and then, together with the copper concentrate produced in the copper-lead circuit of the massive ore flotation process, will be cleaned in a separate step. This cleaning will result in the production of a final copper concentrate.

- Zinc Flotation

The feed to the zinc flotation circuit will consist of the following two tailing products:

1) Stringer ore scavenger tailing;

2) Massive ore copper-lead scavenger tailing.

The total zinc flotation circuit feed will be conditioned with reagents and directed to zinc flotation. Zinc rougher and scavenger concentrates will be produced.

The zinc rougher and scavenger concentrate will be reground prior to cleaning. The regrind circuit will consist of a ball mill and cyclones operating in closed circuit. Following regrinding, the concentrate will be cleaned four times to produce a final zinc concentrate. The zinc scavenger tailing will pass to the backfill preparation circuit.

Concentrate Handling

In the process described above, the zinc, copper, and lead minerals will have been concentrated and separated. The step remaining will be to separate the concentrates from the water that accompanies them in the processing to facilitate storing and shipping of the concentrate.

The dewatering process will occur in two steps. First, the froth will pass to a thickener where the solids will be allowed to settle. The thickened concentrates will be further dewatered by means of a filter, resulting in a filter cake containing approximately 8 to 12 percent moisture. The filtered concentrates will be transported by belt conveyors to a concentrate storage and loadout facility. Concentrate shipment will be by rail.

Backfill Systems

The underground mining method used for extracting ore, termed sublevel open stoping, uses backfill to stabilize the peripheral in-place rock after the ore is mined. The backfill material to be used is a combination of the coarse fraction of the mill tailing and cement. A cyclone classification process will be used to recover the coarse fraction of the mill tailing. This process is shown in Figure 7 (attached).

The mine backfill will use all the coarse fractions of the mill tailing. The coarse tailing will be mixed with cement (as required) and water and will be pumped to the mine as backfill. The fine fraction of the mill tailing will be too fine for use as mine backfill and will be pumped to the tailing pond as waste.

The backfill preparation plant will include two sets of pumps and three cyclone clusters to recover the coarse fraction from the mill tailing, storage tanks for the coarse tailing, a cement storage tank with feeder, a batch mixing tank, and pumps to deliver the prepared backfill mix to the

(FIGURE FOR RESPONSE TO COMMENT NO. 177.)

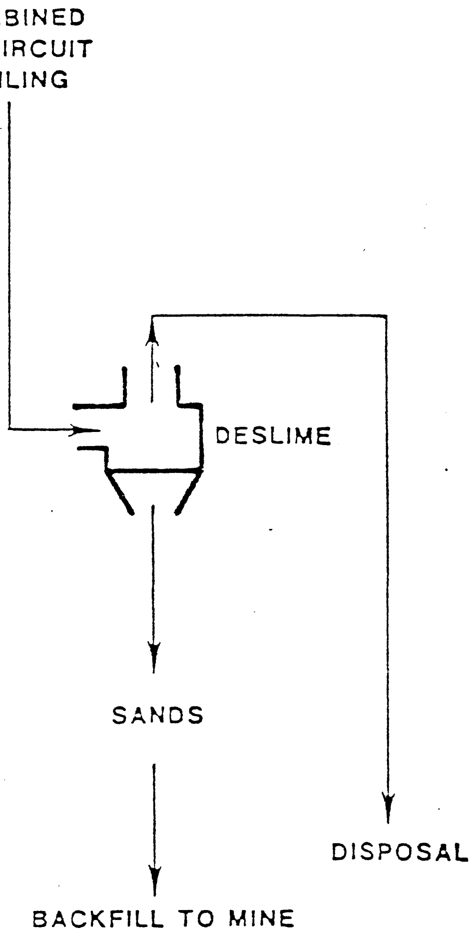


FIGURE 7 -- Schematic flowsheet of tailing desliming step for mine backfill.

mine. The backfill preparation area will also include temporary storage bunkers for backfill and storage when, for short periods of time, the mine cannot accept backfill (see also response to comment No. 179 for a more complete description).

Fine Tailing Thickening

The fine fraction of the final mill tailing will be pumped to a tailing thickener located outdoors. The thickened underflow will be pumped to the tailings pond. A portion of the clarified thickener overflow water will be recycled to the backfill preparation facility, while the remainder will be pumped directly to the reclaim pond.

SECTION 1.4.3.3, CONCENTRATE HANDLING AND SHIPPING

Comment No. 178

Provide a detailed description of the physical characteristics of the concentrates.

Response:

The following information summarizes the physical characteristics of the three concentrates.

	Copper	Lead	Zinc
Specific gravity	4.21	4.14	4.06
Color	brassy	black	brassy
Approximate % Moisture	9	9	8
Particle Size	90% -25μm	90% -25μm	90% -25μm

SECTION 1.4.3.4, SURFACE BACKFILL SYSTEM

Comment No. 179

Provide additional information on the operation of the mine backfill storage and preparation plant. Describe how the backfill sand will be recovered and prepared for replacement into the mine while maintaining a sufficient level of quality to assure stability of the backfilled stopes.

Response:

The process flow diagram No. DBM-6-L-009 in Attachment No. 16 illustrates the method of storing and handling cycloned sands for mine backfill. The following is a brief description of the process. The cycloned sands are pumped from the desliming cyclones directly to a "repulping tank." The system described here for repulping from the repulping tank is similar to that used successfully at other operating mining properties.

The lower part of the repulping tank is shaped to a cone and fitted with a nozzle and jet system to permit repulping to the highest percent solids consistent with pumpability. At other operations this has been approximately 70 percent.

To deliver sand to the mine, the nozzle/jet system is activated and the repulping tank discharge valve is opened. A density controller in the discharge line maintains the required percent solids.

Cement is added to the system by injection of the cement slurry directly into the tailings slurry feed line to the mine. The variable speed drive of the rotary feeder at the discharge of the cement bin is controlled by a mass totalizer in the tailings slurry line, thus assuring the correct cement/sands ratio (assumed 6 percent by weight).

Limited surge storage of cycloned tailings sands is provided in horizontal concrete storage bunkers. A total of six such bunkers provides sufficient capacity for the storage of approximately 18,000 t (20,000 short tons) of cycloned tailings sands (approximately 4 days of mill production). These bunkers are located inside and adjacent to the fine ore crushing area.

The tailings sands are reclaimed from the bunker using monitor jets to wash the material into a collecting launder and sump. A sand reclaim pump delivers the sand slurry at 30 to 60 percent solids to a second repulping tank for density adjustment. The cement slurry is then injected into the delivery line to the mine as before.

High quality backfill mixture is assured by the two desliming cyclones placed in series and the precise density control and sands/cement ratio control which can be achieved with the system proposed.

SECTION 1.4.3.6, WATER BALANCE

Comment No. 180

The tailings ponds and reclaim ponds should be included in Figure 1.4-10. Do the numbers and this figure represent maximum flows in each stream? If not, please show the maximum flows expected.

Response:

EIR Figure 1.4-10 is a water balance for the mill and related process facilities and was not meant to depict the whole Crandon complex. A detailed overall water balance for the mine, mill, tailings and reclaim ponds is presented on EIR Figure 1.4-18 in subsection 1.4.5. The flow rates listed on EIR Figure 1.4-10 or 1.4-18 were used for preliminary design. Maximum flow rates for water treatment and discharge are addressed in the WPDES Permit Application. Sizing of the unit process operations in the water treatment facility is commented on in Sections VIII "Conceptual Design Basis" of Volume 2 of the CH2M Hill's Phase III Water Management Study (previously provided to the DNR). Maximum and minimum flow rates for all streams will be assessed in final engineering.

Comment No. 181

What will be the source of the fresh water required for the mill process start-up? What will be the source of the standby water?

Response:

Mine water stored in reclaim ponds R1 and R2 will be used as a source of water for mill start-up. Standby water required during mill start-up or mature operation will be from the reclaim pond or high-capacity well.

Comment No. 182

Please provide the data, methods, assumptions and model used to derive the water balance.

Response:

The basis for the water balance for the mill and related facilities, as depicted on EIR Figure 1.4-10, is primarily the CH2M Hill Report Phase III Water Management Study (previously provided to the DNR). Sections IV-Site Water Sources, V-Site Water Use, and VI-Water Losses from Site contain the data and assumptions for the water balance.

To a large extent, the ore tonnage through the mill defines mill process water requirements. Processes such as grinding and flotation in the mill and related facilities operate at optimum percent solids. A water and solids material balance is presented in Figure 4 "Mill Water Balance-Mature Operation," Section VII-Crandon Water Balance of the Phase III Water Management Study. A more detailed material balance inside the mill facility is given in Figure 2 "Metallurgical and Material Balance for 9,555 DMTPD Capacity" in Section V-Site Water Uses. A general description of the operation of a mill is given in Chapter 1 of the EIR, subsection 1.4.3, Mill Operations and in the response to comment No. 176.

SECTION 1.4.3.7, REAGENT RECEIVING, STORAGE & USE

Comment No. 183

Provide a diagram illustrating how and where various reagents are introduced into the flotation process.

Response:

The addition points for the various reagents are shown in the attached Figures 1, 2 and 3. Generally, these reagents are added as aqueous solutions or slurries through steel or plastic pipe to the addition points in the flotation and grinding process. Whenever possible, the supply pipes are extended below the surface of the ore slurry stream.

FIGURE 1

EXXON MINERALS COMPANY
CRANDON PROJECT

MASSIVE ORE FLOWSHEET
GRINDING AND COPPER-LEAD FLOTATION

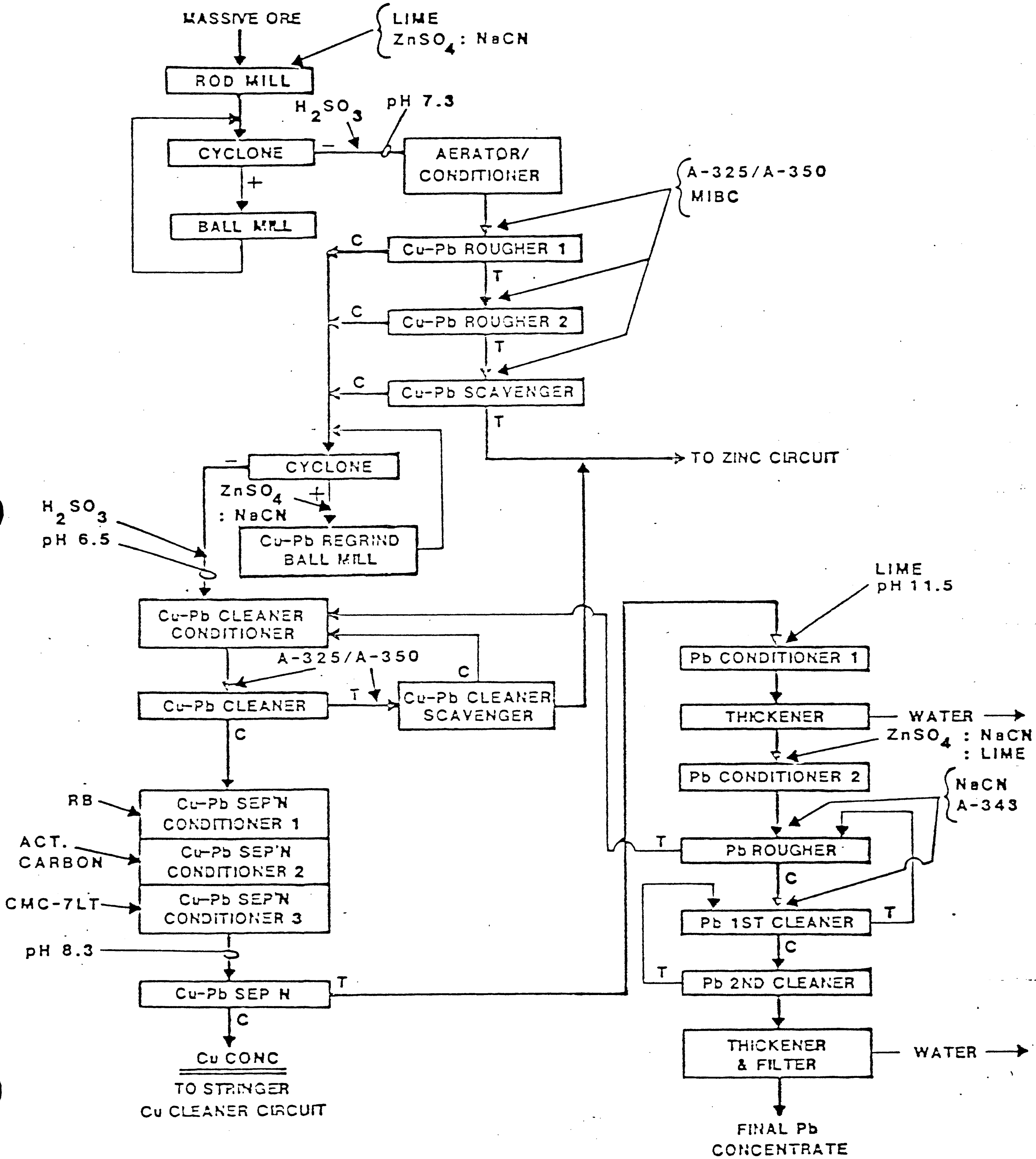


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FIGURE 2

EXXON MINERALS COMPANY
CRANDON PROJECT

STRINGER ORE FLOWSHEET GRINDING AND COPPER FLOTATION

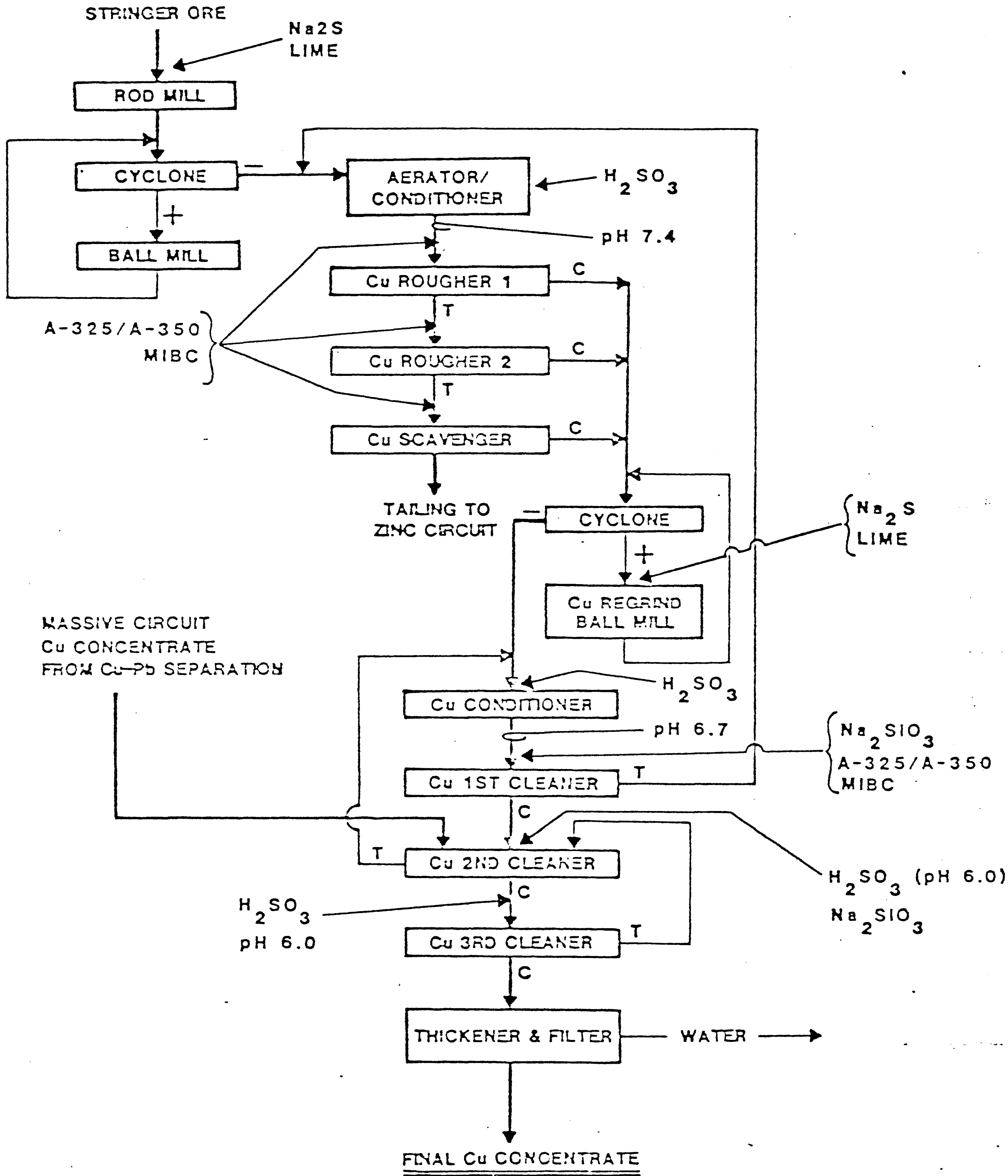

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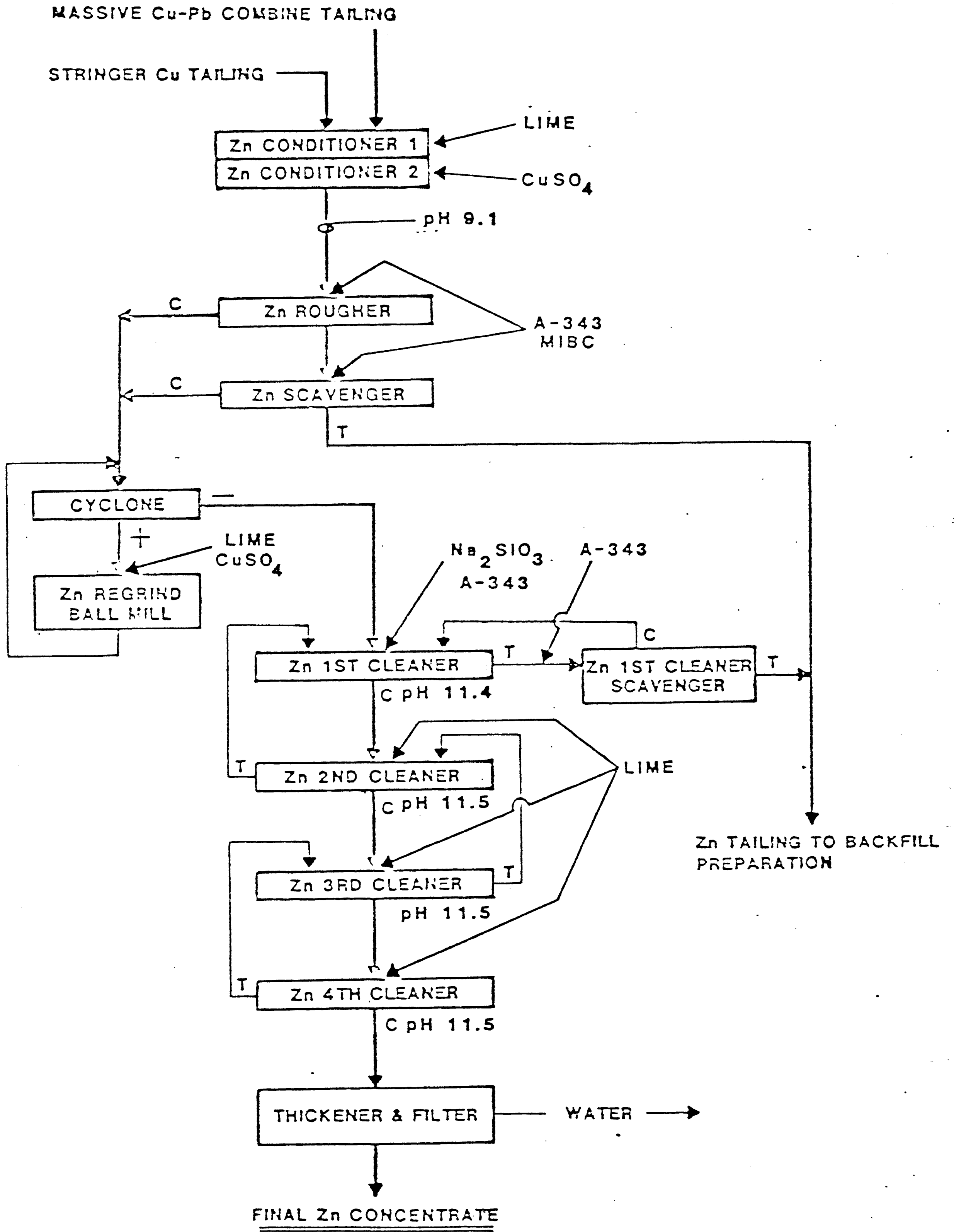
FIGURE 3

EXXON MINERALS COMPANY
CRANDON PROJECT

COMBINED ZINC FLOTATION FLOWSHEET



A-ME-0056 2-4-82 RCD

Comment No. 184

What will be done with reagents in damaged containers? How will nonreturnable reagent containers be disposed?

Response:

EIR Table 1.4-4, "Typical Reagent Use, Consumption Rate, and Storage" in subsection 1.4.3.7, indicates that those reagent chemicals used in bulk quantities are received by tank car, railcar, or truck. If these bulk shipment "containers" are damaged, which would interfere with the use of the reagent, the shipper would be contacted to either repair the "container" or arrange for its return. The railroad will not accept cars or other containers damaged in any way which makes them unsafe to transport.

Chemicals/reagents received in drums, bags or small containers, if damaged to the point of not being useable, would be returned to the vendor. For example, sodium cyanide is received in specially designed containers (Flo-Bin™) owned and provided by a vendor. If these were damaged they would be returned to the vendor.

Nonreturnable reagent containers such as bags, would be disposed in a licensed solid waste facility. Fiber drums are returnable and reusable.

SECTION 1.4.3.9, LUBRICATION

Comment No. 185

What type of storage facility will be available for waste oil and grease?

Response:

Waste oil and grease will be retained in drums or holding tanks pending removal off-site. This material may be sold for reuse.

SECTION 1.4.3.10, SPILLS AND ODORS

Comment No. 186

Describe the reagents and odors which may need to be exhausted through the atmosphere. Discuss the odors' nature, frequency, duration and intensity of odors. Discuss the potential of generation of hydrogen sulfide and other odors from the concentrator and if possible mechanisms for control.

Response:

The list of reagents to be used in the concentrator is presented in Table 1.4-4 of the EIR. Of these, the xanthates may produce a noticeable odor in the immediate flotation area, within the concentrator building. The odors from this source will dissipate rapidly inside the building and will not be discharged by the building's heating and ventilation systems in detectable amounts to the atmosphere.

EIR subsection 1.4.3.7, Reagent Receiving Storage and Use, will be revised as follows: Liquid sulfur dioxide will be added directly as needed to the ore slurries. It will rapidly dissolve to form sulfurous acid and will not be emitted as SO_2 to the atmosphere. All odors produced will occur for short periods (10 minutes or less) and almost exclusively during reagent mixing. Control of odor generation will be affected by proper and safe handling and mixing of reagents and immediate capture and containment of all spills.

Comment No. 187

Where would spilled reagents be disposed of if necessary?

Response:

There should be no disposal of reagents. Recovered reagents will be collected in such a manner to assure that they can still be used as intended. Reagent storage and preparation facilities will be designed with the criteria that any spills are to be contained for recovery and use. Also, see the response to comment No. 70.

SECTION 1.4.4.2, TAILINGS SLURRY AND WATER TRANSPORT SYSTEMS

Comment No. 188

Describe any leak detection system and proposed facilities or actions designed to prevent groundwater contamination in the event of a pipeline failure. What inspection, maintenance and replacement procedures are planned?

Response:

Leak detection systems and actions designed to prevent ground water contamination in the event of a pipeline failure are described in the response to comment No. 84.

The pipeline corridor will be visually inspected by periodically walking along the route. Physical inspection of pipe materials is best conducted at the pump station during scheduled maintenance. Physical measurements of pipe wall thickness will be completed routinely. If necessary, flanged pipe test spools can be inserted into the pipelines at selected intervals and in easily accessible locations.

Spare plastic pipe will be stored on-site so that it is available for repairs when required. Repairs to HDPE pipelines are expected to be needed infrequently and the pipeline life in slurry service is expected to be longer than would be anticipated for pipelines constructed of alternative materials. For water service, the life of HDPE pipe is expected to be longer than would be expected for carbon steel pipe.

SECTION 1.4.4.3, MINE WASTE DISPOSAL PONDS

Comment No. 189

Describe a "suitable" water depth in the tailings pond. Provide details on how the slurry discharge into the ponds will be conducted in order to prevent degradation of the filter and drainage layers.

Response:

The development of the pond water pool is dependent on the permeability of the exposed filter area embankment slope and the rate of decant pumping. These considerations are presented in the paper "Tailing Ponds Water Clarification Pools" (previously provided to the DNR). From that study it appeared that pond depths of approximately 5.0 m (16.4 feet) would be maintained. A barge mounted pump system is planned to decant water from the tailings pond.

Waste rock will be used as necessary at the slurry discharge point to protect the filter and drain layer from erosion. A rock layer of a few feet will cover the filter/layer in the area of the slurry discharge. Regular inspection and maintenance of the protective waste rock will ensure that erosion of the underlying layers does not occur.

Comment No. 190

This section should also describe operation of the seepage control systems during both short and long-term mine shutdowns.

Response:

Operation of the seepage control system will be maintained during Project shutdowns. While the volume rate of underdrain pumping is not great, it is important to remove water entering the underdrain to minimize the water head on the liner. This assures that seepage through the liner will be minimized. These flows will normally be pumped to the water reclaim ponds. Water treatment and discharge facilities will be operated during plant shutdowns to handle mine inflow and other water streams, such as the reclaim water return. However, there is excess capacity in the reclaim pond system for storage of additional water should it be necessary. Also, although it is not anticipated, it would be possible to recirculate underdrain water within the tailings pond. This would increase the tailings pond water volume, and increase the total water pumped from the underdrain, but would maintain the minimal tailings pond seepage rates.

SECTION 1.4.5.1, WATER RECLAIM SYSTEM

Comment No. 191

Provide additional detail on the operation and the maintenance of the reclaim ponds. Describe specifically the chemical constituents the ponds are designed to control. Describe the chemical and physical characteristics of the water going into and out of both ponds. Please be more specific than "trace" and "small amounts". Provide data to support the projected treatment which will occur in the ponds. Provide data which will support the expected cyanide reduction due to treatment in the ponds.

Response:

Details on the operation and maintenance of the reclaim ponds are provided in responses to comment No. 109 through 117, particularly No. 113. Relevant portions will not be repeated here.

The chemical composition change projected to occur across the reclaim pond is presented in the CH2M Hill Phase III Water Management Study, Volume 3, Appendix E, "Model Printout - Mature Operations (reclaim pond influent is column heading No. 117, effluent is column heading No. 118). This report was previously provided to the DNR. Essentially the projected difference between reclaim pond influent and effluent is that the total organic carbon (TOC) is reduced by 90 percent and that the thiosalts are reduced by 90 percent in summer and 10 percent in winter.

Cyanide is degraded during ponding by such mechanisms as: volatilization, photodecomposition, oxidation, biodegradation, and precipitation/adsorption. The first two, volatilization and photodecomposition, are thought to be the most important mechanisms. Thus, in the absence of an ice cover, cyanide concentration is found to decrease during ponding. This is documented in the literature for Dome mines in Ontario, where from degradation mechanisms alone, the cyanide concentration in a gold mill effluent was decreased from 68.7 to 0.08 mg/l (99.9 percent) for the period April through September. Cyanide is also reported to react with reduced sulphur species (thiosulfates) to produce thiocyanate, as follows:

$$CN^- + S_2O_3^= \Longrightarrow SCN^- + SO_3^=$$

The following are supporting references:

Schmidt, J. W., et. al., Natural Degradation of Cyanides in Gold Mill Effluents, Presentation for Cyanide and Gold Mining Industrial Seminar, January 22-23, 1981, Ottawa, Ontario.

Ingles, J. C. and Scott, J. S., Overview of Cyanide Treatment Methods, Presentation at the Cyanide and Gold Mining Seminar, January 22, 1981, Ottawa, Ontario.

Luthy, R. G. and Bruce, Jr., S. G., Kinetics of Reaction of Cyanide and Reduced Sulphur Species in Aqueous Solution, Environmental Science and Technology, 13, December 1979, 1481-1487.

Comment No. 192

How will anaerobic decomposition affect the thionate oxidation process? Provide data to demonstrate the compatibility of the liner materials with the chemical characteristics of the water.

Response:

As stated in the response to comment No. 115, it is not expected that the reclaim pond will go anaerobic. As documented in the response to comment No. 113, thiosalts are effectively biodegraded in reclaim ponds. The anaerobic decomposition products of thiosulfate would be to change the relative proportion of one polythionate species to another (i.e., $S_3O_6^=$ vs. $S_4O_6^=$).

The compatability of reclaim pond water with synthetic liner materials is discussed in "Evaluation of Prospective Common Liners, Crandon Project, Waste Disposal System, Project Report 6.2", dated December 1981 prepared by Golder Associates (previously given to the DNR).

Comment No. 193

While the volume of the reclaim ponds will provide surge capacity when both ponds are in operation, what will happen if one of the ponds is taken out of service.

Response:

Reclaim pond R1 has a depth of 8.7 m (28.5 feet) and reclaim pond R2 a depth of 7.0 m (23.0 feet). Maximum normal operating water level for both ponds will be maintained at 6.1 m (20 feet). With this water volume and the planned flow rates, water will be retained in the pond system for the desired time. The freeboard capacity of the ponds serves a number of purposes including: 100-year, 24-hour storm and wave runup, probable maximum precipitation (PMP) for 6 hours (including the volume of water from the largest tailing ponds), or 2 weeks of excess water system discharge flow (at 2500 gallons per minute) if that water had to be returned and held in the reclaim ponds. All of these events can be accommodated singularly, but not simultaneously. The system is designed as a two pond system and shutdown of a pond is not planned or anticipated. If for some unexpected reason that became necessary, a change in operating procedures would be required. If process flow rates were to be maintained, then a reduced retention time would have to be accepted and, if reclaim pond R2 was the remaining pond, then a lower water operating depth would be necessary to maintain sufficient freeboard capacity.

SECTION 1.4.5.2, WATER TREATMENT SYSTEM

Comment No. 194

(1) While the maximum flow of contaminated groundwater is shown in Figure 1.4-17, the other flow values given are average. Please provide maximum flows for each of the processes shown in this figure. What are the flow values for the "brine" "condensate" and "reverse osmosis permeate". (2) The area for "discharge to environment" shows two flow blocks. Since one is labeled Maximum, is the other Average? (3) What is the projected maximum which could be recycled back to the mill? (4) Provide a discussion of factors which could prevent recycle of water to the mill. (5) What effect would elimination of the recycle to the mill have on the projected maximum discharge flow?

Response:

(1) Typical and maximum flow rates for the water treatment plant are shown in the CH2M Hill, "Phase III Water Management Study", Volume 3, Figures 26 through 29. Average flow rates are presented in EIR Figure 1.4-17. The total flow rate of reverse osmosis permeate, and condensates from the evaporator and crystallizer will range from 194.6 to 396.9 m^3/h (857 to 1749 gallons per minute).

(2) The "discharge to environment" line in EIR Figure 1.4-17 indicates a flow rate of 202.3 m^3/h (892 gallons per minute) as an average if there is no uncontaminated mine water entering the discharge. The discharge volume of 429.4 m^3/h (1892 gallons per minute) includes the 202.3 m^3/h (892 gallons per minute) of treated water and a maximum of 227.1 m^3/h (1000 gallons per minute) of uncontaminated mine water. A total volume of 624 m^3/h (2,749 gallons per minute) could be discharged under the following situation:

- mill is shutdown and no treated recycle water is needed
- water treatment plant continues to operate at normal capacity
- uncontaminated mine water flow is at 227.1 m^3/h (1000 gallons per minute).

(3) The projected volume of treated water to be recycled to the mill is 194.6 m^3/h (857 gallons per minute). Examination of EIR Figure 1.4-10 indicates that all process requirements are met by recycling untreated and treated water.

(4) Water would not be recycled to the mill from the treatment facility if the mill were shutdown (i.e., for maintenance).

(5) Elimination or reduction of the treated water recycled to the mill would simply add a corresponding volume to the discharge. This assumes that the treatment plant is operating at its normal capacity.

Comment No. 195

Will the treatment system be designed to accommodate full treatment of the "uncontaminated" mine water? What measures will be available if the mine inflow exceeds the expected 2,000 gallons per minute?

Response:

The treatment plant will not be designed to treat the "uncontaminated" mine water, which could be up to a maximum of 227.1 m^3/h (1000 gallons per minute). If this water is intercepted at ground water quality (see EIR Table 2.3-8), it should not require treatment. However, if it is determined that this water does require treatment on a long-term basis, appropriate water management and treatment technology would be used. Also, see the response to comment No. 106 for additional information on this subject. A discussion of total mine inflow potential is presented in the response to comment No. 62.

Comment No. 196

What are the projected wastewater characteristics going into each of the treatment systems? What are the projected treatment system effluent characteristics? Exxon does not need the effluent limits to derive this information.

Response:

The projected water analysis of the three principal influent streams and the corresponding effluent for water treatment and monitoring systems are documented in the CH2M Hill Phase III Water Management Study, Volume 3, Appendix E "Model Printout Mature Operations" (previously provided to the DNR). The particular columns in the computer printout which correspond to the influent and effluent stream composition for each identifying stream and its treatment system are identified below:

STREAM	INFLUENT*	TREATMENT	EFFLUENT*
Uncontaminated mine water	1	none	1
Contaminated mine water	69	lime-soda softening	207
Reclaim pond water Recycle to mill	118	lime-soda softening RO/VCE	209

*Computer print-out column number

The WPDES Permit Application will provide information on chemical composition of influent and effluent water on the treatment system for discharge.

SECTION 1.4.5.2, WATER TREATMENT SYSTEM

Comment No. 197

(1) Under what circumstances would or would not the "uncontaminated" mine water go through the water treatment system? (2) Assuming all "uncontaminated" mine water would need to be treated, how long could the mine and mill continue to operate in the event of a treatment system failure?

Response:

(1) The "uncontaminated" mine water (or intercepted ground water) would be treated appropriately if necessary. If the discharge water quality does not meet WPDES effluent limits, and the source is the "uncontaminated" mine water, appropriate water management and/or treatment technology would be used. For example, if the problem was deemed to be short-term, the "uncontaminated" mine water could be temporarily pumped to the reclaim ponds. However, if the problem is expected to be long-term, the "uncontaminated" mine water would receive appropriate treatment.

(2) Assuming that the total water pumped out of the mine is 530 m^3/h (2335 gallons per minute) and that none of it can be disposed, and that 194.6 m^3/h (857 gallons per minute) are still required as make up in the mill, the remaining 335.6 m^3/h (1478 gallons per minute) would be pumped to the reclaim ponds if the treatment plant was completely shutdown. Assuming 310,950 m^3 (82,153,000 gallons) of available freeboard volume (75 percent of total freeboard) in two reclaim ponds, the mine and mill could continue to operate for 39 days before this freeboard volume is used up. This still leaves freeboard for the 100-year, 24-hour storm and allowance for wave run-up. In addition, there is freeboard volume available in the operating tailing pond that could be used to store additional water. However, it is highly unlikely that the treatment plant would be totally shutdown for extended periods of time.

Contaminated water from mine	1335 gpm
Uncontaminated	1000 gpm
	2335
Less water needed in mill	857
	1478 gpm

Freeboard available 82,153,000 gal (75 percent of total)

$$\frac{82{,}153{,}000 \text{ gal}}{1478 \text{ gal/min}} = 55{,}584 \text{ min or about 39 days}$$

SECTION 1.4.6, OVERALL WATER BALANCE

Comment No. 198

The overall water balance provided was for "mature" operation. When will the mine/mill complex become "mature"? Provide a discussion of the water balance over the start up, development, operation, and closure of the mine.

Response:

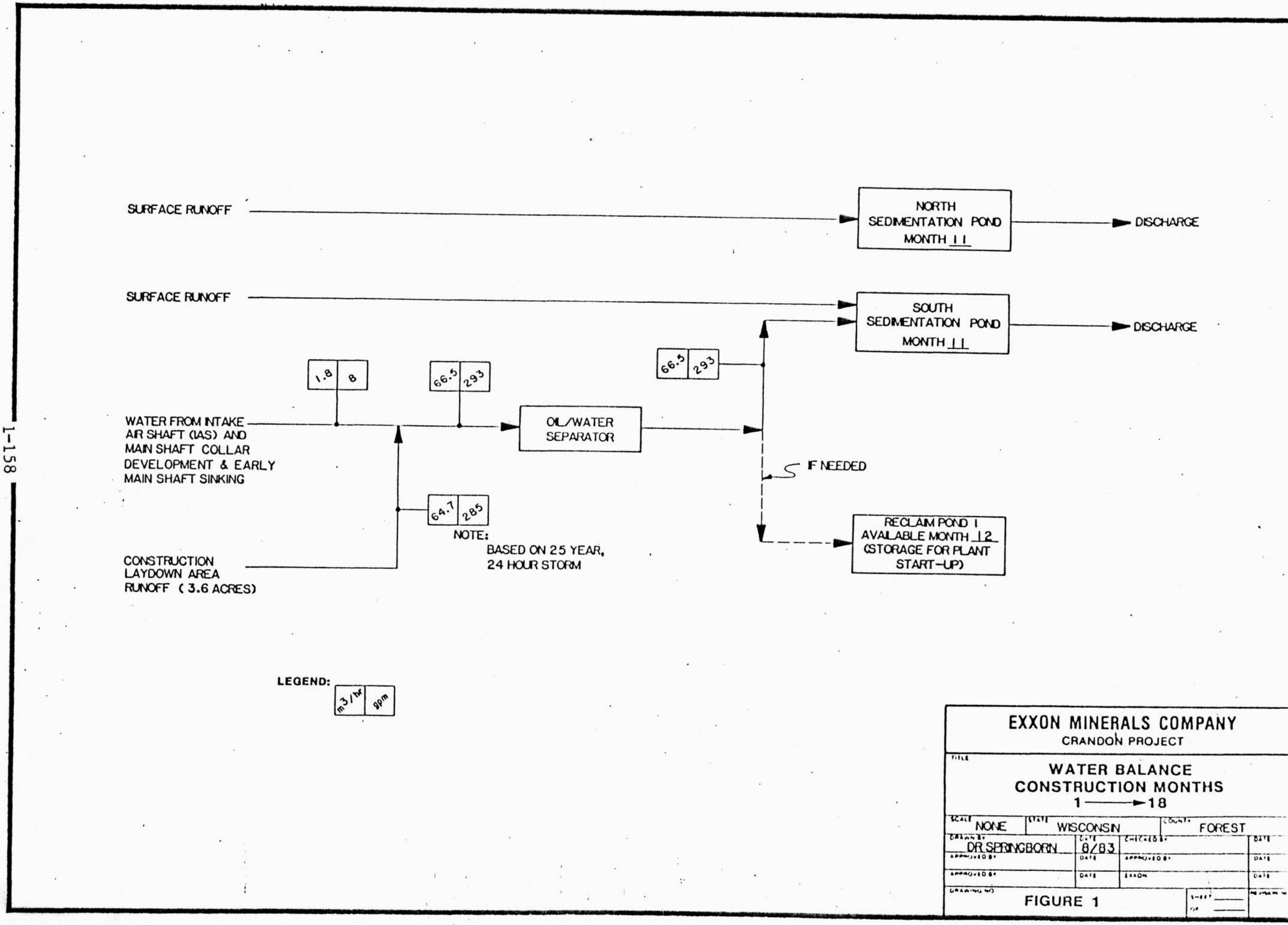
"Mature" operation of the mine/mill complex begins when the mine and mill have both reached their normal operating capacity. This is currently expected to occur in 1991.

Water balances for construction, start-up, and mine closure cannot be accurately shown because they represent periods when conditions will change continuously. However, Figures 1 and 2 (attached) show conceptually how water will be handled during these periods; volumes shown on these figures are the flow rates currently being considered in the design.

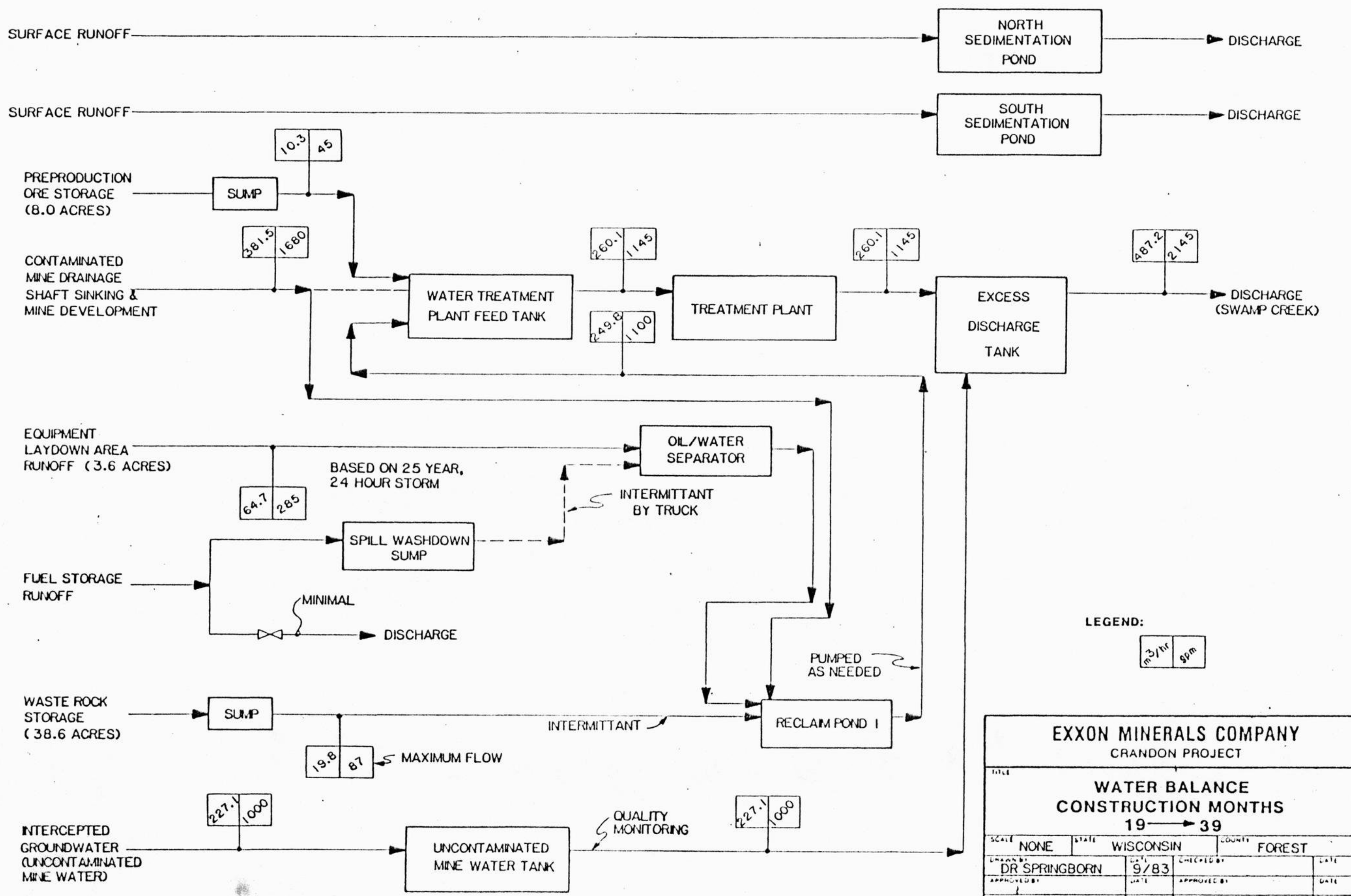
Figure 1 shows the balance for the first 18 months of actual construction. The north and south sedimentation ponds would be constructed early and will remain in use throughout the life of the Project as part of erosion control system; they will serve to remove sediments from surface runoff and control the direction and rate of discharge of the runoff. Water from the intake air shaft sinking and main shaft collar development will be collected and sent to the oil/water separator near the northwest corner of the south sedimentation pond. Water from the separator will flow into the south sedimentation pond. During this same period, allowance has been made to collect runoff from a 1.45-ha (3.6-acre) area designated "Construction Laydown Area." There is potential for oil contamination in this water and it will also go to the oil/water separator. The flow rate shown is 64.7 m^3/h (285 gallons per minute) which is equivalent to a 25-year, 24-hour storm event. The flow rate from this area is more likely to average about 1.3 m^3/h (5.7 gallons per minute) over the year.

Figure 2 shows how water will be handled during construction months 19 through 39. Again both sedimentation ponds are available to receive surface runoff from the Project site. Runoff from the preproduction ore storage area will be collected in an adjacent sump and pumped directly to the water treatment plant feed tank or, alternatively, it could go to the reclaim pond if necessary. The runoff volume shown in Figure 2 of 10.3 m^3/h (45.2 gallons per minute) assumes collection of runoff from a 25-year, 24-hour storm and pumping that volume to the treatment plant over a 14-day period. The contaminated water from mine shaft sinking and mine development will reach a peak flow rate of about 382 m^3/h (1680 gallons per minute) and then decrease to 227.1 m^3/h (1000 gallons per minute) or less. This water will be sent to the reclaim pond and pumped to the water treatment plant feed tank as necessary. It should be noted that the peak flow of contaminated mine water of 382 m^3/h (1680 gallons per minute) occurs before significant quantities of uncontaminated mine water (intercepted ground water) are encountered. Therefore, as stated in response to comment No. 164, the total water flow from the mine should not exceed 454.2 m^3/h (2000 gallons per minute). Storage in the reclaim pond will provide water needed for mill startup. Water from the equipment laydown area will continue to be treated by an oil/water separator and pumped to the reclaim pond. Runoff from the fuel storage areas will be discharged in a controlled manner by opening a valve to allow collected precipitation to drain. If a

(FIGURE FOR RESPONSE TO COMMENT NO. 198.)



1-158



EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE: WATER BALANCE CONSTRUCTION MONTHS 19 → 39		
SCALE: NONE	STATE: WISCONSIN	COUNTY: FOREST
DRAWN BY: DR SPRINGBORN	DATE: 9/83	CHECKED BY:
APPROVED BY:	DATE:	APPROVED BY:
APPROVED BY:	DATE:	EXXON:
DRAWING NO: FIGURE 2	SHEET: OF:	REVISION NO:

1-159

small fuel spill occurs, the spill and wash down water will be collected in a blind sump. The contents of the sump will be pumped into a tank truck and hauled to the oil/water separator; water effluent then goes to the reclaim pond. Runoff collected from the waste rock storage area will be pumped to the reclaim pond and stored for use as process water during plant startup. The volume shown is the water volume that accumulates during a 10-year, 24-hour storm event and is pumped to the reclaim pond over a 30-day period.

The mill is currently expected to start processing ore 40 months after the start of construction. A water balance for early operation is shown in Figure 3 (attached) and is a balance for milling a maximum of 5750 t/d (6340 short tons per day) of massive ore. Although minor revisions are expected to be made to this balance as a result of on-going engineering, the important point is that the handling of process water and mine water will be the same as for mature operation. The ore throughput during start-up will be increasing gradually during this period and water flows to and from the tailing pond and reclaim ponds will be increasing until they approach the volume flow rates for the mature operation of the mill.

It would be premature to develop a water balance for the closure of the Project, but the concepts can be discussed. Water will continue to be pumped from the mine until all salvageable equipment has been removed and mine closure operations have been completed. Contaminated water pumped from the mine will continue to be treated. Water coming from the tailings area will be retained in the reclaim ponds. Water will be pumped from the reclaim ponds at a controlled rate to the treatment plant, treated, and discharged. The treatment plant will continue to operate during the reclamation period as long as there is contaminated water requiring treatment prior to discharge.

Comment No. 199

(1)This section states that the average amount of water expected to be discharged will be up to 1893 gallons per minute. (2)Section 1.4.5.4 indicates that this figure is the maximum flow to be discharged. (3)Please specify the maximum flow to be discharged.

Response:

(1) The discharge volume shown in EIR subsection 1.4.6, Figure 1.4-18 includes 202.8 m^3/h (893 gallons per minute) of treated water and an allowance for a maximum of 227.1 m^3/h (1000 gallons per minute) of uncontaminated mine water. This gives a total discharge flow rate of 429.9 m^3/h (1893 gallons per minute).

(2) Subsection 1.4.5.4 addresses "Water Treatment Wastes" and not excess water discharge volume.

(3) The maximum effluent volume has been determined with the following assumptions:

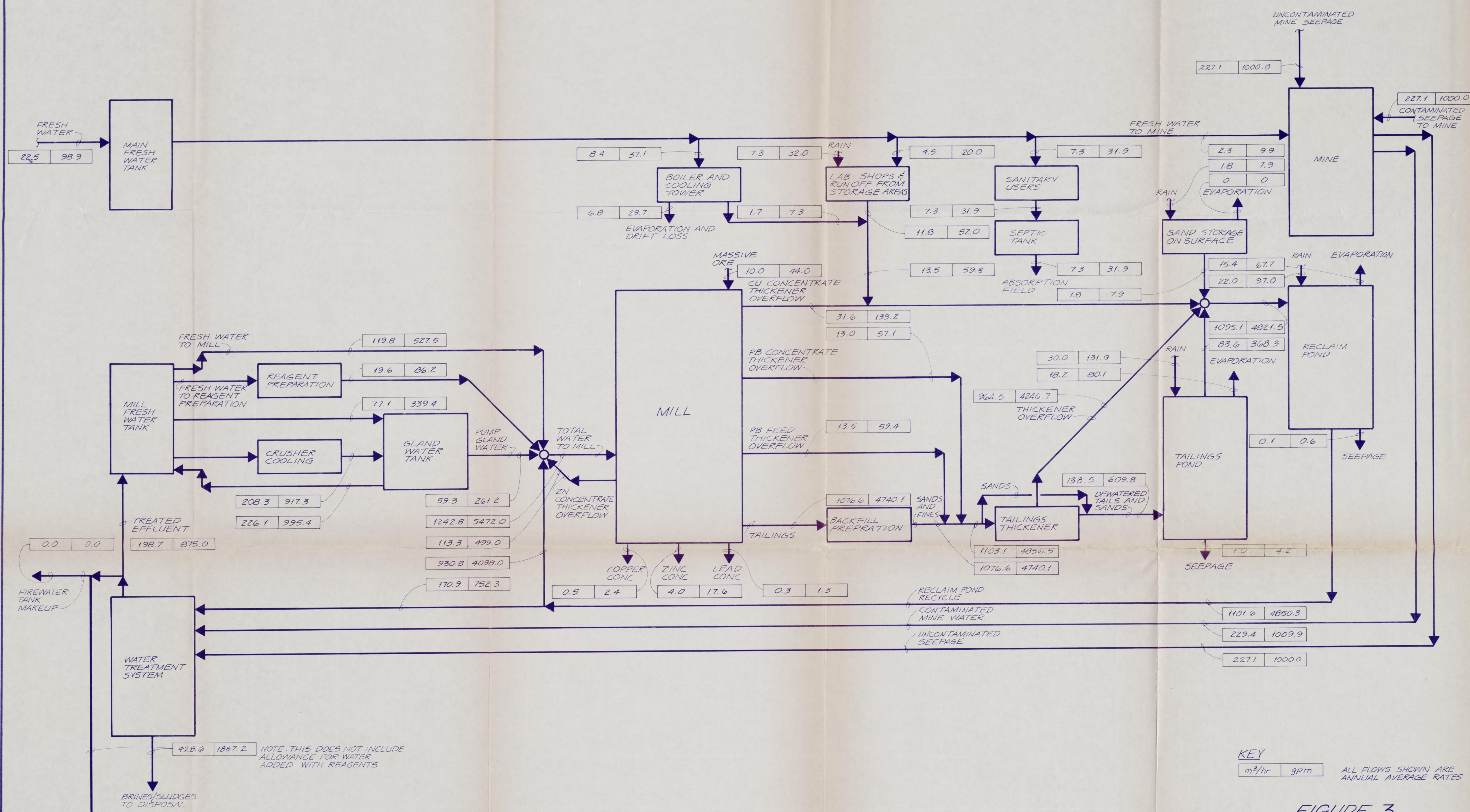


FIGURE 3

EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE: OVERALL WATER BALANCE FOR CRANDON PROJECT- EARLY SUMMER OPERATION

SCALE: NONE | STATE: WISCONSIN | COUNTY: FOREST

DRAWN BY: DLA
APPROVED BY: MRH

DRAWING NO. 051-7-L-011

CH2M HILL

EXXON PROPRIETARY

GBB 5/1981

SOURCE	ASSUMED MAXIMUM VOLUME FLOW RATES m^3/h	(gallons per minute)
Uncontaminated Mine Water	272.5	(1200)
Contaminated Mine Water	348.6	(1535)
Treated Reclaim Pond Water	60.2	(265)
Total	681.3	(3000)

These assumptions include 272.5 m^3/h (1200 gallons per minute) as the maximum flow rate of uncontaminated mine water. Contaminated mine water also includes 272.5 m^3/h (1200 gallons per minute) and 76.1 m^3/h (335 gallons per minute) of backfill drainage (and some excess potable water). An allowance was made to keep treating some water from the reclaim pond with the assumption that it would all be discharged (i.e., the mill is not operating and recycle is not needed). Under this unlikely set of assumed circumstances, the maximum discharge volume is estimated to be 681.3 m^3/h (3000 gallons per minute).

Comment No. 200

The maximum flow rate previously provided to the Department by Exxon of 3.34 cubic feet/second was used to develop preliminary effluent limits for Swamp Creek. This is substantially less than the apparent anticipated maximum flow. Final effluent limits will be based on maximum flow rate. Thorough documentation of the estimated maximum flow rate will be necessary.

Response:

The discharge rate of 0.119 m^3/s (1,893 gallons per minute) presented represents the estimated average. Documentation of the projected flow rates is provided in Sections IV through VII of the "Phase III-Water Management Study", December 1982, prepared by CH2M Hill (previously provided to the DNR). The maximum effluent volume is presented in the response to comment No. 199.

SECTION 1.4.7, OPERATIONS TRAFFIC

Comment No. 201

What was the basis for assuming 1.25 persons per vehicle? Please provide estimates of vehicle miles traveled. Quantify by type the truck traffic throughout the operation phase including trucks removing materials from the site.

Response:

For various studies of potential traffic effects from the Crandon Project, vehicle occupancy rates ranging from 1.0-2.0 people per vehicle have been used. The 1.25 persons per vehicle used for the operations traffic is conservative in predicting increased traffic. If 1.25 people/vehicle were assumed, the estimated daily mileage would be approximately 33,300 daily vehicle miles.

The trucks to and from the site will consist of panel trucks for small supplies, dump trucks for various wastes, and tank trucks for fuel hauling. Truck traffic anticipated during operations is presented in the attached listing.

SECTION 1.4.8.2, TREATMENT OF SANITARY WASTES

Comment No. 202

Provide the basis for the average daily flow rate of 32 gallons per minute. The Wisconsin Administrative Code referenced in Figure 1.4-20 should be H 63.14 rather than H 63.10.

Response:

A per capita flow rate of 0.19 m^3/d (50 gallons per day) has been used for estimating sanitary wastewater. The total sewage flow was based on a conservatively high project workforce of approximately 890 people. Additional detail on sanitary wastewater quantity is presented in CH2M Hill's Phase III Water Management Study, Volume I - Section VI (previously provided to the DNR).

The comment on the code reference correction is acknowledged.

SECTION 1.4.8.3, WASTE

Comment No. 203

This discussion of waste disposal is very general and does not substantially add to previous sections. Please discuss in detail the production, transport and disposal (including off-site disposal) of all waste materials.

Response:

The type and quantity of refuse expected are discussed in the response to comment No. 38. The exact location where refuse will be disposed has not been determined. However, the disposal site will be one that is licensed and operated under procedures approved by the State of Wisconsin.

SECTION 1.4.8.4, FUELS AND OTHER ENERGY REQUIREMENTS

Comment No. 204

The CPCN application estimates the peak electrical demand level at 37 mw while the EIR indicates a demand between 40 and 45 mw. Please resolve this discrepancy and provide a detailed electric load forecast, including a detailed list of equipment with electrical load data which comprise the mine energy requirements (including lighting, heating, etc.)

Response:

EIR subsection 1.4.8.4 includes a statement that the Project has a 40-45 mw load. This is the connected load not the demand load. The demand load was projected to be 37 mw with a 15 percent variation to allow for revisions

(LISTING FOR THE RESPONSE TO COMMENT NO. 201)

OPERATIONS TRUCK TRAFFIC

Item	Nominal Trucks per day	Actual Frequency	Truck
1) Mill balls @ 1.9 lb short ton ore 19,000 lb day	0.50 trucks/day	1 truck/2 days	Semi/Flatbed Trailer
2) Liners @ 65,000 lb/month	0.07 trucks/day	2 trucks/month	Semi/Flatbed Trailer
3) Explosives @ 7,000 lb/day	0.20 trucks/day	1 truck/week	Semi/Closed Trailer
4) Fuel oil 1,400,000 gal/year	1.00 truck/day	1 truck/day	Tanker
5) Gasoline 45,000 gal/year	0.03 trucks/day	1 truck/month	Tanker
6) Sodium sulfate (remove from site) @ 15 short tons/day (Maximum)	1.00 trucks/day	1 truck/day	Dump
7) All process reagents and water treatment supplies that will be delivered by truck	0.60 trucks/day	1 truck/day	Tankers Flatbed/ Closed Trailer
8) Operating supplies, drill steel, rock bolts, tires, timber, etc.	0.50 trucks/day	1 truck/2 days	Flatbed/ Closed Trailer
9) Scrap metal, rubber (remove from site)	0.03 trucks/day	1 truck/month	Dump
10) Waste oil, hydraulic fluid (remove from site)	0.03 trucks/day	1 truck/month	Flatbed
11) Replacement equipment and machinery parts	0.50 trucks/day	1 truck/2 days	Flatbed
12) Refuse, garbage, solid waste (remove from site)	0.50 trucks/day	1 truck/2 days	Dump
13) Sanitary sludge (remove from site)	0.07 trucks/day	1 truck/2 weeks	Panel
14) Office suppies	0.50 trucks/day	1 truck/2 days	Panel
15) Food, drink, vendor supply	1.00 trucks/day	1 truck/day	Panel
16) Concrete	1.00 trucks/day	1 truck/day	Mixer
average	7.53 trucks/day (8 trucks per day)		

during detailed engineering. Recent revisions have lowered the demand load estimate to 32 mw with a 10 percent variation. Data for the 32 mw demand load are based on current engineering, major equipment sizing with diversity factors, and allowances for miscellaneous equipment for the Project. A list of the equipment or projections in determining the load forecast will be provided in the revised EIR.

SECTION 1.4.9, POLLUTION CONTROL, EMISSIONS AND EFFLUENTS

Comment No. 205

Discuss the disposition of all air pollution control nonrecyclable dusts and sludges.

Responses:

There are no dusts and sludges which will be nonrecyclable from the air pollution control equipment. All concentrates will be recovered for shipment and other dusts and sludges will be recycled to the process streams.

Comment No. 206

Please provide a description of the separate burnt pebble lime facility in Section 1.2, including plan elevation drawings of process equipment and air pollution control equipment.

Response:

Detailed engineering of this facility is not complete. However, the design criteria specify that the dust associated with unloading, transferring, and slaking the lime will be adequately contained by use of a dust collector(s). See Attachment No. 6 to the response to comment No. 70 for drawings of the lime facility.

SECTION 1.4.10, OPERATIONS PERSONNEL

Comment No. 207

Please provide a detailed account by job category of operations workers including the hiring schedule by year to indicate work force buildup. Discuss the job categories which could be filled locally, and provide a detailed discussion on Exxon's hiring policies. Provide an estimate of the minimum and maximum number of positions filled locally, and the basis for those estimates. Discuss any contracts or agreements at other Exxon operations which could impact employment opportunities at the Crandon mine.

Response:

Table 1 (attached) gives an account of the employment categories of operations workers along with an annual hiring schedule. It is very difficult at this time to estimate with precision the number of operations workers which will be hired locally (local hires are defined as residents of the socioeconomic report local study area). The actual number will depend on many factors, some of which are listed below.

(TABLE 1 FOR RESPONSE TO COMMENT NO. 207)

EXXON EMPLOYMENT CATEGORIES
CRANDON PROJECT

	PROJECT PHASES (NO. OF PERSONNEL AT YEAR-END)									
	PRECONSTRUCTION			CONSTRUCTION			OPERATION			
	BASE YEAR	ADDITIONAL PERSONNEL OVER BASE YEAR								
EMPLOYMENT CATEGORY	1983	1984	1985	1986	1987	1988	1989	1990	1991	TOTAL
Administration	22	(6)	--	25	16	18	11	--	--	86
Mine Technical	--	--	--	18	4	8	5	--	--	35
Mine Operations	--	--	--	4	126	108	37	24	--	299
Mine Maintenance	--	--	--	--	50	15	20	11	--	96
Mill Operations	--	--	--	1	6	9	44	3	--	63
Mill Technical	--	--	--	4	5	9	13	(5)	--	26
Mill Maintenance	--	--	--	2	5	20	1	2	--	30
Central Maintenance	--	--	--	17	14	20	17	--	--	68
Construction Mgmt.	--	--	6	34	(6)	(2)	(6)	(26)	--	0
Total New Additional	--	(6)	6	105	220	205	142	9	0	
TOTAL	22	16	22	127	347	552	694	703	703*	703

*This number maintained throughout Project life.

1) Local unemployment rates at the time of hiring.

2) The availability of required skills in the local labor force.

3) The willingness of local workers to accept employment at the Project. Mining is new to the area, and it is difficult to estimate how the local labor force will view underground employment.

4) Level of locally trained technical school graduates.

Based on the job requirements estimated for the Project, it is possible to make some general judgements on the local hiring picture. Table 2 (attached) gives a summary of the estimated educational requirements and projected hiring schedule for the Project work force; and Table 3 (attached) presents a summary of the estimated educational requirements of the Project work force and the number of employees which might be hired locally.

As stated above, these percentages are estimates and must not be treated as commitments on the part of Exxon. They represent the number of local hires which could be achieved given current plans for the Project.

It is Exxon's policy to hire qualified candidates without regard to age, race, creed, color, sex, handicap, national origin, or ancestry. With respect to employment at the Crandon Project, Exxon is committed to hiring local people preferentially to the extent allowed by applicable laws and by the necessary skill requirements. Furthermore, Exxon will request construction contractors to give preference to hiring local people, including Native Americans, among equally qualified candidates, to the extent allowed by law. This policy has been communicated to the local communities during various meetings, as well as through written correspondence between Exxon management and local community leaders and their representatives.

Exxon has no contracts or agreements at other Exxon operations which could impact employment opportunities at the Crandon Project.

SECTION 1.5.1, FACILITIES REMOVAL

Comment No. 208

Concrete and masonry waste material used as fill will need to be disposed of in accordance with solid waste requirements.

Response:

Reclamation plans in the mine/mill area include the removal of all concrete and masonry to approximately 0.5 m (1.6 feet) below final proposed grades. Deeper concrete and masonry would be left in place; however, large expanses of concrete (such as floor slabs or pits) would be broken up before covering to permit normal infiltration of precipitation. Following solid waste disposal requirements, a one-time disposal permit would be applied for to utilize the disposal concrete and masonry as reclamation fill in the mine/mill area. A minimum 0.5 m (1.6 feet) soil cover would also be provided in these fill areas.

(TABLE 2 FOR RESPONSE TO COMMENT NO. 207)

PROJECTED HIRING SCHEDULE BASED ON EDUCATION LEVEL
FOR THE CRANDON PROJECT

YEAR	EMPLOYEE EDUCATIONAL REQUIREMENTS COLLEGE	VOTECH	HIGH SCHOOL	TOTAL NEW HIRES
Present (1983 Year-End)	16	3	3	--
	Additional Personnel Required Over 1983 Year-End			
1984	(6)	0	0	(6)
1985	6	0	0	6
1986	45	15	45	105
1987	5	22	193	220
1988	11	36	158	205
1989	7	20	115	142
1990	(25)	4	30	9
1991	0	0	0	0
TOTALS	59	100	544	703

(TABLE 3 FOR RESPONSE TO COMMENT NO. 207)

NUMBER OF EMPLOYEES TO BE HIRED LOCALLY FOR THE CRANDON PROJECT

EDUCATIONAL REQUIREMENTS*	TOTAL	LOCAL HIRES %	LOCAL HIRES NO.
College	59	18	10
Vocational/Technical	100	37	37
High School	544	69	375
TOTAL	703	60	422

*These represent actual degrees or equivalent.

Comment No. 209

Please provide us with the documentation supporting the conclusion that "the proposed mining practices would have a negligible affect on surface topography."

Response:

The original ground surface above the proposed Crandon mine will be maintained by a permanent bridge or "crown pillar" of bedrock left undisturbed above the mine workings. Mining methods and practices contributing to the stability of the protective crown pillar are described in Chapter 1.0, response to comments No. 54 (Subsidence Control) and No. 173 (Stabilized Mine Backfill), and in Chapter 3.0, response to comment No. 22 (Mining Methods).

The selection of mining methods for preservation of the crown pillar was based on a suite of physical testing programs including soil mechanics, rock mechanics, and mine backfill. These studies determined the soil characteristics, rock mass strengths, inherent rock stresses, and backfill properties such as density, compaction, and percent cement addition necessary for a structurally safe mine design.

John D. Smith Engineering Associates Limited, mine rock mechanics specialists, prepared a summary report, "Evaluation of Surface Effects" in April 1982. Their analysis integrated all the related test work and described and quantified potential subsidence mechanisms:

1) Overburden Compaction - Because of the consolidated nature of the glacial overburden, partial dewatering of these soils will result in little additional compaction and resultant subsidence.

2) Gross Rock Failure - Mine stope dimensions, methods, development sequences, and backfilling practices have been designed to preclude failure of the crown pillar or rock surrounding the ore deposit during and after normal mine operations. Maintenance of the surface is contingent on the stability of the bedrock subcrop.

3) Backfill Compression - Long-term, post-operation, rock failure mechanisms investigated included rotational failure of the hanging wall, wedge failure of the hanging wall, and crown pillar collapse. Each of these failure modes is related to backfill compressibility and placement practices. The properties are such that with proper placement, particularly beneath the crown pillar, the bedrock surrounding the mine workings should remain perpetually stable.

The summary conclusion of all subsidence evaluations is that the combined effects of any bedrock/soil movements will result in less than 0.15 m (6 inch) maximum change in surface elevations over the ore deposit. Gradational deflections of this magnitude distributed through glacial overburden of varying thickness will have a negligible effect on surface topography or land use.

Comment No. 210

What types of equipment would likely be left underground? No equipment which may pose a threat to groundwater will be allowed to remain underground.

Response:

As mining areas are systematically depleted and levels abandoned throughout the mine life, installed facilities and materials will be salvaged for reuse when practicable. Abandonment of any mine area will also include removal of any equipment or material containing chemical agents or other decay-prone substances. Similarly, at final mine closure all materials and equipment with residual value or with potential for ground water contamination will be reclaimed prior to inundation and shaft sealing. Items which may remain underground include pipelines, electrical switchgear, haulage track, shaft and crusher station steel, and obsolete machine parts.

Comment No. 211

It is extremely doubtful that the hydraulic gradient will be restored to that which existed prior to the beginning of mining. It is also doubtful that "no flow through the mine workings will be possible." Some flow through fractures will occur.

Response:

Simulations of the impacts of mining operations show that within 3 years after cessation of mining the potentiometric surface of the main aquifer will return to nearly original pre-mining elevation and configuration. These simulations are based upon the current ground water recharge rates and aquifer configuration. This being the case, the pre-mining gradients will also be restored at approximately the same rate.

Ground water quality and potentiometric data developed during the environmental baseline studies indicate that there is no active, measurable vertical interaction between the water in the orebody and the water in the overlying glacial material. Furthermore, exploratory drilling has shown the rock around the orebody to be virtually impermeable. Fractures that were encountered in the boreholes were virtually all sealed with secondary mineralization and/or weathered clay minerals. Therefore, when mining operations have terminated and the mine is sealed, it is expected that the hydrologic regime will return to its pre-mining condition.

Comment No. 212

Please state specifically whether all shafts and galleries of the mine will be filled prior to flooding. Discuss contingency measures available should the mine cause ground water degradation after closure.

Response:

Mine backfill consisting of development waste rock and prepared mill tailings will be universally placed in ore extraction areas (stopes) to maintain perpetual mine area rock mass and overburden stability. Access drifts and shafts developed exterior to the orebody will not be filled prior to mine closure, except as described for those openings extending to surface.

Site geotechnical investigations and hydrologic studies (Dames and-Moore, Golder Associates, D'Appolonia, Prickett) have concluded that the bedrock is not now and at mine closure will not be a functional component of the Project area geohydrologic regime. This conclusion is based upon the absence of major bedrock fracturing now, and the premise that planned mining methods will not disturb the rocks adjacent to the ore deposit and the overburden. Possible convective ground water flow through zones of orebody weathering should have less potential after mining than for baseline conditions, since some of the water flow paths will have been replaced with less permeable backfill or will have been sealed by grouting. Any such water flows would be so small compared to the transient volume of the glacial overburden aquifer that their presence would likely be undetectable. If a measurable impact were to occur, bentonite grouting of the overburden/bedrock interface could be used to control such an excursion.

Comment No. 213

This section should include permanent abandonment of water wells on the property.

Response:

The potable water supply well(s) at the surface facilities site will be plugged and abandoned, in accordance with applicable state regulations, upon cessation of mining activities.

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Carroll D. Besadny
Secretary

BOX 7921
MADISON, WISCONSIN 53707

October 20, 1983

File Ref: 1630
Exxon

Dear Interested Citizen:

Last spring (April 6, 1983) the Department conducted an informational open house on the proposed Exxon-Crandon mine at the Nashville Town Hall. At that time, we agreed that it would be appropriate to have another similar meeting later in the year. After talking with some of the local officials and Native American tribes, we have set the next open house date for Tuesday, November 8, 1983 at the Nashville Town Hall, Crandon, Wisconsin. There will be both afternoon (1:00 p.m.) and evening (6:30 p.m.) sessions in order to accommodate the greatest number of local residents and any interested citizens.

The objective of the open house is to encourage as much communication as possible about the Exxon project between Department of Natural Resources personnel, its consultants, town and other local governmental officials, Native American tribes, residents in the region and all interested citizens.

Our agenda for this meeting will be:

1. A welcome and introductions from John Brasch, DNR, North Central District Director from Rhinelander.

2. Bob Ramharter, Project Coordinator will give you a status report on the state agency review of Exxon's EIR and identify major issues arising from this review.

3. Two presentations - one on socioeconomics and another on groundwater impacts.

4. Table discussions will again be available where DNR personnel and citizens can discuss specific issues such as:

Noise and Air	Socioeconomics
Groundwater	Wetlands, Wildlife and Fish
Tailings Ponds	Geology
Solid Waste	Mine Permit and Reclamation
Wastewater	Legal
Lakes and Streams	Public Service Commission

Agency personnel who participated in last spring's meeting felt it was helpful in identifying the issues which were of concern to the area residents. We hope to continue to focus on these issues in our upcoming meeting.

If you have any specific questions or comments on the meeting, please contact Gen Bancroft, DNR, Bureau of Environmental Impact, Box 7921, Madison, WI 53707; Phone: 608-267-7758.

Hope to see you there!

Sincerely,
Bureau of Environmental Impact

Bob Ramharter

Bob Ramharter
Environmental Specialist

BR:mm

cc: John Brasch - NCD

Wisconsin Department of Natural Resources

Box 7921

Madison, WI 53707

FOR IMMEDIATE RELEASE - October 19, 1983

MINING EIR AND COMMENTS AVAILABLE

MADISON, WI--Several new documents relating to the permitting process for the proposed Exxon mining operation in the Crandon area are now available for public review at various locations around the state.

They include a response by the firm to some of the Department of Natural Resources initial comments on those portions of the environmental impact report (EIR) submitted in December, 1982. The portions of the EIR submitted in December, 1982 and the DNR's initial review comments are already available for public review at the libraries listed below.

Exxon's partial response covers the Department's initial comments on Chapters 2 and 3 of the EIR and on the appendices. Chapter 2 deals with the physical environment at the proposed mining area (including air quality, groundwater, surface water hydrology, and noise). Chapter 3 deals with the alternatives to the proposed action. Exxon has indicated to the Department that their response to the Department's initial review comments on the remaining portions of the EIR will be forthcoming in the next several weeks.

The Department required Exxon to submit an EIR as an early part of the mining permit application process. The EIR provides background

(MORE)

information on existing environmental, social, and economic conditions in the area. It also thoroughly describes each phase of the proposed mining operation and alternatives to chosen methods. The DNR will use this information to write an environmental impact statement (EIS). The EIS is an assessment of how the proposed mine would affect the environment and is a tool the state will use to evaluate if mining permits should be granted. If mining is permitted, the EIS will also specify special conditions and precautions Exxon must meet to minimize environmental changes in the project area. The Department must first determine that the EIR is accurate and complete before an EIS is prepared. Portions of the EIR remaining to be submitted by Exxon include several of the firm's technical reports and results of their socioeconomic studies.

Copies of the Department's EIR review comments and Exxon's responses to those comments are available for the public's information at various libraries around the state that serve as repositories for the Exxon Crandon Mine EIR. These libraries include: Antigo Public Library - Antigo; Vaughn Public Library - Ashland; Crandon Public Library - Crandon; Brown County Library - Green Bay; City and County Library - Ladysmith; Madison Public Library - Madison; Milwaukee Public Library - Milwaukee; Platteville Public Library - Platteville; Rhinelander Public Library - Rhinelander; Charles M. White Memorial Public Library - Stevens Point; Learning Resources Center - Nicolet College - Rhinelander; Marathon Public Library - Wausau; and the LE Phillips Memorial Public Library - Eau Claire. The Department has requested each library to keep these comments located with the rest of the Exxon Crandon Mine EIR materials. Copies of future Department review comments and responses by Exxon will also be located at the libraries for public review. Copies of the draft EIS and the final EIS will also be placed with these materials as they become available.

For further information, contact Bob Ramharter at (608)266-3915.

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Carroll D. Besadny
Secretary

BOX 7921
MADISON, WISCONSIN 53707

October 5, 1983

IN REPLY REFER TO: 1630
Exxon

Dear Librarian:

Please add the enclosed materials to the red 3-ring binder that I sent to you May 12, 1983. The enclosures relate to Exxon's Environmental Impact Report (EIR) of the zinc-copper mine proposed near Crandon, Wisconsin.

These materials represent a partial response by Exxon to the Department's initial review of portions of Exxon's EIR submitted in December of 1982. This partial response pertains to Chapters 2 and 3 of Exxon's EIR. We anticipate that Exxon will be sending us additional responses to our review comments on other chapters of their EIR - I will send you copies of those responses as we receive them. Please place any future Department review comments and Exxon responses to those comments in the red binder.

A copy of the news release regarding these items is enclosed for your information.

Thank you for your cooperation. Please feel free to call me at (608)267-7538 if you have any questions or if you need additional information brochures about the Exxon Environmental Impact Statement process (POINTS FOR CITIZEN ACTION - Exxon's Crandon Project).

Sincerely,
Bureau of Environmental Impact

Carol Nelson

Carol Nelson
Environmental Specialist

CN:us/3095P-2

NEWS RELEASE
RE: EXXON'S RESPONSE TO THE DNR'S
INITIAL EIR REVIEW COMMENTS OF APRIL 30, 1983

DEPARTMENT OF NATURAL RESOURCES
P.O. BOX 7921
Madison, Wisconsin 53707

FOR RELEASE - October 10, 1983

MADISON, WI -- Several documents relating to the permitting process for the proposed Exxon mining operation in the Crandon area are now available for public review at various locations around the state.

They include those portions of the environmental impact report (EIR) submitted in December, 1982 to the Department of Natural Resources, DNR's initial comments on that report, and a response to some of those comments by the firm. Portions of the EIR remaining to be submitted by Exxon include several of the firm's technical reports and results of their socioeconomic studies.

Exxon's partial response covers the Department's initial comments on Chapters 2 and 3 of the EIR and on the appendices. Exxon has indicated to the Department that their response to the Department's initial review comments on the remaining portions of the EIR will be forthcoming in the next several weeks.

The Department required Exxon to submit an EIR as an early part of the mining permit application process. The EIR provides information describing the project proposal, alternatives and the existing environmental, social, and economic conditions in the Crandon area. The Department needs this information to prepare an environmental impact statement (EIS). The EIS is a document the state uses to help determine whether to grant Exxon mining permits, and any special conditions Exxon must meet so that undesirable environmental impacts can be avoided or minimized. The Department must first determine that the EIR is accurate and complete before an EIS is prepared.

Copies of the Department's EIR review comments and Exxon's responses to those comments are available for the public's information at various libraries around the state that serve as repositories for the Exxon Crandon Mine EIR. These libraries include: Antigo Public Library - Antigo; Vaughn Public Library - Ashland; Crandon Public Library - Crandon; Brown County Library - Green Bay; City and County Library - Ladysmith; Madison Public Library - Madison; Milwaukee Public Library - Milwaukee; Platteville Public Library - Platteville; Rhinelander Public Library - Rhinelander; Charles M. White Memorial Public Library - Stevens Point; Learning Resources Center - Nicolet College - Rhinelander; Marathon Public Library - Wausau; and the LE Phillips Memorial Public Library - Eau Claire. The Department has requested each library to keep these comments located with the rest of the Exxon Crandon Mine EIR materials. Copies of future Department review comments and responses by Exxon will also be located at the libraries for public review. Copies of the draft EIS and the final EIS will also be placed with these materials as they become available.

For further information, contact Bob Ramharter at (608)266-3915.

3095P

RESPONSES TO DNR COMMENTS ON CHAPTER 2
OF
THE ENVIRONMENTAL IMPACT REPORT

Exxon Minerals Company
Crandon Project

September 16, 1983

CHAPTER 2 - DESCRIPTION OF THE ENVIRONMENT

Comment No. 1

Please provide plan sheet maps of the site area with appropriate coordinates documenting existing conditions including all roads, trails, disturbed areas, reclaimed areas, drill holes, borings, private wells, dust pits, contours and other significant landmarks. Most of the maps previously provided by Exxon are at least three years old and do not show the work done since then or the current network of roads and trails.

Response:

Considerable aerial photography and mapping at various scales have been completed during Project study work. No work at the site has altered contours or topography although tree line changes and some minor trails to drill sites could be provided in new or revised mapping. The attached index (Attachment No. 1) includes all original mapping which can be supplied on your request.

Copies of the original maps have been used as base maps to locate specific site features such as piezometers, boreholes, test pits, and others. Generally, a map is prepared for a specific purpose and a certain type or category of feature(s) is included. For instance, maps of small enough scale to show all outlying features would not be legible for the concentration of borings in the mine/mill area.

SECTION 2.1 - METEOROLOGY AND AIR QUALITY

SECTION: 2.1.1.4, ANALYTICAL PROCEDURES

Comment No. 2

The method used for particulate characterization was inadequate. The use of a dissecting needle with mounting liquid to lift a portion of the filter particulate does not provide a representative sample. The recommended procedures include cavitation in an ultrasonic bath to remove particulates from a section of the filter excised by surgical cutting. Low temperature ashing of the particulates is also recommended.

Response:

As indicated in previous correspondence (letters from B. Hansen to R. Ramharter dated March 14, 1983), the methodology designed for the particulate characterization allowed for a qualitative evaluation of the samples. It was not designed for a quantitative analysis which would have utilized a methodology as described by the DNR. The data presentation in the EIR indicates its qualitative nature by presenting approximate percentages for the particle categories. The data are not presented at an accuracy comparable to the methodology suggested by the DNR.

Comment No. 3

There is no indication of how many microscopical fields were examined and/or how many total particles were counted.

Response:

Each slide was initially inspected to determine the distribution of particulates. One field, which was judged to be representative of the slide, was selected and completely analyzed. All particles within this field were counted with the assistance of a Whipple disc. The number of particles counted varied from 10 to 239.

Comment No. 4

The analysis conducted failed to account for sulphates and nitrates; verification by DNR indicated these were major components. These components are usually found in the filter matrix and the methodology employed would not provide access to those particles.

Response:

The methodology employed did not measure sulfates or nitrates, nor was it designed for this purpose. Data of this nature were not presented in the EIR because the methodology does not provide this analysis.

SECTION: 2.1.1.5, QUALITY CONTROL

Comment No. 5

The statement that "DNR observed and approved the calibration of the air quality monitors is inaccurate." DNR does not "approve" calibrations.

Response:

The statement on page 2.1-12 of the EIR will be amended to indicate that the DNR observed the calibration of the air quality monitors. The amended sentence will not indicate "approval" of calibrations.

Comment No. 6.

The laboratory procedures utilized for analyses did not meet EPA requirements and were not approved until November 1, 1977 when the sample handling and sample conditioning procedures were changed. Thus, the data certification date for Station 1 and Table 2.1-2 is in error. The correct date should be November 1, 1977.

Response:

As indicated in previous correspondence (letter from B. Hansen to R. Ramharter dated March 14, 1983), the DNR's official certification date for the monitoring system is November 1, 1977. Table 2.1-2 will be amended to indicate the correct certification as presented by the DNR.

SECTION: 2.1.4, DISPERSION METEOROLOGY

Comment No. 7

The meteorological data used for air dispersion modeling in the air permit application is inadequate. This issue will be discussed in further reviews of the air permit application.

Response:

From earlier discussions with the DNR Air Quality Management Group we indicated and agreed with them that their recommendation for use of the Quinnesec data is not warranted since the data base is inadequate. We have agreed to remodel for the amended Project Air Permit Application with the DNR recommended Eau Claire, Wisconsin-St. Cloud, Minnesota meteorological data bases.

SECTION: 2.1.5.1, TOTAL SUSPENDED PARTICULATES

Comment No. 8

This section states that the second highest 24-hour TSP concentrations ranged from 60 to 72 ug/m^3 while Table 2.1-8 indicates that they actually ranged from 61 to 77 ug/m^3.

Response:

The Table 2.1-8 numbers of 61 to 77 ug/m^3 are correct. The text contained typing errors which were not found in review and will be corrected in the revised EIR.

Comment No. 9

Our computations of the data submitted reveal some differences from those in Table 2.1-8 as follows:

		Table Value	DNR Value
October-December 1977	Station 1	13.2	13.0
January-March 1978	Station 2	11.1	11.5
January-March 1978	Station 3	11.6	11.2
July-September 1978	Station 1	18.8	18.9
Annual Geometric Mean	Station 3	17.9	17.1

Please explain these differences, in particular, the annual geometric mean for Station 3.

Response:

The geometric mean values presented in Table 2.1-8 are correct based on our recalculations of the data in Appendix 2.1B. We used the following formula:

$$\log (G.M.) = \frac{1}{n} \sum_{i=1}^{n} = 1 \log x_i .$$

The DNR values are not that different from those we calculated and either set of geometric mean calculations can be used as representative baseline TSP concentrations.

Comment No. 10

As mentioned in previous correspondence, the results of your particulate characterization study are inadequate. These results failed to provide the breakdown of the classes of particles. The data sheets generally indicate the specific components of the classes, but there is no indication that any of those components were specifically identified in the analyses. Also, the statement that the samples were about evenly divided between large and small particles appears inconsistent with the data in Appendix 2.1B.

Response:

As mentioned in previous correspondence (letter from B. Hansen to R. Ramharter dated March 14, 1983), the design of these studies was not intended to provide "classes" of particles. As a result, no identifications were specifically completed in the analyses. However, general characterizations were provided and reported.

The statement regarding large and small particles was also a generalization from looking at the data and is not based on any specific analysis. This generalization appears to be overstated for the biological particulate types but tends to be more consistent for the minerals and combustion products.

SECTION: 2.1.5.3, TRACE ELEMENTS

Comment No. 11

Copper was found in the highest concentration, not lead. The possible anomalous nature of the copper concentration does not necessarily discount the observed values.

Response:

This section described the selected trace elements analysis for the TSP filters. The values reported were to represent those of the ambient atmosphere. Because the copper concentrations were obviously affected by other than ambient atmosphere contributions, it was felt that any reporting as such would be erroneous. Since we could not separate the sampler motor contributions from the atmospheric concentrations of copper, we felt the distinction should be presented in the report. We did not discount the measured concentrations but did not present the data as necessarily representative of atmospheric concentrations. The statement on lead will be qualified in the revised EIR to indicate that it is the highest value attributable to ambient atmospheric contributions.

SECTION: 2.1.6, EXISTING AIR QUALITY MONITORING PROGRAMS

Comment No. 12

Some of the air quality concentration units in this section are not identified.

Response:

The air quality concentration units reported in this section inadvertently omitted the u symbol (i.e., micro) in the numeric quantities. All of the reported concentrations in this section are micrograms per cubic meter (ug/m^3).

Comment No. 13

The ozone and nitrogen oxide data collected in Marathon County are meaningless. The data were collected through April which misses the entire season (May-September) when ozone concentrations are high. Comparing a four month average nitrogen dioxide concentration with an annual standard is not acceptable. Please provide the most recent years worth of nitrogen oxide data from the nearest Northwoods or rural site.

Response:

Based on information from and discussions with the DNR Air Quality Management Group, there are no nitrogen oxide data from a rural monitoring location in the Northwoods. We agree the nearest NO_x monitoring location would be meaningless for the Project. We also agreed with the DNR Air Quality Management Group that using any distant nitrogen oxide measurements would not be warranted for the Air Permit Application. The Air Permit Application assumed a conservative number (approximately 20 ug/m^3) for background levels and with the Project predicted concentrations did not indicate any major change in ambient air quality.

SECTION: 2.1.7.3, AREA SOURCES

Comment No. 14

There are area sources of air pollution within the environmental study area. These sources include agricultural, residential heating, motor boats, snowmobiles, and aircraft. These are all minor sources.

Response:

There are several area sources for air emissions within the environmental study area. However, they are all minor sources and should not alter air quality in the environmental study area. Further, it is not expected that any interaction of their emissions with the small quantities of Project air emissions will change the current air quality.

SECTION 2.2, GEOLOGY

Comment No. 15

Discuss the geologic relationship of the Crandon deposit with the Mole Lake deposit and the potential for other deposits within the study region.

Response:

We have no information on a "Mole Lake deposit." Perhaps the State Geologist can provide such information. Exxon is not aware of any discoveries within the study region. Potential for other deposits exists as much within the study region as anywhere within the volcanic belt which stretches approximately from Ladysmith on the west to Pembine on the east. Any discussion on our part of this potential would be speculative and without basis, and we are not prepared to offer such speculation.

SECTION 2.2.1 FIELD AND LABORATORY METHODS

Comment No. 16

This section covers only a small portion of the overall geological investigation methodology. Include a description of all tests that were run for both glacial geology and bedrock geology. Discuss the reasons for conducting the tests, the methods used in obtaining the samples and analyzing them, and the quality assurance programs that were employed. Describe the methodologies for drill hole and soil borings abandonment.

Response:

A more detailed review of the overall geological investigation methodologies is presented in subsection 2.3.1 of the EIR. For a discussion of methods used in obtaining samples and quality assurance programs, see the response to comments No. 21, 24 and 25. The attached table contains a listing of the types of testing conducted on glacial and bedrock material. See the response to comment No. 18 for a hole-by-hole breakdown of each test type.

SECTION 2.2.1.1, PRELIMINARY INVESTIGATIONS

Comment No. 17

Provide additional information on the process by which the surficial glacial geology map was prepared. Describe the technical resources utilized in this process.

Response:

Additional information on the process and technical resources utilized are described in the following geotechnical report (Golder Associates, 1981) previously provided to the DNR:

> Geotechnical Review, Crandon Project Waste Disposal System, Volume 1, Section 2.2.

(TABLE FOR RESPONSE TO COMMENT NO. 16)

LISTING OF TESTS THAT WERE PERFORMED ON GLACIAL AND BEDROCK MATERIALS AND PRIMARY REASONS FOR CONDUCTING THE TESTS

Tests	Reasons For Testing
Sieve Analysis	- Determine Soil Classification - Grain size analysis for Hazen's Approximation
Permeability	- Investigation of aquifer characteristics - Mine water inflow - Soil characteristics
Carbonate Pebble Analysis	- Soil attenuation - Aid in glacial history interpretation
pH	- Soil attenuation - Aid in glacial history interpretation
Clay Analysis	- Soil attenuation - Aid in glacial history interpretation
Compaction	- Soil rock mechanics
Triaxial	- Soil rock mechanics
Chemical Analysis	- Water quality
Bedrock Rock Mechanics Testing (Unaxial, Triaxial, P.L. Brazilian)	- Stope span calculations - Pillar strength dimensions and sequencing - Stope and pillar blasting procedures - Distribution of rock strengths
Assays	- Economic evaluation
Radiological	- Characterize radioactivity
Specific Gravity	- Criteria needed for determining ore reserves

SECTION 2.2.1.2, DRILLING PROGRAM

Comment No. 18

Please provide plan sheets and summarize tables indicating all of the borings within the study area and the parameters analyzed in these borings.

Response:

All boring locations are shown on Figure 2.2-5 of the EIR. A listing of the tests performed in the glacial and bedrock borings is presented in Attachment No. 2. A summary of the reports containing the results of the glacial and bedrock testing is presented in the attached table.

SECTION 2.2.1.3, SOIL TESTING

Comment No. 19

ASTM or equivalent procedures were used except for pH testing. In the pH procedure, the ratio of soil to water was 25 g to 100 ml instead of the ASTM ratio of 3 g to 50 ml. The different proportions of soil and water would cause slight differences in the measured pH. The soil and water mixtures were equilibrated for 24 hours instead of 30 minutes as specified by ASTM. pH values would change during the 24 hour period because of CO_2 exchange between the sample and the atmosphere. Please explain this deviation from the ASTM procedure.

Response:

ASTM methods for pH are for peat materials, not for the soil types encountered in the borings, and, therefore, were considered inappropriate. The soil pH method employed by Dames and Moore was developed in the absence of an ASTM standard method.

Comment No. 20

Appendix 2.2A states that the clay mineral analysis results are reported as parts per ten because of plus or minus 2 percent variability in the test. Table 2.2-5 reports these results as percentages, rather than parts per ten.

Response:

Appendix 2.2A states that the clay mineral analysis results are reported as parts per ten and as percentages of the total clay fraction. As indicated in prior correspondence (letter from B. Hansen to R. Ramharter dated April 18, 1983), reporting results as parts-in-ten of the total mineral content rather than percentages was done because the limits of detectability are subject to a deviation of $\pm$ 2 percent or greater.

(TABLE FOR RESPONSE TO COMMENT NO. 18)

REPORTS CONTAINING THE RESULTS OF GLACIAL AND BEDROCK TESTING

Geotechnical Report/ Volume	Section/ Table/ Figure	Name of Summary Document
Report 1[a]		
Vol. 1	Fig. 4.2	Grain Size Distrib. Summary: Site 40 Till
Vol. 1	Fig. 4.3	Grain Size Distrib. Summary: Site 41 Till
Vol. 1	Fig. 4.4	Grain Size Distrib. Summary: Site 40 Cse Strat. Drift
Vol. 1	Fig. 4.5	Grain Size Distrib. Summary: Site 41 Cse Strat. Drift
Vol. 1	Fig. 4.6	Grain Size Distrib. Summary: Site 40/41 Fn Strat. Drift
Vol. 1	Fig. 4.7	Grain Size Distrib. Summary: Outwash
Vol. 1	Fig. 4.8	Grain Size Distrib. Summary: Site 40/41 Lacustrine
Vol. 1	Table 4.1	Summary of Glacial Material Properties
Vol. 1	Table 4.2	Summary of Bulk Sample Test Results
Vol. 1	Table 4.3	Carbonate Content Test Results
Vol. 1	Table A-1	List of Test Borings by Phase
Vol. 1	Table C-2	Permeability Estimates by Hazen's Approximation
Vol. 2	Fig. V2-12	Permeability Test Results - TP Series
Report 2[b]		
Vol. 2	Sec. 2.2.2 Table 2.2-2	Results of Soil pH Analyses
Vol. 2	Sec. 2.2.2 Table 2.2-3	The Color of Soil Samples Based on Monsell Classification
Vol. 2	Sec. 2.2.2 Table 2.2-4	Results of Carbonate Pebble Content Analysis
Vol. 2	Sec. 2.2.2 Table 2.2-5	Results of Clay Mineralogy Analysis
Vol. 2	Sec. 2.3.1.4 Table 2.3-6	Summary of Permeability Tests
Vol. 2	Sec. 2.3.3.5 Page 2.3-28	Summary of Range of Permeabilities for Glacial Drift in Site Area
Vol. 2	Sec. 2.3.3.6 Page 2.3-29	Summary of Aquifer Characteristics
Vol. 2	Sec. 2.3.3.7 Page 2.3-7	Summary of Bedrock Permeabilities
Vol. 2	Sec. 2.3.4.1 Table 2.3-8	Summary of Ground Water Quality for Principal Aquifers
Vol. 2	Sec. 2.3.4.1 Table 2.3-9	Summary of USGS Ground Water Quality Data
Vol. 2	Sec. 2.3.4.2 Table 2.3-11	Results of Chemical Analysis of Bedrock Ground Water Samples

TABLE (continued)

Geotechnical Report/ Volume	Section/ Table/ Figure	Name of Summary Document
Vol. 7	Appendix 2.3E	Results of Field Permeability Tests
Vol. 7	Appendix 2.3F	Results of Laboratory Permeability Tests and Hazen Permeability Approximations
Report 3[c]	Table 4.1	Hydrologic Parameter of Overburden and Orebody
Report 4[d]	Table 1	Results of Laboratory Permeability Tests.

[a] Geotechnical Review, Crandon Project Waste Disposal System, October 1981, Golder Associates.

[b] Environmental Impact Report, Crandon Project, December 1982, Exxon Minerals Company.

[c] Geohydrologic Characterization, Crandon Project, May 1982, Golder Associates.

[d] Results of Geologic, Geotechnical and Hydrologic Investigations of a Portion of the Proposed Exploration Ramp, August 1977, Dames and Moore.

Comment No. 21

This section should include a discussion of procedures used in obtaining the samples from borings and should indicate what drilling fluids were used. Include a discussion of the potential for contamination of the samples from drilling fluids.

Response:

A discussion of procedures and drilling fluids is contained in the following geotechnical reports (previously provided to the DNR):

1) Geotechnical Review, Crandon Project Waste Disposal System, Volume 1, Appendix A, Section A-2.2 by Golder Associates.

2) Ground Water Study and Study Methods, Section 6.3 by Dames and Moore.

Two types of drilling fluid were used, depending upon the depth of hole. For borings drilled to depths of approximately 50 to 75 m (164 to 246 feet), Revert, a biodegradable viscosity-increasing agent was the most common drilling fluid. Revert, however, decomposes with time, and is difficult to use when borings require more than a few days and/or remain open for the weekend.

More satisfactory product combinations for deeper holes are the Baroid products Quickgel, Quicktrol, and Barafos. All of these products are non-toxic. Quicktrol is a polymer which coats the walls of the hole and prevents the Quickgel, a high yield bentonite, from penetrating the formation. Upon completion, the Quickgel is broken down with Barafos, a disbursing agent. No evidence of well contamination from any of the drilling agents was found.

Comment No. 22

The thin sections for asbestiform mineral testing were verified by the Wisconsin Geologic and Natural History Survey geologists, not DNR geologists.

Response:

Comment acknowledged and in subsection 2.2.1.3 of the revised EIR it will be indicated that the Wisconsin Geologic and Natural History Survey geologists verified the thin sections for asbestiform mineral testing.

Comment No. 23

The methods described for asbestiform are adequate for a gross analysis for geological purposes, but are insufficient for determining the potential impact on air quality of small or trace quantities of asbestiform fiber in the tailings material or glacial tills. Additional analyses will be necessary to evaluate these potential asbestiform sources. Please consult with our Bureau of Air Management prior to initiating additional testing.

Response:

In addition to the information on asbestiform methods presented in the EIR, correspondence related to our asbestiform mineral study was provided to the DNR in a letter dated July 15, 1983 from B. Hansen to P. Didier. Also, the Wisconsin Geologic and Natural History Survey geologists have prepared a report on the asbestiform mineralization associated with the Crandon Project.

In consideration of air quality concerns, the following summary of the analyses indicates: First, no asbestiform minerals have been found in the samples, such as chrysolite and the fibrous amphibole polymorphs of actinolite, tremolite, grunerite, commingtonite, anthophyllite and riebeckite; and second, the rocks at Crandon are low grade metamorphic rocks. The temperature-pressure conditions during metamorphism have not been high enough to develop the amphibole polymorphs. Therefore, the metamorphic grade precludes an asbestiform mineral source and supports the conclusion. We feel no additional testing is warranted at this time; however, we are willing to discuss this matter with the Bureau of Air Management.

Comment No. 24

This section should include a separate subsection entitled, "Bedrock Testing" and should include the methodology used for the physical, chemical and radiological testing of bedrock samples. Both the soil testing and bedrock testing sections need to provide more detail regarding the logic used in the selection of samples for testing purposes, and the methods used for preparing composite samples.

Response:

Additional information on soil testing methodologies is presented in subsection 2.3.1 of the EIR as well as the Golder Associates report titled "Geotechnical Review Crandon Project," Volume 1, Appendices A, B, C.

Reports covering bedrock testing and methodology are outlined below:

1) Radiological Testing Program, Crandon Project, August 1981 by Hazleton Environmental Sciences.

2) Rock Mechanics Testing, December 1980 by Exxon Minerals Company.

3) Results of Permeability Tests and Analysis of Water Samples for Deep Exploration Holes, April 1978 by Dames and Moore.

Skyline Labs, Tucson, Arizona was our prime assay contractor. A procedures write-up supplied by Skyline is presented in Attachment No. 3. Every tenth sample was sent to Hazen Research, Golden, Colorado as a check assay. If they did not check, we requested the two laboratories to exchange their pulps and re-run the assay.

Specific gravity determinations were both calculated and measured. Several hundred calculations were made from the % Cu, % Zn, % Pb, and % S. The sulfur was allocated to the copper for chalcopyrite, to zinc for sphalerite, to lead for galena, and that left over to percent pyrite. These calculations are based on typical specific gravity for the minerals as well as typical chemical compositions assuming the sphalerite has 2 percent Fe replacing the zinc. Several hundred specific gravity measurements were also made by weighing the sample in water versus air. Comparisons of results between the two methods were good.

SECTION 2.2.1.4, QUALITY CONTROL

Comment No. 25

This section contains no detailed information. Describe the quality control procedures used by the field and laboratory personnel. Provide quality control data collected when Exxon's samples were analyzed (i.e., results of spikes, duplicates, standard reference samples) and describe the evaluation of the quality control data. Without this information, we can reach no conclusions as to the accuracy and precision of the soil testing data.

Response:

The detail and quality control procedures are described in EIR subection 2.3.1. Also, laboratory testing procedures are described in Appendix B of the following Golder Associates report titled "Geotechnical Review, Crandon Project Waste Disposal System," Volume 1.

SECTION 2.2.2.1, BEDROCK GEOLOGY

Comment No. 26

The ranges in time for the ages of the Pleistocene given in Table 2.2-1 are incorrect. The correct ranges, in millions of years, are as follows:

Wisconsin	-	0.007 - 0.075
Valderan	-	0.007 - 0.011
Twocreekan	-	0.011 - 0.0125
Woodfordian	-	0.0125 - 0.022
Farmdalian	-	0.022 - 0.028
Altonian	-	0.028 - 0.075

Response:

Comment acknowledged and revisions will be made in Table 2.2-1 of the revised EIR.

Comment No. 27

Characterization of the Pleistocene deposits as "sand and gravel" is inaccurate. A more general term such as "glacial drift" should be used and a description of the drift provided.

Response:

Comment acknowledged. A more general term such as "glacial drift" will be used in the revised EIR.

Comment No. 28

Please provide boring logs for all data points utilitzed in preparation of the bedrock surface map (Figure 2.2-2). Include geophysical data such as resistivity, conductivity, spontaneous potential, and gamma and neutron absorption.

Response:

The glacial borings are listed in Appendix 2.2B of the EIR. Detailed information on glacial borings is provided in the Golder Associates report (previously provided to the DNR) titled "Geotechnical Review, Crandon Project Waste Disposal System," Volume 1, Appendix D. Two geophysical studies, listed below, provided information in areas where drilling data were not available.

1) An Interpretation Report for a Gravity and Vertical Electrical Sounding Survey, November 1981 by Geoterrex.

2) Logistic Report on a Refraction Seismic Survey, April 1980 by Geoterrex.

Comment No. 29

The discussion of bedrock weathering indicates that it took place since the end of glaciation. It seems more likely that the bedrock surface was weathered prior to deposition of the glacial deposits. Please provide additional discussion and documentation of Exxon's interpretation.

Response:

Comments acknowledged and revisions will be made in the EIR to indicate the bedrock surface was weathered prior to deposition of the glacial deposits. A detailed discussion of bedrock supergene weathering is presented in subsection 2.2.3.2 which represents Exxon's interpretation of bedrock weathering associated with the Crandon deposit.

SECTION 2.2.2.2, SURFICIAL GEOLOGY

Comment No. 30

The discussion of physiography indicates that Rolling Stone Lake is west of the orebody. It is actually south of the orebody.

Response:

Comment acknowledged and the location of Rolling Stone Lake in relation to the orebody will be changed from west to south in subsection 2.2.2.2 of the revised EIR.

Comment No. 31

The DM series of borings expressed the carbonate content of the sample as a percentage of the pebble count. All parameters should be indicated in uniform units such as percent $CaCO_3$ for the total sample.

Response:

The DM series gave percent carbonate on materials retained on a No. 4 U.S. standard sieve, strictly as an aid to determine glacial history. The percent carbonate of the smaller fraction was not determined, so the percent carbonate for the total sample is not known.

SECTION 2.2.3.2, BEDROCK

Comment No. 32

The average ore grades given are inconsistent with other figures provided elsewhere in the report. Estimates in this section are 5.5 percent zinc, 1.1 percent copper, and no estimates for lead, gold or silver. Volume V, Appendix 1.2A indicates grades of 5.8 percent zinc., 1.4 percent copper, and 0.5 percent lead. Please indicate the actual estimated average grade for all recoverable metals.

Response:

New reserve estimates were calculated based on reinterpretation of the data. A reserve figure depends upon whether it is based on in-place, diluted, or mine recoverable ore. Reserve estimates can be expected to change slightly in the future based on changes in the above criteria.

The current mine recoverable reserve estimate is 76.4 million metric tons (84.2 million short tons) with average grades of 5.20 percent zinc, 1.18 percent copper, 0.46 percent lead, 38.1 g/t silver and 1.05 g/t gold.

Comment No. 33

What is the basis for the statement that the glaciers stripped off about 50 feet of weathered rock?

Response:

The purpose of this statement was to provide an order of magnitude estimate of the amount of strongly weathered material that may have been present prior to glacial stripping. The statement is based on the fact that weathering has occurred since uplift, approximately 1.8 billion years ago. In contrast to the Crandon deposit, the Flambeau deposit, being partially protected from extensive glacial stripping by a sandstone cap, has approximately 15 m (50 feet) of strongly weathered material.

SECTION 2.2.4, GEOLOGY OF THE SOLID WASTE DISPOSAL SITE

Comment No. 34

This section should contain a definitive statement regarding the presence or absence of valuable mineral deposits (both metallic and non-metallic) in both Sites 40 and 41 along with a discussion of the methods and information used to arrive at the conclusions.

Response:

Sites 40 and 41 were evaluated for mineral potential from airborne geophysics, induced polarizaton, geologic trends, and several bedrock core holes. Holes 199, 203, 204, 205 and 206 were drilled to evaluate Site 41 and holes 136, 200, 201, and 208 were drilled to evaluate Site 40.

Based on these results, there is no potential for economic mineralization (metallic or non-metallic) under Sites 40 and 41.

SECTION 2.3 - GROUND WATER

SECTION 2.3.1.1, PIEZOMETER INSTALLATIONS

Comment No. 35

Some variations from the described typical piezometer installation did occur, most of which appear to be detailed in the referenced appendices. These construction variations should be carefully reviewed during the final selection of permanent monitoring wells. Figure 2.3-2 should show the layer of fine sand between the sand/gravel and bentonite slurry.

Response:

Comment acknowledged and Figure 2.3-2 has been revised to show the layer of fine sand between the sand/gravel and bentonite slurry (see attached figure).

Comment No. 36

The piezometer design has resulted in damage to the upper portions of some piezometers by frost heaving. Periodic field inspections should be scheduled to assure that the wells are properly secured, identified, and maintained. The design of any new piezometers should be modified to eliminate the frost heaving problem. The casing elevation of any piezometers will need to be reestablished.

Response:

An inspection of existing piezometers has been made to ascertain their physical, surficial conditions. Dislocated or damaged piezometers have been repaired and their elevations resurveyed.

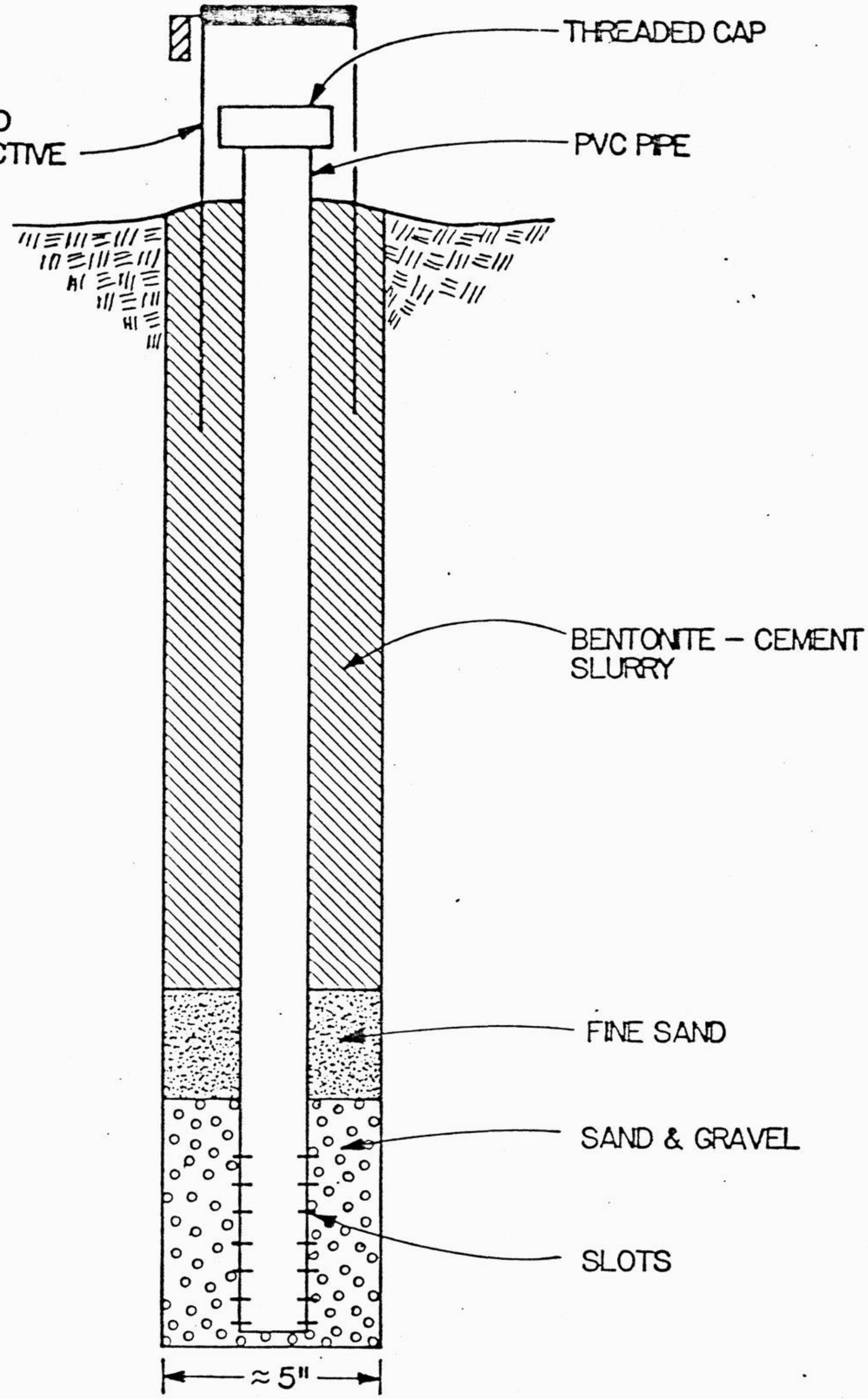
SECTION 2.3.1.2, GROUNDWATER LEVELS

Comment No. 37

The Department was not involved in the September, 1980 water levels survey of the 109 piezometers or in subsequent water level surveys. Collection of another data set with appropriate Department participation is necessary. Prior to doing this survey, it is essential that Exxon complete the piezometer inspection and repair work mentioned above.

Response:

Six sets of water level readings have been made since September 1980. The DNR participated in obtaining the most recent set of readings during July 1983. These data will be submitted to the DNR in the fall of 1983. All piezometers used in the July 1983 sampling were inspected and repaired (see response to comment No. 36).



NOTE:
NOT TO SCALE

EXXON MINERALS COMPANY
CRANDON PROJECT

TYPICAL PIEZOMETER INSTALLATION

FIGURE 2.3-2

SECTION 2.3.1.3, GROUNDWATER QUALITY

Comment No. 38

This section should note that inert gas was used whenever air lifting was the selected method for well evacuation prior to sampling.

Response:

The following statement will be added to subsection 2.3.1.4 of the revised EIR:

> Inert gas (argon) was used whenever air lifting was the selected method for well evacuation.

Comment No. 39

Describe filtration of samples in the field including the reasons for filtering and the types of filters and apparatus used. A new DNR quality assurance manual covering the sampling of groundwater is being developed and should be reviewed prior to the collection of any future groundwater samples.

Response:

The ground water samples were filtered in the field prior to laboratory analyses for consistency. The filtering apparatus consisted of a vacuum pump, Erlenmyer flask, Buchner funnel, and coarse glass fiber filters.

We would appreciate receiving a copy of the DNR's quality assurance manual covering the sampling of ground water when it is available.

SECTION 2.3.1.4, SOIL PERMEABILITY

Comment No. 40

How was well efficiency determined or what value was assumed for well efficiency for the in-situ field permeability test calculations?

Response:

The results of the in-situ field permeability tests were evaluated using Hvorslev's[1] method. Among the stated assumptions of the method are negligible hydraulic losses in pipes and well points (i.e., 100 percent efficiency).

Comment No. 41

The Dames & Moore groundwater report briefly describes the TW-1 and WW-2 pumping tests and the exploration borehole packer test, but the level of detail is insufficient for the Department's review and verification purposes. Please provide further documentation on these tests.

---

[1] Hvorslev, M. J., 1951, Time lag and soil permeability in groundwater observations: U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi, Bulletin No. 36, 50 p.

Further details of the pump tests and exploration borehole packer tests conducted at Wells TW-1 and WW-2 are presented in the Dames and Moore reports entitled, "Investigation of Feasibility of Dewatering and Other Alternatives for Open Pit Mine Option, near Crandon, Wisconsin," dated May 20, 1977; and "Results of Permeability Tests and Analyses of Water Samples from Deep Exploration Holes, Crandon, Wisconsin," dated April 19, 1978. These reports will be provided to the DNR.

Comment No. 42

Please provide discussion and documentation of the CDM pumping tests of 1981.

Response:

Documentation of the CDM pumping test is presented in the report "Mine Hydrology Test Data Analysis, Crandon Project," dated May 27, 1982 (previously provided to the DNR).

SECTION 2.3.1.4, SOIL PERMEABILITY

Comment No.: 43

The use of the Hazen approximation to estimate the permeability of soil samples is questionable. This method was intended to be applied to clean uniformly graded sands, not to gravels or sands with silt or clay. Please apply the Fair-Hatch approximation to confirm permeabilities from a broad range of soil types previously analyzed with the Hazen methods.

Response:

Permeability data obtained using the Hazen approximation correlate well with field test permeability data. Therefore, it can be considered as an applicable method of approximating soil permeabilities in the proposed Crandon Project area.

Another, more recent and widely accepted, method of analysis of the permeability of granular materials has been developed by the U.S. Department of Transportation, Federal Highway Administration. This method, described in their report "Highway Subdrainage Design" (Report No. FHWA-TS-80-224, [pp. 45-50], August 1980) is based on a statistical correlation of the measured coefficients of permeability for a large number of samples with those properties known to exert an influence on permeability. They have concluded that the dominant factors that determine permeability are the effective grain size (D_{10}), the porosity (n) and the percent of the sample passing the No. 200 sieve (P_{200}). These three parameters accounted for over 91 percent of the variation in the coefficient of permeability of the samples tested. Analyses of six selected samples of the till material by this method yielded values of permeability in the range of 1×10^{-4} to 2.1×10^{-7}cm/s. These values are also consistent with the range of values obtained from the Dames and Moore field permeability tests.

Use of the Fair-Hatch approximation would probably give similar results.

Comment No. 44

Provide detailed discussion and documentation of all Packer tests performed in deep exploration bore holes and clarify the relation of bore holes to the ore body.

Response:

A discussion of the Packer tests performed and a summary of the results of the testing are given in subsection 2.3.4.2, Bedrock of the EIR. A more detailed discussion is presented below:

An injection straddle packer manufactured by Lynes Incorporated of Houston, Texas was used for the tests. The packer consists of two water-inflatable rubber elements separated by a spacer or mandrel. The unit can be operated either as a single packer or as a straddle packer depending upon the orientation of internal valves.

In general the operation was as follows:

1) The hole to be tested and sampled was sounded to determine if the hole was open to the drilled depth and to assess the condition of the fluids in the hole;

2) The hole was investigated by borehole geophysical logging to determine hole conditions and rock and fluid characteristics;

3) The hole was flushed by running in a string of hollow drilling rods and injecting air or water to remove the fluids from the hole. Air flushing was the preferred method;

4) The packer assembly, predressed with new O-rings and the valves oriented so as to operate the assembly either as a single or as a straddle packer, was run (tripped) into the hole on N-rods to the lowest desired test depth for the particular hole;

5) A Bean positive displacement pump was connected to the N-rods and water under about 800 to 1000 psi pressure was forced into the system to inflate the packer(s);

6) The N-rods were rotated to lock the pressure into the packer elements and then raised to disengage and by-pass the valves so as to establish continuity with the borehole through a port located below the top packer;

7) Additional pressure was applied to assess if the port was open and if the packers had inflated and sealed against the walls of the borehole. If a seal was not made, bubbles and water would rise up the borehole above the packer assembly;

8) If this test was satisfied, the pressure was released from the N-rods and the connection with the pump removed;

9) A string of A-rods, up to 800-900 feet long, were then placed in the N-rods, packer position permitting;

10) The ground water levels in the A-rods were then monitored until a trend or equilibrium was established;

11) Compressed air was injected through the A-rods under pressure to 400 psi. This creates an air-lift pumping phenomenon, whereas the water-air mist rises in the annulus between the N-rods and the A-rods. The air pressure was adjusted and possibly the A-rods lowered into the hole depending upon the productivity of the zone below the top packer and the depth of the packer. If too much air pressure was applied, a back pressure would result because of the limited annular area above the bottom of the A-rods. This back pressure would equilibrate in the hole and largely prevent water from rising through the annulus;

12) The hole would be "pumped" by air lift for sufficient time to remove the water in the drilling rods above the packer and to withdraw water from the test zone;

13) The quantity of water air lifted from the hole was monitored by volume changes as a function of time in a calibrated tank receiving the discharge or by catching the discharge in a bucket and timing with a stopwatch. Water samples were also collected from the discharge and the field conductivity was measured. The pH of several water samples was also measured;

14) At the cessation of the air lift pumping, the water levels in the hole were measured through the A-rods with respect to time for a period of about 2-1/2 hours. These data were then used to assess the permeability of a selected zone in the hole;

15) The collected bulk water samples were filtered as soon as practical and placed in "treat" or "no treat" sample bottles and refrigerated until shipped to Aqualab of Streamwood, Illinois, a certified laboraroty, for chemical analyses; and

16) At the completion of monitoring water level recovery, the A-rods were removed from within the N-rods, the packer released by reversing the setting procedure, and the packer assembly raised to the next test position and the method repeated.

Figure 1 (attached) shows the plan distribution of the deep exploration bore holes, and Figure 2 (attached) shows the cross-sectional distribution.

SECTION 2.3.1.5, WATER WELL INVENTORY

Comment No. 45

Now that the extent of the potential groundwater drawdown has been delineated, further information regarding the private water wells and systems within the drawdown area is needed in order to properly project impacts to individual water systems. Additional data needed include pump type, pump capacity, depth of pump intake, well elevation, along with the data currently missing from the various columns of Appendix 2.3-G.

Response:

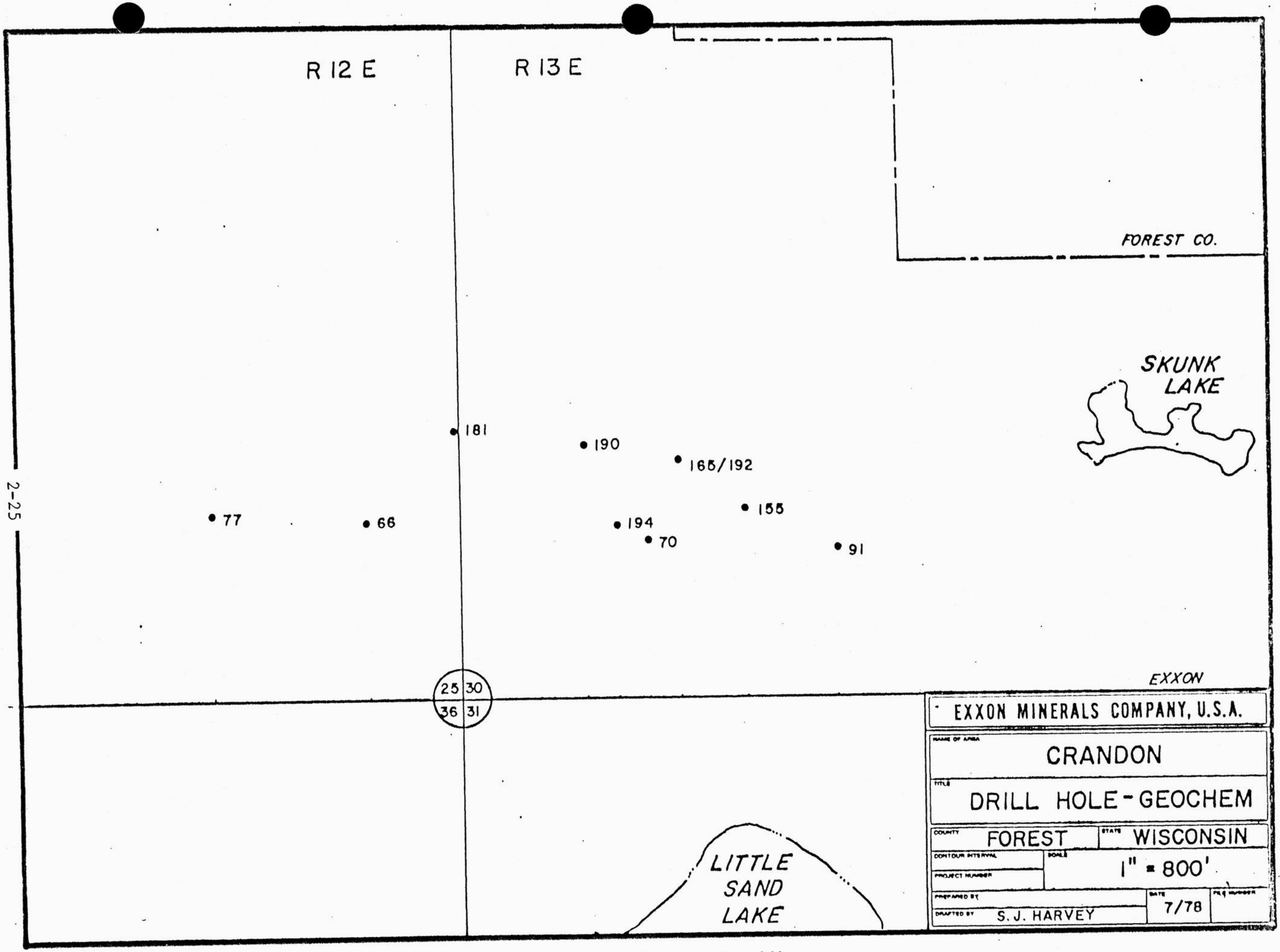
An inventory of all private water wells and systems within the area of potential ground water drawdown (as described in EIR subsections 4.1.3 and 4.2.3) will be completed as part of the pre-construction monitoring program. To the extent that information is available, the following will be provided in addition to the missing data in Appendix 2.3G: pump type, pump capacity, depth of pump intake and well elevation.

Comment No. 46

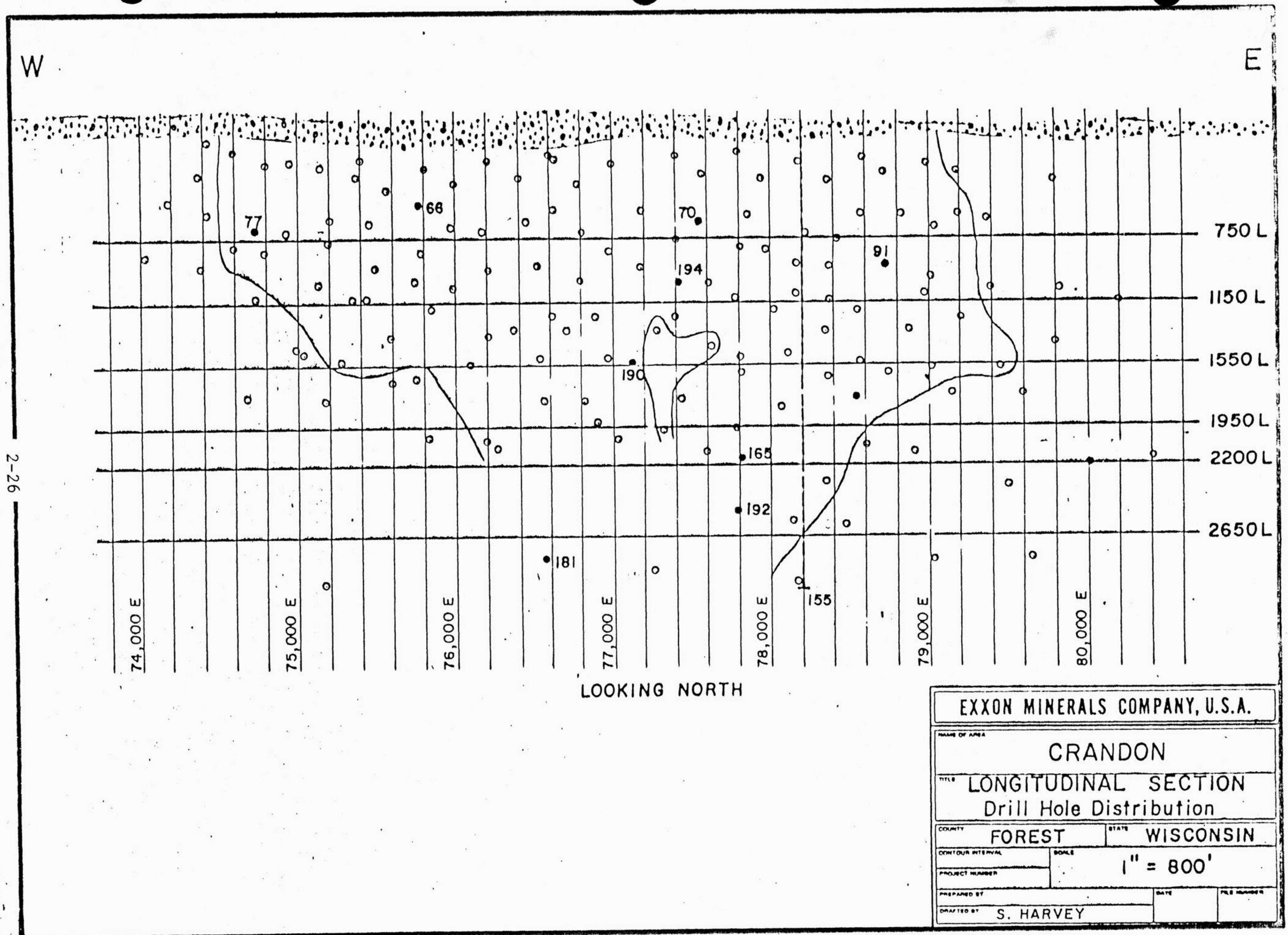
In order to assure that replacement water supplies will be at least equivalent in quality and capacity to the existing supplies, it will be necessary to establish baseline capacity and quality for each of the existing wells. Because of the variability of the aquifer in both quality and capacity, this cannot be accomplished accurately by extrapolating data from the existing monitoring system. We suggest that Exxon meet with the Department to further delineate the scope of the necessary studies. Study goals should include a determination of the potential for water quality changes resulting from the redirection of groundwater flow, the needs for well and pump modification or for a centralized water distribution system, and the potential for significant increases in operation, maintenance and pumping costs.

Response:

The scope of the studies to establish baseline capacity and quality for each of the private water wells in the potential ground water drawdown area has been discussed with the DNR. This study will be performed as part of the pre-construction monitoring program. A water quality sample will be collected from each well and will be analyzed in the laboratory for the parameters presented in Table 2.3-3 of the EIR. The method to be used in establishing well capacity will be determined in further discussions with the Department.



(Figure for Response to Comment No. 44)



(Figure for Response to Comment No. 44)

SUBSECTION 2.3.1.6, SPRING SEEP AND INTERMITTENT STREAM SURVEY

Comment No. 47

Where are the results of the September, 1978 spring seep and intermittent stream survey presented? These results should be included on appropriate maps and tables.

Response:

The locations of the intermittent streams, seeps and springs sampled are shown on Figure 2.3-17 of the EIR. The data for the spring seep and intermittent stream survey are presented in Appendix 2.3H of the EIR.

Comment No. 48

Several residents have reported observing springs in Little Sand Lake. Did the reconnaissance confirm the presence of this type of flow into otherwise perched lakes, and how is this flow incorporated into the overall water balance of the surface water bodies?

Response:

Some intermittent seeps and/or springs have been observed in the environmental study area, including the Little Sand Lake basin (Figure 2.3-17; Appendix 2.3H). The results of the Little Sand Lake drilling program performed in March 1983 did not indicate the presence of springs upwelling in the lake.

Intermittent springs are only seasonally active, responding primarily to the spring snowmelt and to precipitation events. Because of their position with respect to the ground water potentiometric surface, they function as a very short-term, delayed yield to surface water runoff. Therefore, in the overall water balance for the environmental study area these phenomena are considered primarily as surface runoff.

SECTION 2.3.1.7, CHEMICAL ANALYSES

Comment No. 49

Please provide details regarding the quality assurance procedures used for the chemical preservatives contained in the sample collection bottles.

Response:

The analytical laboratory (Aqualab) used the recommended preservatives and techniques outlined in "Standard Methods for the Examination of Water and Waste Water" and USEPA publications for the chemical preservatives used in sample bottles. Reagent grade chemicals were added to sample bottles by Aqualab personnel prior to sampling. Micropipettes and/or auto re-pipettes were used to assure uniform volume delivery in all sample bottles.

SUBSECTION 2.3.2.2, GROUNDWATER OCCURRENCE

Comment No. 50

The statement that "the groundwater contained within the Precambrian rocks are highly mineralized and unsuitable without treatment for many domestic, industrial or agricultural uses" is not accurate and should either be substantiated by facts or removed. Please provide a more detailed discussion on the occurrence and availability of groundwater in the region.

Response:

The statement regarding the quality of the ground water in the Precambrian rocks will be removed from subsection 2.3.2.2.

For a general regional summary of the occurrence and availability of ground water, the statements in the EIR are based upon the McGuiness (1963) reference cited and the papers by Borman (1971), Hadley (1976), Hew (1959), Olcott (1968), Ostrom (1976), Steuck and Andrews (1976), Steuck et al. (1977), and the U.S. Geological Survey unpublished water quality data. Additional detail from these reports can be provided to specific questions regarding the proposed facilities and regional ground water resources.

SECTION 2.3.3.1, GEOLOGY

Comment No. 51

Please clarify the range of thickness of drift material within the environmental study area. This section states that the drift ranges from less than 8 m to more than 91 m, while on page 2.2-31 the overburden at the solid waste disposal area is characterized as up to 98 m thick.

Response:

The range of the thickness of the glacial drift (<8 m to >91 m) is a general average for the environmental study area as presented for the regional thicknesses of glacial drift in subsection 2.3.2.1.

Comment No. 52

The Precambrian bedrock in the proposed mine area strikes approximately <u>north</u> 80° west.

Response:

Comment acknowledged and the following corrected sentence will be included in subsection 2.3.3.1 of the revised EIR:

> The Precambrian bedrock in the proposed mine area strikes approximately north 80 degrees west and dips 70 degrees north to vertical.

SECTION 2.3.3.2, GROUNDWATER OCCURRENCE

Comment No. 53

This section needs to be expanded to include more area-specific information on the occurrence of groundwater and the extent of perched, unconfined and confined aquifer conditions.

Response:

As discussed in previous correspondence (letter form B. Hansen to R. Ramharter dated April 18, 1983), limited information is available in the environmental study area on the distribution of local perched aquifer conditions. These perched aquifer conditions occur in association with localized lenses of fine grained alluvial and lacustrine deposits that are lower in premeability than the surrounding deposits and retard percolation of water to the main ground water aquifer. Shallow ground water movement also may occur in association with surface or near surface alluvium and lacustrine deposits. The nature of ground water movement in these areas and the surficial units through which the movement occurs have not been thoroughly characterized because the lacustrine deposits constitute a small portion of the overall volume of glacial soils in the site area and are primarily found in association with wetlands or lakes. Alluvium and lacustrine deposits are described in subsection 2.2.2.2 (p. 2.2-22) and are shown on Figure 2.2-6 of the EIR.

A more detailed description of the distribution, thickness and character of the main hydrostratigraphic units in the environmental study area is given in the Golder Associates' report, "Geohydrologic Characterization, Crandon Project," (Chapter 4.0, pp. 31-49) dated May 1982 (previously submitted to the DNR).

Comment No. 54

Please provide all available groundwater maps and supporting documentation. Provide maps showing the seasonal groundwater fluctuations. These maps should be on the large plan sheet format on a suitable base map with the data control points indicated. The resolution for the MWDF should be increased by adding one meter isopleths.

Response:

Available ground water potentiometric surface maps were provided to the DNR on July 14, 1983. Based upon a series of potentiometric surface readings, also supplied to the DNR on July 14, 1983, the seasonal fluctuations in the potentiometric surface are not considered to be large enough to support the construction of a 1 m (3.3 feet) isopleth map of the Project area. The same criteria can be applied to the MWDF area. A 2 m (6.6 feet) isopleth map of the potentiometric surface is included in the report "Geohydrologic Characterization, Crandon Project," (pp. 33 and 34) by Golder Associates (previously submitted to the DNR). Full size reproducibles of these maps were submitted to the DNR on April 27, 1983.

SECTION 2.3.3.3, GROUNDWATER RECHARGE-DISCHARGE REGIME

Comment No. 55

It is stated that the rate of groundwater recharge from Skunk, Oak, Little Sand and Duck Lakes is unknown. It is possible that some of these rates will need to be ascertained in order to accurately assess the project's impacts. Additional data needs will be evaluated during our review of the groundwater modeling effort.

Response:

Comment acknowledged.

Comment No. 56

Additional detail on the hydraulics of Little Sand Lake are necessary. Is this an area of strictly groundwater recharge or is there some groundwater flow through the lake? Provide water level data from beneath the lake (in msl elevations) and describe the well construction. Discuss the relationship of lake levels to groundwater elevations and the saturated/unsaturated conditions beneath the lake.

Response:

The detail requested for the hydraulics of Little Sand Lake is contained in the "Geohydrologic Characterization, Crandon Project" report (Chapter 7.0, pp. 87-93), May 1982 by Golder Associates (previously submitted to the DNR) and in Appendix 4.1A of the EIR. The relationship of the lake levels to ground water elevations is also discussed in Chapter 7.0 of the May 1982 Golder Associates report.

Comment No. 57

The statement on the top of page 2.3-23 that the bottom of Little Sand Lake is 6.1 meters (20 feet) below the groundwater table is inconsistent with the findings of the Little Sand Lake drilling project. The lake has a reported maximum depth of 21 feet and the water table is approximately 11 feet below the surface. The lake bottom, therefore, is approximately 10 feet below the regional water table. Were incorrect figures used for the lake seepage rate calculations?

Response:

Comment acknowledged and subsection 2.3.3.3 will be revised to indicate the bottom of Little Sand Lake is approximately 3 m (10 feet) below the regional water table.

The correct depth below ground water, based on the results of the Little Sand Lake drilling program, was used as a basis for calculation of seepage rates from the lake.

Comment No. 58

The extent of groundwater basins and location of groundwater divides should be shown on Figure 2.3-4.

Response:

Figure 2.3-4 indicates the extent of the ground water basins and divides by the potentiometric contours and flowlines. An additional reference is provided in Appendix 4.1A, Figure A-19.

Comment No. 59

Please provide a north-south oriented hydrogeologic cross-section through the mine/mill area.

Response:

A north-south hydrogeologic cross-section through the mine/mill site is shown in Appendix 4.1A, Figures A-8 and A-9. The revised EIR will include a cross reference to these additional cross-sections. Also, the note on EIR Figures 2.3-6 through 2.3-10 will be revised to refer to Figure 2.3-5, rather than Figure 2.3-4 for the locations of the cross-sections.

Comment No. 60

Provide additional detail on other "local" aquifer conditions present. Did Exxon make any attempt to delineate the extent of these zones? Please indicate where these conditions are known to exist.

Response:

Subsequent analysis of the differences in potentiometric head in piezometers placed at varying depths and in various classifications of the glacial overburden indicate that differences in potentiometric head between the different glacial materials is small (submitted to the DNR, June 3, 1983). Although there are strata within the glacial overburden of varying permeability, and the predominant ground water movement is in the stratified drift layer, there are apparently no extensive perched or "local" aquifers in the site area. The only documented location of a "local aquifer" is the location identified on page 2.3-23. Data evaluations to date have not shown these conditions to be present in proposed facility areas. Also, see response to comment No. 53.

Comment No. 61

Please provide a comparison of the groundwater hydrographs with precipitation data and with representative lake and/or stream hydrographs.

Response:

A general, comparative analysis of the ground water hydrographs and stream flow records shows that, on the average, the highest water flow rates occur between March and June, whereas the higher ground water elevations occur between May and December. The higher stream flows are directly attributable to the annual snow-melt. A rise in the elevation of the ground-water potentiometric surface occurring about 2 months later could indicate the lag time for percolation of snow melt into the system. Precipitation data in the study area are not available, but the longest period of record, from Nicolet College in Rhinelander, Wisconsin indicates that the maximum precipitation occurs during the months of May through September (EIR subsection 2.1.3.3). Assuming that similar conditions occur in the study area, the percolation lag time would account for the extended period of higher ground-water potentiometric elevations.

Comment No. 62

Document the rationale for use of the selected intermittent piezometer hydrographs.

Response:

As stated in subsection 2.3.3.3, intermittent piezometer records accurately reflected the data recorded by the continuous water level recorders. Therefore, the intermittent data were considered acceptable for the determination of water level fluctuations throughout the year. This procedure was employed because the installation of continuous recorders in every well for several years becomes cost prohibitive.

Comment No.: 63

Well DMB-14 seems to be a poor example for discussing seasonal water level changes because of its extremely short period of record. How can seasonal trends be discussed when this well was not observed for a full seasonal cycle?

Response:

Well DMB-14 will be removed as an example of a well in a lowlying area receiving ground water discharge, and well DMA-17 will be substituted as a second example in addition to DMA-13.

Comment No. 64

Please elaborate on the conclusion that changes in groundwater storage can be considered negligible. The preceding statement that the rate of groundwater discharge was influenced by long periods of high or low precipitation appears to conflict with this conclusion rather than support it.

Response:

The contribution of the ground water to the stream flow (base flow) remained uniform throughout the period of record (May 1977 to December 1980). The total stream flow was influenced directly by precipitation. Piezometer records indicated that the seasonal variation of the potentiometric surface varies with the amount of recharge available from precipitation (see response to comment No. 61). Therefore, the variation in the water available for storage is a seasonal phenomenon and is not a major influence on the stream base flow.

SECTION 2.3.3.4, MAIN GROUNDWATER AQUIFER CHARACTERISTICS

Comment No. 65

Please expand this section to include a detailed discussion of the geology, hydrology and hydrologic characteristics of the main aquifer.

Response:

A discussion of the geology, hydrology and hydrologic characteristics of the main aquifer is presented in the report "Geohydrologic Characterization, Crandon Project" (May 1982) by Golder Associates (previously provided to the DNR) and in Appendix 4.1A of the EIR.

SECTION 2.3.3.5, GLACIAL DRIFT

Comment No. 66

Please describe the methodology used to determine which samples were to be tested for permeability in the appropriate section.

Response:

Soil samples were taken at regular intervals from the exploratory borings drilled at the site, and selected samples were chosen for laboratory permeability testing. The rationale for selection was to evaluate samples of different lithology, depth, and location. Physical limitations also played a part in the sample selection process. Only undisturbed samples are suitable for laboratory permeability testing. Because of the granular nature of most of the subsurface materials, relatively few undisturbed samples were available from which to choose. From the available suitable samples, tests were performed on those samples which appeared to be representative of the various soil types present at the site. Soil samples of similar types but from different depths and locations were also evaluated. This information was supplemented by estimating the hydraulic conductivity from grain size analyses using Hazen's approximation. Agreement between the two methods was generally good.

Comment No. 67

Very little information on the vertical component of groundwater flow is provided. Additional information will be necessary for an evaluation of potential impacts to the groundwater system. At minimum, the vertical head distribution in the groundwater flow system must be presented by the addition of groundwater flow nests to the vertical hydraulic cross-sections in Section 2.3, Appendix 1.2A and Appendix 4.18. This requires at least two piezometer nests in each cross-section and will necessitate reorientation of some of the cross-sections and the installation of piezometers at some of the existing well locations to provide an adequate number of piezometer nests.

Response:

An analysis of the differences in potentiometric heads from nested piezometers was prepared by Exxon and submitted to the DNR on June 3, 1983. These data indicate that there is little difference in potentiometric head between and within various units of the glacial overburden. Discussions are continuing with the DNR Bureau of Solid Waste Management on the analysis of vertical permeability and the need for additional documentation.

Comment No. 68

The boundaries utilized in the groundwater flow modeling need to be documented by fully penetrating the indicated discharge points. Multiple piezometers will be needed to indicate the orientation of the gradients at these points.

I suggest that you consult with Department staff before installing additional piezometers.

Response:

Comment acknowledged.

SECTION 2.3.3.6, BEDROCK

Comment No. 69

Please provide a detailed description of the groundwater flow through the bedrock. Include a detailed analysis of the horizontal and vertical gradients, permeability, and changes of flow through time. Describe the type and number of rock fractures and the associated flows.

Response:

Additional detail concerning the bedrock hydrogeology is contained in the "Mine Hydrology Test Data Analysis," (pp. 1-44) by Camp Dresser & McKee, Inc. and in the "Ground Water Inflow Model for the Proposed Crandon Mine," (pp. 13-16) by Thomas A. Prickett and Associates. These reports were previously submitted to the DNR.

Comment No. 70

The absence of large vertical gradients between the bedrock and overburden materials does not preclude vertical contaminant transport. It has not yet been demonstrated that minor gradients do not exist. Other transport mechanisms such as convection flow resulting from thermal and chemical density variables may also be in operation.

Response:

It may be theoretically possible for minor vertical gradients to exist within the orebody's highly weathered zones. Data from water quality samples within the orebody and from the overlying glacial drift indicate that there is no measurable amount of mixing between the two systems. This implies that if any minor vertical gradients occur within the orebody their potential effect on the ground water in the glacial drift will be small.

Within the orebody it is theoretically possible that some small amount of thermal and/or chemical mixing of the water could occur. However, based on the existing evidence these exchanges are probably very slow (on the order of 1 m/century, [Freeze and Cherry, 1979, pp. 25, 103, 507]) and any effects on the main ground water aquifer in the glacial material should not be measurable. Therefore, the extent of possible mixing of ground water within the orebody and the main ground water aquifer is very minor.

Comment No. 71

Where is the relationship between potentiometric surface and deep boreholes and drift addressed in the Recharge/Discharge Section?

Response:

The reference to the recharge-discharge section in the second paragraph on page 2.3-30 will be deleted. The paragraph will begin: "The potentiometric levels..."

SECTION 2.3.3.7, GROUNDWATER USE

Comment No. 72

Please provide estimates on categories and amounts of water use in the area.

Reponse:

The wells that may be affected by mining operations are all domestic wells with specific capacities ranging from 0.1 to 3.8 gallons per minute per foot of drawdown (Appendix 2.3G, well numbers 98-149). The location of these wells is shown on Figure 2.3-13.

Comment No. 73

Please indicate the locations of all wells in the area. Were the well owners not available during the initial field survey ever recontacted? Additional attempts to contact these owners should be made.

Response:

The location of wells that may be affected during mining operations are shown on Figure 2.3-13 (well numbers 98-149). Currently, Exxon is the major owner of these wells and no additional effort has been made to contact the other well owners since the original survey. As indicated in the response to comment No. 45, an inventory of private water wells within the potential ground water drawdown area will be completed as part of the pre-construction monitoring program. Information to complete Appendix 2.3G will be collected.

Comment No. 74

This section indicated that WW-1 has a specific capacity of 5.0 gpm/foot. The correct figure for this well should be less than 0.5 gpm/foot based on its total capacity of less than 10 gpm. The poor yield of WW-1 is the reason that it was necessary to construct WW-2.

Response:

Comment acknowledged and the following change will be made in the EIR: The specific capacity of WW-1, in the last paragraph on page 2.3-31, will be changed from 5.0 gallons per minute/foot to ". . .approximately 0.01 l/s per meter (0.5 gallons per minute per foot)."

Comment No. 75

The quote from Olcott, 1968 and Borman, 1971 does not agree with the results of the various Exxon studies which indicate that water well yields of less than 10 gpm to more than 1,500 gpm are possible in the immediate vicinity.

Response:

The last sentence of the second paragraph on page 2.3-31 (subsection 2.3.3.7) which references Borman (1971) and Olcott (1968) will be removed from the paragraph.

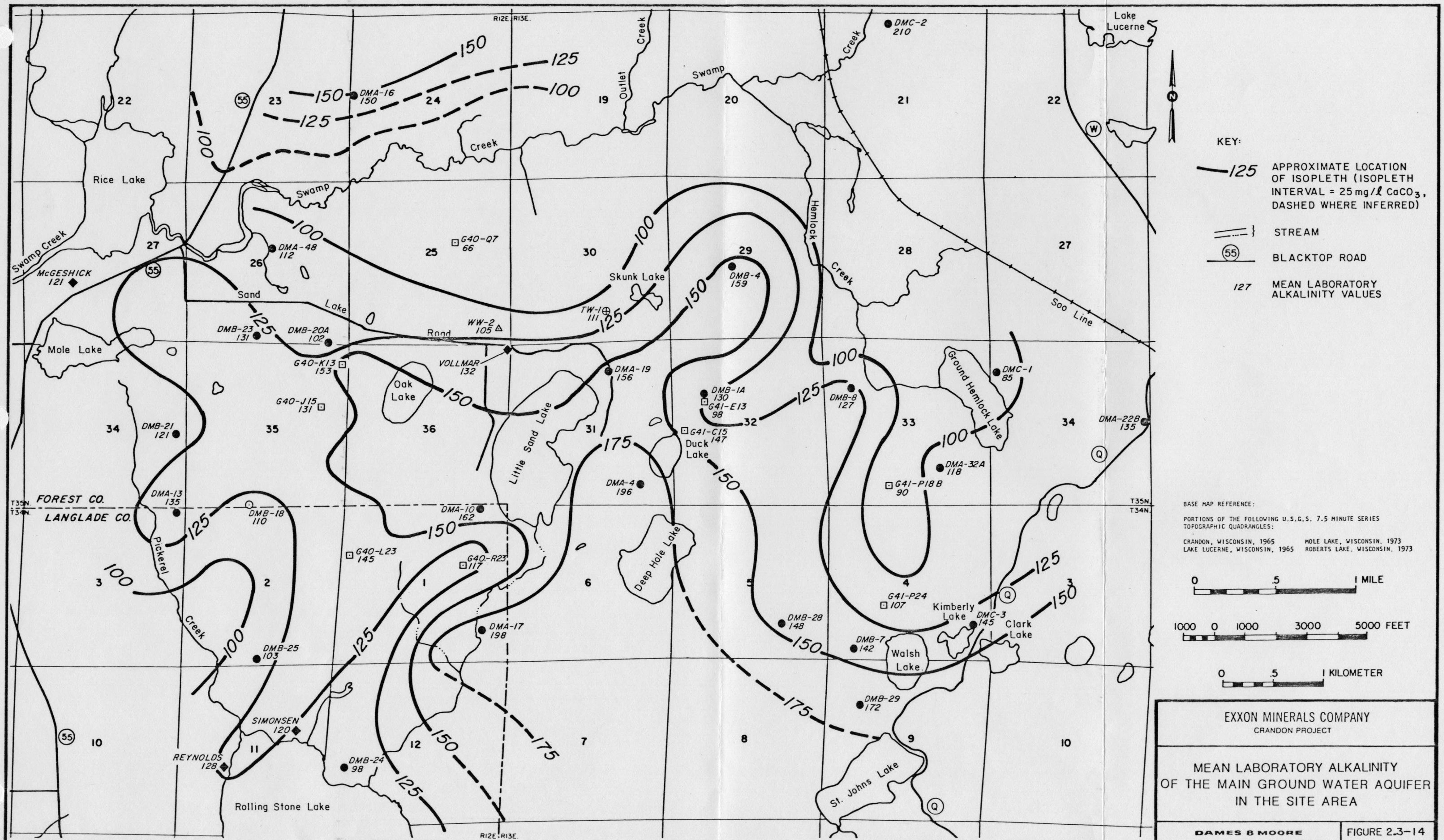
SECTION 2.3.4, GROUNDWATER QUALITY

Comment No. 76

Please include data points on Figures 2.3-14, 15 and 16.

Response:

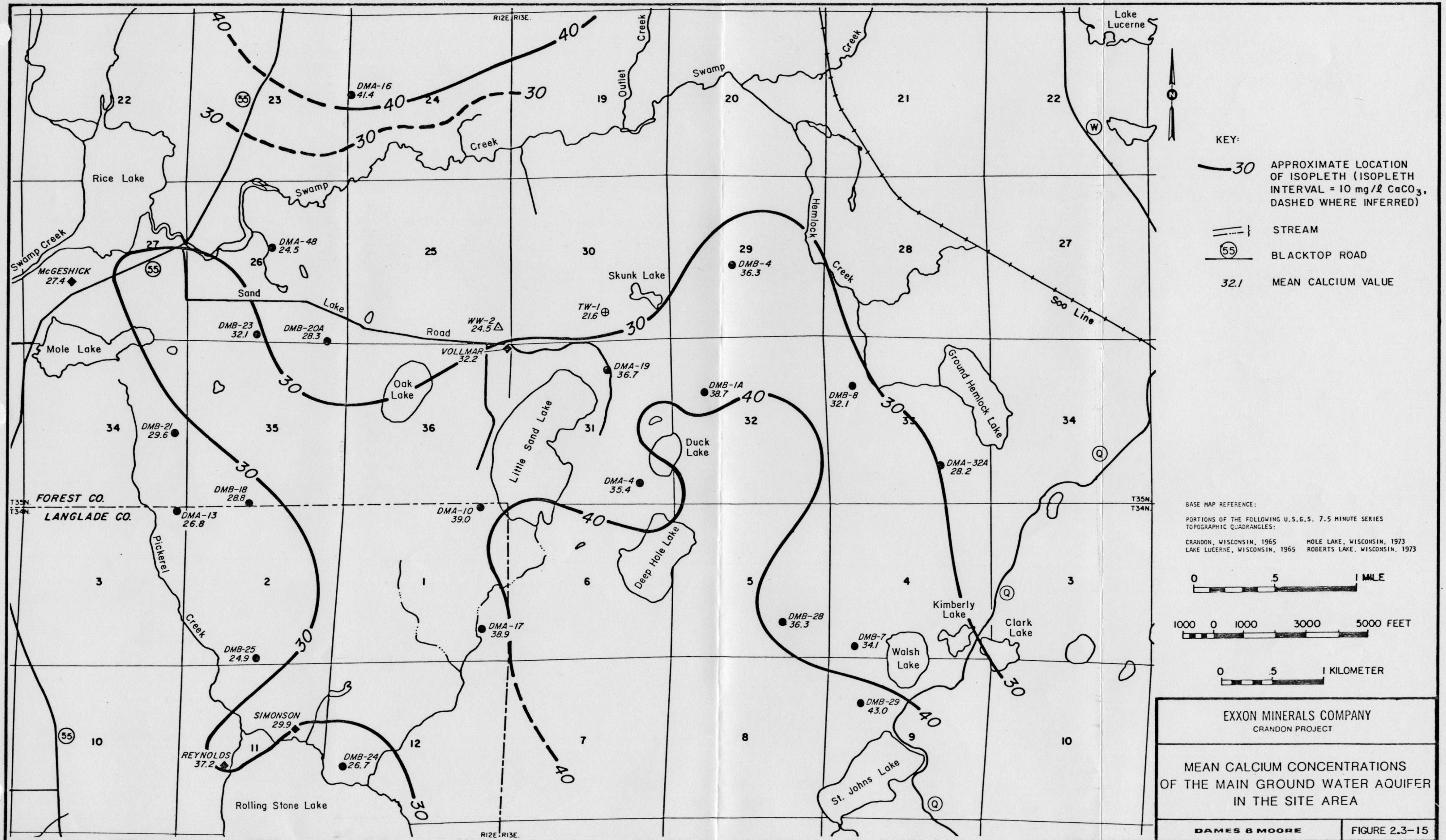
Figures 2.3-14, 2.3-15 and 2.3-16 (attached) have been revised to include the data points used to develop isopleths for mean laboratory alkalinity, calcium, and hardness concentrations.



EXXON MINERALS COMPANY
CRANDON PROJECT

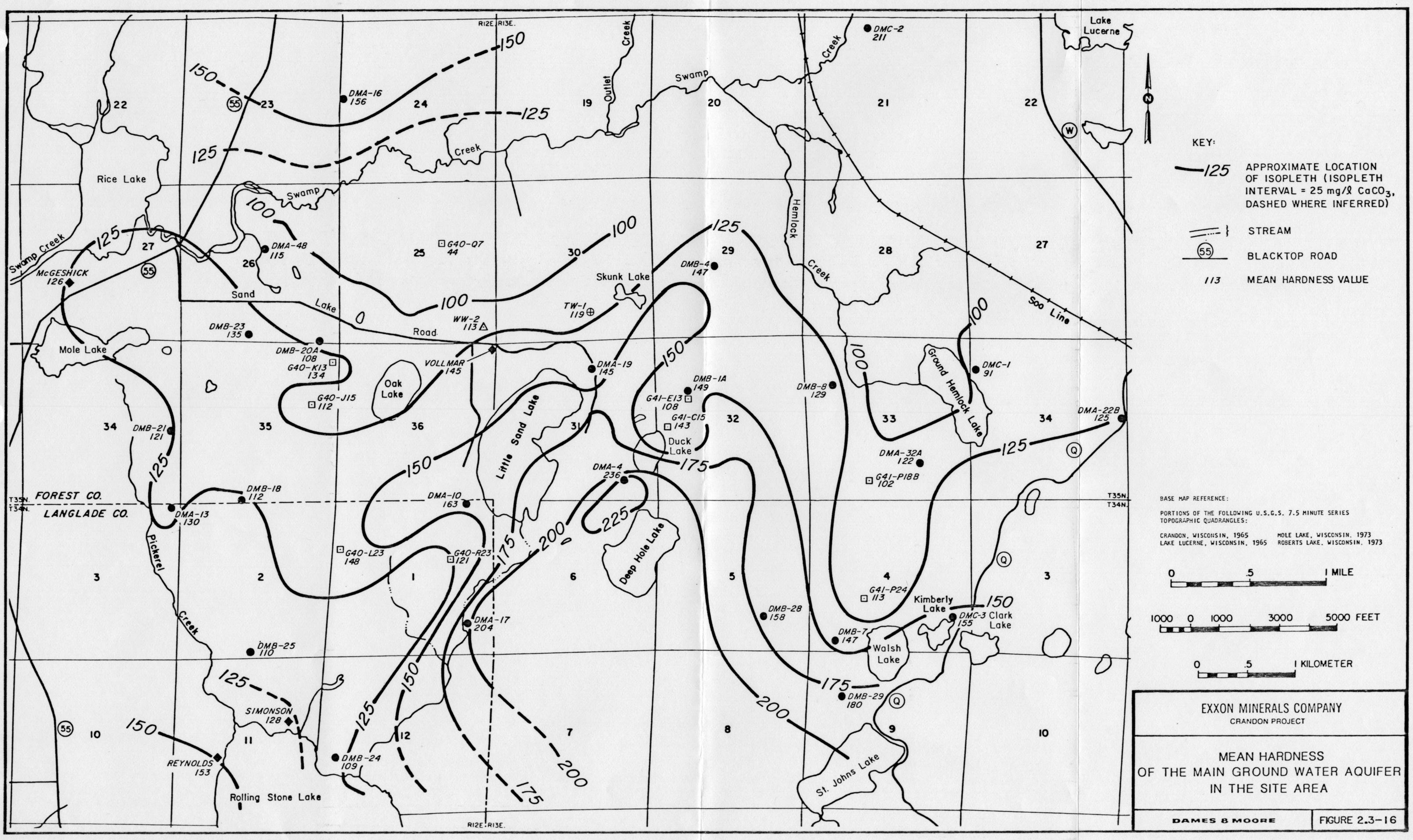
MEAN LABORATORY ALKALINITY OF THE MAIN GROUND WATER AQUIFER IN THE SITE AREA

DAMES & MOORE | FIGURE 2.3-14



MEAN CALCIUM CONCENTRATIONS OF THE MAIN GROUND WATER AQUIFER IN THE SITE AREA

FIGURE 2.3-15



EXXON MINERALS COMPANY
CRANDON PROJECT

MEAN HARDNESS OF THE MAIN GROUND WATER AQUIFER IN THE SITE AREA

DAMES & MOORE | FIGURE 2.3-16

SECTION 2.4, SURFACE WATER

SECTION 2.4.1, FIELD AND LABORATORY METHODS

Comment No. 77

Locating the staff gauges below culverts at road crossings likely produced lower than actual flow values, particularly during higher flows, due to attenuation caused by the culverts. Undisturbed natural settings provide more accurate flow information.

Response:

Comment acknowledged.

Comment No. 78

Table 2.4-1 does not indicate a gauging station on Squaw Creek at CTH "M". SG-20 is indicated at that location on a Dames and Moore map dated November 9, 1977. On October 11, 1977 a gauging station was established there as well as on Spider Creek (SG-21). Please provide discussions of these gauging stations.

Response:

Staff gages (SG-20 and SG-21) and water quality monitoring stations (R, T, W, and X) were established to monitor surface water near a proposed tailings disposal site located in an area that was predominantly wetlands. When the DNR disallowed the use of wetlands as potential tailings waste disposal areas, this area was not evaluated and these gages and stations were deleted from the study.

Comment No. 79

Sampling stations R, T, W and X are not included in Table 2.4-2 or Figure 2.4-2. Please provide a discussion of these stations.

Response:

See response to comment No. 78.

SECTION 2.4.1.1, LAKE LEVELS

Comment No. 80

Apparently lake gauges were read only in April of 1979, the second wettest year in the period of record. This means that little information is available on the expected lake fluctuation in a wet year.

Response:

Comment acknowledged.

Comment No. 81

Table 2.4-4 should indicate that sediment sampling was conducted concurrently with the water discharge monitoring at the locations listed.

Response:

Comment acknowledged and a note will be added to Table 2.4-4 indicating that sediment sampling was conducted concurrently with water discharge monitoring at the locations listed.

SECTION 2.4.1.2, STREAM FLOW RATES

Comment No. 82

Since the staff gauges installed in the streams had to be corrected for ice movement each spring, the readings obtained during the winter are of questionable accuracy. Stream flow values were determined only for the reliability limit for the gauges. Higher and lower flow values were not determined. This incomplete data base is of questionable value for preparation of hydrographs and for estimating base flow.

Response:

The change in gage datum due to the freeze and thaw cycle over the winter had little effect on the accuracy of stage-discharge measurements. Flows were measured during only one winter, 1977-1978. The average change in gage datum was 3.0 cm (0.10 feet) for the 8 gages being monitored. This small change in elevation (which was corrected in the spring) detracted little from the accuracy of the measurements. In other years, data collection was suspended during the winter and restarted in early spring. The gage datum were resurveyed at each restart of data collection.

Hydrographs and average base flow estimates computed from the data are accurate within the limitation imposed by the gage network configuration, type of gages, and locale. For 10 of the principal gages, over 100 readings were made and included in the calculations presented in the EIR. The quality of data collected, consideration of the potential for the gage datum to vary, and the use of established techniques for the measurements of discharge indicate that the data base is both reliable and accurate.

SECTION 2.4.1.4, WATER AND BOTTOM SEDIMENT CHEMISTRY

Comment No. 83

Table 2.4-10 described the method for "Total Sulfur" analysis as "acid cook, analyze for sulfate, sum with sulfide". Please provide a description of the method or a reference.

Response:

Since there was no documented method for total sulfur in water or sediment samples available at the time this project was initiated, and, at this date, there is still no documented total sulfur method for water and sediment samples, Aqualab devised and used the following method:

Total sulfur was determined turbidimetrically as sulfate after rigorous digestion to oxidize all sulfur compounds to sulfate. The water or sediment sample was acidified with concentrated nitric acid and boiled on a hot plate for 15 minutes after the addition of 30 percent hydrogen peroxide. The neutralized sample was then analyzed for sulfate using the "Standard Methods" procedure. Total sulfur was calculated as:

$$\text{Total S} = \text{sulfate} \times 0.333 + \text{total sulfide}$$

The detection limit for total sulfur in water samples is 0.33 mg/l. This detection limit was incorrectly reported in Table 2.4-10.

Comment No. 84

The detection limit listed in Table 2.4-10 for sulfate (as SO_4) is 1 mg/l. The detection limit for total sulfur (as S) is 0.01 mg/l. If the final analytical procedure for both parameters is the turbidimetric measure of sulfate, the detection limit for total sulfur (as S) should be 1 mg/l x Formula weight of S/Formula weight of SO_4 0.3 mg/l. All total sulfur data in the EIR are reported to the nearest 0.01 mg/l while SO_4 data are reported to the nearest 1 mg/l. Please explain how total S data can be reported to a greater number of significant figures than the SO_4 data from which it is partially derived.

Response:

See response to comment No. 83.

Comment No. 85

For almost all of the water samples, total sulfur values are almost exactly 1/3 of the sulfate values. However, for the sediment data, all samples except Swamp Creek Station D have total sulfur values much greater than sulfate/3 plus sulfide. This seems to be a discrepancy if the total sulfur method is measuring the sum of sulfate and sulfide. Is it possible that sediment components interfered with the turbidimetric method? Please explain this discrepancy.

Response:

The analytical procedure for total sulfur includes all forms of sulfur which are oxidized to sulfate and then sulfate is measured. Sulfide and sulfate sulfur will only equal total sulfur when these are the only two forms of sulfur present. Organically bound sulfur and/or inorganic sulfides would not necessarily be detected by either sulfate or sulfide analytical techniques.

Comment No. 86

Heavy metals (except mercury and arsenic) in sediments were run on a solution of the ashed sample rather than on an acid digestate. This is not a standard procedure and spike recovery data should be provided to demonstrate the suitability of the method.

Response:

According to the analytical procedures cited for sediment chemistry analyses in Table 2.4-13, heavy metals were solubilized by an acid digestion prior to atomic absorption analysis.

Sediment sample preparation for heavy metals by the dry ashing technique is a standard procedure. Nationally recognized methods are presented on page 143 in "Standard Methods for the Examination of Water and Waste Water" (15th Edition) and page 3-103 in "Procedures for Handling and Chemical Analysis of Sediment and Water Samples" (USEPA/Corps of Engineers, May 1981).

Comment No. 87

Are the detection limits for the parameters listed in Table 2.4-10 the same as the reporting limits? Are the detection limits for fecal streptococcus and fecal coliform one organism per ml or one organism per 100 ml? Why is the detection limit for total chromium 0.0001 mg/l when Cr^{+3} is 0.001 mg/l and Cr^{+6} is 0.01 mg/l? Should the filter pore size in the footnote be 0.45?

Response:

The detection limits listed in Table 2.4-10 are the same as the reporting limits. However, the table incorrectly presents some detection limits. The following are the correct detection limits:

Fecal Coliform	1 organism/100 ml
Fecal Streptococci	1 organism/100 ml
Total Chromium	0.001 mg/l

These corrections will be made in Table 2.4-10 of the revised EIR.

The footnote will be revised to read: The methods for determination of dissolved metals consist of filtration through a 0.45 u (micron) filter followed by atomic absorption spectroscopy.

Comment No. 88

The arithemetic mean for pH should be "negative log" instead of "anti log" of the geometric mean of the H^+ ion concentration.

Response:

Comment acknowledged and the following corrected statement will be included in subsection 2.4.1.4 (p. 2.4-14) of the revised EIR: Arithmetic means were calculated for all parameters (which for pH is the negative log of the geometric mean of the H^+ ion concentration).

Comment No. 89

Fecal coliform for Station E was the only parameter reported as having a "greater than" value. The parameters should be reported as such in the text rather than stating that a parameter may occasionally be reported as "greater than" in the appendices.

Response:

Comment acknowledged and parameters having "greater than" values will be reported as such in the text of the revised EIR.

SECTION 2.4.1.5, QUALITY CONTROL

Comment No. 90

Please provide descriptions of the quality control procedures governing field activities. Reference the "standard methods" of field calibrations which were used.

Response:

The standard methods of field calibration that were used consist of the following:

The pH electrode was standardized using the appropriate pH buffers according to manufacturer's specifications. Fresh buffers were periodically supplied by Aqualab throughout the study;

The turbidity meter was calibrated using the calibration standards supplied by the manufacturer; and

The dissolved oxygen meter was calibrated using the barometric pressure and temperature per the manufacturer's directions.

Calibration of these meters was performed daily by the field crew prior to initiation of measurements.

SECTION 2.4.2.4, REGIONAL EVAPOTRANSPIRATION

Comment No. 91

The assumption that evapotranspiration is the difference between precipitation and runoff is too general for the surface water analysis.

Response:

The concept that stream flow rate (Q) is equal to the precipitation (P) minus the evapotranspiration (E) is a widely accepted, general statement, providing that there is no net flux of ground water to the stream. Each unit of the equation ($Q = P-E$) has several components that can be evaluated in detail for a specific stream flow rate analysis; however, for a general description of a regional system, such as that described in subsection 2.4.2.4, the general equation is sufficient. Further details on an analysis of a surface water drainage basin are presented on pages 4, 205-207, 211 and 230-231 in Freeze and Cherry (1979).

SECTION 2.4.2.5, SURFACE WATER USE

Comment No. 92

Permits are not required for all diversions, only agricultural or irrigation diversions. Domestic uses may be occurring. Also, water rights are separable from riparian lands.

Response:

Comment acknowledged.

Comment No. 93

Most of Table 2.4-16 is out-of-date. Permits number 1, 3, 4, and 5 have been revoked. There is no pending court review. The permit for number 7 is now under Schroeder Bros. Farms. The application for the permit under number 8 has been dismissed. The reference cited as the source for this information is incorrect.

Response:

Comment acknowledged and Table 2.4-16 (attached) has been updated to reflect the current status of irrigation diversion permits.

SECTION 2.4.3, HYDROLOGIC CHARACTERISTICS OF THE ENVIRONMENTAL STUDY AREA

Comment No. 94

The statement that the glacial drift of the area allows water to move under the ground and stores water percolating from the surface conflicts with the generalized assumption about evapotranspiration (that) is discussed earlier.

Response:

The key assumption in the generalized equation for a water balance in a stream basin is that there is no net flux of ground water out of the basin and that the amount of water held in storage in both the ground water and surface water reservoirs remains constant. That is, the average annual amount of ground water that flows out of the basin is equal to the amount of recharge to the basin and that the average annual amount of surface water lost from storage in the surface water system (in lakes, ponds, etc.) is replaced by precipitation. These assumptions have been proven to be generally accurate by emperial studies. Therefore, there is no conflict in the statement that evapotranspiration (E) is equal to the precipitation (P) minus the runoff (Q) and the statement that glacial drift allows movement of water underground and stores water that percolates from the surface (recharge). This concept is expressed in the equation (Freeze and Cherry, 1979, p. 205):

$$P = Q + E + \Delta S_S + \Delta S_G$$

TABLE 2.4-16

IRRIGATION DIVERSION PERMITS FOR THE
WOLF RIVER DRAINAGE BASIN IN FOREST AND LANGLADE COUNTIES

PERMITTEE	STREAM	COUNTY	LOCATION			MAXIMUM RATE (cfs)	DOCKET NUMBER
			SECTION	TWP.	RANGE		
William Koehler & John Witman	Lily River	Langlade	11, 14, 15	33N	13E	2.22	2-WP-1076
Bula Potato Farms	Wolf River	Langlade	12, 13	34N	11E	2.00	2-WP-1092
Schroeder Brothers Farms	Pollack Creek	Langlade	3, 4, 10	34N	11E	1.50	2-WP-1120

Source: DNR, 1983.

where: ΔS_S = change in storage of the surface-water reservoir and
ΔS_G = change in storage of the ground-water reservoir

and, according to the observations made in numerous basins:

$$\Delta S_S = \Delta S_G = 0$$

for a given basin.

Therefore, the general equation for evapotranspiration becomes:

$$E = P - Q$$

but there is no net flux of water from a given basins storage reservoirs for ground and surface water.

Comment No. 95

The characterization of stream dynamics should include the storing and flow dampening effects of wetlands.

Response:

The analysis of the storing and flow dampening effects of wetlands on the hydrologic system is a complex process and often difficult to quantify. Basically, the wetlands act as a retarding agent to surface water drainage which, in turn, serves as a source of delayed yield to ground water aquifers and to precipitation surface runoff and tends to dampen the flash-flood effects of precipitation events.

The assessment and modeling of these effects is contained in the IEP, Inc. report "Hydrologic Balance for Selected Wetlands" and in the August 1982 "Wetlands Assessment Report," (Chapter 2.0 [p. 2.1-1] and Chapter 4.0 [p. 4.1-11]; Appendices E and F; and the "Wetlands Assessment Inventory Reports") all of which were prepared by Normandeau Associates, Inc., and IEP, Inc. All of the reports listed above have been submitted to the DNR and will provide a more detailed analysis of the effects of wetlands on stream dynamics.

Comment: No. 96

It should be made clear that the hydrographs (Appendix 2.4J) only partially show the seasonal stream discharges. By not determining certain high or low values, the hydrographs are not an accurate presentation of actual stream flows that occurred.

Response:

Comment acknowledged and the following sentence will be added to the last paragraph on page 2.4-23: Although some of the peak values were beyond the rating curves for the stream gage, their hydrographs show the seasonal pattern of stream flows in the study areas.

SECTION 2.4.4, SWAMP CREEK DRAINAGE BASIN

SECTION 2.4.4.1, DRAINAGE LAKES AND ASSOCIATED STREAMS

Comment No. 97

Table 2.4-18 does not indicate that there is considerable marl present in Ground Hemlock Lake.

Response:

Comment acknowledged and marl will be added to Table 2.4-18 as a substrate type present in Ground Hemlock Lake based on observations by the DNR.

Comment No. 98

Rice Lake - What were the reasons for the concentration for iron (4.34 mg/l) in January, 1978 at Station F and the low values for alkalinity (1 mg/l on 7/7/77 and 7 mg/l on 9/7/77) at Station N? Are these actual values or the result of contaminated samples or laboratory errors?

Response:

The anomalously high iron concentration in the water sample collected from Station F in January 1978 also had the highest suspended solids concentration, 28 mg/l. Therefore, there may have been some problem with filtration and/or the presence of colloidal (unfilterable) iron oxides.

The two low alkalinity (bicarbonate) values at Station N apparently are in error, since the respective hardness concentrations are not dissimilar from other sample concentrations. Bicarbonate is the dominant anion available to ion balance calcium and magnesium cations (hardness). The anomalous values will be identified by footnote in the revised EIR as probable errors caused by sample contamination or in field measurements.

Comment No. 99

Please discuss the ranges of parameter concentrations measured in sediments and characterize the values as polluted, moderately polluted, or unpolluted.

Response:

A comparison between Table 2.4-23, "Bottom Sediment Chemistry Summary," and Appendix 2.4E, Table E-4, "Comparison of Selected Metal Concentrations on Bottom Sediment From The Environmental Study Area With Report Concentrations For Background Levels or/Nonindustrial Use Areas," indicates that mean concentration of metals in bottom sediments from the environmental study area are within means or ranges of reported background levels. The variability of sediment chemical analyses probably results from different stream and lake environments. To our knowledge, there is no valid classification scheme for characterizing sediments as polluted, moderately polluted, or unpolluted.

Comment No. 100

Hemlock Creek - Ten of the stations listed in Table 2.4-19 had undetermined flow values lower than the estimated base flows. Please provide a detailed discussion on how the estimated annual average base flows were derived. Footnote B describes the normal procedure for determining base flow. How can base flow be accurately estimated on the basis of incomplete and possibly erroneous data due to ice movement of gauges?

Response:

In response to comments regarding base flow and average base flow, the estimates have been refined and Table 2.4-19 (attached) revised for clarity. Average base flow was estimated at each gage using the entire period of record. A smoothed line was drawn connecting selected low points of each station's hydrograph. Areas found above this line but below the recorded flows were planimetered and corrected to a flow. The flow was assumed to consist of direct runoff and interflow. Likewise, areas found below the smoothed line and above the zero flow line were planimetered and also converted to a flow. This second value represented the average base flow over the period of record as reported in Table 2.4-19.

The new column labeled "Base Flow" was estimated in the following manner. For USGS gages, the minimum instantaneous flow of record was selected. For all other gages, the minimum of either the measured flow or a flow computed by an area weighted estimate based on the minimum flow and area at the USGS gage at Langlade and the drainage area of the named gage was used. No estimate of "Base Flow" is provided for Hoffman Creek due to the few measurements collected and the ill-defined drainage area above the gage.

The estimates of "Average Base Flow" are considered very reliable. In most cases, they are based on over 100 measurements of flow collected at each gage. Individual flow measurements were collected according to published USGS techniques. Changes in gage datums were continually monitored to minimize errors. (Also, see response to comment No. 82).

The "Base Flows" shown in the revised Table 2.4-19 are the most reliable estimates possible with the existing data base. They are based on a combination of parameters, each permitting a high degree of accuracy to be maintained. These parameters include estimates of drainage areas, low flow measurements, and a 13-year record of flow data collected by the USGS.

"Base Flow" is a stochastic variable that is expected to change each year. As such, a probability that a flow will occur that is less than the value shown is always possible. For the flows in the revised Table 2.4-19, this probability is 1 in 13; i.e., 1 chance in 13 exists that a lower flow will occur in any year. This probability is developed by relation to the USGS Langlade gage. This gage indicated that the low flows were collected in the year of the lowest runoff in 13 years. Selecting the "Base Flow" by either area weighting or measurement in the dry year would maintain a similar probability of occurrence as for data associated directly with the Langlade gage.

TABLE 2.4-19

SUMMARY OF STREAM DISCHARGES IN THE ENVIRONMENTAL STUDY AREA (cfs)

STREAM GAGING LOCATION	AVERAGE BASE FLOW[a]	BASE FLOW[b]	MAXIMUM	MINIMUM
Wolf River[c] (at Langlade-USGS)	n/c	175	1840	175
Swamp Creek				
SG-1	42	24	>203	<29.9
USGS Below Rice Lake	33	17	209	17
USGS Above Rice Lake	19	8	151	8
SG-2	21	14	>53.2	<19.2
SG-3	23	13	138	<13.4
SG-5B	3	<2.3	30.7	<2.3
Hoffman Creek (SG-E and SG-F)	n/c	n/c	11.9	0.4
Outlet Creek (SG-4)	7	<3.0	>30.0	<3.0
Hemlock Creek (SG-6)	4	<0.8	>17.5	>0.8
Duck Lake Outlet (SG-B)	n/c	<0.2	10.3	<0.2
Pickerel Creek				
SG-22	7	4.8	74.0	<4.9
SG-19	4	0.9	23.4	<1.8
Creek 12-9				
SG-23	3	2.0	42.2	<3.0
SG-8	<1	<0.6	10.1	<0.6

Note: n/c = not calculated.

[a]During periods of record between April 1977 and November 1980. Periods of record vary -- see Table 2.4-3 and Appendix 2.4A.

[b]Minimum of either recorded flow or the ratio of the drainage area weighted average of named gage to the Langlade gage.

[c]Low flow over 13 years of record (water years 1965 to 1979).

Comment No. 101

The flow data at SG-6 Hemlock Creek (Table 2.4-19) are incomplete since higher and lower flow values could not be quantified.

Response:

The data for SG-6 are presented as greater than or lower than. The actual peaks were not measured because they exceeded the rating curve for the gage. The data sets are complete, although they do not have exact values for the high and low flow rates.

Comment No. 102

Please provide the temperature and percent saturation of dissolved oxygen on page 2.4-30 where the concentrations of dissolved oxygen is discussed.

Response:

Comment acknowledged and the following revised sentence will be substituted for the last sentence on page 2.4-30: The concentration of dissolved oxygen in Hemlock Creek was below 5 mg/l during June 1977 at Station A-1 (3.2 mg/l oxygen, 32 percent saturation at 13.5°C), but all other measurements at both stations were approximately 5 mg/l or 60 percent oxygen saturation.

Comment No. 103

Please discuss the high (66.2 ppm) value for Cr in the bottom sediment sample at Station A-1 on Hemlock Creek. How many composites were made for the bottom sediment samples?

Response:

Chromium is a widely distributed element in soils. Endrogenous concentrations have been reported to range from 5 to 3000 ppm with a mean of 100 ppm[1], although most soils have concentrations less than 1000 ppm[2]. The chromium concentration measured in the sediments of Hemlock Creek at Station A-1 (66.2 ppm) was one of several relatively high values measured in the Swamp Creek and Pickerel Creek drainage basins. Concentrations of 180.8, 57.9, and 92.1 ppm were measured at Stations D, E, and M-1, respectively, and none of these values seems unusually high since this region of Wisconsin is highly mineralized, as evidenced by the Crandon deposit.

The sediment samples were not composited. Each sample was obtained from a single Ekman grab sampler.

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[1]Bowen, H.J.M., 1966, Trace elements in biochemistry: Academic Press, London, 241 p.
[2]Brown, K.W., and Deuel, L., 1980, Hazardous waste land treatment: USEPA, SW-874, 974 p. (September).

Comment No. 104

Swamp Creek - The small tributary stream system flowing into Swamp Creek from the north Section 24 of T35N, R12E, should also be discussed.

Response:

The following discussion of the tributary stream system flowing into Swamp Creek from the north Section 24, T35, R12E will be added to subsection 2.4.4.1 of the revised EIR:

An additional unnamed tributary to Swamp Creek, designated Creek 24-15, is located in Sections 13 and 24, T35N, R12E. The confluence of Creek 24-15 with Swamp Creek is located approximately 457 m (1500 feet) downstream from the proposed access road crossing. Three unnamed tributaries, Creeks 24-4, 24-13 and 24-14, contribute flow to Creek 24-15. No stream gage measurements have been taken in this stream system. Steuck (1981) described Creek 24-15 as a medium hardwater trout stream (Class IB), with slightly alkaline, light brown water. In August 1983 a beaver dam was observed on Creek 24-15 approximately 61 m (200 feet) upstream from the confluence with Swamp Creek.

Reference: Steuck, R., 1981, Wisconsin DNR - Woodruff, Interdepartmental Memorandum, December 28, 1981.

Comment No. 105

The statement on page 2.4-34 that no metals were measured above detection limits at Stations D and E during 1979 and 1980 sampling is inaccurate. Appendix 2.4F, Table F-29 for Station D indicates detectable levels of aluminum, iron, manganese, and zinc were found. Please provide the water chemistry collected by USGS that corresponds to the period of sampling by Exxon. Explain why iron, manganese, phenol, and sulfates were all very high at Station D in comparison to other stations in the study area.

Response:

Comment acknowledged and the second sentence in the last paragraph on page 2.4-34 will be revised to the following: All parameters measured were within the mean concentrations from the previous samplings.

The USGS water chemistry data for Swamp Creek for the period as reported in Appendix 2.4F, Table F-29, are presented in Appendix 2.4L, Table L-8.

Data presented in Appendix 2.4G, Table G-14 and Appendix 2.4H, Table H-3 indicate the mean concentrations of iron, manganese, phenol and sulfates at Station D are the same as those measured at Stations B, E, V, Q and S. There are no detectable station differences because variability of chemical concentration within a given sample station in Swamp Creek is greater than the variability between stations.

Comment No. 106

Outlet (Metonga) Creek - Higher and lower flow values for Outlet Creek occurred on numerous occasions but could not be quantified. Please discuss how this affects the accuracy and reliability of the base flow estimate.

Response:

As indicated in revised Table 2.4-19 (see response to comment No. 100), the "Base Flow" estimates for Outlet Creek are given as "less than 3.0 cfs." At Gage SG-4 on Outlet Creek, 11 estimates of gage elevation fall below the lower end of the rating curve. These 11 values preclude greater refinement of the base flow estimate than provided above.

Comment No. 107

Hoffman Creek and Springs - This section states that the base flow for Hoffman Creek was estimated from limited discharge data. Please discuss the accuracy and reliability of the estimate of base flow.

Response:

In revised Table 2.4-19 (see response to comment No. 100), no estimate of the base flow is provided for Hoffman Creek and Springs.

SECTION 2.4.4.2, SPRING LAKES

Comment No. 108

Please include a discussion of any wetland influence on lake level variation. Also, marl is a common lake substance.

Response:

In a spring fed lake, such as Ground Hemlock Lake, the primary source of water supply to the lake is ground water. If there is a wetland associated with the lake which is also ground water fed, then the level of water in both should fluctuate about the same although there would be a delayed yield of water to the lake from the wetland which would tend to stabilize the lake level. If, however, the wetlands are perched, as many are, then the wetland discharge to the lake could have a stabilizing effect on the level of the lake. Also refer to the Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. August 1982 Wetlands Assessment Report (Appendices E and F) (previously submitted to the DNR).

Comment acknowledged and as indicated in the response to comment No. 97, marl will be added to Table 2.4-18 as a substrate type present in Ground Hemlock Lake based on DNR observations.

Comment No. 109

The metalimnion temperature change is described as 16°C which is not equivalent to 61°F.

Response:

Comment acknowledged and the English equivalent of 16°C (29°F) will be inserted.

SECTION 2.4.5.1, DRAINAGE LAKES AND ASSOCIATED STREAMS

Comment No. 110

Rolling Stone Lake - Again, no mention is made of the possible effects of wetlands on water level fluctuations. Rolling Stone Lake has a shoreline of 40% wetland.

Response:

See response to comment No. 108.

Comment No. 111

Please provide a discussion of why Station M-4 had much higher sediment concentration levels of Cr, Cu, Fe, Pb, phenol and sulfate than Station M-2.

Response:

The difference in the mentioned chemical constituents concentrations at stations M-2 and M-4 in Rolling Stone Lake sediments is less than the variance measured in the creeks and lake sediments of the Pickerel Creek drainage basin Appendix 2.4E, Table E-2, or within the Swamp Creek drainage basin, Appendix 2.4E, Table E-1. Considering this range of values, there is essentially no difference.

Comment No. 112

Pickerel Creek - Although a measured flow of 1.2 cfs was recorded and low flow rates occurred on numerous occasions but could not be quantified, the base flow estimate for Pickerel Creek is 2 cfs at SG-19. Please discuss this apparent discrepancy.

Response:

Some flows less than 1.2 cfs were recorded at SG-19 on Pickerel Creek and the drainage area weighted average is 0.9 (see revised Table 2.4-19 attached to the response to comment No. 100). These two values are in agreement. The revised Table 2.4-19 indicates that the average base flow at SG-19 is 4 cfs, based upon the area weighted average. Although this average base flow is higher than some of the recorded low flows, it is not inconsistent to have an average base flow higher than the lowest recorded reading. Base flow varies seasonally as well as from year-to-year; therefore, the average could be higher than the lowest recorded value at a particular gage.

Comment No. 113

Creek 12-9 - Flows lower than the base flow estimate of 3 cfs occurred but could not be quantified. Please discuss the reliability of this base flow estimate and the base flow contribution provided by the extensive adjoining wetland.

Response:

The "Base Flow" for Creek 12-9 is estimated to be 2.0 cfs (see revised Table 2.4-19 attached to the response to comment No. 100). The value of 2.0 was selected by use of an area weighting procedure described in the response to comment No. 100. The value selected is less than the lower limit of the stage-discharge curve.

The probability of a flow occurring that is less that 2 is approximately 1 chance in 13 on an annual basis (see response to comment No. 100).

The value is considered reliable and accurate given the gage type and the locale (see response to comment No. 100).

The extensve adjoining wetlands provide a source of base flow to the creek. They tend to maintain flow in the stream under drought conditions longer than would be expected in their absence. The wetlands dampen changes in both high and low flows. This dampening is proportional to their surface area and hydraulic connection to the stream.

Comment No. 114

Skunk Lake does not intermittently contribute surface water drainage to Little Sand Lake. Page 2.5-99 states "Skunk Lake has no surface water discharge...".

Response:

Comment acknowledged and the last sentence in the paragraph under the heading "Creek 12-9" (p. 2.4-52) will be revised to the following: Duck and Deep Hole lakes contribute surface water drainage intermittently to Little Sand Lake, which is the headwater of Creek 12-9.

SECTION: 2.4.5.2, SEEPAGE LAKES

Comment No. 115

Little Sand Lake - Dissolved oxygen levels below 5.0 mg/l were described at Station H in March, 1977 and 1978 and at Station I in March, 1978. Appendix 2.4H, Table H-7 indicates dissolved oxygen below 5.0 mg/l were found at Station I in March, 1977, at both stations in February, 1978, and at Station H in February, 1980. Please discuss these findings.

Response:

The observation of low dissolved oxygen concentrations levels during February and March was not unique to Little Sand Lake but similar trends were observed in other lakes. Low dissolved oxygen concentrations are reasonable considering that lakes are likely to have been covered by ice since December. Revisions will be made in the discussion of dissolved oxygen levels in Little Sand Lake (pp. 2.4-57 and 2.4-58) and all periods when the dissolved oxygen levels were lower than 5.0 mg/l will be identified.

Comment No. 116

Explain the discrepancies between sediment samples Stations H and I for total sulfur, Fe, Pb and Mn.

Response:

The difference in the mentioned chemical constituents concentrations at Stations H and I in Little Sand Lake sediments is less than the natural variance measured in the creeks and lake sediments of the Pickerel Creek drainage basin (Appendix 2.4E, Table E-2), or within the Swamp Creek drainage basin (Appendix 2.4E, Table E-1). Considering this range of values, there is essentially no difference. The concentration of lead at Station I, 156 ppm, is the highest reported value for all sediments and may be a erroneous value.

Comment No. 117

Duck Lake - The intermittent outlet stream from Duck Lake should be described as passing through a major wetland before discharging into Little Sand Lake.

Response:

Comment acknowledged and the last sentence of the first paragraph under the heading "Duck Lake" (page 2.4-59) will be revised to the following: The lake has no clearly defined inlet stream and an intermittent outlet stream, which flow through a major wetland before discharging into Little Sand Lake.

Comment No. 118

Although the base flow estimate for the outlet of Duck Lake was estimated at 0.5 cfs, most low flow discharges recorded in Table A-14 are lower. This indicates that the base flow estimate is too high. Please provide the basis for this estimate and a discussion of its reliability.

Response:

The "Base Flow" for the outlet of Duck Lake has been changed to less than 0.2 cfs (see revised Table 2.4-19 attached to the response to comment No. 100). The computation method and a discussion of reliability of the estimate are presented in the response to comment No. 100.

Comment No. 119

The water chemistry data presented reflects conditions prior to the 1980 pump test discharge. Since this discharge significantly altered the water chemistry of the lake, these data do not represent current baseline conditions. Please include a discussion of the affect of the discharge on the lake chemistry and provide baseline data describing the current water chemistry.

Response:

Chemical analysis of Duck Lake water was reported in Appendix 2.4F, Table F-7, both before the pumping test and one analysis was completed 3 weeks later. Alkalinity, hardness, TDS, and pH had measured increases after the pumping test. There was no detectable increase in metal concentrations. Rain water which is low in TDS, alkalinity, hardness, and pH should restore Duck Lake to its pre-pumping test water quality.

Comment No. 120

Deep Hole Lake - Please describe the two intermittent outlets from Deep Hole Lake.

Response:

The main outlet from Deep Hole Lake is through a shallow marsh located on the west-central part of the lake. A beaver dam, located approximately 244 to 305 m (800 to 1000 feet) west of the lake proper, controls discharge from the lake. The U-shaped dam is is approximately 38 m (125 feet) in length and in August 1983 the water level was 0.3 to 0.5 m (1 to 1.5 feet) upstream of the dam. The only water flowing downstream of the dam was from seepage which occurs at several locations at the toe of the dam. There is no well defined stream channel downstream from the dam. Water seeping from the dam flows through an area approximately 30 m (100 feet) in width before entering a coniferous swamp located approximately 46 m (150 feet) downstream.

The secondary outlet is located on the southwest side of the lake. A beaver dam, approximately 152 m (500 feet) south of the lake proper, controls flow from this outlet. A shallow marsh wetland is located between the open water part of the lake and the beaver dam. In August 1983, the water level was below the bottom of the 30-m (100-foot) long dam and there was no seepage through the dam. There is no well defined channel downstream of the dam. The area downstream of the dam is grass with scattered trees (streamside wetland). When the lake level is high and water flows over or through the dam, it enters this streamside wetland before entering a shrub swamp wetland approximately 250 m (820 feet) downstream.

Comment No. 121

Deep Hole Lake is described as a lake with a neutral pH. However, the water quality data in Appendix 2.4F show that Deep Hole Lake has a pH range of 4.5-6.6 which reflects a slightly acidic condition.

Response:

Comment acknowledged and the first sentence in paragraph three on page 2.4-63 will be revised to the following: The water chemistry data indicate that Deep Hole Lake was a soft, slightly acidic, light brown colored lake.

Comment No. 122

Mole Lake - Please provide additional discussion and clarification on the drainage to and from Mole Lake. District personnel have observed the stream flowing into Mole Lake.

Response:

The EIR discussion of surface water drainage associated with Mole Lake will be revised to include the findings of field observations in 1983. The information on surface water drainage presented in subsection 2.4.5.2 (p. 2.4-67) and shown graphically on Figure 2.4-5, will be based on the surface flow observations in 1983. Mole Lake has no known outlet. Local residents report that an outlet was present on the northwest side of the lake; however, drainage from the lake is no longer possible from this outlet because of road and home construction in this area. During periods of extremely high water, a portion of State Highway 55 has been flooded with water originating in Mole Lake and in the agricultural fields located west of Highway 55.

Mole Lake is located on the Swamp Creek-Pickerel Creek drainage basin divide. Surface water drainage enters Mole Lake from the east and south via culverts under Black Joe Road and South Mole Lake Road, respectively. Drainage from both of these sources is intermittent and is greatest in spring and early summer during periods of high runoff and precipitation.

SECTION: 2.4.6, WOLF RIVER DRAINAGE BASIN

Comment No. 123

The dissolved oxygen concentrations at Station Y on the Wolf River were consistently above 5 mg/l. Dissolved oxygen ranged from 1.4 to 2.7 mg/l at Station Z in the summer of 1978. Please provide a discussion of the possible explanations for the low level of dissolved oxygen observed at Station Z.

Response:

The dissolved oxygen concentrations at both Stations Y and Z on the Wolf River reach their lowest value during the summer when the water temperature is at its maximum. The lower range of dissolved oxygen concentration at Station Z does not correlate with differences in BOD, COD or stream sediment chemistry. The Wolf River at Station Z has the additional input from Swamp, Spider, and Pickerel creeks, which may explain the differences in dissolved oxygen concentration.

SECTION: 2.4.7, HYDROLOGICAL RELATIONSHIPS

Comment No. 124

This section states that a major portion of the water generated during precipitation events infiltrates into the groundwater. Discuss how this statement relates to the assumptions used in calculating regional evapotranspiration in Section 2.4.2.4.

Response:

For a more detailed discussion of the relationship between precipitation and ground water recharge, refer to the Golder Associates report, "Geohydrologic Characterization, Crandon Project," (Chapter 5.0, pp. 67-78) (previously submitted to the DNR), and to Freeze and Cherry (1979, pp. 203-207, 211, 544-545) cited in subsection 2.4.2.4

The value for evapotranspiration cited in subsection 2.4.2.4 was not calculated. It is a measured value taken from the USGS data at Langlade.

Comment No. 125

Water Balances - Please discuss the relationship of the various water budgets developed to the project proposal. Provide additional justification for the groundwater inflow and outflow estimates based on available hydrogeological data. Explain in detail why the available data were sufficient to establish a water budget upstream from SG-19 and for Swamp Creek at Highway 55.

Response:

Ground water inflow and outflow estimates were computed using Darcy's law for saturated flow,

$$g = ki\,A_N$$

where: g = instantaneous rate of flow (cfs);
k = average aquifer permeability (ft/s);
i = slope of the piezometric gradeline (ft/ft); and
A_N = area of the aquifer normal to the direction of flow (ft^2).

The annual flow was computed by summing (integrating) the above equation over time.

Values of k were estimated from field tests, laboratory tests, and material grain size. The value of k was approximately $3x10^{-4}$ ft/s. Values of i were computed from the map shown in Figure 2.3-4. Finally, values of A were obtained by estimating the average depth of the aquifer from the drill logs and multiplying by the width of the subbasin boundary.

Data were considered insufficient to perform a water balance above SG-19 on Pickerel Creek due to the inability to compute sufficiently accurate ground water flows under reasonable assumptions of aquifer permeability, the measured surface, and aquifer thickness. A water balance was not computed for Swamp Creek above Highway 55 because the large size of the area would have required an extrapolation of the data base beyond the limits of its accuracy to define the hydrologic conditions in the subbasin.

Comment No. 126

Response:

Why don't the water balances for sub-basins SG-6 and SG-23 (summer time) sum to zero?

The water balance for subbasin SG-6 does not zero because of a typographical error in Table 2.4-21 in the third column under "Evapotranspiration." The "40" found here should be changed to "60."
The water balance for subbasin SG-23 does not sum to zero for a different reason. The water balance covers less than a full year, and changes in ground water, lake, and soil moisture levels occur. Computed estimates of each were 17, 1, and -7 percent, respectively. When summed with other loss terms (i.e., 62, 18, and 9 [Table 2.4-21]), they equal 100 percent. As stated on page 2.4-76, the annual values for the change in storage in lakes, methods, and ground water when averaged over a long time are zero. The compilation of a water balance from subbasin SG-23 for the summertime used the full equation on page 2.4-75.

Comment No. 127

Water Quality - A comparison of mean values of alkalinity between Hemlock Creek (Stations A-1 and A-2) and Swamp Creek (Station V) is not valid since alkalinity varies seasonally and Station V lacks a complete year's worth of data.

Response:

This statement is considered valid because Station V in Swamp Creek was sampled monthly (except June and July) between October 1977 and September 1978 (see Table 2.4-6). Please note that the order of presentation of pages 2 and 3 of this table should be reversed.

SECTION 2.4.8, SUMMARY AND CONCLUSIONS

Comment No. 128

Conclusion number 7 is contradicted by unexplained, unusually high metal concentrations reported for both water and sediment samples at several stations.

Response:

Although there is some variability in the concentrations of various metals in both the surface water and in the stream sediment samples among stations, there do not appear to be any concentrations that are unusually high for any of the metals for which analyses were run. Appendices 2.4E and 2.4F list the means and ranges of the metals detected in water and sediment samples. There do not appear to be any values detected that are significantly outside of the means and ranges listed for typical non-industrial water and sediment samples.

SECTION 2.5, AQUATIC ECOLOGY

SECTION 2.5.1.1, PHYTOPLANKTON

Comment No. 129

This section indicates that samples for phytoplankton were collected with "two calibrated centrifical pumps that were deployed in tandem." What was the purpose of using two pumps?

Response:

Two pumps in tandem were utilized in the collection of plankton samples to increase volume in order to minimize sampling time.

Comment No. 130

Were the 50-liters phytoplankton samples collected at each one meter interval or did the sample reflect a depth composite? If the sample was depth-composited, how was this accomplished?

Response:

As stated on page 2.5-6 of the EIR, a total of 50 liters was collected for each phytoplankton sample. For each sample, with the exception of those collected at the shallow lakes (i.e., Rice and Skunk samples were collected immediately beneath the surface), the intake hoses were lowered to a position immediately above the substrate and then raised at 1-m (3.3-foot) intervals to obtain a vertically integrated sample of the water column.

Comment No. 131

Samples were preserved with three buffered formalin. Problems with cell distortion and disruption would likely occur using formalin particularly with sensitive algal forms such as Crytophyceae and Chrysophyceae. How were these samples stored prior to enumeration and identification? What was the approximate length of time between field collection and analysis?

Response:

The phytoplankton samples were preserved in the field with 3 percent buffered formalin and returned to the laboratory where they were stored. The length of time between field collection and laboratory analysis varied over the course of the work but was often 3 months or longer.

Comment No. 132

A Sedgewick-Rafter (SR) counting cell was utilized for identification and enumeration of species present. How was Exxon able to identify to the species level and occasionally variety level using the SR cell? Use of the SR cell usually precludes the use of high magnification required to identify many forms to this level. Were other methods used to identify to the lowest taxon level? What power of magnification was used? Were any other algal concentration techniques used in counting? Were fresh (unpreserved) samples ever collected for identification purposes?

Response:

Prior to formal enumeration of phytoplankton, wet mounts and some permanent mounts were commonly made by the analyst for the purpose of becoming familiar with species composition at magnifications higher (up to 1000X) than those possible with the S-R cell. The S-R cell was then used in the enumeration of phytoplankton present. In the course of enumeration, species names could be commonly attributed to smaller forms because of the familiarity gained beforehand. No other algal concentration techniques were used in counting. Fresh (unpreserved) samples were not collected for identification purposes because they could not be kept alive for the duration of field sampling activities.

Comment No. 133

The chlorophyll method utilized in this work (APHA, 1971) differs from that more recently recommended (APHA 1975, 1980). The main difference is that one N HCL is recommended in the pheophytin a correction technique. The use of a stronger acid solution may lead to significant errors. What was the normality of the HCL used in the chlorophyll analysis? What were the typical ratios of optical density at 663 nm or 665 nm before and after acidificaiton? Did this ratio ever exceed 1.70?

Response:

A 0.02 ml quantity of concentrated HCL, which had a normality of 11 to 12, was used in the chlorophyll a method (APHA, 1971).

The ratios of optical density before and after acidification ranged between 1 and 7, varying with the sample location and sampling period. As indicated, this ratio did exceed 1.70.

Comment No. 134

What type of filter was utilized in the chlorophyll a analysis? How much water was usually filtered to collect the chlorophyll a sample? What extraction method was used?

Response:

Approximately 500 ml of sample was filtered utilizing 0.45 u membrane filters.

Extraction was accomplished by placing the filters in vials containing 90 percent aqueous acetone.

SECTION 2.5.1.5, BENTHIC MACROINVERTEBRATES

Comment No. 135

Where are the "miscellaneous substrate" recorded? Please provide a (description) of the substrate types actually sampled qualitatively.

Response:

As indicated on page 2.5-11 of the EIR, qualitative benthos samples were collected from "miscellaneous substrates"; a more accurate term may be "miscellaneous habitats." Samples were collected by hand and/or with a dip-net. Typically, shoreline areas were investigated for suitable substrates such as rocks or sticks which might provide benthic habitat. Also, a dip-net was swept through aquatic macrophytes and/or over-hanging terrestrial vegetation, if present, and surficial sediments. The attached table provides a listing of the substrate types sampled at each location.

Comment No. 136

Please describe in more detail how the diversity index was calculated and what taxa level was used to calculate diversity.

Response:

Species diversity was calculated according to Brillouin's formula based on $\log_{10}$ (Pielou, 1966) as indicated on page 2.5-12 of the EIR. The formula for Brillouin's index is:

$$H = \frac{1}{N} \ln \frac{N!}{N_1!N_2!\ldots N_s!}$$

where:

H	=	diversity;
N	=	the total number of individuals in the sample;
N1,N2...,	=	the number of individuals in taxa 1, 2,...; and
s	=	the total number of taxa in the collection.

(TABLE FOR RESPONSE TO COMMENT NO. 135)

SUBSTRATE TYPES SAMPLED FOR THE COLLECTION OF QUALITATIVE BENTHIC MACROVERTEBRATES

LOCATION	SAMPLING STATION	SUBSTRATE
Swamp Creek Drainage Basin		
Rice Lake	F	Aquatic vegetation, peat, muck, detritus
Rice Lake	N	Aquatic vegetation, peat, muck, detritus
Hemlock Creek	A-1	Silt, sand, detritus, sticks
Swamp Creek	D	Rocks, gravel, sticks, shoreline vegetation
Swamp Creek	E	Shoreline vegetation, aquatic vegetation, sticks, detritus
Oak Lake	G	Aquatic macrophytes, sticks, sand
Pickerel Creek Drainage Basin		
Rolling Stone Lake	M-2	Aquatic macrophytes, detritus, sticks
Rolling Stone Lake	M-4	Aquatic macrophytes, rocks, gravel, muck
Pickerel Creek	M-5	Shoreline vegetation, detritus, sticks
Creek 12-9	M-1	Shoreline vegetation, detritus, sticks
Creek 11-4	M-3	Shoreline vegetation, detritus, sand, sticks
Little Sand Lake	H	Shoreline vegetation, detritus, sticks
Little Sand Lake	I	Aquatic macrophytes, rocks, sand, sticks
Duck Lake	K	Aquatic macrophytes, muck, peat, detritus, sticks
Deep Hole Lake	L	Aquatic macrophytes, rubble, sand, gravel, muck, detritus
Skunk Lake	J	Aquatic macrophytes, muck
Wolf River	Y	Sand detritus, sticks
Wolf River	Z	Aquatic macrophytes, rocks, gravel, sand detritus

The taxa level used to calculate diversity was the lowest positive taxon to which each organism was identified. In general this was as follows:

- Coelenterata: genus
- Platyhelminthes: order
- Nematoda: phylum
- Oligochaeta
  - Naididae: species
  - Tubificidae: species (except immatures)
  - Enchytraeidae: family
  - Lumbriculidae: family
  - Branchiobedellida: family
- Hirudinea: family, genus, species
- Crustacea: genus, species
- Hydracarina: order
- Insecta: genus, species
- Mollusca: genus

SECTION 2.5.1.7, TISSUE CHEMISTRY

Comment No. 137

As acknowledged in your March 11, 1983 letter, the study design for tissue chemistry was not adequate to establish baseline metal concentrations in plant and animal tissues. It is essential that these conditions be established as part of the pre-operational program. This program should utilize single species samples, not composites of unknown proportions. Representative species should be selected by a review of the literature to identify indicator species, and should represent each trophic level. A taxonomic reference collection must be made of organisms used in the program, and excess material for each sample must be collected and secured for future verification or reconfirmation.

Response:

Sampling and analysis of metal concentrations in plant and animal tissues will be conducted as part of the pre-operational environmental monitoring program in the Project area. This program will establish baseline metal concentrations in representative species found in the study area. The species to be analyzed will be selected in conjunction with the DNR and will represent each major trophic level. A taxonomic reference collection will be made of the organisms used and excess material for each sample will be collected and secured for future verification purposes, if necessary.

Comment No. 138

Monitoring activities for fish tissue analyses should include the fillets with the skin left on the muscle tissue. This is consistent with the Department's monitoring programs and is necessary for accurate comparison with FDA standards.

Response:

During the pre-operational monitoring program, chemical analyses will be performed to establish baseline metal concentrations in fish tissue. To be consistent with the Department's monitoring programs, the analyses of the fish fillets will be completed with the skin left on the muscle tissue. As part of the 1983 Aquatic Monitoring Program in Swamp Creek, tissue analyses of fish species collected in the vicinity of the proposed water discharge site are being performed in accordance with this procedure.

Comment No. 139

Is it necessary to use 20 to 25 fish for one composite sample. Five to 10 individuals will provide an adequate sample.

Response:

As recommended by the DNR, the tissues from five individuals of each fish species are being analyzed to determine metal concentrations as part of the 1983 Aquatic Monitoring Program in Swamp Creek. For the pre-operational monitoring program, five or more individuals also will be used in any tissue analyses.

SECTION 2.5.2.1, DRAINAGE LAKES AND ASSOCIATED STREAMS

Comment No. 140

The statement "Biological sampling stations were established near...habitat that was representative of the overall stream or lake system" is misleading. Even though that habitat type may be predominant, it cannot be considered representative for an entire lake or stream system.

Response:

Comment acknowledged and the work "representative" will be changed to "typical" in the revised EIR.

Comment No. 141

Phytoplankton-Rice Lake - In Table 2.5-8, Cryptophyceae were reported in one collection from Rice Lake. Appendix 2.5A indicates the genus and species were a number of different Cryptomonads included in this count? It is unusual that Cryptomonads weren't reported more frequently in other phytoplankton samples from Rice Lake especially when they were reported in high concentrations in the August 1, 1981 sample at Station N. Please elaborate on this apparent anomaly.

Response:

As presented in Appendix 2.5A, the Cryptophyceae (unid. sp.) identified in samples collected from Rice Lake during August 1978 represents one specific alga.

Phytoplankton sampling was conducted on a quarterly basis during 1978 to provide data on the continuity of general composition to supplement the results of the monthly data collected during 1977. The population dynamics of the species, therefore, could account for its absence in samples collected during other sampling periods.

Comment No. 142

The occurrence of the unknown "Chrysococcus-like" algae at high concentrations is surprising. Was MacFarland's tentative identification of this algae confirmed by other phycologists. Please describe the "quality of preservation" which apparently inhibited this identification. Were any samples collected fresh and analyzed before preservation?

Response:

Crysophycean forms were also identified by Dr. T. Roeder, University of Wisconsin, Stevens Point and Mr. M. Fenwick, Northern Illinois, Dekalb.

Discussions with these advisors indicated that the occurrence of Chrysococcus at high concentrations is not surprising or unusual, particularly in soft water lakes. Mr. Fenwick has identified multiple species of this genus in many samples collected from soft water lakes.

The tentative identifications were made by Dames and Moore staff but were referred to as unidentified Chrysococcus-like algae at the suggestion of Mr. B. MacFarland of the USEPA Environmental Monitoring and Support Laboratory (see EIR page 2.5-28).

Although the quality of preservation is a factor with any preservative causing some cell distortion, the number of similar species present and their small size were the principal reasons for the lack of confidence in the identification as undertaken in the counting cell. Fresh samples were not analyzed.

Comment No. 143

Does the chlorophyll data reported represent pheophytin corrected data? If so, what pheophytin levels were reported?

Response:

The chlorophyll a data reported represent pheophytin a corrected data. However, it was not until May 1978 that these levels were calculated and reported. They are as follows:

STATION	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
G-1, Rep 1	0.008			0.009		
G-1, Rep 2	0.009			0.004		
G-2, Rep 1	<0.001			0.009		
G-2, Rep 2	<0.001			0.006		
H, Rep 1	0.001			0.002		
H, Rep 2	<0.001			0.003		
I, Rep 1	0.003			0.001		
I, Rep 2	0.001			0.004		
N, Rep 1	0.006			0.010		
N, Rep 2	0.008			0.007		
K, Rep 1	0.002	0.045	0.041	0.005	0.012	0.005
K, Rep 2	0.021	0.053	0.065	0.003	0.014	0.009
L, Rep 1	0.014	0.012	0.044	0.014	<0.001	0.005
L, Rep 2	0.006	0.026	0.029	<0.001	<0.001	0.004
M-2, Rep 1	<0.001			0.001		
M-2, Rep 2	0.019			0.002		
M-4, Rep 1	0.005			0.001		
M-4, Rep 2	0.004			0.002		

Comment No. 144

Periphyton - The "Chrysococcus-like" algae was reported in abundance in the periphyton community at Station D on Swamp Creek in March and August of 1977. If this algae was Chrysococcus, it does not seem reasonable since this algae is free-swimming and would not be expected to be an important member of the periphytic "attached" algae community.

Response:

Although Chrysococcus is a motile form and would not be expected to be an important member of the periphyton, its occurrence in the periphyton community is not impossible. It is possible that this alga originated in an upstream, still water area. During the sampling period of this study, there was a large beaver pond upstream of Station D which may have been the source of this algae.

SECTION 2.5.2.3, PONDS

Comment No. 145

Fish - Brook trout are reported locally in Hoffman Springs. We will conduct additional sampling to verify their existence.

Response:

Comment acknowledged.

SECTION 2.5.2.4, ECOLOGICAL RELATIONSHIPS OF SWAMP CREEK DRAINAGE BASIN

Comment No. 146

This section is inadequate due to a lack of data for the portion of Swamp Creek below Rice Lake. The discussion needs to include the biotic and physical sub-watershed contributions to downstream segments and the groundwater and ecological linkages of this watershed to adjacent watersheds (e.g. in-out migration, recolonizations, water and nutrient exchanges, etc.).

Response:

Data on macroinvertebrates and fish in Swamp Creek downstream from Rice Lake are presented in revised EIR Appendix 2.5G.

The hydrologic characteristics of the Swamp Creek drainage basin, including sub-watershed contributions from Hemlock Creek, Outlet Creek and Hoffman Creek, are discussed in Section 2.4, Surface Water of the EIR. A cross-reference to Section 2.4 will be added to subsection 2.5.2.4 for information on surface water flow contributions to Swamp Creek and for a discussion of changes in flow rate from upstream to downstream segments of Swamp Creek. During the baseline monitoring studies from 1977 through 1980, stream gages were established to monitor flow rates in Hemlock Creek (SG 6), Outlet Creek (SG 4,) Hoffman Creek (SG E) and at seven locations in Swamp Creek (SG 1, SG 2, SG 3, SG 5B and SG 5A and two USGS stations) (see EIR Figure 2.4-1). During this monitoring period, surface water levels also were recorded in Rice Lake (LG 14). Additional stream gage measurements have been taken in Swamp Creek (April 1982 to date) at County Trunk Highway M by the U.S. Geological Survey and at SG 24 (in the vicinity of the proposed water discharge site) by Ecological Analysts, Inc. (an Exxon contractor). The results of the April 1982 through March 1983 monitoring are presented in revised EIR Appendix 2.4L.

As discussed in subsections 2.4.4.1 and 2.4.7, water chemistry of streams in the Swamp Creek drainage basin was generally similar. Data presented in Section 2.3, Ground Water, indicate that the same aquifer feeds Rice and Ground Hemlock lakes and the Hemlock-Swamp-Outlet Creek system in the Swamp Creek drainage basin. This evidence includes the water chemistry summary data presented in Table 2.4-22 which indicate that all the above mentioned water bodies have relatively high alkalinity and hardness and neutral pH. This suggests a close relationship between the main ground water aquifer and surface water. Surface water chemistry data for the drainage lakes and streams when compared to ground water quality support this relationship. Differences in water chemistry upstream and downstream of Rice Lake were slight.

The water quality data presented in Section 2.4 and Appendices 2.4F and 2.4G for the water bodies sampled indicated nutrient and metal concentrations were generally low in Hemlock Creek (Stations A-1 and A-2), Outlet Creek (Station C) and Swamp Creek at stations upstream (B, D and E) and downstream (Q, S and V) of Rice Lake (see EIR Figure 2.4-2). Water chemistry data from Rolling Stone Lake at stations in the north (N) and south (F) portions of the lake were generally similar. Further information on the water quality characteristics of water bodies in the Swamp Creek drainage basin is presented in subsections 2.4.4 and 2.4.7. The Hemlock-Swamp-Outlet Creek systems, including Rice Lake, is an area of ground water discharge from the main ground water aquifer (see subsection 2.3.3.3). No ground water recharge occurs in this system.

A discussion of fish community structure, including potential movements, in Swamp Creek upstream and downstream of Rice Lake and in the Wolf River near the confluence with Swamp Creek is presented in revised Appendix 2.5G, subsection 4.1. In general, fish community structure upstream and downstream of Rice Lake is similar and all species collected in Rice Lake were present upstream and/or downstream of the lake. Bluegill and brook trout were the only species captured in Rice Lake that were not collected downstream in Swamp Creek during the 1982-83 Aquatic Monitoring Program. Because only 10 northern pike were collected in Rice Lake, the potential is minimal for a major spawning run by this species into Swamp Creek.

Three species (white sucker, shorthead redhorse, northern pike) have been collected in the Wolf River that have the potential to migrate into Swamp Creek. Both white sucker and shorthead redhorse are apparently present in sufficient numbers to provide a migrating stock; however, the northern pike was present in such low numbers that it seems unlikely this species would migrate into Swamp Creek.

The relationship of benthic communities in Rice Lake and in Swamp Creek upstream and downstream of Rice Lake is discussed in revised EIR Appendix 2.5G, subsection 4.2 (pp. 2.5G-60 and 2.5G-61). Biologically, the Swamp Creek watershed is connected only with the Wolf River watershed. There are no other surface water connections with any other watersheds via lakes or streams that would allow movements of fish, macroinvertebrates or other forms of aquatic biota between watersheds.

The flow rate of tributary streams to Swamp Creek and Rice Lake is sufficient to support biological populations which could serve as sources for colonization of downstream water bodies.

Comment No. 147

As indicated on page 2.5-46, there are at least 9 species of macrophytes in Oak Lake, not 5.

Response:

Comment acknowledged and this sentence in subsection 2.5.2.4 (p. 2.5-52) will be revised to the following:

> The littoral area supported a macrophyte community consisting of nine species or more, including water lobelia and pipewort which are typical of softwater habitats (Moyle, 1945).

SECTION 2.5.3, PICKERAL CREEK DRAINAGE BASIN

SECTION 2.5.3.2, SEEPAGE LAKES

Comment No. 148

The reddish colored algal bloom in July, 1977 and Little Sand lake was attributed to Phacus pyrum. This seems unusual since Prescott (Algae of the Western Great Lakes Area) does not indicate this species is noted to form algal blooms. Smith (Freshwater Algae of the United States) reports that the genus Phacus is rarely found in abundance. Was this finding confirmed by the phycologist responsible for verifying phytoplankton identification?

Response:

In July 1977, residents of Little Sand Lake along the northwest shoreline became concerned about a reddish-color that was observed in the shallow water of the beaches in front of their homes. In response to this concern, Dames and Moore collected a whole-water grab sample for analysis. Subsequent examination revealed that the algae Phacus pyrum was the apparent cause of the red colored water. This identification was not confirmed by the phycologists previously mentioned as responsible for verification of phytoplankton.

Comment No. 149

At what depths were the March, 1978 phytoplankton samples in Skunk Lake collected when chlorophyll a levels exceeded 300 ug/l? Was the lake ice and snow covered at the time?

Response:

During March 1978, phytoplankton samples in Skunk Lake were collected at a depth of approximately 0.5 m (1.6 feet). The ice cover at the sampling location was approximately 30.5 cm (12 inches) in thickness. There was a patchy snow cover which varied across the lake.

Comment No. 150

What were the distinguishing features between Chrysococcus-like algae and Chrysococcus major found in the periphyton community of Duck Lake.

Response:

The main conspicuous feature that was employed by the phycologist to distinguish between Chrysococcus-like algae and Chrysococcus major was size. Chrysococcus major is a species with a cell size diameter between 9 and 14 microns. The smaller Chrysoccous-like forms are <8 microns in diameter.

Comment No. 151

Aquatic Macrophytes - What is the "rush" listed for Little Sand Lake? The waterwort listed is probably Elatine minima rather than Elantine (sic) triandra.

Response:

The "rush" listed for Little Sand Lake was the mud rush, Juncus pelocarpus. The waterwort listed was verified as Elatine triandra under the direction and supervision of Dr. H. Iltis, University of Wisconsin, Madison.

Comment No. 152

Department personnel have also found three-way sedge (Dulichium arundinaceum), Robbin's pondweed (Potamogeton robbinsii), sedges (Scirpus sp,), cattail (Typha latifolia), bladderwort (Utricularia sp.), bulrush (Scirpus sp.), sphagnum moss (Sphagnum sp.), leatherleaf (Chamaedaphne calyculata), and water moss (Drepanocladus sp.) in Skunk Lake.

Response:

Comment acknowledged and the occurrence of the above listed species will be added to the list of aquatic macrophytes found in Skunk Lake based on reported DNR observations.

SECTION 2.5.3.4, ECOLOGICAL RELATIONSHIPS OF PICKEREL CREEK DRAINAGE BASIN

Comment No. 153

Please see Section 2.5.2.4 for applicable comments.

Response:

The information requested on physical sub-watershed contributions in the Pickerel Creek drainage basin to downstream segments is presented in Section 2.4, Surface Water of the EIR. A cross-reference to Section 2.4 will be added to subsection 2.5.3.4 for information on flow volume contributions from Pickerel Creek and Creek 12-9 to Rolling Stone Lake. Also, the flow contribution of Rolling Stone Lake and tributaries to Pickerel Creek at East Shore Road is discussed in Section 2.4.

As discussed in subsection 2.4.7 of the EIR, water chemistry of streams in the Swamp Creek and Pickerel Creek drainage basins was similar. Evidence is presented in Section 2.3, Ground Water which suggests that the main ground water aquifer in the site area feeds Rice and Ground Hemlock lakes and the Hemlock-Swamp-Outlet Creek system in the Swamp Creek drainage basin, and Rolling Stone Lake, Pickerel Creek, and creeks 12-9 and 11-4 in the Pickerel Creek drainage basin. The water quality parameters measured for Rolling Stone Lake typically were within the range of water quality values reported from Pickerel Creek (above Rolling Stone Lake), Creek 12-9 and Creek 11-4.

The water quality data presented in Section 2.4 and Appendices 2.4F and 2.4G for the water bodies sampled indicated nutrient and metal concentrations were generally low in Pickerel Creek (Station M-5), Creek 11-4 (Station M-3) and Creek 12-9 (Station M-1) and there was minimal contribution to Rolling Stone Lake. Water chemistry data from Rolling Stone Lake at stations in the north (M-2) and south (M-4) portions of the lake were generally similar, indicating that the lake is well mixed. Further information on the water quality characteristics of water bodies in the Pickerel Creek drainage basin is presented in subsections 2.4.5 and 2.4.7.

The southwest portion of the site area, including Pickerel Creek, Creeks 11-4 and 12-9 and Rolling Stone Lake, is an area of ground water discharge from the main ground water aquifer (see subsection 2.3.3.3). No ground water recharge occurs in this part of the site area.

Ecologically, there is no linkage for aquatic species between the Pickerel Creek watershed and any adjacent watersheds except the Wolf River (see subsection 2.4.3).

Two species (white sucker and northern pike) collected in Rolling Stone Lake could potentially migrate to tributary streams, such as Pickerel Creek and Creeks 11-4 and 12-9, for spawning. However, the absence of these species in fish collections from these tributary streams during spring 1978 suggests no movement of these species from Rolling Stone Lake.

The flow rate in tributary streams to Rolling Stone Lake is sufficient to support biological populations which could serve as sources for colonization of downstream water bodies.

SECTION 2.5.4, WOLF RIVER

Comment No. 154

This section needs to include a discussion on macrophytes occurrence, particularly the existence and extent of wild rice beds. Also, please provide an explanation for the low dissolved oxygen readings at Station Z.

Response:

An inventory to determine the relative abundance of aquatic macrophytes in Swamp Creek and the Wolf River was completed in June 1983 by Normandeau Associates, Inc. The inventory was initiated 0.4 km (0.25 mile) upstream of the proposed discharge site on Swamp Creek and terminated on the Wolf River approximately 1.2 km (0.75 mile) downstream from the confluence with Swamp Creek at the bend in Lost Lake Road. The relative abundance of macrophyte species was determined by visual estimates. The following results of this inventory will be included in Section 2.5 of the revised EIR:

> The density of rooted aquatic vegetation was higher in the upstream half of Swamp Creek and was reduced in the downstream segment and in the Wolf River. The relative abundance of individual species identified during the inventory is presented in the attached table. The most abundant species throughout Swamp Creek and the Wolf River

(TABLE FOR RESPONSE TO COMMENT NO. 154)

RELATIVE ABUNDANCE OF VASCULAR PLANTS IDENTIFIED IN SWAMP CREEK AND THE WOLF RIVER AND ALONG THE ADJACENT STREAM BANKS (June 1983)

Location/Taxa	Relative Abundance*	Location/Taxa	Relative Abundance
STREAM BOTTOM		ADJACENT STREAM BANKS	
Above Discharge			
Sagittaria sp. (submersed leaves)	A	Alnus rugosa	A
Ceratophyllum demersum	MA	Cornus stolonifera	MA
Potamogeton praelongus	A	Salix sericea	A
Spirodella polyrhiza	S	Carex stricta	A
Elodea canadensis	A		
Vallisneria americana	S		
Below Discharge			
Elodea canadensis	A	Carex stricta	A
Sagittaria sp. (submersed leaves)	A	C. lacustris	A
Eleocharis palustris	MA	Alnus rugosa	A
Campanula aparinoides	S	Salix sericea	A
Nuphar variegatum	MA	Cornus stolonifera	MA
Scirpus validus	MA	Cicuta maculata (basaHvs.)	S
Utricularia vulgaris	S	Typha latifolia	S
Spirodella polyrhiza	S	Viburnum cassinoides	MA
Sparganium americanum	A	Ribes lacustre	MA
Potamogeton epihydrus (submersed leaves)	MA	Myrica gale	MA
P. praelongus	A	Trillium cernuum	S
Rumex orbiculatus	MA	Galium asprellum	MA
Ludwigia palustris	MA	Spiraea tomentosa	MA
Myriophyllum heterophyllum	S	Onoclea sensibilis	MA
Glyceria borealis	S	Thalictrum polygamum	MA
		Picea mariana	A
		Larix laricina	MA
		Prunus serotina	MA
		Amelanchier canadensis	MA
		Fraxinus nigra	MA
		Acer rubrum	MA
		Spiraea latifolia	MA
		Caltha palustris	MA
		Acer saccharinum	MA
		Betula papyrifera	S
		Abies balsamea	MA
		Pinus sylvestris	S
		P. resinosa	S
		Populus balsamifera	S
		Phalaris arundinacea	MA
		Calamagrostis canadensis	MA

*A = Abundant
MA = Moderately Abundant
S = Sparse

were frog bit (Elodea canadensis), arrowhead (Sagittaria sp.), bur-reed (Sparganium sp.) and pondweed (Potamogeton epihydrus and P. praelongus). Several small scattered patches of float grass (Glyceria borealis) were also present in the lower portion of Swamp Creek in the floating leaf form. No wild rice beds were identified.

Total areal coverage of the bottom by rooted vascular plants ranged from approximately 80 percent in some areas upstream of County Trunk Highway K to 20 percent in portions of the downstream segment of Swamp Creek. Plant species composition of the bottom and adjacent bank of Swamp Creek and the Wolf River was typical for the existing substrate and flow conditions.

Low dissolved oxygen (DO) concentrations were recorded at Station Z on the Wolf River on August 1, 1978. This condition was unique to this reach of the river since the DO concentration upstream at Station Y was 6.9 ppm and at the confluence with the Hunting River immediately downstream of Station Z, it was 5.9 ppm. (Also, see response to comment No. 123.)

SECTION 2.5.5, ECOLOGICAL AND HYDROLOGICAL RELATIONSHIPS

Comment No. 155

Threatened and Endangered Species - The references cited for state and federal government listings of threatened or endangered species should be updated to reflect the current Chapter NR 27, Wis. Admin. Code and the 1982 Federal Register, respectively. Also, the references to the DNR "watch list" are misleading. This list only identifies species for which additional information on their status is needed. Use of the "watch list" implies knowledge of a species status which does not exist.

Response:

Comment acknowledged and the following revisions will be made in the Threatened and Endangered Species discussion on page 2.5-116:

The reference in the second line (Wisconsin DNR, 1979) will be changed to: Jurewitz, R., 1983, Wisconsin DNR-Madison, Office of Endangered and Nongame Species, personal communication, August 1.

In the second paragraph the Federal Register reference will be changed to: U.S. Department of the Interior, Fish and Wildlife Service, 1982, Endangered and Threatened Wildlife and Plants: 50 CFR 17.11 and 17.12, reprinted January 1, 1982, 13 p.

The last paragraph under the subheading Threatened and Endangered Species will be deleted.

SECTION 2.6, TERRESTRIAL ECOLOGY

SECTION 2.6.1, FIELD AND LABORATORY METHODS

Comment No. 156

This section should include discussion of methodologies employed by consultants doing EIR-related studies, such as Mine Waste Reclamation, Ltd. (soils), Normandeau Associates, Inc. and IEP, Inc. (wetlands), Steigerwaldt (forestry) etc.

Response:

All references contained in this comment have been provided to the DNR and are therefore considered a part of the EIR.

SECTION 2.6.3, VEGETATION

SECTION 2.6.3.2, PROJECT AREA

Comment No. 157

The integration of relevant consultant reports (e.g. Steigerwaldt, 1982, Normandeau Associates, 1982) is cursory and does not provide the necessary descriptive detail. These reports must either be incorporated in or appended to the EIR.

Response:

See response to comment No. 156. A more in-depth discussion of the results of forestry and wetlands field work by Steigerwaldt (1982), Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. (1982) and Interdisciplinary Environmental Planning, Inc. (1982) is contained in their reports which are considered a part of the EIR.

Comment No. 158

The two large areas in Section 1, T34N, R12E, classified as "F" should be "N". These are aspen regeneration sites.

Response:

Comment acknowledged and Figure 2.6-8 will be revised accordingly in the revised EIR.

Comment No. 159

As we have previously stated, the transect selected for characterization of the "swamp conifer type" was not representative of a typical swamp conifer wetland in the area.

Response:

As indicated in a letter from B. Hansen to R. Ramharter dated February 3, 1983, the results of sampling in five additional swamp conifer stands are presented in the August 1982 Wetlands Assessment Report (Normandeau Associates, Inc., and Interdisciplinary Environmental Planning, Inc., 1982). Tamarack and black spruce were the dominant species in each of these five communities and the results of the sampling are summarized in subsection 2.6.3.2 (p. 2.6-27) of the EIR. In the site area conifer swamps dominated by tamarack and black spruce are most representative of this wetland type.

Comment No. 160

Please provide the referenced addendum to the Normandeau Report to the Department.

Response:

This report entitled "Supplemental Wetlands Assessment Report, Crandon Project" was prepared by Interdisciplinary Environmental Planning in December 1982 and was provided to the DNR in June 1983.

Comment No. 161

The species identified as green ash (Fraxinus pennsylvanica) in this and other sections appears to include individuals which are actually black ash (Fraxinus nigra). Please discuss the identification of these species.

Response:

Green ash and black ash were identified primarily by the color of the buds. Black ash has an inky black colored bud and green ash a brown bud.

SECTION 2.6.4.1, MAMMALS

Comment No. 162

The white-tail deer densities should be eight to nineteen per 259 ha (1 square mile) of deer range. Table 2.6-12 columns 3 and 4 should be titled "Total Gun Harvest". The 1979 gun harvest was 563 in Unit 44.

Response:

Comment acknowledged and the following revisions will be made in the EIR: The statement in subsection 2.6.4.1 regarding white-tailed deer densities will be revised to reflect a density of 8 to 19 per 259 ha (1 square mile) of deer range.

In Table 2.6-12 the heading for columns 3 and 4 will be revised to "Total Gun Harvest."

The gun harvest for 1979 will be revised to 563 deer in Unit 44.

Comment No. 163

The heron rookery indicated on Figure 2.6-9 south of County Trunk Highway "K" is no longer active.

Response:

Comment acknowledged and Figure 2.6-9 will be revised accordingly in the revised EIR.

SECTION 2.6.4.2, BIRDS

Comment No. 164

Bald eagles should be included in the listing of summer resident raptors. Please identify where the three broad-winged hawk nests were located.

Response:

Subsection 2.6.4.2, page 2.6-41, will be revised to include the bald eagle as a summer resident raptor. The following revised sentences in paragraph two (sentences three, four and five) under the heading "Summer Residents" will be incorporated into the revised EIR:

> Uncommon or rare raptors are the red-tailed hawk (Buteo jamaicensis), red-shouldered hawk (Buteo lineatus), Cooper's hawk (Accipiter cooperii), marsh hawk (Circus cyaneus) osprey, bald eagle, and short-eared owl (Asio flammeus). All but the short-eared owl were observed in the environmental study area. The Cooper's hawk, osprey, bald eagle, and red-shouldered hawk are listed as endangered or threatened species and are discussed in subsection 2.6.5.

Broad-winged hawk nests were found near Rolling Stone Lake, Pond 25-11, and northwest of Exxon's field office (former Vollmar house).

SECTION 2.6.5, THREATENED AND ENDANGERED SPECIES

Comment No. 165

The distance between an endangered or threatened species occurrence and the mine site should be given as the distance to the closest mine-related development rather than to the ore body.

Response:

Subsection 2.6.5 will be revised, as indicated below, to reflect the distances between bald eagle and osprey nest sites and the nearest proposed mine-related facility.

The nearest bald eagle nests to any proposed mine related facility is the Swamp Creek nest located approximately 760 m (2492 feet) south of the proposed south turnout for the railroad spur and the Bishop Lake nest located 805 m (2640 feet) north of the proposed water discharge structure.

The nearest osprey nest to any proposed mine related facility is the Mole Lake nest located within 402 m (1320 feet) of the proposed water discharge pipeline.

SECTION 2.6.5.2, WILDLIFE

Comment No. 166

Three, not four listed mammals are found in Wisconsin. The Indiana Myotis is not considered a Wisconsin species and it should be deleted from Table 2.6-21.

Response:

Comment acknowledged and Table 2.6-21 (attached) has been updated accordingly.

Comment No. 167

The Canada Lynx is a state-listed endangered species that might occur in the study area considering habitat types and known locations in northeast Wisconsin. Please include a discussion of the Lynx in this section.

Response:

Comment acknowledged and the following write-up on the lynx will be added to subsection 2.6.5.2 (p. 2.6-57) of the revised EIR:

Lynx - Historically, the lynx occurred throughout Wisconsin whenever mature forest and swamp brushland habitat was predominant (Jackson, 1961). However, the lynx has always been uncommon or rare in Wisconsin. Habitat changes that resulted from lumbering in the late 1800's and early 1900's along with hunting/trapping pressure, and possibly competition with bobcats, have significantly reduced lynx populations in Wisconsin (Wisconsin DNR, 1979).

Since 1973, nine positive records of the lynx are known for Wisconsin (Jurewitz, 1983). All of these are from the northern two tiers of counties. Since 1977, the Wisconsin DNR has summarized the number of lynx observations reported on bobcat hunter/trapper questionnaires. An average of 10 lynx have been reported every year, with a total of only six observations having been recorded in northeastern Wisconsin. There have been no recent sightings of lynx in the environmental study area, and the closest reported lynx sighting is at least 19.3 km (12 miles) west of the environmental study area in Oneida County (Jurewitz, 1983).

The dense forests that characterize the environmental study area constitute suitable habitat for the lynx.

TABLE 2.6-21

ENDANGERED AND THREATENED TERRESTRIAL WILDLIFE OF WISCONSIN[a]

	FEDERAL STATUS		
	ENDANGERED	THREATENED	WATCH (ADVISORY)
BIRDS	Peregrine Falcon	Bald Eagle[b]	N/A
MAMMALS	Gray Wolf[c]	-	N/A
	Indiana Myotis	-	N/A

	STATE STATUS		
	ENDANGERED	THREATENED	WATCH (ADVISORY)
AMPHIBIANS	Blanchard's-Cricket Frog	Tremblay's Salamander[c]	Bullfrog[c] Pickerel Frog Burns' Leopard Frog Leopard Frog[b] Tiger Salamander Spotted Salamander[b]
REPTILES	Ornate Box Turtle Slender Glass Lizard Queen Snake Massasauga Western Ribbon Snake Northern Ribbon Snake	Blanding's Turtle Wood Turtle[c]	Ring-Necked Snake[c] Black Rat Snake Eastern Hognose Snake Butler's Garter Snake[c] Milk Snake Smooth Green Snake[c] Bull Snake Fox Snake[b] Garter Snake[b] Red-Bellied Snake[c]
BIRDS	Bald Eagle[b] Osprey[b] Peregrine Falcon Piping Plover Forster's Tern Common Tern Barn Owl Loggerhead Shrike	Red-Necked Grebe Double-Crested Cormorant Cooper's Hawk[b] Red-Shouldered Hawk[b] Greater Prairie Chicken Great Egret	Common Loon[b] Great Blue Heron[b] Black-Crowned Night Heron Black Duck[b] Red-Breasted Merganser[c] Merlin[b] Marsh Hawk[b] Spruce Grouse[b] Sharp-Tailed Grouse Yellow Rail[c] Upland Sandpiper[b] Caspian Tern Black Tern[b] Common Flicker[b] Bewick's Wren Eastern Bluebird[b] Dickcissel Grasshopper Sparrow[b] Vesper Sparrow[b] Field Sparrow[b]
MAMMALS	Marten[c] Lynx[c] Gray Wolf[c]		Mountain Lion Bobcat[b] Moose Fisher[c] White-Tailed Jack Rabbit Gray Fox Woodland Vole Least Shrew Thompson's Pigmy Shrew

Sources: U.S. Department of the Interior, 1982.
Wisconsin Department of Natural Resources, 1979, 1982b; Jurewitz, 1983.

[a]Scientific names are listed in Appendices 2.6B, 2.6C, and 2.6D.
[b]Observed in the environmental study area.
[c]Could reasonably occur in the environmental study area.
N/A = Not Applicable

Comment No. 168

Table 2.6-21 should be updated with current information. Please see NR 27, Wis. Adm. Code. Also, there are 12 state-listed bird species, not 11.

Response:

Comment acknowledged and Table 2.6-21 has been updated with current information on endangered and threatened species. (See revised Table 2.6-21 attached to response to comment No. 166.)

The last sentence on page 2.6-57 will be revised to indicate 12 bird species are listed as endangered or threatened by the DNR.

Comment No. 169

The discussion of bald eagle productivity needs to be updated. See the attached report by C. Sindelar. The discussion of osprey productivity should similarly be updated with the attached summary table.

Response:

The discussion of bald eagle productivity will be updated in the EIR. The last sentence in paragraph one following the heading "Bald Eagle" (p. 2.6-58) will be revised to the following:

> Bald eagle productivity has remained relatively stable since 1978, and the number of occupied territories has increased from 140 in 1978 to 207 in 1982 (Sindelar, 1982).

The Sindelar citation will be added to subsection 2.6.9.

The discussion of osprey productivity will be updated in the EIR. Sentences three and four in paragraph one following the heading "Osprey" (p. 2.6-59) will be revised to the following:

> Osprey productivity has remained relatively stable since 1978 at approximately 1.1 young per active territory (Wisconsin DNR, 1983). The number of active breeding territories in Wisconsin has increased steadily from 125 in 1978 to 186 or more in 1982 (Wisconsin DNR, 1983).

The Wisconsin DNR citation will be added to subsection 2.6.9.

Comment No. 170

There are now ten, not 12 species of amphibians and reptiles on the Wisconsin lists. The wood turtle is considered threatened and the spotted salamander has been deleted from the threatened list.

Response:

Comment acknowledged and the status of the wood turtle has been changed from endangered to threatened in Table 2.6-21 (attached to response to comment No. 166), and the spotted salamander will be removed from the threatened species list.

SECTION 2.6.6, SENSITIVE RECEPTORS

Comment No. 171

This section must include a discussion of sensitive receptors in the aquatic environment and must identify the most probable pollutants expected from the mining operation. For example, a detailed description of the sensitivity of wild rice to water borne sulfates is needed.

Response:

The following discussion will be added to subsection 2.6.6, Sensitive Receptors:

2.6.6.3 Aquatic Organisms

The aquatic resources of the site and environmental study area are typical of North Central Wisconsin. Based on baseline data collection activities, sensitive receptors in the aquatic environment appear to be the algal-leaved pond weed (a threatened plant species found in Duck Lake), trout streams, and wild rice.

The algal-leaved pond weed, a rooted macrophyte species, was found floating at the surface of Duck Lake on only one occasion (see EIR subsection 2.5.3.2, p. 2.5-87). A subsequent investigation of Duck, Deep Hole, and Skunk lakes located no other specimens of this plant. Therefore, the significance of this species in terms of distribution, abundance or potential impact is uncertain.

Brook trout require silt-free, cold water streams, high in dissolved oxygen concentrations. Within the environmental study area, there are 11.7 km (7.3 miles) of Class I trout streams and 31.1 km of Class II trout streams. Streams located in the site area that are designated as Class II trout streams include Hemlock, Hoffman, Metonga and Swamp (above State Highway 55) creeks.

Rice Lake contains extensive beds of wild rice and concern over potential impacts to this sensitive species from mine development have been expressed by the Mole Lake Indian Community and the DNR. The inpetus for the concern arises from a Minnesota water quality standard (WPC 15, "Criteria for the Classification of Interstate Water of the State and Establishment of Standards of Quality and Purity") that, in one section, specifically limits sulfate levels in waters where wild rice grows to a concentration of 10 mg/l during the growing season. No wild rice has been observed in Swamp Creek from a point approximately 0.4 km (0.25 mile) upstream of the proposed water discharge site to the confluence downstream with the Wolf River.

Growth of wild rice has been shown to be dependent upon an interrelated set of biological, physical, and chemical variables. Lee and Stewart (1981) found wild rice density, water depth, water temperature, water and sediment quality to be the four most important variables affecting wild rice growth in Minnesota. They modeled wild rice growth based on studies of rice growth in relation to a wide variety of environmental factors that included sulfate concentrations in the water.

Wild rice density was found to influence productivity through intraspecific competition. Commercial growers in Minnesota have found that mechanically thinned wild rice fields are more productive than denser, unthinned fields (Lundberg and Trihey, 1975). Changes in water levels at the critical submerged-and floating-leaf stages appear to increase plant mortality and thus to lower productivity (Lee and Stewart, 1978). Wild rice beds located near the outfall from a coal-fired power plant were found to be more productive than other nearby beds because of higher water temperatures (Lee and Stewart, 1978). An important chemical factor in wild rice growth, identified by Lee and Stewart (1981), was alkalinity. However, under natural conditions, no chemical parameter, including sulfate and alkalinity, was found to act upon wild rice growth in isolation (Lee and Stewart, 1978). No single chemical element could be specifically identified as the factor controlling wild rice growth.

Minnesota's standard of 10 mg/l of sulfate in natural waters was based upon work done throughout Minnesota by Moyle (1944, 1945) and Trippler (1978). However, subsequent advances in quantitative ecology have allowed more thorough analysis of the impact of sulfate and other water quality parameters upon wild rice growth (Lee and Stewart, 1978, 1981, 1983).

Although Moyle suggested that sulfate levels above 10 mg/l inhibited wild rice growth, he acknowledged that wild rice occurs in Minnesota water with up to 282 mg/l of sulfates (Moyle, 1944). Wild rice planted in Saskatchewan has grown well in water with between 105 and 575 mg/l sulfate (median 220 mg/l) (Peden, 1982). Lee and Stewart (1978) have shown that sulfate in water in a Minnesota wild rice bed varied temporally from approximately 20 to 120 mg/l. Wild rice has also been found growing in lake bottom sediments where sulfate concentrations were 1500 mg/l (Vicario and Halstead, 1968). Lee and Stewart (1978) experimentally grew wild rice in water with varying concentrations of sulfate. They found a statistically significant linear relationship between increased weight per plant and increasing sulfate concentrations, up to at least 200 mg/l sulfate.

Sulfates in Rice Lake averaged 4 mg/l (Range 4-8), in Swamp Creek, 5 mg/l (range 4 to 12), and in the Wolf River, 6 mg/l (range 4 to 9). With these ambient sulfate levels in the environemental study area, sulfate concentrations in water bodies where wild rice grows would appear to be able to sustain a substantial increase before detrimental impacts to wild rice prduction would be expected.

References

Lee, P., and Stewart, J., 1978, Impact of sulfate discharges on the ecology of wild rice stands at CBSES, study performed for Minnesota Power and Light, 152 p., plus appendices.

_________, 1981, Ecological relationships of wild rice, Zizania aquatica 1. A model for among-site growth, Canadian Journal of Botany vol. 59, no. 11, p. 2140-2151.

_________, 1983, Ecological relationship of wild rice, Zizania aquatica 2. Sediment-plant tissue nutrient relationships, Canadian Journal of Botany vol. 61, no. 6, p. 1775-1784.

Lundberg, K. R., and Trihey, P. T., 1975, Water quality control through single crop agriculture No. 4, USEPA 660/2-75-026, 116 p.

Moyle, J. G., 1944, Wild rice in Minnesota, Journal of Wildlife Management vol. 8, no. 3, p. 177-184.

_________, 1945, Some chemical factors influencing the distribution of aquatic plants in Minnesota, The American Midland Naturalist, vol. 34, p. 402-420.

Peden, D. G., 1982, Factors associated with growth of wild rice in Northern Saskatchewan, Arctic vol. 35, no. 2, p. 307-311.

Trippler, D., 1980, Minnesota Pollution Control Agency, personal communication, February 20.

Vicario, B., and Halstead, E., 1968, Progress report on wild rice research, University of Saskatchewan.

SECTION 2.6.7, ECOLOGICAL RELATIONSHIPS

Comment No. 172

This section is exceedingly brief and narrow in scope. The discussion should characterize the area as a remote, low population density region possessing intrinsic values for both human use and ecological relationships. These values enable the area to support species preferring solitary habitats and support the tourism industry, an essential element of the area's economy.

Response:

Comment acknowledged and the following paragraph will be added to subsection 2.6.7.1:

> The environmental study area is a remote, low population density area possessing intrinsic values for both human use and ecological relationships. These values enable the area to support some species preferring solitary habitats and to support the tourism industry, an essential element of the area's economy (Wisconsin DNR, 1983).

Comment No. 173

The statement that "the forests of the site area are primarily second-growth northern hardwood pole timber that are managed for pulp wood production" is not correct. These forests are managed for production of quality saw logs employing intermediate cuts to release saw log crop trees. These intermediate cuts result in production of hardwood pulp.

Response:

Comment acknowledged and in the revised EIR, subsection 2.6.7.1 (p. 2.6-66, paragraph one, sentence two) will be revised and the following will be substituted:

> The forests of the site area are primarily second-growth northern hardwood pole timber. Landowner preferences dictate a variety of management practices. Many areas are managed for pulp production because of the quicker return on investment. Management for saw logs requires longer time between harvesting and the resultant economic return. Management for quality saw logs with intermediate cuts to release saw log crop trees and, thus, intermediate production of hardwood pulp is also a frequent management practice.

Comment No. 174

Other notable resources of the area include a small southern flying squirrel population, and breeding bald eagles, osprey and Cooper's hawks.

Response:

Comment acknowledged and in the revised EIR, subsection 2.6.7.1, (p. 2.6-67, first paragraph, sentence two) will be revised and the following will be substituted:

> These notable resources are a bur oak swamp near Skunk Lake, the wild rice beds in Rice Lake, a possible population of algal-leaved pondweed in Duck Lake, breeding bald eagles, ospreys, Cooper's hawks, red-shouldered hawks, and a small population of the southern flying squirrel.

SECTION 2.6.8, SUMMARY AND CONCLUSIONS

Comment No. 175

The forest reconnaissance survey results should be summarized under vegetation along with a summary of "special importance wetlands" identified in the wetland assessment report. As stated previously, the description of white cedar as a dominant overstory species for the Swamp Conifer type is misleading.

Response:

A summary paragraph containing the results of the forest inventory is presented as item 4 under Vegetation in this subsection. The following additional summary statements will be added to the list:

- The total cord volume and board foot volume for forest resources within the 1407-ha (3,474-acre) area included in the forest inventory were 43,892 cords and 2,534,599 board feet, respectively. Sugar maple, American basswood, aspen, white birch and red oak were the species with the highest cord and/or board foot volumes. The market value of merchantable forest resources in the inventory area was estimated at approximately $435,000.

- A forest management plan for the inventory area was developed, based on DNR silvicultural guidelines, to stimulate timber production through prescribed stand treatments and to maintain aesthetic qualities. A harvesting schedule was prepared that would be most advantageous for wildlife and aesthetics.

- A total of 157 wetlands were inventoried and evaluated within the 4,278 ha (10,562 acres) wetlands study area. Approximately 539 ha (1,330 acres) were classified as wetlands in the study area. Wetlands in the Project area constituted 3.9 percent of the estimated total land area of wetlands in the region, Wolf River drainage basin upstream from Langlade, Wisconsin.

- The most common wetland type in the study area was the coniferous swamp 699 ha (1,727 acres). Less common types included bogs 79 ha (195 acres), deciduous swamps 60 ha (147 acres) and shrub swamps 60 ha (148 acres), marshes 55 ha (136 acres) and aquatic beds 2 ha (5 acres).

Of the ten highest ranked wetlands in the study area seven were shallow marshes, two were bogs and one was a coniferous swamp. These wetlands were assigned high functional values because they possessed many of the following characteristics: large size (>1.9 ha [4.6 acres]), high number of wetland classes, favorable water/cover interspersion, high interspersion of wetland types, part of a riparian system and high scenic or recreational qualities.

Black spruce and tamarack are identified as dominant species on the wet-Northern Forest type in item 3 under the subheading Vegetation in this subsection. (Also, see response to comment No. 159.)

Comment No. 176

The statements regarding threatened and endangered species need to be updated.

Response:

Comment acknowledged and in the revised EIR, the summary and conclusions regarding threatened and endangered species will be updated to reflect the current status of species in these categories. Specifically, the last sentence under item 7 (p. 2.6-72) will be deleted and item 8 (p. 2.6-72) will be deleted in entirety.

SECTION 2.7, ARCHAEOLOGICAL AND HISTORICAL RESOURCES

Comment No. 177

With one exception, the proposal is in compliance with State and Federal regulations concerning the protection of historic and archaeological sites. The exception is the proposed water discharge pipeline corridor which has not been surveyed. It is our understanding that this corridor will be surveyed this spring.

Response:

An inventory of cultural resources was completed by Great Lakes Archaeological Research Center, Inc. within the proposed water discharge pipeline corridor in June 1983. The report containing the results of this inventory was provided to the DNR in August 1983.

SECTION: 2.8, NOISE

Comment No.: 178

We are currently evaluating the technical expertise available within state agencies to address the portions of the EIR dealing with noise. If sufficient expertise is not available, we intend to employ a qualified consultant to conduct this portion of the review. In either case, we will provide you with our comments at the earliest opportunity.

Response:

Comment acknowledged.

SECTION 2.9, LAND USE AND AESTHETICS

SECTION 2.9.2.1, FORESTRY

Comment No. 179

This section states that ". . . Forest Crop law and Woodland Tax Law . . . lands . . . must be opened to public hunting and fishing." This is incorrect. Only Forest Crop law lands are required to be opened for public hunting and fishing.

Response:

Comment acknowledged. The statement will be revised in subsection 2.9.2.1 to indicate that lands entered in the Woodland Tax Law program are not open for public hunting and fishing.

Comment No. 180

The average growing stock volume of six cords per acre is too low unless this includes non-productive cover types; the average saw timber volume of 4,050 board feet per acre is too high unless this includes only saw timber stands. Please provide the basis for these volume estimates.

Response:

The last sentence in the final paragraph of subsection 2.9.2.1 (p. 2.9-7) will be revised to the following in the EIR: The average net volume for saw timber and pole timber size classes on commercial forest lands in the three-county area is approximately 38 cords/ha (15.7 cords per acre); saw timber volumes average approximately 24,562 board feet/ha (9928 board feet per acre) for saw timber stands only (Spencer and Thorne, 1972).

SECTION 2.9.2.3, RECREATION

Comment No. 181

We know of no public access on Walsh Lake as shown on Figure 2.9-3. Also, the public access indicated on the south shore of Rolling Stone Lake is undeveloped.

Response:

Comment acknowledged and Figure 2.9-3 will be revised to reflect no public access on Walsh Lake.

The public access on the south shore of Rolling Stone Lake will remain designated on Figure 2.9-3 even though it is undeveloped.

Comment No. 182

Kramer's Ski Trails discontinued operations several years ago.

Response:

Comment acknowledged and Kramer's Ski Trails will be removed from subsection 2.9.2.3 as an operating private enterprise in the environmental study area.

Comment No. 183

The Spider Creek Wildlife Area should also be mentioned in the discussion of public land open to recreational activities.

Response:

Comment acknowledged and the Spider Creek Wildlife Area will be identified on page 2.9-13 of the EIR as a recreational area located in the regional study area.

SECTION 2.9.2.7, PUBLIC LANDS

Comment No. 184

Not all state lands in the area are State Trust Lands. The Department owns the NW 1/4, Section 28, T35N, R13E, and the Lily Lake Wildlife Area lands.

Response:

Comment acknowledged and subsection 2.9.2.7, including Figure 2.9-7 will be revised to reflect DNR ownership of the NW 1/4, Section 28, T35N, R13E, and the Lily Lake Wildlife Area.

SECTION 2.9.3, AESTHETICS

Comment No. 185

Please include a discussion of the presence or absence of intrusive man-made features such as towers, airport beacons, etc., that affect the natural aesthetics of the area.

Response:

Within the environmental study area there are no known intrusive man-made features such as towers and airport beacons. Such a statement will be added to subsection 2.9.3 of the revised EIR.

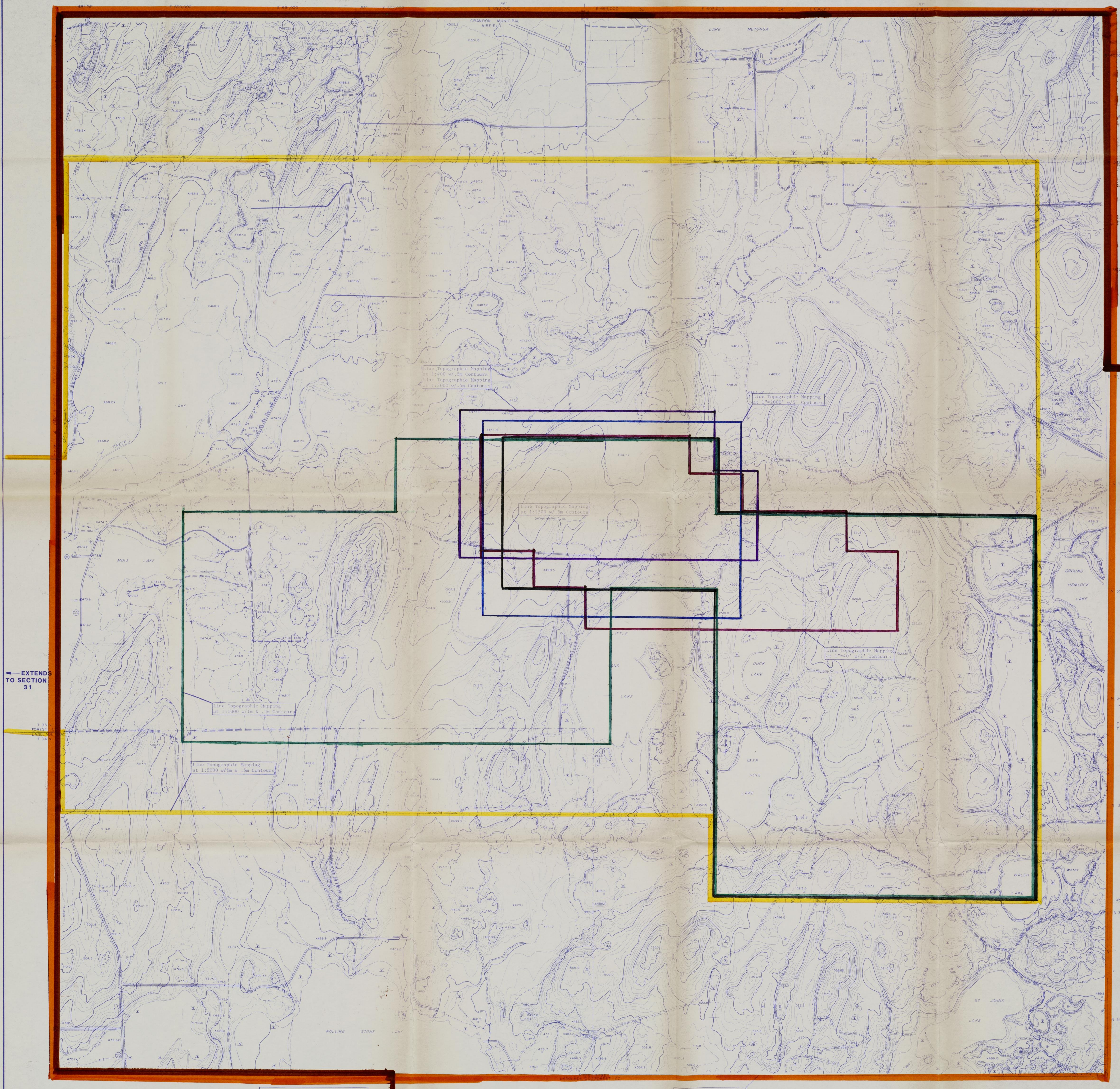
SECTION 2.10, SOCIO-ECONOMICS

Comment No. 186

Our review of this section will be primarily conducted by our consultant(s). Portions of the reviews which we have provided to you critiquing the methodology papers are relevant to this section and are herein incorporated by reference. The remainder of our comments on socio-economics will be provided at the earliest opportunity.

Response:

Comment acknowledged.



Orthophoto Topographic Mapping
at 1"=400' w/5' Contours
Orthophotos also include
Bradley Lake, Jungle Lake,
Lily Lake, Crane Lake & Pickerel Lake

Line Topographic Mapping
at 1"=400' w/5' Contours
Line Topographic Mapping
at 1"=1000' w/5' Contours
Line Topographic Mapping
at 1:12,500 w/2m Contours

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS FOR 2 METER CONTOUR INTERVAL MAPPING.

CONTOUR INTERVAL 2 METER BASED ON MEAN SEA LEVEL DATUM

HORIZONTAL DATUM BASED ON WISCONSIN STATE PLANE COORDINATE SYSTEM.

DATE OF PHOTOGRAPHY APRIL 28, 1976

AERO-METRIC ENGINEERING PROJECT NO. 117815

0 250 500 750 1000 Meters

SCALE 1:12,500

C-TM-0128

PREPARED FOR
EXXON COMPANY, U.S.A.
PREPARED BY
AERO-METRIC ENGINEERING, INC.
SHEBOYGAN, WISCONSIN

TOPOGRAPHIC MAPPING

SECTIONS 1,2,3,10,11,12 T34N ,R12E
SECTIONS 13,14,15,22,23,24,25,26,27,34,35,36 T35N ,R12E
SECTIONS 4,5,6,7,8,9 T34N ,R13E
SECTIONS 16,17,18,19,20,21,28,29,30,31,32,33 T35N ,R13E
FOREST & LANGLADE COUNTIES, WISCONSIN

CHAPTER 2.0
COMMENT NO. 1
ATTACHMENT NO. 1
INDEX FOR ORIGINAL MAPPING, CRANDON PROJECT

RESPONSES TO DNR COMMENTS ON CHAPTER 3
OF
THE ENVIRONMENTAL IMPACT REPORT

Exxon Minerals Company
Crandon Project

September 16, 1983

SECTION 3.1, NO ACTION

Comment No. 1

Please include a discussion of areas already affected by the mining proposal and the ramifications of the "no action" alternative on these areas. Include descriptions of Exxon activities that have already occurred, mining impact funds which have been distributed, land speculation and housing impacts, and other economic and social influences occurring from the existence of the Exxon office, its payroll, and its families.

Response:

Exxon's socioeconomic study report, the Forecast of Future Conditions, contains a "without project" scenario that identifies potential Project related impacts. Areas already affected by Project activities include lands cleared for drilling sites and for other engineering and environmental studies in the site area. Most of these areas have been reclaimed. In the event of a "no action" alternative, the remaining disturbed areas would be reclaimed in accordance with the submitted Reclamation Plan.

The only element of the DNR comment not addressed within our "without project" scenario is the effect of the distribution of Mining Investment and Local Impact Fund payments. The initial payments, following filing of application for permits to mine, were distributed in January 1983 in the amount of $100,000 each to the Townships of Lincoln and Nashville and the two Native American communities within those townships. In accordance with current Wisconsin law, similar payments to each jurisdiction, adjusted by the 1983 GNP deflator, will be made for three additional years during the course of the permitting process.

SECTION: 3.2, EXPAND THE PROPOSED PROJECT

Comment No. 2

Provide a detailed discussion of the alternative of expanding the project by servicing other orebodies in the area. Include an evaluation of the technical or economic feasibilty of such an expansion and describe the design modifications which would be necessary. Discuss the likelihood and ramifications of ore reserves exceeding the current estimate.

Response:

Section 3.2 of the EIR will be revised to include the following: The potential use of Crandon facilities for milling of the ores of other owners is discussed in subsection 3.7.1. Extended use of the Crandon concentrator and related facilities would require that ores from other properties be relatively compatible with the Crandon processes. Exxon is in no position to judge whether or not the owners of any future ore deposits are economic to mine or process.

Historically, large concentrator plants to service a single mine like Crandon usually do not mix their ores with those of other independent shippers because of the difficulty in storing, processing, and accounting for ores and concentrates on behalf of a non-affiliated shipper. Accordingly, it is not probable that the processing of such ores would be of interest or advantageous to Exxon during the mining and processing of the Crandon ore deposit.

Comment No. 3

Please provide a specific discussion of ore cut-off points at various metal prices. Include an explicit description of the function relating ore cut-off points with the various metal prices.

Response:

Ore cut-offs for the Crandon orebody may vary from time to time, depending upon metal prices, operating costs, profit objectives, and other production objectives of the Company.

The use of ore cut-off grades lower than that currently considered in the EIR (stated within ore reserves) is not deemed a significant production variable when considering mine economics.

SECTION 3.4 - SITING

SECTION 3.4.1, MINE/MILL FACILITIES SITING

Comment No. 4

Include a discussion of the social, political and economic ramifications of relocating the mill facilities within Site Area A across the township boundaries.

Response:

The mine and mill surface facilities are currently located to take maximum advantage of the location of the main mine shaft in relationship to the orebody. Both the Towns of Lincoln and Nashville are in the Crandon School District. Consequently, taxpayers of both towns receive the major tax benefit of the school property taxes associated with the mill.

There are no political or social advantages or disadvantages to mill facility location. The Project design did not include special considerations for political or social results since these were not applicable to the ore deposit. The location designations were based on engineering design.

SECTION 3.4.2.1, MINE WASTE DISPOSAL FACILITY

Comment No. 5

Issues related to siting of the MWDF have been addressed in a November 23, 1982 letter from the Department. This section does not respond to the comments and questions contained in that letter which are incorporated herein by reference.

Response:

MWDF siting issues presented in your November 23, 1982 letter have been addressed in a letter from B. Hansen to S. Druckenmiller and P. Didier dated July 11, 1983.

Comment No. 6

The wetlands identified in Figures 3.4-2 through 3.4-5 are inconsistent with the Normandeau Report, particularly the wetland drainages. The small wetland northeast of Deep Hole Lake is not shown on Figure 3.4-3. Please resolve these inconsistencies.

Response:

Designation of wetlands on Figures 3.4-2 through 3.4-5 was based on the location of wetlands presented in Figures 4.3-1F and 4.3-1I in the August 1982 Wetlands Assessment Report (Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc., 1982). Any discrepancies in the identification of wetlands in the figures in subsection 3.4.2.1, such as wetland drainages and the omission on Figure 3.4-3 of the small wetland northeast of Deep Hole Lake, when compared to the Wetlands Assessment Report, were inadvertent and will be revised in the EIR.

Figures 3.4-2 through 3.4-5 show the connections of wetlands, and the drainage to a given wetland area can be determined from the topographic elevations; (e.g., direction of flow and approximate watershed area); however, the actual drainage basin area for individual wetlands is not shown on these figures. Wetland and watershed area data for each wetland in the area of the MWDF alternative sites are presented in Appendix G and depicted graphically in Figures 4.3-1E, 4.3-1F and 4.3-1I of the August 1982 Wetlands Assessment Report.

Comment No. 7

Please include data describing the indirect wetland destruction resulting from alternate layouts and a discussion of the relationship of alternative layouts to different sub-watersheds.

Response:

Wetlands impacts are presented in Section 4.4 of the EIR. These data represent the most complete and recent documentation from studies by Normandeau Associates, Inc and Interdisciplinary Environmental Planning, Inc. The information presented in Section 4.4 of the EIR includes effects to each wetland associated with each sub-watershed for the alternative layouts. Information on indirect effects of the various MWDF layouts on wetland sub-watersheds is provided in the Interdisciplinary Environmental Planning, Inc. December 1982 report titled "Hydrological Balance for Selected Wetlands." This report was submitted to the Department in June 1983. See Section 4.2 (p. 4.2-1 and Figures 4.2-1 and 4.2-2) in this report.

Comment No. 8

Please provide a separate discussion of siting alternatives for the reclaim water ponds.

Response:

Throughout the extended MWDF siting study period, the reclaim water ponds have been considered along with the MWDF tailings ponds in siting these facilities. Various MWDF and reclaim pond layouts were reviewed during this study, including some layouts with separated ponds. As a result of the studies, it was generally concluded that separate locations for these facilities would spread the land disturbance over a greater area and complicate the transfer of water from the tailings ponds to the reclaim ponds.

A more complete review of the MWDF siting studies, which included the water reclaim ponds, is presented in the June 1982 siting report "Review of Potential Alternative Mine Waste Disposal Areas" (previously provided to the DNR). Because the reclaim ponds are quite shallow compared to the tailings ponds, a relatively flat area was considered to be most suitable for their location and construction. In Site 41, the area north of Duck Lake met this criterion. Other factors that were considered in the siting included the function of the reclaim ponds as water holding and transfer ponds between the mine/mill area and the MWDF. A location between the two facilities would minimize the water handling systems. In that regard, because the majority of the water circulated in the reclaim ponds comes directly from the thickeners at the mine/mill area, location of the reclaim ponds close to the mine/mill area is considered preferred.

SECTION 3.4.2.2, TAILINGS AND RECLAIM WATER PIPELINE AND HAUL ROAD CORRIDOR

Commment No. 9

Please provide the assumptions utilized in calculating the area of wetlands affected by the various alternatives. Previous discussions with the Department indicated a proposed corridor width of approximately 66 feet. Chapter 1 of the EIR does not provide any description of the corridor and Chapter 4 indicates a width (of) approximately 200 feet.

Response:

For purposes of estimating impacts, a corridor width of 60 m (200 feet) was used. The impacted wetland areas presented in Chapter 4 of the EIR are based on the 60 m (200 feet) corridor width. The typical haul road/pipeline cross section is shown on Plan Sheet No. 24 of the Mine Waste Disposal Facility Feasibility Report. This plan sheet shows a roadway and pipeline width of 20 m (66 feet). Exact construction limits will be determined during detailed engineering when the road profile and cut and fill limits are established. However, these limits will probably be no greater than approximately 40 m (131 feet). The 60 m (200 feet) corridor provides a conservative width and allows an estimate of impacts which should be reduced based on actual construction.

Comment No. 10

Discuss the proximity of Route 1 to Skunk Lake and potential impacts to waterfowl. Discuss a "no wetland impact" alternative.

Response:

The distance between Skunk Lake and the wetland (F11) located immediately southwest of the lake is approximately 80 m (262 feet) at the narrowest point. The maximum width of the proposed haul road and slurry pipeline corridor (Route 1), including the zone for construction, is projected to be 60 m (200 feet). During construction of this facility, a buffer zone of approximately 15 to 18 m (50 to 60 feet) will be maintained between Skunk Lake and the outermost limit of construction activity. This will minimize any direct impact to Skunk Lake; however, some disturbance to wetland F11 will occur.

Use of Skunk Lake by resident and migratory waterfowl could be affected during construction of the haul road and slurry pipeline and by vehicular traffic using the corridor. The wooded buffer zone between Skunk Lake and the haul road will help to reduce noise levels and visual disturbance in the direction of Skunk Lake. However, during construction of this facility, estimated to be 2 months in duration, and when truck traffic to the MWDF area is greatest, approximately a 2 year period when waste rock is being hauled, a temporary reduction in use of Skunk Lake by waterfowl is projected to occur. During other periods of construction and operation, use of the lake by waterfowl probably will not be affected.

Based on the results of the migratory waterfowl survey and brood counts on Skunk Lake (EIR subsection 2.6.4.2, Tables 2.6-15 and 2.6-16), the lake appears to receive low to moderate use in contrast to other lakes that were surveyed in the environmental study area. Skunk Lake receives moderate use by several migratory waterfowl species. No observations were made of duck broods on the lake, indicating present use by waterfowl for nesting is low.

The proposed route, as well as each of the three alternatives, is projected to effect a maximum of 0.5 ha (1.3 acres) of wetland vegetation. A modification of Route 4 is the only feasible alternative for avoiding all wetlands (revised Figure 3.4-6 attached). This "no wetland impact" route (Route 5) would require relocation of a 300-350 m (984-1148 feet) segment of Sand Lake Road, which would require approval from the Town of Nashville, so that the haul road and slurry pipeline could be located in the area now occupied by the existing road. The existing road corridor would have to be widened to accommodate the Project facilities and a new area cleared for Sand Lake Road. The new route would follow Sand Lake Road south for a distance of 200 m (656 feet) beyond the point where the corridor for Route 4 currently leaves the road. From this point, the route would traverse in an east-northeast direction to the northwest corner of Reclaim Pond R1. This route would be approximately 1520 m (4987 feet) in total length and would disturb no wetland areas larger than 0.1 ha (0.25 acres) in size. Because this route would be longer than the proposed and other alternative routes and would require greater overall land disturbance due to the relocation of Sand Lake Road, it is judged to be less viable than Routes 1, 2, 3 and 4.

Comment No. 11

Describe the significance of the route length. Why was Route 1 chosen over Route 2 when Route 2 is shorter, has comparable topography and affects the same acreage of wetlands?

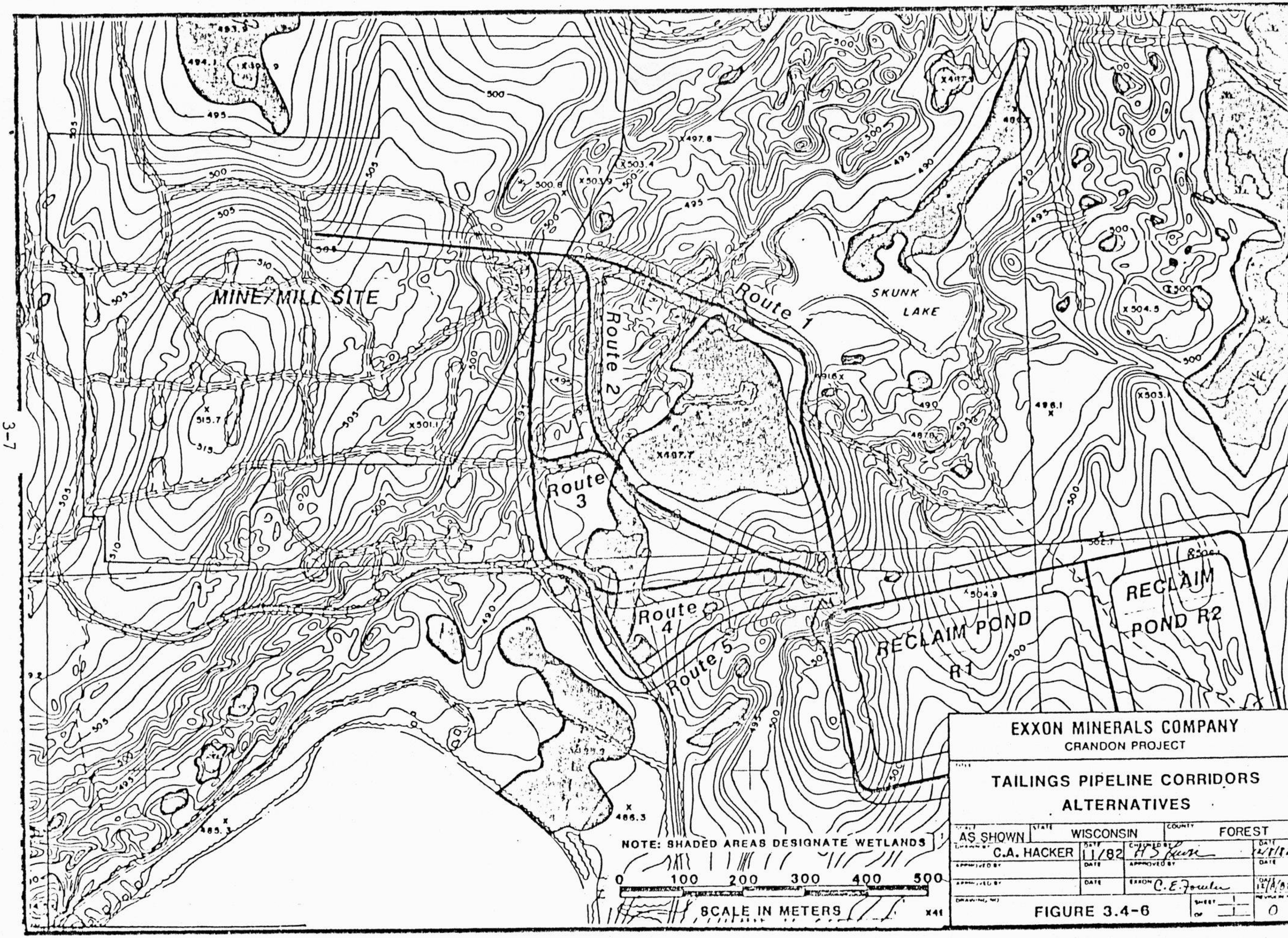
Response:

There are no major differences between the four routes, and any one would be acceptable. The length differences were not considered significant, and for Routes 1 and 2, at least, could be even closer upon completion of detailed engineering. Route 3 has two additional turns and Route 4 runs adjacent to Sand Lake Road at one point, which made them less attractive. Route 1 was selected over Route 2 because Route 2 crosses the middle of wetland F11.

SECTION 3.4.3.1, RAILROAD SPUR

Comment No. 12

At least 5 alternate routes were evaluated by Exxon. Please include in this section a discussion of Alternate "F" and any other routes which were considered.



EXXON MINERALS COMPANY
CRANDON PROJECT

TAILINGS PIPELINE CORRIDORS ALTERNATIVES

AS SHOWN	WISCONSIN	FOREST	
C.A. HACKER	11/82	H S Kuse	12/8/82
		C. E. Fowler	12/8/82
FIGURE 3.4-6			0

Response:

An Exxon report entitled, Summary Description - Access Corridor Siting Sequence" was submitted to the DNR on March 9, 1982. That report provided a review of the major events and identified alternatives in the railroad siting sequence. It included a description of routing alternatives "A" through "E" and three siding alternatives for the railroad. Another alternative route designated "F" was briefly reviewed in-house when it appeared there might be difficulty securing land for the preferred route. Route "F" was connected to the Soo mainline at the same point as Route "D" and was routed west approximately 1830 m (6000 feet) before turning south toward the mine/mill area. Route "F" was estimated to be approximately 1250 m (4100 feet) longer than the proposed route, approximately $375K more costly, and crossed Outlet Creek in addition to Swamp Creek. However, since "F" was similar to "E" and was developed because of the same land availability concern, it was not included in the Summary Description report.

Comment No. 13

Discuss additional alternative siding locations south of Swamp Creek including locations at or near the mill site. The information requested in a June 8, 1982 letter from the Department regarding the Industrial Spur Agreement must also be submitted as part of the EIR.

Response:

The only alternative siding location south of Swamp Creek for which a layout was prepared is alternative "C" presented in Figure 3.4-8 of the EIR. A siding location immediately north of the mine/mill complex was discussed and considered but not pursued. The deadend location of the siding in that area along with the additional congestion from having all car handling activities centralized was not viewed favorably. Also, it was Exxon's objective to minimize reliance on the Soo Line Railroad by keeping their car handling operations and travel on the spur line to a minimum.

The estimated additional wetland area removed for the three siding tracks in their proposed location is approximately 0.4 ha (1.0 acre). In accordance with current engineering design, the area immediately north of the mine/mill site is being proposed for the location of preproduction ore storage. This location was formerly proposed for the backfill storage area; however, the requirement for such an area has been eliminated. Assuming a siding in the mine/mill area is located north of the preproduction ore storage area, it would pass through wetland P2, affecting approximately 0.5 ha (1.2 acres) of wetland vegetation. A siding location in this area versus the proposed location would affect a larger wetland area.

Comment No. 14

Please describe the basis for the wetland impacts presented in Table 3.4-2. Define the extent of wetland destruction necessary for the proposed and alternative siding locations. Revise Table 3.4-2 to show that Alternative C crosses Hemlock Creek rather than Swamp Creek.

Response:

The wetland impacts identified as "Area of Wetlands Affected" on Table 3.4-2 were calculated using an average construction corridor width of 60 m (200 feet). Disturbed area was calculated by multiplying the corridor width by the length of wetlands crossed as shown on Figure 3.4-8 of the EIR (detailed wetland maps are provided in the wetlands assessment reports previously provided to the DNR).

In subsection 3.4.3.1 (p. 3.4-8) of the EIR three siding alternatives are identified which are shown on Figure 3.4-8. As noted on page 3.4-8, Alternative C would cause little disturbance, if any, to wetlands. However, it does not meet the siding grade constraint of 0.5 percent maximum grade and is, therefore, not a viable alternative.

Table 3.4-2 (attached) has been revised to note that railroad spur Alternative C crosses Hemlock Creek rather then Swamp Creek.

Comment No. 15

The discussion of Route C should include the wetland-spring pond complex along the east end. The description of Alternative C siding should include the potential for disturbance and erosion problems affecting the wetland to the west.

Response:

Railroad Spur Alternative C would pass along the south edge of the referenced wetland lying west of the intersection with the Soo Line. Although the wetlands in this area were not mapped in detail, this alternative route would follow the higher ground south of the wetland and would result in infringement on the wetland-spring pond complex.

The coniferous swamp west of siding Alternative C would receive limited, if any, physical disturbance during construction and operation of this alternative. The erosion control plan would reduce siltation caused by erosion through the use of surface diversions in conjunction with straw bales and berms.

Proper construction and timely revegetation of slopes as described in the erosion control plan (see the Mining Permit Application, Section D, Reclamation Plan) would insure erosion is minimized.

The above information will be included in the revised EIR.

SECTION 3.4.3.2, ACCESS ROAD

Comment No. 16

Please include discussion of all other alternate road corridors which were considered. Provide the methods and assumptions which were used to calculate the aerial extent of wetland destruction.

Table 3.4-2

RAILROAD ALTERNATIVES ROUTING DATA

Route Characteristic	Railroad Route A	B	C	D
Overall Track Length, m (feet)	3,400 (11,115)	4,000 (13,123)	3,200 (10,499)	5,106 (16,752)
Siding Length, m (feet)	a	a	a	3,010 (9,875)
Number of Stream Crossings (Stream Crossed)	3 (Swamp Creek)	1 (Swamp Creek)	1 (Hemlock Creek)	1 (Swamp Creek)
Area of Wetlands Affected, ha (acres)	6.2 (15.3)	4.3 (10.6)	5.68 (14.0)	3.0 (7.6)
Closest Eagle or Osprey Nest[b], km (mile)	0.08 (0.05)	0.72 (0.45)	0.78 (0.48)	0.75 (0.47)

[a] No siding alternatives developed for these routes. Would be about the same length as for Route D.

[b] There is one known eagle and one known osprey nest within 0.8 km (0.5 mile) of all alternative railroad routes.

Response:

The Summary Description report noted in the response to Comment No. 12 above provides a review of the alternatives and siting studies sequence for the access road. Wetlands impacts for the access road alternatives are presented in Section 4.4 of the EIR.

The area of wetland disturbance was based on a corridor width of 60 m (200 feet). The area of wetlands affected within this corridor was measured with a planimeter.

Comment No. 17

This section states Route A-1 reflects an alignment adjustment made to minimize wetland destruction. However, as stated in our June 8, 1982 letter, Route A-1 appears to cross approximately 400 feet <u>more</u> wetlands than A-2. Please resolve this discrepancy.

Response:

Your assessment in the June 8, 1982 letter is correct that Route A-1 crosses more wetlands than Route A-2. The intent of the statement was that we tried to refine the "A" alignment using several judgement factors. One was wetland disturbance. However, this consideration had to be evaluated against the need to improve the crossing at Swamp Creek. We believe that Route A-1 of the "A" routes is the best compromise on these issues, and was presented in the EIR.

Comment No. 18

The discussion (on) Route E should clarify if the projected amount of wetland destruction includes the effects of upgrading Little Sand Lake Road.

Response:

This route utilizes an existing road which already passes through several small wetlands. Therefore, only the incremental additional wetland disturbance (1.0 ha [2.5 acres]) was identified. This disturbance would be caused by widening the existing road. No currently unaffected wetlands would be disturbed by the alternative.

SECTION: 3.4.3.4, SURFACE WATER DISCHARGE

Comment No. 19

(1) Please describe and discuss the alternative corridor locations for Route A along with the reasons they were not selected or attainable. (2) Describe the "various environmental reasons" which led to the selection of the proposed route. (3) Discuss alternative discharge structures and alternatives for the access road needed to maintain the structure.

Response:

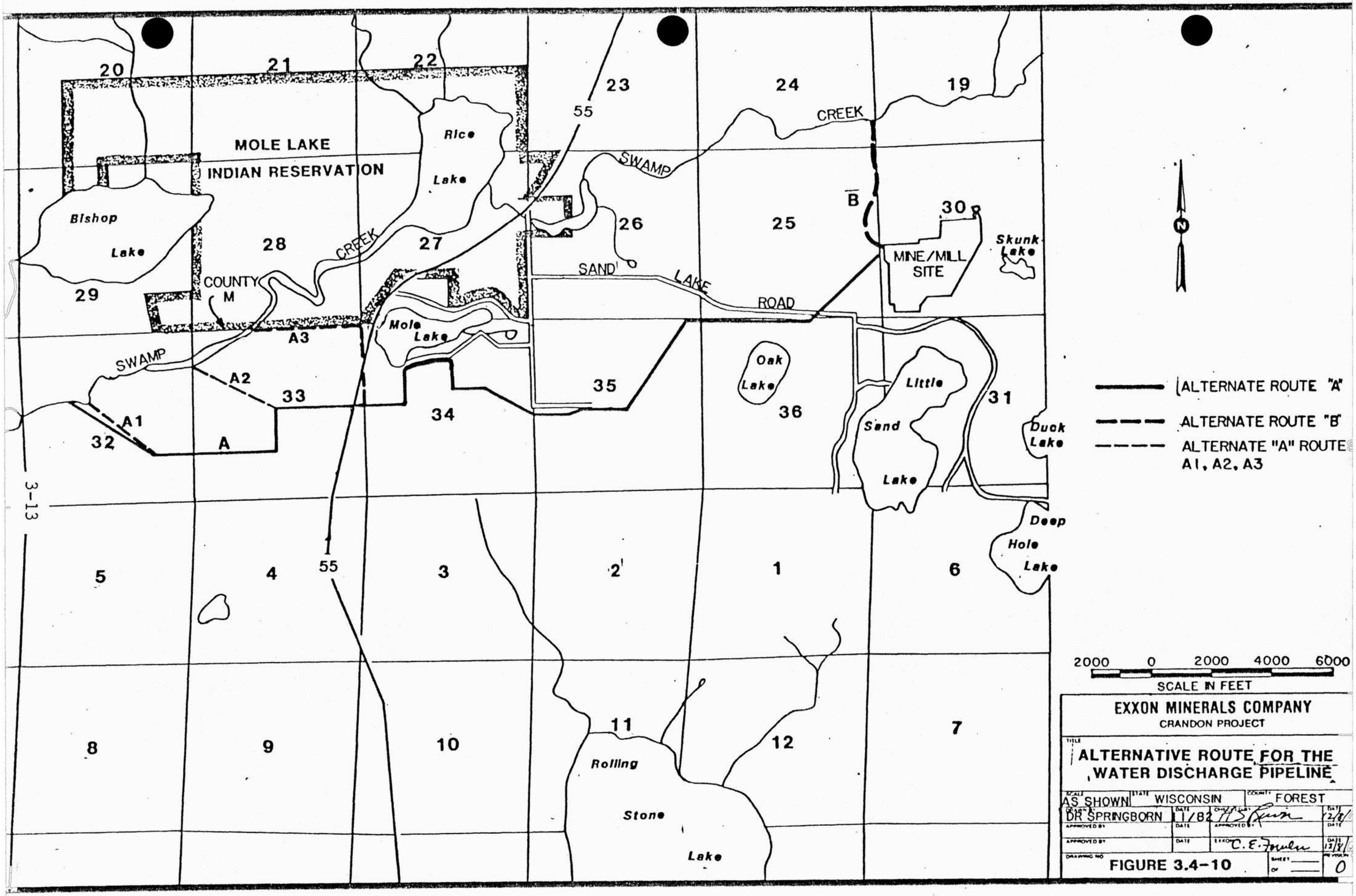
(1) As stated in subsection 3.4.3.4, although alternative potential routes to discharge points from State Highway 55 (see revised Figure 3.4-10 attached) were considered, land negotiations were successful only on Route "A." All alternative "A" routes were downstream of Rice Lake.

(2) There were several environmental factors used in selecting the proposed alternative over Route "B." Route "B" discharges into Swamp Creek in a stream section designated by the DNR as a Class II trout stream. The fish community in this cold water section of Swamp Creek would be more sensitive to moderate variations in water quality resulting from the proposed discharge than would the warm water populations downstream of Rice Lake.

Also Route "B" discharges upstream of Rice Lake which is part of an extensive wetland system producing wild rice in sufficient quantities to be commercially harvested. This lake also has abundant phytoplankton and invertebrate populations which serve as food sources for downstream fish populations. The potential impacts to this aquatic system from discharge of excess water were considered to be greater than potential impacts of Route "A." Although Route B does present some advantages over Route A as discussed in subsection 4.4.1.6, of the EIR, the overall potential for environmental impacts appears greater with Route B.

(3) Several generic discharge structures were considered for use. One type discharges from the stream bank (the proposed plan) while the other would be placed in the stream channel. While structures placed in the stream channel would have less aesthetic impact and allow increased mixing, they would cause greater disturbance to the existing aquatic environment (e.g., displacement of habitat area and food organisms), possibly impact navigation, and increase the potential for substrate erosion during operation. For these reasons a stream bank discharge method was chosen.

A temporary construction access road will be required while the discharge pipeline is being laid. After construction, only periodic access for sampling and inspection normally would be required. As part of the access easement with the landowner, a new road will be constructed to the discharge site area from Shallock Lane located directly north of the proposed discharge. The easement for the one-lane gravel road is 8 m (25 feet) wide and approximately 610 m (2000 feet) long and the road would terminate near the stream bank opposite the discharge structure. The temporary construction area for the pipeline and discharge structure would be allowed to revegetate and no all weather (hard surface or gravel) access road is required. If some maintenance for the discharge structure or pipeline is required (i.e., replacement of rip-rap), a construction access road along the pipeline route would again be utilized.


MOLE LAKE
INDIAN RESERVATION
Bishop
Lake
Rice
Lake
Mole
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Oak
Lake
Little
Sand
Lake
Skunk
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Duck
Lake
Deep
Hole
Lake
Rolling
Stone
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CREEK
SWAMP
CREEK
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SAND LAKE ROAD
MINE/MILL
SITE
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ALTERNATE ROUTE "A"
ALTERNATE ROUTE "B"
ALTERNATE "A" ROUTES
A1, A2, A3
2000 0 2000 4000 6000
SCALE IN FEET
EXXON MINERALS COMPANY
CRANDON PROJECT
ALTERNATIVE ROUTE FOR THE
WATER DISCHARGE PIPELINE
AS SHOWN
WISCONSIN
FOREST
DR SPRINGBORN
11/82
FIGURE 3.4-10
0

SECTION: 3.4.3.5, GROUND WATER DISCHARGE

Comment No. 20

Please provide the available data for the four alternative seepage lagoon sites. Include information on groundwater conditions, subsurface stratigraphy, permeabilities, seepage rates, and other site-specific data.

Response:

Additional data and site conditions are described in the Golder Associates December 1981 report "Excess Water Discharge, Crandon Project" (previously provided to the DNR).

SECTION: 3.5, STRUCTURAL/OPERATIONAL ALTERNATIVES

Comment No. 21

This section must include discussions of structural and operational alternatives which could reduce emissions and effluents. For example, there is no discussion of alternatives which would reduce noise emissions such as relocating the compressor and mine exhaust fans underground, utilizing electric instead of diesel powered locomotives above ground, and using conveyors instead of trucks for moving earth and preproduction ore. Additional details on alternatives which mitigate environmental impacts are needed.

Response:

Consideration was given to reducing air emissions and noise wherever possible. However, certain "tradeoffs" were necessary from either an economic, regulatory or environmental impact evaluation. For example, utilizing an electric powered locomotive and covered conveyors would have some reduction in air emissions. However, the air emissions attributed to the diesel locomotive and haul trucks are minor (see Table 2.4 of the Air Permit Application) compared to other construction and operation sources (see Tables 2.4, 2.6 and 2.7), especially dumping and loading. Further, the resulting concentrations of air contaminants predicted by the air dispersion modelling indicate no impacts to ambient air quality (see Chapter 4 of the Air Permit Application). Finally, when evaluated with the environmental impacts resulting from construction and operation of additional electric power distribution (see the WPS CPCN filing) necessary for mine/mill operations, and the increased loading and dumping for conveyors, the tradeoff of slightly fewer air emissions is not warranted. When economics are also included in the evaluation, the utilization of electrical power instead of diesel power is not cost-effective.

Ambient noise levels could be reduced by relocating the compressor and mine exhaust fans underground. However, proposed MSHA regulations prohibit this alternative for certain mines and virtually eliminate this alternative for all but a few mines (see Title 30 CFR, Part 58, Section 21).

SECTION 3.5.1, MINING METHODS

Comment No. 22

Please provide a discussion of the various types of underground mining considered for the Crandon Project. Describe how an open pit operation would be conducted. Why would the potential environmental affects of the caving methods be greater than those of the proposed methods.

Response:

The primary criteria for selection of an orebody mining method are the size, shape, grade (contained value), rock strengths, and location of the deposit. On this basis, the Crandon deposit can be characterized as a large tabular orebody of relatively average grade, vertically oriented in a host of competent volcanic rocks, overlain by a thick mantle of partially saturated glacial overburden, and situated in an environmentally sensitive lake, wetland and forest natural resource area.

Mining method alternatives considered included open pit, underground, and combination mine plans. It was concluded at an early phase of Project evaluation that any extent of open pit mining at the Crandon site would be impractical and environmentally unacceptable. Extensive site dewatering would be required for pit development. Large volumes of overburden and waste rock would be generated for surface disposal. Nearby surface waters and wetland resources would limit pit expanse, and thus depth and resource recovery. Finally, pit and waste stockpile reclamation to a point approaching pre-mining site conditions would be extremely difficult.

Similar site preservation criteria were applied during selection of the appropriate underground mining method. Caving type methods, which propagate surface subsidence were excluded. To minimize surface land use (i.e., waste disposal and subsidence), the preferred underground method should provide for retention of waste rock and return of mill tailings to backfill mining areas. Backfill methods have the additional advantages of enhancing resource recovery and providing for long-term stability of the mine area bedrock.

For the sake of mining efficiency, and thus cost effectiveness, mine stopes are made as large as the orebody and wallrocks will allow. The competent ground at Crandon will permit substantial open dimensions; 120 m (394 feet) high by 45 m (148 feet) wide on strike by as much as 50 m (164 feet) deep from hanging wall to footwall. Therefore, small dimension cut and fill methods, or stope supporting methods like shrinkage stoping are not required. Large stopes like those possible in the Crandon volcanic rocks are also more amenable to mechanization than more limited size openings typical of methods applied in weaker ground.

The mining method selected for primary recovery of the Crandon orebody is mechanized sublevel blasthole open stoping with delayed backfill. It is a highly efficient method for mining vertical deposits in competent ground with techniques for drilling, blasting, and haulage similar to those of surface mines. A cost effective method like this is required for economic viability since the deposit is of only average grade. No alternative mining method is applicable on a broad scale. The only planned method variation is reduction of stope dimensions for recovery of weakened but enriched weathered zones beneath the orebody crown pillar. In these areas shrinkage blasthole stoping and horizontal cut and fill methods will be practiced where these less efficient methods can remain profitable.

Comment No. 23

Considerably more information is needed on alternatives for controlling groundwater inflow to the mine. Discuss additional methods of controlling mine inflow including freezing portions of the upper levels of the orebody and construction of a slurry cut-off wall or other barrier to groundwater flow around the orebody in the unconsolidated deposits. Provide an economic comparison of inflow control alternatives.

Response:

Potential mine inflow control techniques were investigated by Klohn Leonoff Consulting Engineers and are described in their June 1982 report entitled "Crandon Project Mine Water Control Plan - Alternative Evaluation and Preliminary Engineering" (previously provided to the DNR). This study includes a review of all technically applicable ground water control methods and a comparison of their site specific feasibility, including relative effectiveness and cost. A synopsis of this inflow control method study is presented in response to comment No. 60, subsection 1.2.1.2.16, Mine Drainage.

Comment No. 24

Provide documentation for the estimated effectiveness of pumping the overburden aquifer. Describe the likely quality of the water which would be pumped along with the potential environmental ramifications of utilizing this alternative.

Response:

Site geohydrologic conditions will limit the flow of ground water into the Crandon Mine to a steady state rate of approximately 0.118 m^3/s (1870 gallons per minute) as documented in the Prickett Associates' report entitled "Ground Water Inflow Model for the Proposed Crandon Mine," December 1982 (previously provided to the DNR). A layer of relatively impermeable glacial till and/or clay-rich weathered bedrock retards ground water entry over much of the mine area. The inflows forecast to occur do so primarily in areas where overburden aquifer sands are in contact with porous weathered rock at the orebody subcrop. The ground water impact modeling presented in EIR Appendix 4.1A reflects the flow mechanics of site geohydrology, in that only partial desaturation of the aquifer above the mine is forecast.

Overburden aquifer pumping schemes have been investigated as potential ground water inflow reduction techniques. These dewatering methods are described and evaluated in the Klohn Leonoff June 1982 report entitled "Crandon Project Mine Water Control Plan - Alternative Evaluation and Preliminary Engineering" (previously provided to the DNR). The summary conclusion of these studies was that overburden pumping over the entire orebody might moderately reduce inflow. Generally, more than twice as much ground water would have to be evacuated from the mine area to produce a drawdown cone with small residual heads over potential mine inflow locations.

However, on a very localized basis involving only a few wells, overburden aquifer pumping may be applicable if a small and particularly active subcrop water course is identified. In such a case, ground water could be pumped to provide local aquifer desaturation. Well field discharge could be directed to surface waters or reinjected by drain field or wells to the ground water system exterior to the locally pumped cone of depression. Ground water displaced by a segregated program of this type should maintain its existing quality. Potential environmental ramifications of utilizing this alternative include recharge of aquifers, sustain water supply wells, maintenance of wetland hydrology, and protection of major surface water drainage patterns.

SECTION: 3.5.2, PROCESS ALTERNATIVES

Comment No. 25

Considerably more documentation will be necessary to evaluate the alternative of pyrite flotation. Please provide information to support your conclusion that pyrite is not marketable and that production of other pyrite products is not economically feasible.

Response:

Additional documentation on pyrite flotation is presented in the response to comment No. 26. Subsection 3.5.2.1 in the EIR included a reference to the 1981 Davy-McKee report (previously provided to the DNR) showing capital and operating costs for producing pyrite concentrates and pyrite products. The Davy-McKee report contains results of a marketing study subcontracted to Commodities Research (CRU) and Consolidated Research Inc., on pyrite and pyrite by-products. Commodities studied included: Pyrite Concentrates, Liquid Sulfur Dioxide, Sulfuric Acid, Sulfur, Iron Oxide Pellets, Phosphoric Acid, Diammonium Phosphate, and Gypsum.

It was concluded that no market exists for Crandon pyrite concentrates and the following observations about why pyrite is not in demand are:

1) Pyrite has potential commercial value only because of its sulfur content; the main use of sulfur is in the manufacture of sulfuric acid.

2) The Frasch process for mining elemental sulfur and the availability of by-product sulfur from metal smelters have eliminated pyrite as a major source of sulfur in North America.

3) The pyrite roasting industry in North America has disappeared for these reasons:

   - competition from less expensive sulfur sources
   - shortage of existing roasting facilities
   - high cost of pyrite roasting
   - future adequacy in North America of other by product sulfur/ sulfuric acid from coal burning power plants and metal smelters.

4) Only one company in the U.S. today processes the pyrite it mines. This is Cities Service Company at Copperhill, Tennessee. They produce only acid from the pyrite; the iron pellet circuit was closed.

Only two possible customers for Crandon pyrite concentrate were identified and they were both eliminated because:

1) Cities Service Company at Copperhill rejected purchases of the concentrate due to shipping costs and fineness of the pyrite.

2) Copper Range at White Pine, Michigan could handle only 10 percent of the possible pyrite production from Crandon and they also had concerns about its fineness.

Since no pyrite concentrate market was identified, the possibility of producing other potentially marketable products from pyrite was studied. The following possible products were eliminated from consideration:

1) Liquid SO_2 - consumption in the potential market areas was only about 200,000 t/y (220,000 short tons per year) and not large enough to warrant investigation.

2) By-product Gypsum - this product would contain impurities which must be removed and the processes are prohibitively expensive.

3) Miscellaneous Iron Products - products, such as pigments, powder, etc., were eliminated due to lack of markets or production consideration.

Davy-McKee's recommendation was that the coarse portion of the plant tailings be used as mine fill with the fine portion settled in the tailings pond leaving the possibility of later reclamation of pyrite if the economics prove favorable.

Comment No. 26

(1) Provide additional detail on the operational advantages and disadvantages of separating pyrite. (2) Provide the capital and operating cost estimates and describe in greater detail the operational requirements for pyrite separation. (3) Explain why more disposal area would be required. (4) Examine the alternative of producing sulfuric acid and other compounds utilized in the mine/mill process.

Response:

(1) Exxon Minerals Company considered the possibility that there might be some potential advantages to pyrite separation of the zinc flotation tailings. However, no advantages were identified. The separation of tailings into pyritic and non-pyritic components has the following operational disadvantages.

(a) Both pyrite and non-pyrite tailings are potentially acid generating. The non-pyritic tailings have a sulfur content of 1.86 percent compared with 22 percent for pyrite tailings (CSMRI, 1982, p. 71) and would have the potential to produce sulfuric acid. Two separate lined tailings deposal areas would be required. The two tailings disposal areas would operate simultaneously and would require two separate tailings thickeners, two tailings transport lines and pumps, and additional capital, manpower, and space.

(b) Since disposal areas for both types of tailings would require liners, there is no incentive to produce a low-sulfur tailing which, conceivably, could go to an unlined pond area.

(c) A pyrite flotation circuit would have to be added to the concentrator requiring additional capital, reagents, manpower, electricity, and mill space. Furthermore, two separate backfill sand production circuits would be needed which will require more cyclones and pumps and more mill area.

(2) If pyrite separation were to be done, capital costs would be expected to increase by about $9.0 million in 1981 dollars and operating costs for the concentrator would increase by 12 percent over currently projected costs. The additional capital costs include requirements for pyrite flotation cells and auxillary equipment, additional backfill cyclones, an extra thickener, additional tailings pumps and extra pipeline. The increased operating costs include additional required reagents, electricty, and manpower.

(3) A larger disposal area would be needed since there would be two separate ponds operating at the same time. The proposed MWDF includes development of four ponds, used sequentially, and reclaimed during the mine life. To operate two ponds simultaneously will mean carrying forward to the front-end of the Project the $15 million cost of the second pond. It follows that with two ponds operating at once with two tailings lines and access to these ponds simultaneously will require more area.

(4) The annual consumption of sulfuric acid by the Crandon concentrator would be about 1814 t (2000 short tons). This compares to a potential production of one-half million tons of acid from Crandon pyrite concentrates. The cost of building an acid plant to produce 1814 t (2000 short tons) of sulfuric acid per year could not be justified nor would it help with disposing of pyrite because the consumption is negligible in comparison to the available pyrite.

Comment No. 27

Discuss the potential for a pyrite market appearing in the future and disposal alternatives which would allow reclaiming pyrite if a market did develop.

Response:

The CRU marketing study (Davy-McKee, 1981) concluded that there is little chance of a reversal in the downward trend in pyrite roasting, because of the relatively high cost and future adequacy in North America of by-product sulfur and sulfuric acid from coal burning power plants and metal smelters. Furthermore, the results were not optimistic about the demand for iron pellets. There is considerable unused capacity to produce pyrite. Consequently, the demand for pyrite is not expected to increase in the next 10 to 20 years.

The Davy-McKee report included a discussion of the possibilities of producing fertilizer by the Pircon-Peck process and concluded:

1) The required deflourinated phosphate rock is expensive;

2) There is no current interest or demand; and

3) Commercial success in the near term is not likely.

Production of elemental sulfur from pyrite roasting with high oxygen in the gas is energy and capital intensive and should not be considered an economic source of elemental sulfur.

The pyrite in the Crandon tailings will not be lost as a resource if the tailings are disposed as planned and could be reclaimed if a suitable market is found.

SECTION: 3.5.3, WASTE ROCK TRANSPORT

Comment No. 28

Please provide additional information on the operational and economic disadvantage of conveyor transport of waste and preproduction ore. Include a discussion of the air emissions expected from both the truck and conveyor transport system. Evaluate the alternative of storing preproduction ore at the mill site.

Response:

The concept of using a conveyor for transport of waste rock and preproduction ore from the main shaft to the MWDF is not operationally or economically desirable for the following reasons:

1) Use of a conveyor system would require crushing of material prior to belt loading, thus presenting schedule problems and increased front end capital,

2) All trucks and loaders would not be eliminated as some equipment would have to be purchased and used for placement of conveyed material in the MWDF,

3) A conveyor would still require construction of a roadway for installation and maintenance of the system, and

4) Any emission reductions realized by use of a covered conveyor system as opposed to truck haulage would be offset by increased emissions from double handling at the MWDF for final placement of material.

Emissions estimates for truck haulage are presented in the Air Permit Application subsection 2.2.3, Mine Waste Disposal Facility Construction and Operation. Values presented in this subsection dealing with truck haulage have a combined volume 12.1 t/y (13.4 short tons per year). In comparison, a conveyor alternative would have an emission rate approximately equal to that for truck haulage.

Based on additional study of backfill management design, the need for backfill storage has been eliminated. The area at the mine/mill site previously designated for backfill storage has been revised to provide for temporary preproduction ore storage; this eliminates the need for temporary preproduction ore storage at the MWDF.

SECTION 3.5.4, TAILINGS TRANSPORT SYSTEM

Comment No. 29

Discuss the capability for early leak detection in both the surface and buried systems and the associated environmental considerations. Describe the anticipated repair and/or replacement frequency and discuss alternatives for a more reliable pipeline along with procedures for replacing lines in both systems.

Response:

Solid and water flow rate gage monitoring equipment will be utilized to immediately warn the plant operator of potential and/or actual pipeline problems. These types of monitoring systems are amenable to use with surface and buried pipelines. Early leak detection capabilities will allow an orderly stoppage of tailings transport so that minimal solid quantities are in the pipeline.

For a worst-case slurry pipeline break with minimal warning, the tailings transport would be stopped and would drain to its lowest point(s). The contents of a 650 m (2132 feet) length of line could leak from the pipeline. This is equal to approximately 20.3 m^3 of slurry (5365 gallons). Because of the low elevation the rate of leakage would be slow. Because the pipeline is buried, little solid material would escape. Clean-up would involve excavation about the area of leakage and disposal of water and tailings solids to the MWDF. With the exception of the excavation area, there will be no other environmental effects of consequence. The buried pipeline prevents a wide dispersal of solids and water.

The anticipated repair and/or replacement frequency has been assessed largely from manufacturers' literature and experience. In water transport service, a 50 year pipeline life might be achieved. This is well within the proposed Project life for active pipeline use of approximately 25 years.

HDPE was provisionally selected as the pipeline material for the following reasons:

Resistance to Corrosion

Corrosion tests performed by PSI, Inc. (Conceptual Engineering Study by PSI, Inc.," Tailings Slurry and Solution Transport Pipeline System," p. 10 of Laboratory Report) indicated that corrosion rates for steel in contact with tailings slurry would be high. In contrast, HDPE is inert to a wide variety of chemicals as evidenced by corrosion tests performed by a leading manufacturer of HDPE materials. In addition, HDPE does not rot, pit, corrode, or lose wall thickness by reaction with the surrounding soil. It is unaffected by algae, bacteria, or fungi.

Abrasion Resistance

The abrasivity of the tailings slurry is low as evidenced by Miller number determinations performed by PSI, Inc. (Exhibit 1 of PSI, Inc., report). In addition, test work performed for a leading manufacturer by Williams Brothers Engineering, Tulsa, Oklahoma, compared a proprietary brand of HDPE pipe to steel in controlled pipe loop pumping tests. HDPE out performed steel by a factor of four to one.

Friction Factor

Friction pressure loss in HDPE pipe is less than pressure loss in steel or cement lined pipe. Typical "C" valves used in the "Hazen and Williams" formula for calculating pressure loss are:

HDPE Pipe	155
New Steel Pipe	140
Cast Iron Pipe	130
Concrete Pipe	120

The favorable friction factor for HDPE pipe results in lower pumping energy consumption and reduced pipeline pressure.

Fusion Welding

Steel and HDPE pipe can be installed in a continuous fusion welded line. Lined steel pipes are joined by flanged connections. A pipeline with many flanged connections is more prone to leakage than a welded line. On this basis, the unflanged fusion welded HDPE pipeline will be superior to flanged pipeline. Therefore, this review indicated that the superior corrosion and abrasion resistance exhibited by HDPE pipe and the life and reliability of HDPE pipelines can be expected to be superior to the life of pipelines fabricated from competing materials, including steel.

In addition, several recent applications of slurry pipeline transport have selected HDPE over other materials. Examples of the use of HDPE in mining industry slurry service are:

1) Pinto Valley (Miami, Arizona);
2) Lornex (Highland Valley, British Columbia);
3) Phelps Dodge (Morenci, Arizona); and
4) Inspiration Consolidated Copper Company (Miami, Arizona).

Therefore, the HDPE pipelines will, we believe, be the most reliable of all the systems we have examined. Burying the pipeline will further improve its reliability.

The procedure for replacing damaged pipe would be to suspend pipeline operation and remove the defective section and replace it with new pipe. Depending upon the pipe diameter the new section would be inserted using fusion welded flanges or flanged spool sections. The repaired pipe would be pressure and leak tested before being returned to service. Spare plastic pipe and fittings would be stored on-site for repair purposes.

SECTION 3.5.1, TAILINGS DISPOSAL METHODS

Comment No. 30

Include a discussion of the effects of various tailings disposal techniques on the tailings chemistry, leachate generation, acid production, stabilization, etc.

Response:

A general description of tailing chemistry is summarized in the Mine Waste Disposal Facility Feasibility Report, subsections 3.3.3, "Leaching Properties" and 3.3.4, "Acid Generation Potential." The information reported therein is taken from the Colorado School of Mines Research Institute (CSMRI) report "Study on Characterization of Crandon Mill Tailings," 1982 previously provided to the DNR . The projected MWDF tailing pond seepage chemistry for the "wet" disposal method is given in EIR Appendix 4.1A, Table A-3.

The three tailings disposal systems discussed have the maximum probable potential differences during the operational phase. During the operational phase of tailings disposal both the "dry" and subaerial disposal result in partially saturated moisture conditions within the tailing mass. The increased exposure to oxygen, relative to the "wet" method, may potentially generate a higher total dissolved solids (TDS) content in the leachate. However, it is unlikely that the leachate will become acidic because of the large acid buffering capacity of the tailings in addition to the lime addition to tailing thickener. The CSMRI study did not indicate a significant difference in tailing leachate chemistry between columns that were continuously flooded (restricted oxygen exposure) and those that experienced alternating wet and dry cycles (enhanced oxygen exposure) during 31 weeks of testing.

The long-term impact after reclamation will depend on the surface seal employed. The seal surface is the same for all three disposal options and it controls the infiltration or transport of water (precipitation) and oxygen. Infiltrating oxygen and water directly determine the quality and quantity of the leachate, respectively. There is a transition period between the operation and reclamation phases where tailings saturate ("dry" and subaerial) or desaturate ("wet") until the leachate production is in equilibrium with the rate of water infiltration through the seal.

Comment No. 31

Please include a discussion of the alternative of constructing the proposed tailings ponds and practicing the subaerial method of tailings deposition.

Response:

Further explanation of the subaerial method is presented in subsection 11.3.3 of the Mine Waste Disposal Facility Feasibility Report NR 182.08. Detailed discussions on development of the design basis, facility construction and operation are presented in "Tailings Storage Facility, Report on Preliminary Design - Crandon Project, Vol. 1 and 2," prepared by Knight & Piesold Ltd., 1982 (previously provided to the DNR).

Comment No. 32

Another advantage of the subaerial method as depicted in Figure 3.5-5 is the greater ease of pipe cleaning.

Response:

It is probable that at least some portions of the underdrainage system for the subaerial facility could be cleaned easier than for the proposed MWDF. The gravity drainage feature of the subaerial system could lend itself to flushing quite readily. However, with the designs of both the proposed MWDF and the subaerial facility, and particularly with the drain blanket material gradation and the pipe perforation sizing specified, minimal cleaning is anticipated.

SECTION 3.5.5.1, TAILINGS POND SEEPAGE CONTROL

Comment No. 33

Please provide additional discussion and documentation on the seepage control system selection process. Provide a cost analysis of the alternatives considered. Evaluate the alternative of using two or more liner materials in conjunction with each other. Include a discussion of specific geomembranes, especially High Density Polyethylene. Provide additional evaluation of the alternative of using the fine fraction of the site till materials. Discuss the alternative liners' performance in the event of a failure of the underdrain system. Provide an evaluation of alternatives for the underdrain system.

Response:

Many studies were conducted and associated reports prepared to select the most efficient and effective method of seepage control. Work presented in the following Golder Associates' reports (previously provided to the DNR) supported the selection process:

1) "Parametric Seepage Rate Estimates,"

2) "Underdrain Review,"

3) "Laboratory Testing Programs,"

4) "General Properties of Common Liners," and

5) "Evaluation of Prospective Common Liners."

The proposed seepage control system was developed from several studies, review, revision and improvement to alternatives or components of the alternatives throughout the evaluation period.

Similarly, the cost comparsions were generated as components of the system were evaluated and developed. For example, costs of alternative liners alone were evaluated in the Golder Associates' liner reports (Reports 4 and 5 mentioned above) and bentonite modified soil liner costs were compared to native clay liner costs in an Exxon report "Use of Local Natural Clay for the Liner and Reclamation Seal" (previously provided to the DNR); and underdrain costs were developed by INDECO (report previously provided to the DNR) as they estimated costs for the entire MWDF.

For relative cost comparison of a 36 mil Hypalon membrane liner versus bentonite modified soil liners, the cost estimates prepared by INDECO in their October 1982 report (previously provided to the DNR) are included below. Approximate costs, as estimated by Exxon in the report noted above, for a 1.5 m (5 foot) thick native clay liner are also included. The cost of individual components of the seepage control systems can be compared directly or they can be combined to form an alternative system, i.e., an underdrain layer over a synthetic liner. Also, costs for varying thickness bentonite modified soil liners can be determined by factoring up or down the cost for the 0.15 m (6 inch) thickness. The bentonite modified soil liner cost is based on a central mix and haul process with 4 percent by weight bentonite. Of the $0.29/ft^2 cost, approximately 50 percent is for bentonite. A mix in-place alternative would lower the overall cost and bentonite adjustments would increase or lower costs directly according to the bentonite content change.

The approximate installed costs (contractors cost) for seepage control systems and components as determined during the MWDF cost studies by INDECO (October 1982) are listed below:

1) Bentonite Modified Soil Seepage Control System

a. 0.15 m (6 inch) thick bentonite modified till liner - (4 percent bentonite)	-	$0.29/ft^2
b. 0.46 m (18 inch) thick underdrain layer of processed till	-	0.31/ft^2
c. 0.46 m (18 inch) thick filter layer of unprocessed till	-	0.10/ft^2
Total cost		$0.70/ft^2

2) Synthetic Membrane Seepage Control System

a.	0.15 m (6 inch) thick bentonite modified till lower liner (4 percent bentonite)	-	$0.31/ft^2$
b.	0.30 m (12 inch) thick noncarbonaceous base cushion below synthetic liner	-	$0.14/ft^2$
c.	Upper synthetic liner - 36 mill Hypalon	-	$0.55/ft^2$
d.	0.46 m (18 inch) thick protective sand cushion above synthetic liner	-	$0.22/ft^2$
	Total cost		$1.22/ft^2$

3) Native Clay Seepage Control System

a.	1.5 m (5 foot) thick native clay liner hauled from Fence area in Florence County	-	$3.70/ft^2$
	Total cost		$3.70/ft^2$

Double lined systems have not been considered for the MWDF. With the proposed liner and underdrain system, seepage is reduced to negligible amounts and a double liner would not substantially improve MWDF performance. As a contingency measure against liner failure, a double liner would be an expensive alternative.

High Density Polyethylene, along with other geomembranes were reviewed in the Golder Associates Reports 4 and 5 mentioned above. It, along with Hypalon, is one of the suggested membranes for the reclaim water ponds.

A liner developed from the fine fraction of the till was studied during preliminary engineering for the sub-aerial MWDF developed by Knight and Piesold, Ltd., "Tailings Storage Facility - Report on Preliminary Design" (previously provided to the DNR). This alternative has potential for further study.

A discussion of alternative liner performance is provided in subsection 11.2.2.5, Seepage Rate Comparisons in the MWDF Feasibility Report. Potential underdrain failures and their effects, as well as contingency measures, are discussed in the Exxon report "Operating Aspects and Contingency Plans" (previously provided to the DNR).

Golder Associates and Knight and Piesold, Ltd. assumed the concept of a drain layer over a liner as the most effective means of reducing liner seepage. The differences between the two designs (i.e., soil particle sizes, herringbone network of collector pipes) and other minor refinements such as varying drain layer thickness resulted in the proposed design.

Comment No. 34

Provide a discussion of the disadvantages of the proposed bentonite admixture liner such as the difficulty of maintaining a uniform thickness during construction, the threat to the structural integrity by construction and operation activities, the problem of maintaining the liner in a saturated state and the possibility of cracking and intrusion of the coarse-grained drainage blanket, and the difficulty of rehydrating the bentonite in a high-salt environment.

Response:

At this time, no problems are foreseen in maintaining a uniform thickness during construction. Construction studies made by INDECO "Construction of Waste Disposal Facilities" and by Exxon "Construction Aspects" (both previously provided to the DNR) provide general details of the necessary tolerance control in layer placement. Final details of the placement techniques to assure that the required minimum liner thickness is obtained will be thoroughly assessed prior to construction as part of final facility design.

The method of construction for the liner/drain system includes placement of drain and filter materials atop the liner both to protect it from rainstorms and equipment traffic. Daily placement of overlying drain and filter materials will also protect the liner from dessication.

Cracking of the liner and intrusion of the coarse-grained drainage blanket material is not considered plausible as a result of the proposed construction sequence. The 0.46 m (1.5 feet) thickness for both the drain and filter layers provides a total cover of 0.92 m (3.0 feet) over the liner which reduces wheel loads to less than 10 percent at the liner depth.

The liner will be hydrated initially during construction and protected by the overlying drain and filter layers. A final hydration step will be performed after the overlying layers are in place. Natural soil moisture levels which will develop and the tailings leachate water will prevent the liner from drying.

Comment No. 35

Please provide additional discussion on the elimination of the surface sealant and polymeric material options and describe why they were eliminated from consideration. Compare and contrast the quality assurance and control requirements for construction of a geomembrane and a six-inch soil-bentonite liner.

Response:

Detailed discussion on numerous liner types including surface sealants and polymeric material options is provided in "Evaluation of Prospective Common Liners, Crandon Project Waste Disposal System," Project Report 6.2, Golder Associates, December 1981 previously submitted to the DNR. The pros and cons of the various liner types are presented leading to the recommended bentonite-modified soil liner currently adopted for design.

A common aspect associated with both geomembrane and soil bentonite liner systems is the earth work construction control. In both systems this applies to shaping and compacting the supporting subgrade. Control of thickness and compaction is required for cushion layers which are usually constructed on top and bottom of the geomembrane liners. Similar construction control is required to develop the design thickness for a soil-bentonite liner with special attention given to material composition (percent bentonite) and compaction moisture content.

Quality assurance and control aspects of construction would have some similarities for both systems including proper thickness control and verification, minimum compaction standards, and proper material gradations. Quality control testing for liner seaming and placement such as vacuum testing, would be unique to polymeric liner systems. Specific quality control requirements for the soil bentonite system would include moisture-control documentation and field and laboratory verification of the design permeability. Depending on the method of construction (in situ or batch), additional quality control procedures addressing liner composition would be performed.

SECTION 3.5.5.3, MINE WASTE DISPOSAL FACILITY RECLAMATION CAP

Comment No. 36

Three capping systems were analyzed but only two are described. Please provide a detailed analysis of using a geomembrane in the cap structure.

Response:

Alternative 3 is as presented in the report, "Waste Disposal Facility Reclamation Cap, Crandon Project, Water Balance Analysis," prepared by Owen Ayres & Associates, Inc., 1982 (previously provided to the DNR). Pages 15 and 26 through 38 state that 0.71 m (28 inches) of glacial till underlain by a 0.20 m (8 inches) coarse drain, in turn, underlain by a 0.15 m (6 inches) bentonite modified soil is proposed for the reclamation cap.

The Alternative 2 presented in the EIR is a composite of Alternatives 2 and 3 presented by Owen Ayres and indicates a range for the upper till thickness. This is the only difference between the two alternatives.

The use of a geomembrane as a seal in the reclamation cap system has been considered but not included in the present design scheme for the following reasons:

1) Expense - preliminary costing shows a geomembrane seal would be approximately twice the cost of using bentonite modified till;

2) Long-Term Integrity - geomembranes are relatively new, and although they have been proven in a variety of similar applications, their performance in perpetuity is unknown; and

3) Construction Experience with Bentonite - bentonite has been used successfully in developing modified soil liners. Similar construction experience is just becoming available for geomembranes.

The use of a "geological" material (bentonite modified soil) as a top seal appears to be the most prudent technology at this time; however, as performance data on geomembranes become available during the course of operation and as both material and construction technologies improve, re-evaluation of geomembranes will be performed.

SECTION 3.5.5.3, MINE WASTE DISPOSAL FACILITY RECLAMATION CAP

Comment No. 37

Describe revegetation of the cap and discuss the effect of revegetation on the alternatives (required species limitation, potential root penetration of the bentonite layer, etc.). Describe the disposition of the water collected in the drain layer for Alternatives 2 and 3. Discuss the use of native clay materials in the cap along with the use of two or more liner materials in conjunction with each other. Discuss the shrink/swell potential of bentonite admixtures and the possibility of dehydrating the cap.

Response:

A discussion of revegetation of the reclamation cap for the mine waste disposal facility is presented in Section 4.4 (pp. 4.4-1 through 4.4-10) of the Reclamation Plan. Selection of plant species for use on the overburden soils which form the upper layer of the tailings cap will be governed by known root habit for a particular species and by the known habitat requirements of the species and the environmental conditions existing on the tailings cap. This will provide assurance that the bentonite modified soil seal will not be penetrated by the roots. Permanent vegetation cover will be composed of forest species typical of the area; however, non-indigenous species may be utilized. Species will be selected for establishment on the cap that have a sinker (flat) tree root system. Potential species are identified in Table A.3 of the Reclamation Plan. Final species selection will be determined by on-site testing encompassing general species adaptability to site conditions.

The same species limitations concerning rooting characteristics, as discussed in subsection 4.4.4 of the Reclamation Plan for the proposed reclamation cap, are applicable to the alternative cap designs. Tree species having tap or heart root systems would not be utilized in order to minimize root penetration of the bentonite modified soil seal layer.

Based on the water balance analysis of the reclamation cap (Owen Ayres and Associates, 1982; previously provided to the DNR), the alternative cap design with a two layered cover system resulted in periods of saturated soil conditions during wet years and periods of minimal soil moisture during dry years. This fluctuation in soil moisture condition would limit species selection for revegetation to those that could withstand such fluctuations.

Alternative 3, a three layered cover system with a 711 mm (28 inch) upper till layer instead of the 914 mm (36 inch) till layer in the proposed design, eliminates the saturated soil condition (because of the drain layer) which occurs during wet years. However, this alternative provides less storage of soil moisture and is considered less suitable for long-term plant species development than the proposed design.

With the species that would be used on the reclamation cap (those having a flat rooting system), the potential for root penetration of the bentonite modified soil layer is minimal for the proposed cap design as well as the alternatives.

According to Owen Ayres and Associates, Inc. (1982) study, the reclamation cap water balance for a normal year is approximately 53.1 mm (2.09 inches) of precipitation per year and will move laterally through the drain. The purpose of the drain is to reduce infiltration through the seal and to transport water to the perimeter of the MWDF. The grading of the reclamation cap (and drain layer) has been planned to distribute this water as uniformly as possible around the MWDF. For the normal year, the 53.1 mm (2.09 inches) of infiltrating precipitation will be distributed uniformly around the 5700 m (18,700 feet) MWDF perimeter. This equates to a water flow rate of 0.00000046 m^3/s per meter (0.0022 gallons per minute per foot) of MWDF perimeter. This flow rate is equivalent to 0.000063 m^3/s for each 138 m (1.0 gallon per minute for each 454 feet) of MWDF perimeter. In the reclamation cap, the drain layer will be continuous with the outside face of the MWDF embankments. The infiltrating water will then begin to percolate through the embankment soils as it leaves the underdrain.

Many aspects of the use of native clay for both the reclamation cap and the pond liner have been discussed in the report entitled "Use of Local Natural Clay for the Liner and Reclamation Seal" (previously provided to the DNR). We have not studied double seals for the reclamation cap (see response to comment No. 33 above).

The coarse drain layer above and the till grading layer below the soil-bentonite seal prevent the development of capillary pore pressures which might draw water from the seal. The water balance analysis by Owen Ayres showed there was sufficient moisture retained in the 0.9 m (3.0 feet) till cover to support the vegetation. The bentonite modified soil is similar to the glacial till soils except for permeability reduction. The soil structure mix is less susceptible to shrinkage and swelling than a high clay content soil.

SECTION 3.5.5.3, MINE WASTE DISPOSAL FACILITY RECLAMATION CAP

Comment No. 38

In Table 3.5-1, please explain why runoff is less for Alternative 2 in a wet year than in a normal year.

Response:

The precipitation data used by Owen Ayres and Associates, Inc. (1982) assumed 100 percent runoff for the period November 20 through March 10 and 5 percent for the rest of the year. The actual data for the extreme wet year of 1978 had a lower than average precipitation from November through March and higher than average precipitation the rest of the year. This pattern of precipitation for 1978 resulted in lower total runoff because most of the precipitation occurred during the low surface water runoff period. If the extreme wet year would have had higher precipitation throughout the year, runoff would have been greater than for a normal year.

SECTION 3.5.6.1, WATER TREATMENT SYSTEMS

Comment No. 39

Table 3.5-2 should define the meaning of Very High, High, Moderate and Low. These discussions should also note that, while each of the unit processes described in the table by itself may not be suitable for use to treat mine/mill water, when used in conjunction with other process units, the resulting treatment system could alleviate some of the problems listed in the comments section. Table 3.5-2 does not identify the 10 treatment systems selected for further evaluation as stated on page 3.5-17. Please provide a table listing each of the 10 treatment systems and comparing performance capability and reliability (based on similar plants currently in use), and cost. Provide specific projections of effluent quality for each of the treatment alternatives analyzed.

Response:

Table 3.5-2 was developed to be a unit process screening tool. The terms Very High, High, Moderate and Low used to describe capital and O and M costs were only used to provide an approximate comparison of one unit process with others. The same terminology and philosophy was used in assessing removal efficiency for various contaminants.

As noted, Table 3.5-2 does not discuss the 10 treatment systems, but contains a list of the 42 water treatment unit process technologies that were originally studied when selecting combinations of unit processes for further consideration. The table that compares the 10 treatment alternatives with Project specific criteria is contained in Figure 19, Chapter XIV, Volume I of the 1982 Report "Phase III Water Management Study," by CH_2M Hill (previously provided to the DNR). Capital and operating costs presented for water treatment systems 9 and 10 on page XIV-16 of Volume I of the CH_2M Hill report can be used as a reference guide to the relative cost ranking given in Figure 19. Information contained in Figure 19 of the CH_2M Hill report was used as a screening tool to compare relative performance of one treatment system to another. Effluent quality information presented in Figure 19 for the 10 treatment systems is related to primary and secondary drinking water standards, Federal New Source Performance Standards (NSPS) for copper, lead and zinc mines and mills, and surface water quality based limitations set forth in a DNR letter from R. Ramharter to B. Hansen dated March 19, 1982.

Comment No. 40

Provide a discussion of facility and operational alternatives for the unit processes of the proposed treatment system. Could the reclaim pond size be reduced by adding mechanical aeration and more frequent sludge removal? Describe other available alternatives.

Response:

At the current level of engineering design, conventional facilities and operating procedures, which are commonly employed and for which proven experience exists, have been assumed. Consideration of specific equipment alternatives would not be expected to affect system performance or resulting environmental impacts.

The main functions of the reclaim ponds are addressed in the response to comment No. 113 in Chapter 1. At this time, there is no known alternative to a reclaim pond that will provide the required surge capacity, oxidative, and evaporative functions that a reclaim pond will provide. We do not know of any mining operations using mechanically aerated systems for this purpose. The chemical reactions occurring in a reclaim pond are very complex and would be difficult to initiate, control, and drive to completion in a treatment process. Studies were made of potential treatment unit operations that might partially accomplish the functions of a reclaim pond. Induced biological oxidation is not a commercially viable process. None of the identified unit processes, alone or in combination, would completely fulfill the functions of a reclaim pond. Technology employed in these unit operations included biological oxidation for thiosulfates, use of activated carbon for adsorption of residual organics, and oxidation systems using hydrogen peroxide and ozone.

Comment No. 41

Hydrocarbons are noted as a potential operating problem for System 7. What will prevent this same problem from occurring in the proposed system?

Response:

Hydrocarbons were noted as a potential operating problem for water treatment system 7 because it uses a sedimentation pond followed by a small neutralization mixer and mixed media filter. This sytem will not afford the flexibility to remove iron and organics efficiently. System 9, the proposed system, uses reactor/clarifiers for removal of hydroxide and carbonate precipitates and a provision for aeration for oxidation is available. Furthermore, activated carbon could be added to the reactor clarifiers if hydrocarbons were deemed to be a problem. Reverse osmosis membranes are used commercially to concentrate medium to high molecular weight organics. Thus, the amount of organics that is not removed in the reclaim pond and by adsorption during carbonate precipitation should present no operating problems for reverse osmosis/vapor compression evaporation unit.

SECTION 3.5.6.2, EXCESS WATER DISCHARGE METHODS

Comment No. 42

This section should recognize the proposal to separate "uncontaminated" water from treated process water. Please provide a discussion of the alternative of using different discharge methods for the two wastewater streams. Include a detailed analysis of using excess water to mitigate surface water impacts resulting from the groundwater drawdown.

Response:

Uncontaminated mine water to be discharged will be kept separate from treated process water. Current plans call for discharge of uncontaminated mine water and treated mine water as one stream. However, the uncontaminated mine water inflow (ambient ground water) collected could be discharged to a wetland system or several systems or directly to a nearby lake or lakes or returned to the ground water. These alternatives are discussed in subsection 3.5.6.2. The process water would be discharged, after treatment, as previously discussed.

Computer simulation of the effects of mining operations on the surface water systems indicates that the potential for measurable impacts is small; therefore, no mitigation measures have been prepared.

SECTION 3.5.6.2, EXCESS WATER DISCHARGE METHODS

Comment No. 43

Please provide more detail on the wetland discharge alternative. This discussion should recognize the sensitivity of wetlands to hydrological changes, metals and organics, and the potential to accumulate metals in this soil. Water quality standards for a wetland discharge would be designed to protect fish and aquatic life against acute toxicity effects as well as protecting plants against phyto-toxicity effects. Effluent limits developed for a wetland discharge would not necessarily be less stringent than those for a surface water discharge. Exxon has not provided enough information to allow a thorough evaluation of this alternative.

Response:

Wetlands for treating wastewaters have been used for small and large scale applications in Europe and the United States (EPA-600/52-82-086, The Use of Wetlands for Water Pollution Control). Wetlands such as marshes, swamps and upland vegetative systems have been shown to remove pollutants even from treated wastewaters. The development of wetlands for surface runoff treatment has been especially easy to justify because of accessory benefits to communities such as recreation, wildlife and fishing enhancement, recharge of groundwater, and water quality renovation (EPA, 1982).

Data are available from some wetland systems which have established hydrological and constituent balances and assessed the pollutant removal capabilities for these ecosystems (EPA, 1982). Examples can be found in New York, Minnesota and Michigan among others. However, further research needs to be conducted on long-term impacts to wetlands including bioaccumulation of trace metals and the interaction of individual pollutant removal mechanisms in various wetland systems. As a result, only preliminary discussions could be presented in the EIR regarding such factors as sensitivity of wetlands to hydrological changes, metals and their potential accumulation in soil, and organic loading. Similarly water quality standards for a wetland discharge would need to consider these factors.

SECTION 3.5.6.2, EXCESS WATER DISCHARGE METHODS

Comment No. 44

Please describe in greater detail why the wetlands and groundwater discharge options were removed from consideration.

Response:

The wetlands and ground water discharge options have not been removed from consideration. However, the available information and the possibility of permitting these options did not appear sufficient to support these options at the time of EIR submittal (see response to comment No. 43).

SECTION 3.5.7, ENERGY SOURCE

Comment No. 45

Please provide a discussion of the alternatives of using propane as a fuel for mobile vehicles and using natural gas as a fuel for the emergency generators. These gases would be cleaner alternatives to diesel fuel and gasoline.

Response:

The majority of the mobile equipment utilized for this Project is located underground. The MSHA regulations (Title 30 CFR Part 55 and 57) require the underground equipment to be electric or diesel driven and fitted with a scrubbing system. With the exception of light trucks and 3-5 automobiles, few surface equipment items can use propane fuel. Propane use would be less than 125 gallons per day equivalent of gasoline. This change would not ultimately affect the overall air emissions and their minor contributions would not alter the air quality or provide a problem in meeting standards.

The emergency generator system could be converted to natural gas. However, the existing natural gas pipeline at Crandon is only marginally adequate to support the present system load for the City of Crandon area and the proposed mine/mill site requirements at 100 percent capacity on a maximum cold day even without the emergency generators. To insure service of the emergency generators, diesel fuel use would be required even with natural gas provisions. In addition, the generators will operate only approximately 30 minutes a week and when power interruptions occur during the operational phase.

SECTION 3.5.7, ENERGY SOURCE

Comment No. 46

Provide an analysis to the 115 kv transmission line including the use of a 69 kv transmission line source and the use of on-site self generation to meet some or all of the electrical requirements.

Response:

The use of a lower voltage power line was addressed in the "Application for Authority to Construct 115,000 volt transmission line Venus to Exxon X-76." Page 20 of the CPCN indicates that the 69 kv alternative would cost approximately 35 percent more than the 115 kv project. The cost for a 69 kv power line was calculated in Figure I and compared to Figure H in the CPCN application. The major difference in costs for the 69 kv power line are larger conductors (447 kcm for 115 kv vs. 795 kcm for 69 kv) and the requirement to add a 115 kv/69 transformer at the Venus substation.

In addition, a lower voltage line that carries large current loads usually has larger line energy losses than higher voltage systems. Line energy losses from a 69 kv power line would cost an additional $1,000,000 when compared to 115 kv power line during a 15 year mine life. A 69 kv power line would also be marginal for motor starting, hoist operation and voltage harmonics.

The use of self-generation was considered for some or all of the operating load requirements. However, it was not considered viable from economic or environmental standpoints. The need for process steam is minimal (i.e., building heating) and, therefore, a steam system with waste heat recovery is not practical. Environmental impacts would also be associated with NO_x and TSP concentrations from a plant fired with coal or wood chips. There also would be potential environmental impacts from fly ash disposal facilities. The use of the diesel generators or natural gas turbines on a continuous basis would increase NO_x and TSP emissions. In addition, the natural gas pipeline could not provide sufficient gas for a 10-20 mW plant without an expansion of the pipeline system from Laona to Crandon. This expansion would also have environmental impacts.

SECTION 3.6, CONCENTRATE TRANSPORT

Comment No. 47

Please discuss the transportation methods, volumes and most likely or preferred final destinations for each of the concentrates.

Response:

As was discussed in the response to comment No. 75 in Chapter 1.0, subsection 1.2.2.9, the concentrates will be loaded into gondola railroad cars and covered with plastic covers. These gondola cars are generally restricted to transporting net weights of less than 91 t (100 short tons). Each car is labeled with its capacity and railroads will not accept a car loaded over its limit. The average car will be loaded with 77 to 86 t (85 to 95 short tons) of concentrate. Due to its high bulk density, the concentrate will not occupy all of the car's volume.

Contracts for the sale of Crandon concentrate will not be developed until permits are received and a decision has been made to proceed with Project development. Likely markets for zinc, copper, and lead concentrates are U.S. and Canada with some zinc concentrate possibly going to Europe.

Amounts of concentrate to be produced and approximate number of rail cars that would move in and out of the site per week for concentrate shipment are as follows:

	Nominal Production Rate		
Concentrate	Dry t/Week	(Dry Short Tons per Week)	Number of Rail Cars per Week
Zinc	6832	(7530)	85-95
Copper	3143	(3470)	40-45
Lead	483	(530)	5-10

The number of rail cars moving in and out of the Project for concentrate shipment was determined assuming a car with net capacity of 81.6 t (90 short tons) and allowing for 9 percent by weight moisture in the concentrates. Other studies for this Project may have used car capacities of 45.3 to 54.4 t (50 to 60 short tons), in which case, the number of car movements would be substantially higher and could be regarded as a worst-case condition.

Comment No. 48

This chapter must include a section on closure and final use alternatives. Provide a detailed analysis of potential uses of the mine/mill facility by other industries. Reference the discussion of extending the project by milling ore from other localities in Section 3.2.

Response:

In the revised EIR, Section 3.7, References, will be renumbered 3.8, References, and the following section will be added as Section 3.7.

SECTION 3.7, FINAL USE ALTERNATIVES FOR FACILITIES

Subsection 3.7.1, Sale or Lease of Milling Facility for Future Producer

Crandon facilities after closure of the Crandon mine would be tendered for other beneficial uses prior to inaugurating demolition and final site reclamation. Planning for such uses should occur as early as possible so as to provide appropriate execution time. In addition to basic plant facilities, some equipment might also be utilized.

The first use to be considered should be that of concentrating ores from other deposits which might be found and developed during the period in which mining occurs at Crandon. Such ores might be beneficially owned by Exxon or by independent parties. If ores are owned by independent parties and the Project facilities at closure are not otherwise economically utilizable by Exxon, the alternative of sale or lease of specific Crandon facilities for use in the concentrating of their ores would be considered on economic merits. In that event, plans for use of the facilities would be included in that applicant's EIR and related document.

Subsection 3.7.2, Alternative Use of Facilities Other Than Mining

Because of the extensive time between now and the closure of the Crandon mine (Year 2012), the future use of facilities beyond mine life is conjectural. Office facilities, shop facilities, warehouses, power transformation equipment, and basic shop equipment as well as the access road and railroad spur may cause considerable segments of the plant to be of interest for business purposes other than mining.

The existence of substantial facilities at Crandon may result in overcoming inherent disadvantages of location for mining related industries. Such disadvantages when compared to centers such as Wausau, Green Bay, and Milwaukee suburbs include transporation cost and potential lack of diversified skilled labor. Labor, however, may not be a disadvantage because of the skilled mining labor force available upon closure of the Crandon Project.

Plant facilities of key interest for light industrial uses would be shops, warehouses, fuel storage, power transmission, water treatment, office complex and railroad. Technology uses would probably require shops, warehouses, and office complex facilities, as well as road access.

Table 3.7-1 (attached) lists some specific types of industries which might be interested in locating in the Crandon area if facilities were available.

Subsection 3.7.3, Post-Mining Land Use

Post mining land uses of the area owned and controlled by Exxon would essentially be those pre-mining uses as outlined in the Reclamation Plan and Chapter 2, with few exceptions. For example, the recreational use of year-around and summer homes in the vicinity of Little Sand Lake would continue. Most other areas in and around the mine/mill site would continue historic forest product use.

The 202 ha (500 acres) MWDF will have some restrictions with regard to the type of forest growth and management of forest production in order to promote long-term stability of the tailings. Emphasis will be upon preserving the integrity of the tailings pond cover as outlined in the Reclamation Plan. This will limit the tree species used, and forest management in the form of selective cutting rather than clear cutting may be necessary.

TABLE 3.7-1

POST-MINING POTENTIAL INDUSTRIAL AND
TECHNOLOGICAL USES OF CRANDON FACILITIES

Light Industrial

Manufacturing
Small Boats
Plastic Components
Machine Tools
Machine Parts (turning, milling, forging, stamping)
Electronic Assembly
Cabinet Manufacture
Sash and Mill Work
Auto Engine Rebuilding

Technology

Paper Research
Forest Product Research
Computer Software Design
Bio-Medical Research
Genetic Engineering

SECTION 3.6, CONCENTRATE TRANSPORT

Comment No. 49

Based on our knowledge of the Department of Energy's requirements for high level radioactive waste, the use of the proposed mine as a repository does not appear to be a feasible final use alternative. However, you should include any information you have related to use of the mine/mill complex as a high level radioactive waste repository facility.

Response:

The U.S. Department of Energy's Office of Crystalline Repository Development (OCRD) has "identified three regions of crystalline rock exhibiting potential for locating repository sites and recommended these regions for further study" (OCRD Geologic Characterization Report, May 1983, p. 5). The North Central Region includes Minnesota, Wisconsin, and the Upper Peninsula of Michigan. Crystalline Rocks are defined as "intrusive igneous and high-grade metamorphic rocks rich in silicate minerals, with a grain size sufficiently coarse that individual mineral grains can be distinguished with the unaided eye" (ibid. p. 1). No other rock types are being considered in the North Central Region because "the Department of Energy's (DOE) program emphasized disposal in mined repositories deep underground in geologically stable formations" (ibid, p. ix) and crystalline rocks are the only rock types which meet those guidelines.

Two factors eliminate the Project's facilities from consideration as a high level nuclear waste repository.

First, the deposit is not located in crystalline rock. The ORCR Report (ibid. Plate 2) identifies and locates all bodies of crystalline rock in Wisconsin. The two bodies of crystalline rock nearest the Crandon deposit lie approximately 16 km (10 miles) to the south and southeast.

The second factor which eliminates the Crandon facilities from consideration is the DOE guideline emphasizing that "mined repositories" (ibid. p. ix) must be built and designed specifically for a high level Nuclear Waste Repository. This is further emphasized in the OCRD report, Section 1.3 (ibid. p. 6) which states "The Crystalline Rock Project is just beginning conceptual design studies, and a conceptual design is expected to be completed by 1985. The repository will be subject to NRC Construction, authorization, and licensing."

In addition, late in July 1983, State Senator Joseph Strohl, Chairman of the Wisconsin Radioactive Waste Review Board, issued a statement indicating that the Department of Energy apparently has precluded several Wisconsin counties from further consideration as the site of a radioactive waste terminal storage facility. Among the counties listed as those meriting no further consideration was Forest County, the location of the Crandon Project.[2]

"'These 11 counties (Forest County and 10 others) were removed from DOE's list because the granite formations there are thought to be not suited for the construction of a national repository for high level nuclear waste,' Strohl explained."[3]

References:

1. U.S. Department of Energy, North Central Regional Geologic Characterization Report (Technical Report), Office of Crystalline Repository Development, Battelle Memorial Institute, Columbus, Ohio, May, 1983.

2. Rhinelander Daily News, "DOE Drops Forest As Nuke Waste Site," United Press International Report, Page 1, August 1, 1983.

3. Wisconsin Radioactive Waste Review Board, Press Release, "Strohl Announces DOE Still Interested in 24 Wisconsin Counties," August 1, 1983.

RESPONSES TO DNR COMMENTS ON THE APPENDICES
OF
THE ENVIRONMENTAL IMPACT REPORT

Exxon Minerals Company
Crandon Project

September 16, 1983

APPENDIX 2.3B

Comment No. A1

Please provide all available groundwater elevation data. These data should be tabulated and converted to actual mean sea level elevations. Please specifically identify the data sets used to develop groundwater models.

Response:

In addition to the ground water elevation data presented in Appendix 2.3B, of the EIR, the following readings are available:

Ground Water Elevation Data

Sampling Dates		
September	10, 11	1980
November	11, 12, 13	1981
February	22, 23, 24	1982
November	12, 13, 14	1982
March	15 through 21	1983
April	25, 26	1983
July	18, 19	1983 (with DNR participation)

A listing of ground water elevations data (converted to actual mean sea level) for all site area piezometers for the sampling dates presented above (except July) is attached (Attachment No. A1).

The February 22-24, 1982 ground water elevation data set was used to develop the Ground Water Model. Moreover, the range of readings for all of the available data was considered in evaluating the sensitivity of the model and for calibration purposes.

APPENDIX 2.3C - Table C-36

Comment No. A2

Why was the Walentowski well frozen on sampling dates 11/20/77 and 02/01/78? The well is located near Little Sand Lake where the groundwater level should be fairly deep (20-30 ft) with respect to the land surface. Is this an artesian well?

Response:

The well at Walentowski's cabin was not sampled between September 28, 1977 and June 5, 1978. The landowner closed the cottage for the winter in October and drained and shut down the pump to prevent freezing and breakage. Water sampling was reinstituted in June 1978 after the water pump had been turned back on . Appendix 2.3C, Table C-36 will be revised to indicate that the well was not available for sampling on Novemer 20, 1977 and February 1, 1978.

The Walentowski well is not an artesian well.

APPENDIX 2.4E - TABLE E-1

Comment No. A3

Swamp Creek Station D - Percent solids are reported as 1.02. This is approximately 10,000 mg/l. Iron is reported as 19,894 mg/l, which is greater than the reported total solids. Please explain this discrepancy.

Response:

To determine percent total solids, an aliquot of the sediment sample was weighed, dried and reweighed. Several portions of the remaining wet sample were then used for analyses of various chemical parameters. These results were reported on a dry weight basis and were calculated using the total solids percentage. The iron value measured for Station D (19,894 ppm) refers to a concentrate of the dry weight and is approximately 2 percent of the 1.02 percent total solids reported.

APPENDIX 2.4F

Comment No. A4

The last sample date for Station K (page F-201) is August 13, 1980. More recent water quality data have been collected (see July 15, 1981 letter from Lewis Blair to Archie Wilson). There were also some sample collectons and analysis performed by Northern Lakes Services. Please provide these and all other data which have been collected.

Response:

All water quality data obtained for Station K will be provided in the EIR Appendix 2.4F. The additional data to be included in Appendix 2.4F are presented in Attachment No. A2.

APPENDIX 2.4F

Comment No. A5

Organic nitrogen values were recorded as very high in comparison to the range of values observed on the 8/1/77 sampling date at the following sampling sites: Station L (18.97 mg/l), Station H (11.12 mg/l), Station I (7.81 mg/l), Station O (5.72 mg/l), Station F (4.03 mg/l), Station N (11.12 mg/l), Station J (6.86 mg/l), Station M-1 (5.76 mg/l), Station A-1 (4.81 mg/l), Station H (4.09 mg/l), Station D (4.23 mg/l), Station E (3.69 mg/l). There may have been some sample contamination on 8/1/77 that caused the high values for organic nitrogen at these stations. Please provide an analyses of these data.

Response:

We agree that the organic nitrogen values were high for the samples collected on August 1, 1977. Although there is always the possibility of sample contamination, we do not suspect this occurred during the field sampling effort. Review of laboratory practices indicates that proper procedures were followed and calculations are correct.

Organic nitrogen values recorded for August 1978 (when available) were much less than the values recorded in August 1977 for all sampling stations. However, not all of the recorded organic nitrogen values were highest at the sampling stations on the 8/1/77 sampling date. Also, some of the sampling sites had relatively low values (3 ppm) on 8/1/77 discounting gross contamination.

APPENDIX 2.4H

Comment No. A6

TABLE H-1, Site M-5 - Dissolved solids plus suspended solids do not equal total solids.

Response:

The dissolved solids value reported for Station M-5 during April 1978 (Appendix 2.4H, Table H-1) should be 88. The value as it is presently reported is a typographical error and will be corrected in the revised EIR.

Comment No. A7

TABLE H-10 - The March, 1977 sample pH is reported as 1.5. Conductivity and turbidity are also significantly higher than for the other sampling data for this station. Please provide an analysis of these results.

Response:

The pH and turbidity values reported for Station N during March 1977 (Table H-10) should be 6.8 and 1.5, respectively. The values, as they are presently reported, are typographical errors and will be corrected in the revised EIR.

The conductivity value of 205 umhos/cm at Station N in March 1977 is a high value when compared to other conductivity values for this station. However, the validity of this value is supported by the dissolved solids concentration which was correspondingly high. We do not wish to speculate on the reason for a single high value.

APPENDIX 2.4L

SECTION 1.2, SAMPLE COLLECTION AND HANDLING PROCEDURES

Comment No. A8

This section does not reflect any changes in the sample collection and handling procedures as requested in our July 9, 1982 letter. We recommended discontinuing the procedure of handling the proceudre of hand-dipping preserved bottles just below the water surface. Later field visits indicated that this procedure was changed. This variation in procedure should be explicitly stated in this section.

Response:

Appropriate changes in the sample collection and handling procedures as recommended by the Department in correspondence dated July 9, 1982 were implemented as part of the Aquatic Monitoring Program. Specifially, starting in July 1982, water samples were collected with a plastic Kemmerer sampler rather than by direct filling of sample bottles just below the water surface. The period of use of both procedures has been stated on page 2.4L-4 in Ecological Analysts final report titled "Water and Sediment Chemistry and Hydrology in Swamp Creek for the Crandon Project." This report has been submitted to the Department and hereafter will be referred to as revised Appendix 2.4L of the EIR.

Comment No. A9

We also requested that water quality samples be iced in the field immediately after collection. Please describe the procedure actually utilized.

Response:

With the exception of water samples collected in June 1982, all water samples collected as part of the April 1982 through March 1983 Aquatic Monitoring Program were packed in ice immediately following collection. In June, ice was added to the cooler containing the samples approximately 1.5 h after the samples had been collected. The procedure for icing samples has been discussed on page 2.4L-4 in revised Appendix 2.4L of the EIR.

SECTION 2.1.3, SAMPLE ANALYSES

Comment No. A10

As noted in our July 9, 1982 letter, the Hydrolab 6D was not used during either of the Department field inspections. A Hydrolab Model 750 was used during the first inspection, and individual field meters for conductivity and pH were used during the second visit with the dissolved oxygen being checked with the modified Winkler method. We also noted problems in the procedures used to calibrate the meter. Please indicate if the procedures were modified as requested and provide a description of the methods actually utilized.

Response:

The Hydrolab Surveyor Model 6D in conjunction with a Hydrolab Model 750 underwater probe system was utilized to measure water temperature, dissolved oxygen, pH, specific conductance, and alkalinity in the field during April through July. From August through March, these parameters were measured using 4S1 Models 33 and 54A and an Orion Model 399a.

In conjunction with each monthly trip, these instruments were calibrated in the field in accordance with the specifications of their respective manufacturers. Two modified Winkler titrations were used to calibrate for dissolved oxygen; pH and conductivity were calibrated against standard solutions; and temperature was calibrated using a mercury thermometer.

Comment No. A11

Were alkalinity, conductivity and pH tests run in the laboratory and checked against field measurement? What quality control procedures were followed to assure that data collected by the Hydrolab were accurate and reliable. Does the Hydrolab stay calibrated well in cold weather? Are the detection limits given in Table L-2 different than the reporting limits for water and sediment sampled parameters? If so, please provide the reporting limits for those parameters being analyzed as part of the Swmap Creek monitoring program. Also, a detection limit of 0.0002 mg/l is necessary for mercury analysis. Is the detection limit for mercury of 0.002 mg/l correct?

Response:

Alkalinity, conductivity and pH tests were performed only in the field (see revised Appendix 2.4L, Table L-1). These parameters were not analyzed in the laboratory.

To maintain quality control, the Hydrolab Surveyor Model 6D and all other instrumentation used in field measurements were calibrated in conjunction with each monthly field sampling (see revised Appendix 2.4L, pp. 2.4L-5 and 2.4L-6).

The Hydrolab Surveyor was used only during the April through July 1982 sampling period; from August 1982 through March 1983, YSI Models 3 and 54A, and an Orion Model 399a were utilized for field measurements (revised Appendix 2.4L, p. 2.4L-5).

The detection limits given in revised Appendix 2.4L, Table L-2 are those that typically can be achieved. However, parameter-specific limits were calculated during the analysis of each set of monthly samples. As a result, the less-than values reported in the tabular summaries (e.g., revised Appendix 2.4L, Tables L-3 and L-4) represent the detection limits achievable on the particular date in question.

The detection limit for mercury is 0.0002 mg/l as indicated in revised Appendix 2.4L, Table L-2.

Comment No. A12

As noted in our July 9, 1982 letter the U.S. Geological Survey recommends that "no more than 5% of the total flow will be in any one segment". Please indicate the number of segments used, the percent flow in each segment, and whether all flow was accounted for in the gauging measurements.

Response:

The procedure used to measure stream discharge is described in revised Appendix 2.4L, subsection 2.2.2. From April through July, depth and current velocity were measured every 0.76 m (2.5 feet) along a line stretched across the stream. From August through March, additional measurements were taken at 0.38 m (1.25 feet) intervals in order to keep the flow in any one segment to <10 percent of the total and the number of vertical sections between 25 and 30 as recommended by both USGS (1969) and Linsley et al. (1975).

Under high stream flow conditions (>80 cfs) and/or when gage readings exceeded 0.61 m (2 feet), some flow does extend beyond the stream bank into the shrub swamp on the east side of the creek. This flow, which is estimated to be less than 10 percent of the total flow, is not accounted for in the gaging measurements.

SECTION 3.1.1, WATER CHEMISTRY

Comment No. A13

Please relate the dissolved oxygen concentrations given to the percent saturation values for dissolved oxygen. The apparent detection limits for selenium, mercury and phenol vary between samples (Tables L-3, L-5 and L-6) and from the limits reported in Table L-2. Please explain these variations.

Response:

The relationship of dissolved oxygen concentrations to the percent saturation values for dissolved oxygen is discussed in revised Appendix 2.4L, page 24L-11.

The reason for the variations in detection limits for selenium, mercury and phenol in Appendix 2.4L, Tables L-3 through L-7 and from the limits reported in Table L-2 is attributed to the parameter-specific detected limits that were calculated during the analysis of each set of monthly samples. As a result of these monthly calculations, the less than values reported in the tabular summaries represent the detection limits achievable on a particular sampling date (see revised Appendix 2.4L, page 2.4L-6).

Comment No. A14

Are the concentrations given in Tables L-5 and L-6 reported as dry weight?

Response:

The concentrations reported in revised Appendix 2.4L, Tables L-5, L-6 and L-7 for the sediment chemistry analyses are in dry weight.

Comment No. 15

The replicate sediment samples taken at Station 3 show significantly different values for total sulfur, total Cr, Fe and Mn. Please provide an explanation of these discrepancies between replicate sediment samples.

Response:

As discussed in revised Appendix 2.4L, pages 2.4L18 and 2.4L19, differences in replicate sediment sample values for total sulphur, total chromium, iron and manganese at Station 3 appeared to be related to the percentage of clay in the sample. The "A" replicates, which had higher concentrations of the parameters identified, had much higher percentages of clay, than did the corresponding "B" replicates. At Station 3, the percentages of clay were

28.3 and 1.4 for replicates A and B, respectively. It is generally accepted that metals and many other chemical constituents are adsorbed preferentially onto fine-grained sediments, particularly clays (Carmody, 1973; Harris, 1976).

SECTION 4.0, DISCUSSION

SECTION 4.1.1, WATER

Comment No. A16

Table L-8 shows significant variations in dissolved oxygen saturation during the period of data collection. It is likely that there are significant swings in the diurnal dissolved oxygen in Swamp Creek. Thus, it will be necessary for Exxon to collect mostly diurnal dissolved oxygen samples at various times during the year when dissolved oxygen levels are critical. This issue is being further addressed in our review of the most recent Swamp Creek monitoring proposal.

Response:

Diurnal dissolved oxygen measurements will be taken in Swamp Creek at Locations 1 and 3 on a monthly schedule from July through September 1983. Measurements will be taken at 3-hour intervals over a 24-hour period during each month. This information will determine if dissolved oxygen levels experience major fluctuations on a daily basis.

Comment No. A17

The conclusion that the area of Swamp Creek between County Trunk Highway "M" and Station 3 is an area of groundwater recharge is not adequately supported. The greatest increases of flow between the USGS and SG 24 measurements were in April and, to a lesser extent, in May. Runoff from the watershed between the two sampling points may have contributed a large portion, if not all, of the difference. Also, in July there was less flow measured by SG 24 than USGS. Please provide additional discussion and analysis of the groundwater contribution to this stream segment. If the groundwater flow is sufficient, trout may occur in the area.

Response:

The stream discharge data collected by the U.S. Geological Survey in Swamp Creek at County Trunk Highway "M" and by Ecological Analysts at Station 3 do not consistently support the contention that this segment of Swamp Creek is a ground water discharge area (see revised Appendix 2.4L, subsections 3.2 and 4.2). Some possible explanations for the descrepancies in flows (lower flow at Station 3 than at County Trunk M) are discussed in subsection 4.2. In additions to the reasons given in subsection 4.2, lower flows at Location 3 than at County Trunk M can be attributed to the fact that some flow at Station 3 is not included in the stream discharge measurements. All flow at Station 3 is not confined within well defined stream banks; some flow, estimated to be less than 10 percent of the total, travels through the shrub swamp wetland located on the east side of the creek and is not measured when stream discharge measurements are taken. The statement in revised Appendix

2.4L of the EIR, that the area of Swamp Creek between County Trunk Highway M and Station 3 is an area of ground water discharge, cannot be supported based on 12 months of data collection; therefore, such a statement has been removed from revised Appendix 2.4L.

The results of fish sampling in Swamp Creek from County Trunk Highway M downstream to Station 3 indicate this segment supports a warm water fishery (EIR revised Appendix 2.5G). During sampling in 1982 and 1983, only one trout was collected and L. Andrews, DNR, Woodruff, supported the conclusion that this specimen was a planted fish.

APPENDIX 2.5A

Comment No. A18

The species list for the project's lake are lacking an algal group, the Crytophyceae, which were commonly encountered in samples collected by the Department. The use of Formalin as a preservative may have destroyed organisms in this group. At a minimum, the phytoplankton samples collected in Oak, Little Sand, Skunk, Deep Hole and Duck lakes should be reevaluated. The quality of the preservation techniques should be analyzed to determine if sensitive algal groups have been destroyed.

Response:

Comment acknowledged. Some algal groups can be destroyed by some preservation techniques. Cryptophyceae was identified in samples collected from Rice Lake. It is assumed, therefore, that if this algae group occurred in samples collected from other water bodies sampled it would have been identified and reported accordingly.

Although the use of formalin may have caused some distortion, Dames and Moore and their outside advisors believe individuals of this group would still be recognizable as Cryptophyceae. Formalin was selected partly for its long-term preservation quality as measured in months or years.

APPENDIX 2.5D

Comment No. A19

Qualitative benthos results are presented only as presence/absence data. If numbers of individuals were recorded for the qualitative sampling, please provide these data.

Response:

The qualitative benthos samples were obtained by dip-netting through sediments, aquatic macrophytes, and terrestrial vegetation overhanging shorelines and by hand-picking organisms from miscellaneous habitats. Typically, shoreline areas near the designated biological sampling stations were sampled until it was judged that the major habitat types had been examined and specimens of observed fauna collected. Supplementally, macroinvertebrates were occasionally collected in minnow traps and seine hauls and, subsequently, added to the qualitative benthos collections. As indicated, these data are strictly qualitative and the numbers collected should in no way be construed as quantitative data either in terms of abundance or density. The specimens collected in the qualitative samples are presented in Attachment No. A3.

Comment No. A20

There are several editorial errors in this section; Orthoclaiinae (Orthocladiinae), Sdigara (Sigara), Talitridaea (Talitridae), Dipteraoridae (Diptera), Tanypodinaeus (Tanypodinae), Boetidae (Baetidae), Boetus (Baetis).

Response:

Comment acknowledged. These typing errors in macroinvertebrate taxonomy will be corrected in the revised EIR.

APPENDIX 2.5E

Comment No. A21

Please provide length-frequency summaries by water body as requested in our August 3, 1982 letter. What was the purpose of the individual collection numbers for each fish? Were all these fish taken to the laboratory?

Response:

Fish length-frequency summaries for each water body that was sampled during the 1977 and 1978 sampling period are presented in Attachment No. A4. Length-frequency distributions for selected fish collected during the April 1982 through March 1983 Aquatic Monitoring Program in Swamp Creek are presented in Appendix 2.5G, Tables G-48 and G-49.

All fish were assigned a collection number for efficiency in data processing, cataloging and future data retrieval, and for quality control.

As indicated in EIR subsection 2.5.1.6 (p. 2.5-15), all fish were returned to the water body where they were collected with the exception of those that were preserved for later identification and enumeration or for voucher specimens or tissue chemistry analysis.

Comment No. A22

Are the unidentified cyprinoids still available for examination? These specimens were apparently not identified because they ". . . were all immature and were not formally identified . . . ", and " . . . they could not be verified through scale counts." The fish in question, however, ranged from 36 mm (1.4 inches) to 67 mm (2.6 inches) total lengths according to Tables E-35, E-36 and E-47, and should have been identifiable. This information was previously requested in our August 3, 1982 letter.

Response:

As indicated in correspondence dated March 11, 1983 from B. Hansen to R. Ramharter (see p.5, response No. 25 of this letter), the unidentified cyprinoids listed in Tables 2.5E-35, 2.5E-36, and 2.5E-47 were all immature and were not formally identified in the field. Although it normally was the contractor's (Dames and Moore) practice to return unidentified or questionably identified specimens to the laboratory for further examination, these specimens were inadvertently released. Based on the field observations, Dames and Moore believes these specimens were common shiners.

APPENDIX 2.5G

SECTION 2., METHODS

Comment No. A23

As requested in our July 30, 1982 letter, please define "kick-seining."

Response:

"Kick-seining" is a sampling technique that can be used to collect fish in water bodies having snags, rock or rubble areas, or other types of habitat used by fish for cover. This technique is effective for darters, sculpins and bottom-dwelling species and consists of positioning the seine downstream of the area to be sampled and driving the fish into the seine by overturning rocks, logs, and other debris.

Comment No. A24

Only two substrate types were collected qualitatively while the other substrates were collected quantitatively (Ponar dredge). By limiting qualitative samples to only those substrates not sampled with the Ponar dredge, some organisms may be unrepresented in the collection. The small sampling area of quantitative samplers is usually not considered adequate to collect a representative sample where a maximum representation of taxa is desired. Qualitative methods which sample a large area are necessary for complete representation of taxa in a sample.

Response:

A variety of habitats was examined at each station to ensure that the entire range of species was collected and to allow a description of overall macroinvertebrate community structure. To ensure complete representation by all taxa present at each station, qualitative collections were taken from all substrate types. Organisms associated with all available habitats (e.g., aquatic vegetation [near shore and midstream] low and high current areas, underwater structures [branches and logs]) were sampled by qualitative hand-picking, dip netting and kick-sampling. The description of the qualitative sampling method is presented in revised Appendix 2.5G (pp. 2.5G-9 and 2.5G-10) of the EIR.

Comment No. A25

Biotic index values were calculated based on qualitative samples of only shoreline habitats, which contradicts Hilsenhoff's recommended methods for sample collection (ripple or fast current areas). This modification to the biotic index calculation does not address the habitat problem which may invalidate the biotic index results.

Response:

The biotic indices presented in revised Appendix 2.5G, Tables G-52 through G-54, are presented for general comparative purposes only. However, due to the modifications that were made in the biotic index calculations (see revised Appendix 2.5G, pp. 2.5G-12 and 2.5G-61) the biases in the index were reduced and the results do provide an indication of biotic diversity.

As part of the January through December 1983 Aquatic Monitoring Program in Swamp Creek, qualitative samples are being collected in accordance with Hilsenhoff's recommended procedures and a biotic index will be calculated for each station. These results will be presented in Ecological Analysts' final report scheduled for completion in February 1984.

SECTION 3.0, RESULTS

Comment No. A26

This section must recognize the possibility that many of the fish captured by seining and electrofishing in the same or adjacent stations were the same fish recaptured.

Response:

Comment acknowledged. A statement has been added to revised Appendix 2.5G, page 2.5G-6 indicating that it was possible that some of the fish captured by seining at the same station could have been the same fish recaptured. However, the number of recaptures is probably low because each seine haul at a given station was usually taken at a different location within the 305 m (1000 feet) study segment.

Comment No. A27

The relative abundances in Table G-13 should be reported in actual percentages based on numerical data rather than in general occurrence category. The data presented in Tables G-14 and G-15 should be supplemented by graphic displays of percent composition by Order and Family.

Response:

Because of the variety of techniques utilized and habitats surveyed during qualitative sampling, the number of organisms collected should not be used to determine absolute densities or percent occurrence at any of the stations. This sampling represented a purely qualitative survey of the benthic macroinvertebrate community and the data were categorized to indicate, on a general level, the relative abundance of the organisms.

Therefore, percentages have not been included in the tables containing macroinvertebrate data collected by qualitative sampling techniques in revised Appendix 2.5G.

Graphic displays of the results of quantitative macroinvertebrate samples have been presented in Figures G-2 through G-6 in revised EIR Appendix 2.5G.

Comment No. A28

The statement that rheophilic benthic taxa were present in low densities is contradicted by Cheumatopsyche sp. which was "abundant" at Station 2 and "common" at Station 3.

Response:

The statement that all rheophilic macroinvertebrate taxa collected were present in low densities has been changed in revised Appendix 2.5G. With the exception of Cheumatopsyche sp., which occurred primarily in the gravel habitats, organisms typically associated with fast currents were generally rare or uncommon. (See Section 4.2, pages 2.5G-59 and 2.5G-60 in Appendix 2.5G.)

Comment No. A29

The discussion of the Biotic Index should address the non-recommended sampling techniques mentioned above. Future Biotic Index samples should be collected from the fastest current areas possible at each station and, if possible, at physically similar sites to allow comparisons between stations.

Response:

The basis for calculation of the Biotic Index for macroinvertebrates is presented on pages 2.5G-12 and 2.5G-61 of revised Appendix 2.5G.

As part of the January through December 1983 Aquatic Monitoring Program in Swamp Creek, macroinvertebrate samples for biotic index determinations are being collected at three stations, in accordance with recommended DNR procedures (i.e., areas of the stream having the fastest current). See the scope of work for this monitoring program that was submitted to the Department on February 17, 1983.

APPENDIX 2.5GA

Comment No. A30

The exact location of the benthos sampling stations should be indicated on Figure GA-1 to allow identification of the segments/habitat data corresponding to each sampling location. The habitat specification (depth, velocity, substrate type) for each benthos sampling station should be listed to allow comparison with segment physical data.

Response:

The location of benthos sampling stations has been indicated in Figure GA-1 in revised Appendix 2.5G. The physical characteristics of each sampling station have been listed in Appendix B to this document.

APPENDIX 2.6G

Comment No. A31

The orchid Arethusa bulbosa also occurs in the study area.

Response:

Comment acknowledged and the orchid Arethusa bulbosa will be added to the plant species list in Appendix 2.6A based on observations by DNR staff.

Comment No. A32

The accepted common name for Nuphar varietum is the yellow water lily.

Response:

Comment acknowledged and the common name for Nuphar variegatum has been changed to yellow water lily in Appendix 2.6A.

APPENDIX 2.6C

Comment No. A33

The green-wing teal has been positively identified on Skunk Lake. Ring-neck ducks are common at times on study area lakes.

Response:

Comment acknowledged and the occurrence of the green-winged teal in the environmental study area and site area will be designated in Appendix 2.6C based on observations by the DNR staff.

Comment No. A34

The red-neck grebe, double-crested cormorant, and the great egret should be listed as state-threatened.

Response:

Comment acknowledged and the red-necked grebe, double-crested cormorant, and the great egret will be listed as state-threatened in Appendix 2.6C.

APPENDIX 2.6D

Comment No. A35

The five-lined skink is not a turtle.

Response:

Comment acknowledged and the five-lined skink will be listed under the category "Mudpuppies, Salamanders and Newts" in Appendix 2.6D.

Comment No. A36

The wood turtle is now listed as threatened and the spotted salamander is no longer listed.

Response:

Comment acknowledged and the status of the wood turtle will be revised from endangered to threatened and the spotted salamander will be removed from the threatened status in Appendix 2.6D.

APPENDIX 2.10A

Comment No. A37

Much of the socio-economic data is at least three years old and no longer accurate. For example, the Oneida County Jail construction was completed about two years ago. One of the two "deteriorated bridges" listed in Table 2.10A-6 was replaced in 1982. Our needs for updated socio-economic baseline data will be identified during our consultant's review of the EIR.

Response:

Comment acknowledged.

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The Crandon Report

JUNE 1983 NO. 3

A PERIODIC UPDATE OF CRANDON PROJECT ACTIVITIES

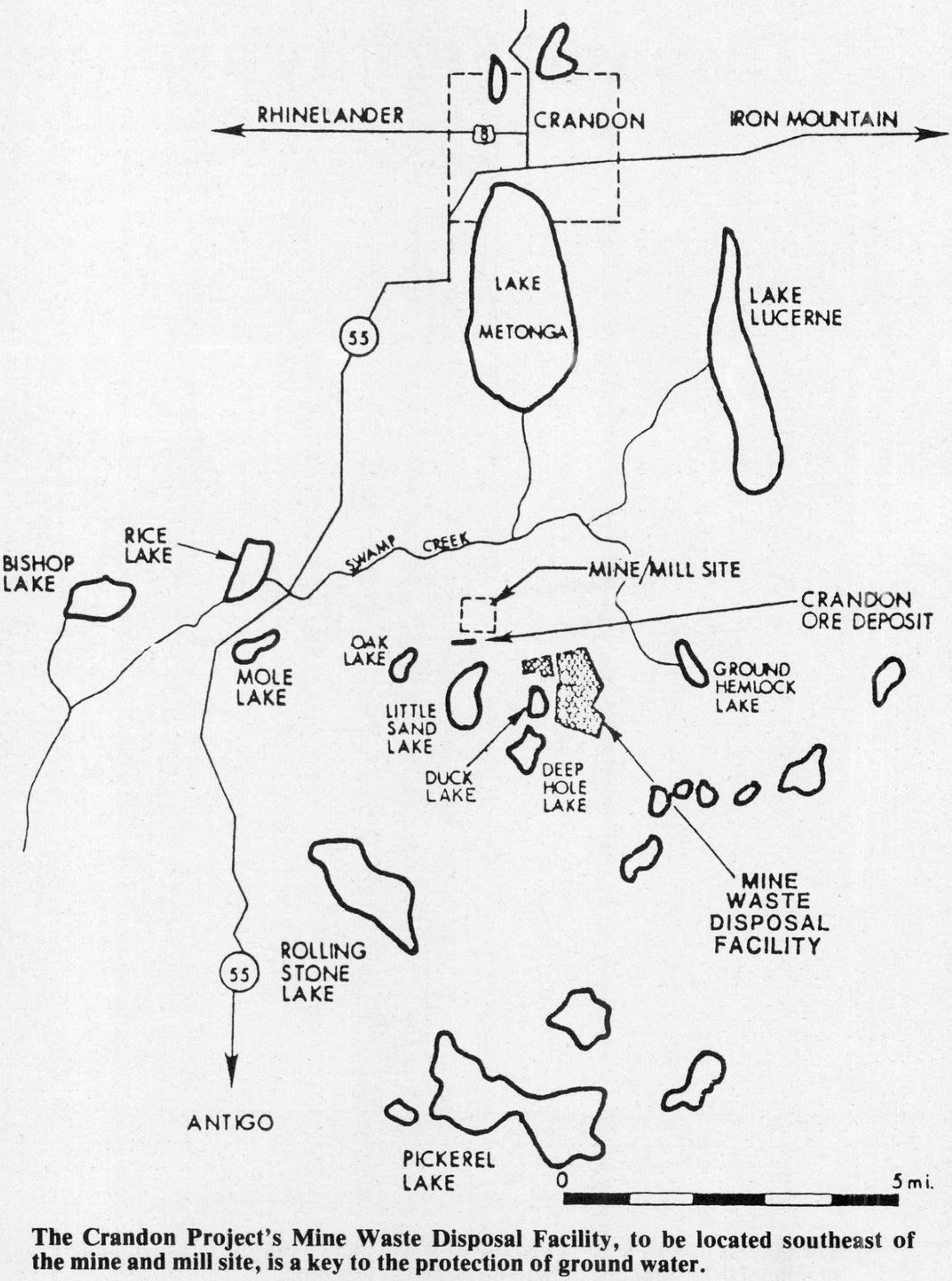
Exxon's Mine Waste Disposal Facility

During mining operations at Exxon's Crandon Project all of the ore brought from the underground mine to the surface will undergo grinding to liberate the valuable mineral products. The metals will be concentrated by a flotation process to produce metal concentrates. About 15 per cent of the ore will be shipped from the mill in the form of concentrates to smelting and refining facilities outside of Wisconsin.

The remaining material, called tailings, has no commercial value. About half of the tailings will be returned underground to fill the mined-out voids created by the underground mining process. The other half of the tailings will not fit underground since grinding increases volume. These wastes must be disposed of on the surface. Rock constitutes the bulk of the mine's waste products. The Crandon tailings would consist primarily of a mixture of pyrite and rocks of volcanic origin.

A great deal of effort has gone into the design, construction techniques, operating plan and reclamation plan of the mine waste disposal facilities for the Crandon Project.

This issue of the Crandon Report discusses these plans, with special attention to the ground water protection afforded by these facilities.

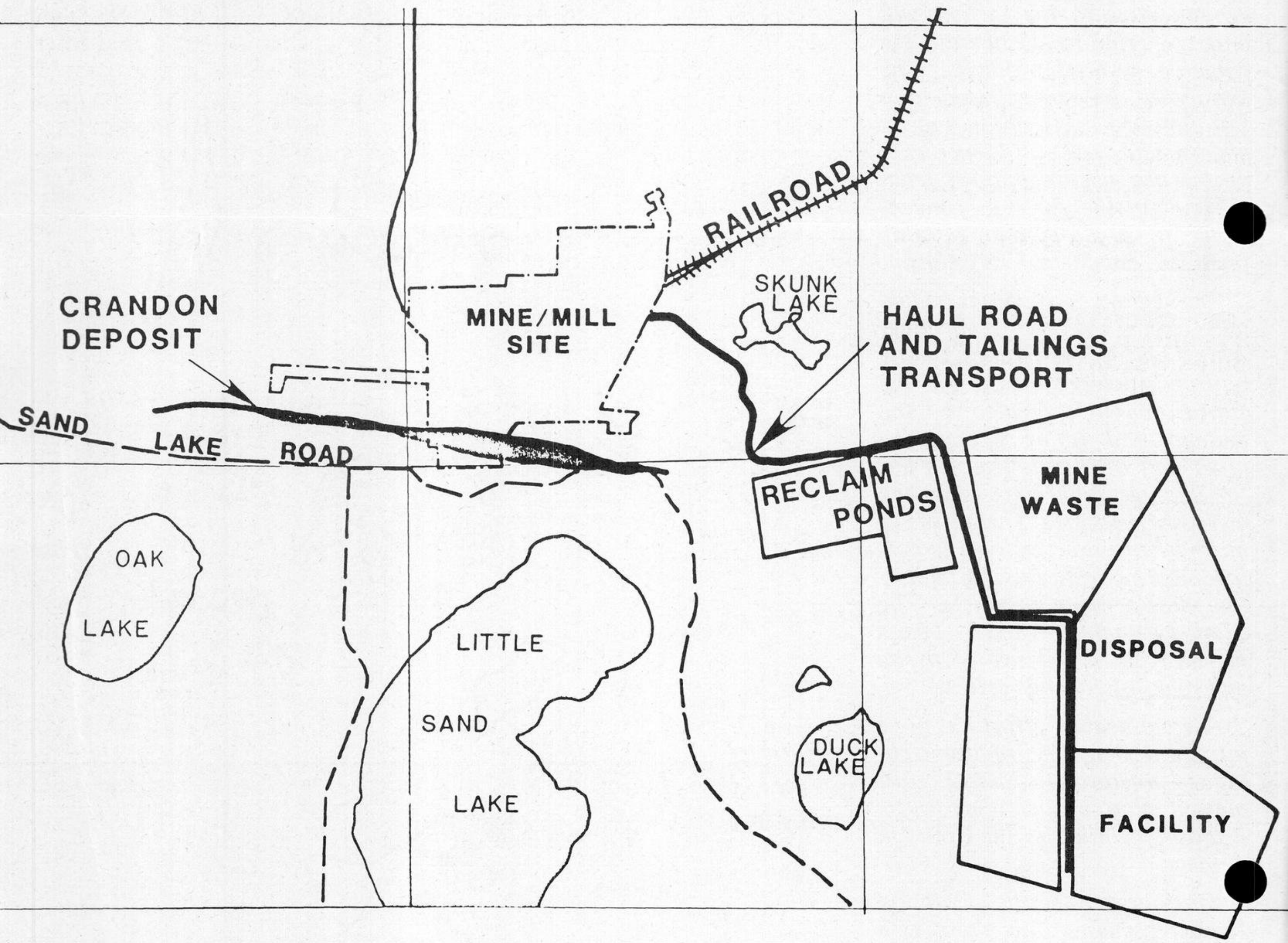


The Crandon Project's Mine Waste Disposal Facility, to be located southeast of the mine and mill site, is a key to the protection of ground water.

Wisconsin law (NR 182) was developed by the consensus process, involving representatives from the Towns of Nashville and Lincoln, and promulgated as DNR regulation in 1982. It represents, we believe, the most comprehensive waste disposal regulations to be enacted in the 50 states. It requires that the waste disposal facility be designed to ensure that waste materials produced from mining are disposed of in a manner that best protects the environment. It also requires submittal to the Department of Natural Resources of very detailed design, and construction, operation, and reclamation plans for the entire facility, as well as demonstration by the applicant for a waste disposal license that ground water will be protected to preserve its usefulness as drinking water.

The Exxon design combines careful siting with sophisticated but proven technologies. The system has a high degree of redundancy to help ensure uninterrupted effective operation. A continual monitoring program would provide an extra *"insurance policy"* by spotting any unanticipated discharges before they could become threats to the ground water in the mine area. Careful design, construction, operation and reclamation of the mine waste disposal facility is of the utmost importance to the protection of the ground water.

The Crandon Project's Mine Waste Disposal Facility and Reclaim Ponds



The tailings ponds, used to dispose of waste that cannot be returned underground, would be developed in sequence to minimize the amount of land disturbed at any time.

The challenges of locating and designing this facility were first addressed by Exxon engineers and environmental professionals in 1978. Because much environmental work had been accomplished by that time, Exxon's engineers and their consultants recognized the need to develop an unusually secure and environmentally compatible overall plan.

Study, design, and additional data gathering and analyses had been a continuing process up to the point of submittal of the EIR and waste disposal facility permit application in December, 1982. The result, Exxon believes, is a facility which meets all of the stringent regulations and provides an exceptionally secure and environmentally sensitive design. Exxon has provided the DNR with detailed reports covering all aspects of the design and environmental assessment. This mass of data provides an unusual degree of detail to those evaluating the Project proposal.

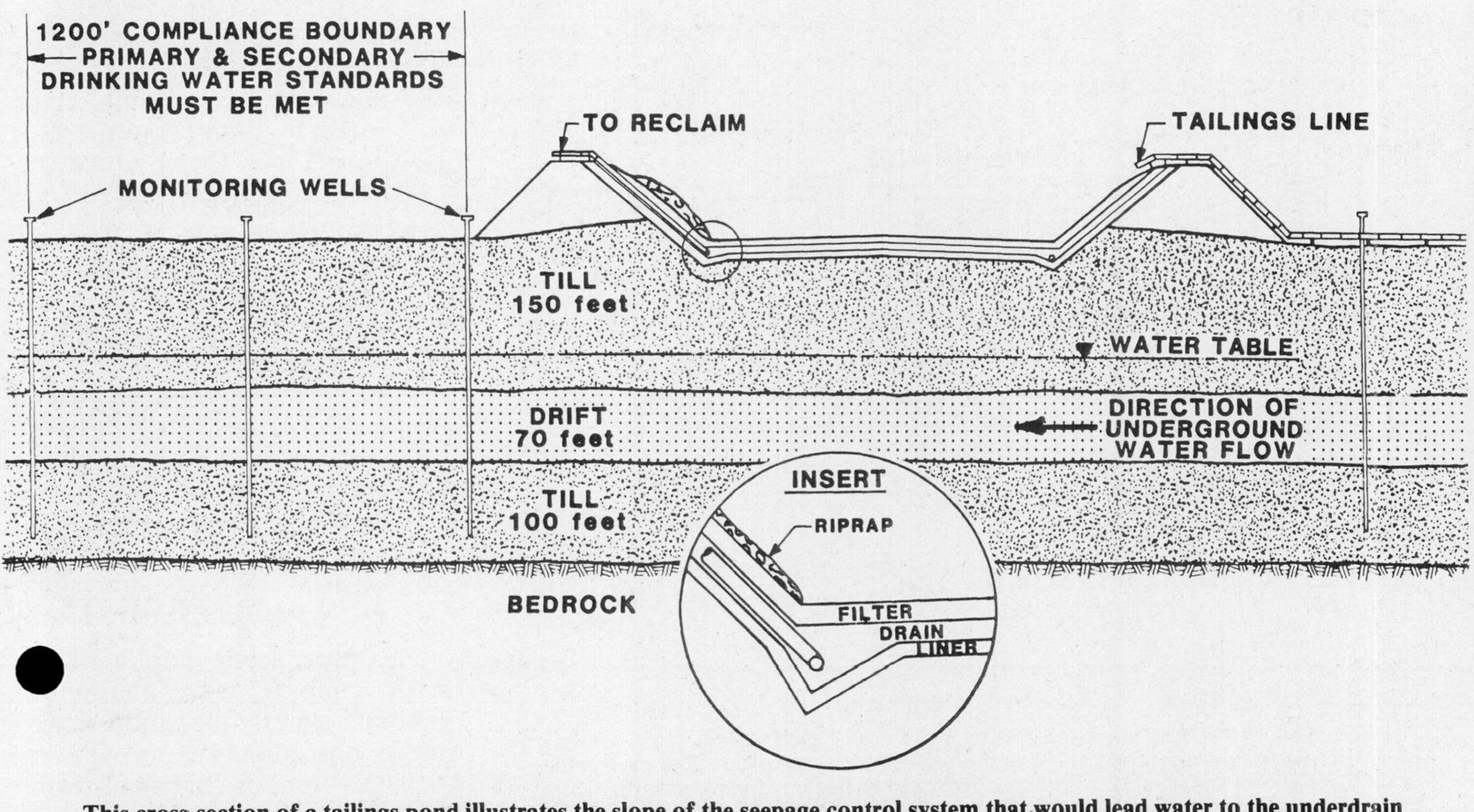
At full production, about 4,300 tons of tailings from the concentrator will be disposed of within the mine waste disposal facility each day. This will be transported by pumping through a pipeline from the concentrator to the mine waste disposal facility in the form of a *"slurry."* The slurry would be a mixture of water with the fine-grained ground waste rock tailings.

At the mine waste disposal facility, the slurry would be discharged into a specially prepared pond of about 100 acres where the solids settle into long level *"beaches"* which are partially covered by water (see map). The first pond will last about five years and, as it nears capacity, a second pond would be constructed, and ultimately a third and fourth pond.

When the first pond is filled, reclamation work begins immediately while the second is being filled. At the end of the mine's life, the final pond would be sealed, covered and revegetated. This multi-staging of ponds will minimize the amount of land disturbed at any given time and provide the opportunity for early reclamation. It will also allow the incorporation of new technology as the second, third and fourth ponds are developed during the life of the Project.

In addition to the four approximately 100-acre ponds used for tailings disposal during the life of the mine, two smaller water reclaim ponds would be built even before mining starts. These smaller ponds would serve as a reservoir for excess water drained from the tailings ponds and allow conditioning of this water prior to its return to the milling and concentrating facility.

COMPLIANCE REQUIREMENTS & SEEPAGE MONITORING



This cross-section of a tailings pond illustrates the slope of the seepage control system that would lead water to the underdrain pipes that would transport water from the ponds back to the mine and mill site for treatment and reuse.

Geotechnical consultants and engineers, under the guidance of Exxon's engineers, have designed all of these facilities to provide for an absolute minimum of seepage from beneath the ponds. Another major objective in design has been to minimize the earthwork and disturbed area and to provide for unusually safe embankments.

Of ultimate importance has been the task of designing seals over the top of the ponds that are filled with tailings. The objective here has been to further minimize environmental effects and provide the security required for *"perpetual burial."* Design of the final cover has included attention to final surface contouring and revegetating with natural species so that historic uses of the land could continue.

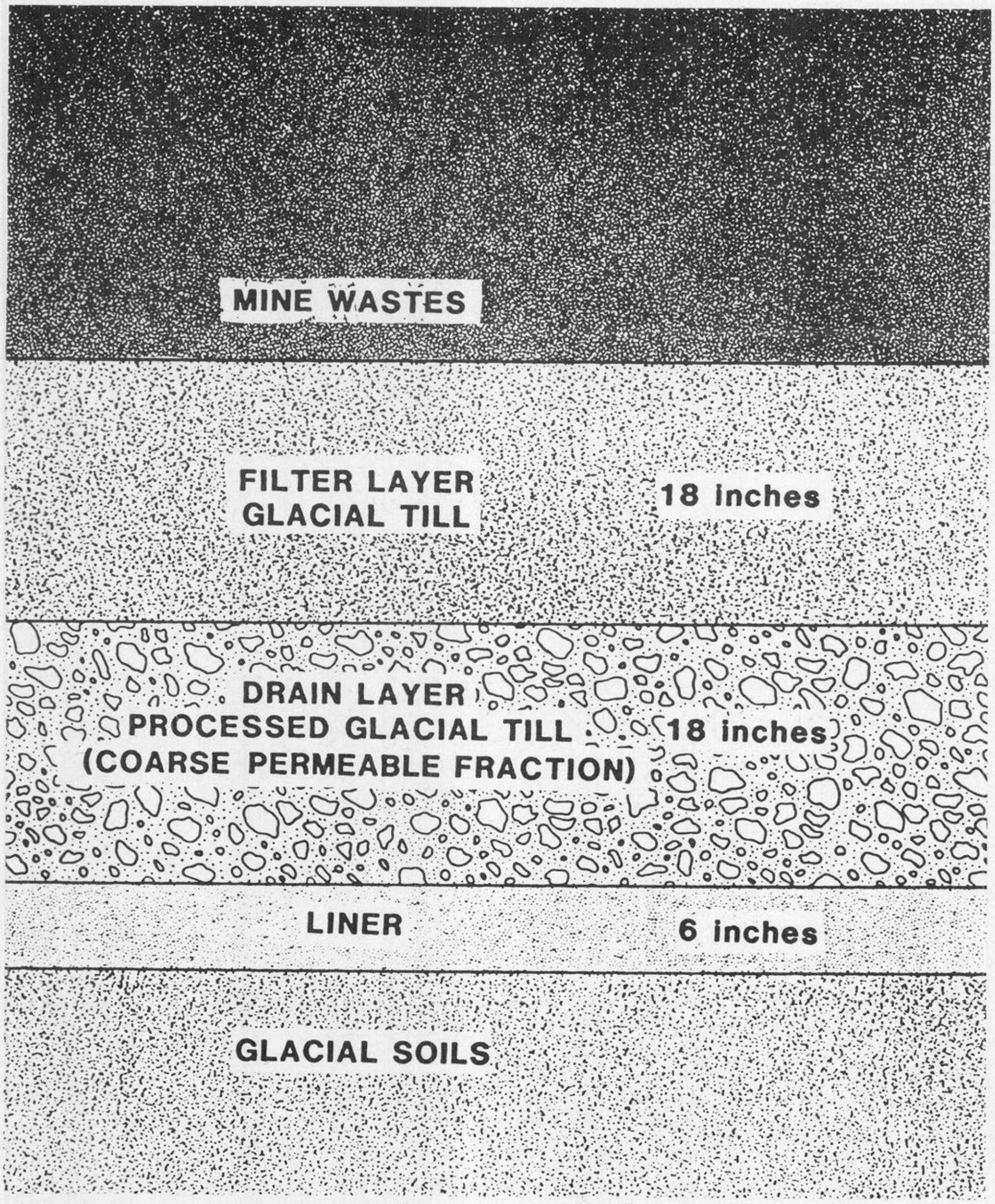
To achieve these results, while we have been able to use proven techniques, Exxon's plan goes much further than is typical for sites used for the disposal of mine wastes. For example, the dikes for each of the ponds are in large part natural, undisturbed glacial till soils. These are made by using existing slopes for two or more sides of the ponds, then excavating material from the center of each pond and using this for the remaining man-made dikes.

To obtain exceedingly low levels of seepage, each of the pond bottoms would be constructed with a filter layer, a drain layer, and a liner at the bottom.

- The filter layer, composed of till soil, would separate the solid wastes from the layers below and prevent the migration of tailings particles into the drain layer.
- The drain layer, composed of coarser sand and gravel, would collect water draining from the tailings and allow water to be drawn from the bottom of the pond and recycled back to the water reclaim ponds and then back to the water treatment facilities at the mine. Withdrawal of water from the drain layer would substantially diminish pressure on the liner thereby greatly reducing seepage.
- The liner would be a layer of fine and relatively impermeable soil mixed with a special clay called bentonite — a unique material that swells to about 15 times its dry volume when mixed with water. This bentonite-soil liner is highly impermeable and would virtually *"seal"* the content of the waste facility from the soil and the ground water below.

This three-layer combination when coupled with continued pumping within the drain layer during operation, will provide an unusual degree of control of seepage during operations.

Seepage Control System



The Seepage Control System on the bottom and sides of each tailings pond consists of a filter layer, a drain layer, and a bentonite-modified soil liner. The permeable drain layer allows water to be withdrawn from the bottom of the pond rather than putting pressure on the liner.

The fine tailings are relatively impermeable and will themselves retard the tendency of the waste water to seep downward. So most of the slurry water will be drawn off (decanted) from above the tailings and returned directly to the water reclaim ponds and then to the mill facility for treatment. A small amount of it will slowly seep through the tailings and the filter layer into the drain layer. The pumping of the waste water out of the drain layer reduces water pressure on the liner and further reduces seepage into the soil below. Any excess water will be treated to the standards required by the State of Wisconsin prior to discharge into Swamp Creek, west of the site.

The seepage control system — filter and drain layer and liner — will be continuous over the pond bottom and the inside slopes of the embankments. The pond bottoms will be sloped to allow water movement in the drain layer to the collection pipelines at the perimeter of the pond. At the low end of the tailings beaches, water also will be allowed to pond prior to its transfer to the reclaim pond, the second key element in the Project's water management system.

Some recent mine tailings ponds have incorporated liners in order to meet low seepage requirements. However, the addition of the filter and drain layer above these, with the objective of pumping of the water from the drain layer just above the liner, is not a typical mining practice. It is, in fact, an expensive addition and greatly increases the cost of the facility. The filter layer and drain layer concepts have been used for years in and around other types of waste facilities. So the techniques and operations proposed for Crandon are well known and the results predictable.

The questions, of course, always arise — will the facility be built as specified in the construction plan within the permit application? How will the public know it is operating as planned? And, how can local residents be assured that seepage will, in fact, be low enough to avoid contamination of the ground water in the area?

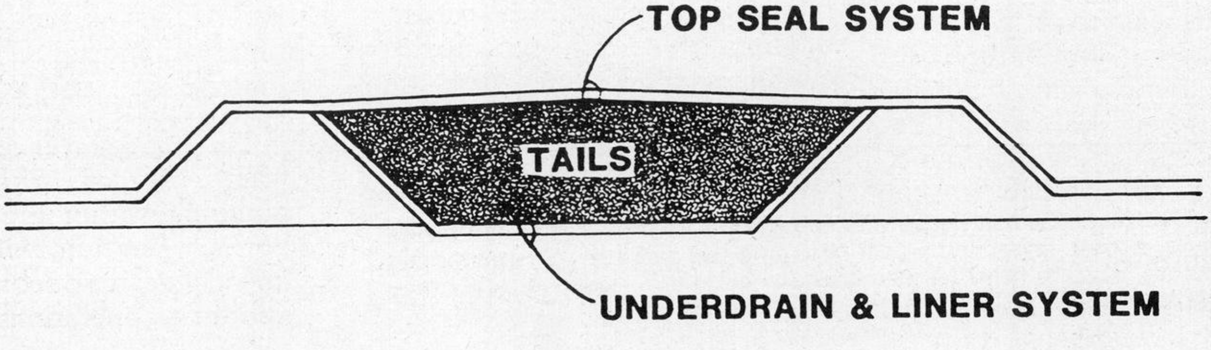
To assure performance, construction will follow strict quality control procedures with testing of all materials as construction of the liner, drain, and filter layers takes place. Exxon has tested what we term *"worst case"* conditions based on very detailed knowledge gained through geotechnical drilling and hydrologic studies beneath the pond sites and in a large area of many square miles surrounding the mine waste disposal facility. We have also chosen staged ponds so that we can modify design should that be necessary or indicated. Additionally, the area beneath the pond and ground water surrounding the facility will be monitored during operations, reclamation, and for a long term following.

The very stringent regulations under NR 182 require meeting primary and secondary drinking water standards at a compliance boundary less than one fourth of a mile from the edge of the facility. To do this, we will monitor, through a series of wells, at the compliance boundary and at intermediate points closer to the waste disposal facilities. We also plan to monitor ground water quality at locations beneath the pond liners to check the amount of seepage.

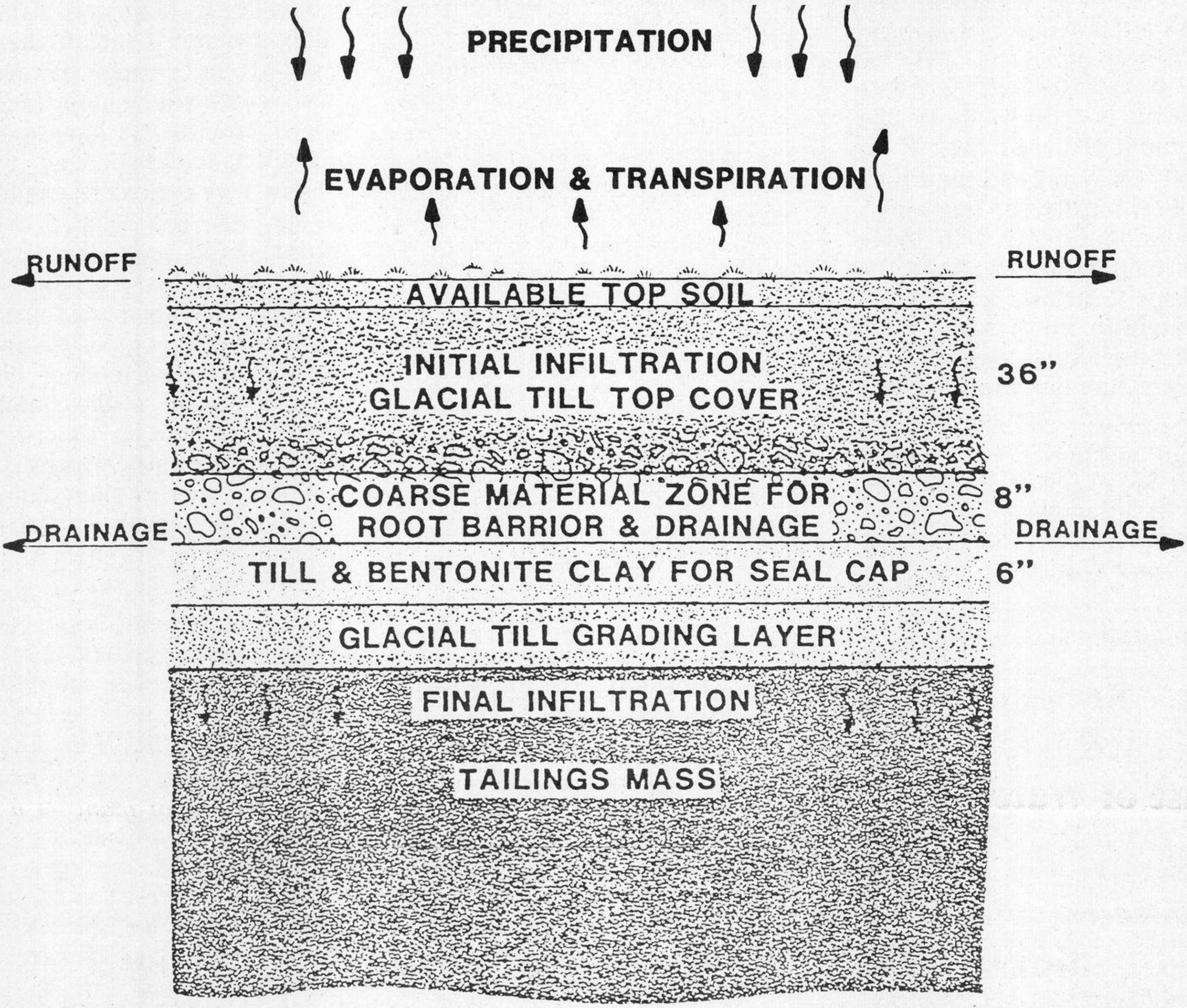
In total, the monitoring program will provide the data needed to determine how well the design is working. The monitoring wells located close to the facility will also provide early warning of any seepage or water quality problems. Also included within our permit applications is a contingency plan that involves pumping of ground water to water treatment facilities in the event things are not working as they should.

The DNR, of course, has a key and continuing role in all of these areas by assuring acceptable design, construction, and operation of the facility.

Top Seal Concept



The Top Cover Seals the Tailings



After about 90 feet of tailings have been deposited in a pond, the tailings are graded, covered with a liner and drain layer, surfaced with topsoil and revegetated. The top drain leads water from rain and snow to the sides of the reclaimed pond and away from the wastes it contains.

Reclamation Is a Key to Long-Term Protection

Reclamation of the tailings ponds (and, when the mine is closed, the water reclaim ponds) is a key element in both ground water protection and future use of the area after the mine is closed. A multi-layered seal would be constructed on top of each pond to provide a stable soil cover — a seal to limit the seepage of water into the deposited wastes, and a suitable layer of soil for vegetation.

After placing a soil grading layer over the waste solids so that the highest point is at the center of a pond, the entire volume of waste is covered with a bentonite clay and soil liner to keep water from flowing downward into the tailings. Then an overdrain layer — relatively permeable sand and gravel — will be deposited on top of the seal. Finally, soils capable of supporting local vegetation including shallow-rooted trees will be placed above the drain layer. Then the pond areas can be revegetated.

After reclamation, water that flows downward through the topsoil will tend to flow to the sides of the pond covering, away from the wastes, and away from the disposal area. The wastes themselves remain within the clay and soil seal. In the long term, the amount of water that could seep out of the pond bottom would be virtually the same as the amount able to seep into the reclaimed pond's top seal. So, after reclamation, the top seal becomes of primary importance. Should a problem ever develop, the top seal is accessible and repairable.

Wisconsin law specifies that Exxon, as owner of the waste disposal facility, would be responsible for the long-term care of the facility. This long-term care involves two additional years of water treatment and monitoring of waste water from the reclaimed ponds, three years of vegetation and drainage structure maintenance and ground and surface water monitoring, and up to 30 years of inspection of the facility. During the years of mining, Exxon would have contributed a significant amount of money to the State's Mine Reclamation Fund, which will finance long-term care after the disposal site has been stabilized and closed.

The mine waste disposal facility incorporated into the Crandon Project plan is, of course, designed as a permanent repository for the waste materials. So after site closure, the land would be returned to its current uses — wildlife habitat and recreation.

Water Reclaim Ponds Will Facilitate Reuse of Water

The two water reclaim ponds, each about 30 acres in area, are located between the mine and mill and the mine waste disposal facility to minimize land disturbance and reduce costs. These ponds will allow fine particulates from the water returned from the tailings ponds to settle before the water is recycled to the mill. Organic compounds used in the concentrating process are reduced in concentration within the ponds by aging.

There are three primary functions of the water reclaim ponds. They will provide surge capacity for all process-related surface facilities. They will also allow sufficient residence time for the settling of a minor amount of fine particulate matter. Finally, the reclaim ponds will allow sufficient residence time for natural evaporative, oxidative and biological processes to occur and thereby control the concentrations of flotation reagents used in making concentrates and thus permit the successful recycle of the water without disrupting the concentrator process.

Meeting the Objectives

When Exxon began the design of the Project's mine waste disposal facility, a number of objecttives were identified as being of great importance. Those objectives, agreed upon by Exxon engineers, required that the disposal facility:

- Protect ground water quality.
- Protect surface water quality.
- Minimize impacts on wetlands.
- Utilize operable, proven technology.
- Provide a high degree of public safety.
- Allow reclamation for stability and return of the land to its former uses.

Although the cost would be high (more than $100 million over the life of the Project), Exxon is confident that the proposed disposal facility will achieve all of these objectives.

Another Crandon Report later this year will describe the Project's water treatment plant — a third key element in the water management system.

Key Concepts In Understanding Mining Waste Disposal

- **Bentonite** — A clay material that when wet expands to 10 to 15 times its dry volume. Mixed with soil, the wet clay expands to fill the pore spaces in the soil, greatly reducing it permeability.
- **Concentrate** — The desired product of the mine and milling process. It is normally a product containing the valuable metal from which most of the waste material in the ore has been eliminated, thereby increasing the percentage concentration of the metal-bearing mineral in the ore. Concentrates are shipped to a smelter or refinery for further processing.
- **Decant** — The overflow product from a water slurry separation normally removed from the top of the settling apparatus or pond, while the solids settle to the bottom.
- **Fines** — Very small material produced in breaking up large lumps of ore or coal. In general, the smallest particles in any classification, process, or sample or run-of-mine material. The fine fraction of the product of rock crushing is that which passes through the screen or screening device.
- **Liners** — A layer or layers of various low permeable materials, such as clay or polyethylene, used to contain liquids in a waste disposal pond.
- **Ore** — A mineral or aggregate of minerals from which a valuable constituent, especially a metal, can be profitably mined or extracted.
- **Reclaim Water** — Water used within the mining and milling operations that will be retained and recycled for reuse within the various project operations.
- **Seepage** — A quantity of a fluid that seeps or passes through permeable material.
- **Sludge** — Sluge may have two meanings in the minerals industry:
  *The mud and cuttings made by a diamond or churn-drill bit and carried to the surface by the uprising stream of water.
  *The product of chemical treatment of waters produced from mining, milling, and tailings storage.
- **Tailings** — Material rejected from a concentration process after the recoverable valuable minerals have been extracted.
- **Waste Rock** — Barren rock in a mine, or at least material that is too low in mineral grade to be of economic value.
- **Water Management** — The practice of planned handling or controlling of all process and associated waters of a manufacturing or processing facility.

Have a Safe and Pleasant Summer!

EXXON MINERALS COMPANY

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Rhinelander, Wisconsin 54501

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ADDRESS CORRECTION REQUESTED

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Carroll D. Besadny
Secretary

May 13, 1983

File Ref: 1630 (Exxon)

Mr. Leonard Swift
Charles M. White Memorial
Public Library
1325 Church St.
Stevens Pt., WI 54481

Dear Librarian:

Enclosed is a copy of the Department of Natural Resource's initial response to Exxon on Exxon's Environmental Impact Report (EIR) for their proposed mine near Crandon. A ring binder to keep this copy and future copies of significant correspondence that I will send to you is being mailed under separate cover. Please place this next to the EIR on your library's shelves.

Please let me know if you need any more copies of the "POINTS FOR CITIZEN ACTION" leaflet. A copy of the news release is also enclosed.

Thank you for your cooperation and assistance.

Sincerely,
Bureau of Environmental Impact

Carol Nelson

Carol Nelson
Environmental Specialist

CN:kk
Enclosure

INFORMATION
WISCONSIN
DEPARTMENT OF NATURAL RESOURCES
Box 7921 Madison, WI 53707

For release May 13, 1983

MADISON,WI-- The Department of Natural Resources has completed an initial review of portions of an Environmental Impact Report (EIR) for Exxon Minerals Company's proposed zinc-copper mine in Crandon. The EIR describes Exxon's plans for developing a mine and details existing environmental conditions near the proposed mine site.

In a cover letter and 52-page comment paper delivered to Exxon late Wednesday, Howard S. Druckenmiller, director of DNR's Bureau of Environmental Impact called the information provided to date, "a major step forward in defining Exxon's mining plans." He added that this letter only communicates DNR's initial concerns and indicates where more information is needed. The DNR is currently reviewing portions of the EIR detailing groundwater modeling studies, socio-economic impacts of the propos mine and reports submitted since the EIR was filed in December.

In the letter, DNR asked for a list of all reports prepared by Exxon and their consultants. The Department requested portions of reports containing information necessary to support conclusions in the EIR. All supporting documents are considered part of the EIR and will be analyzed, verified and distributed to official repositories.

DNR's letter outlines five areas where public and agency reviewers have major concerns:

* How would mine dewatering operations affect groundwater quality and quantity?
* How will disposal, backfill, storage and reclamation operations affect groundwater?
* How would construction and operation of mill, treatment and waste disposal sites affect wetlands, aquatic and terrestrial habitats?
* How would mine dewatering and wastewater discharges affect surface waters?
* How would social and economic factors in the surrounding communities change with potential "boom-bust" development?

(more)

Reviewers were also concerned about potential changes in private water supply quality, potential noise and future recreational plans for the reclaimed mining area.

Druckenmiller said Exxon's response to DNR's informational requirements and their speediness in forwarding results from their studies should allow the review to proceed expeditiously.

"The EIR will not be considered complete until all the necessary permit-related information has been submitted and reviewed," Druckenmiller said. Some questions and concerns raised by federal, state and local governments, Indian tribes and the general public were included in DNR's initial review letter, he stated. Further DNR staff comments as well as appropriate public and agency comments will be sent to Exxon for their response in the near future.

Copies of the EIR review comments will be available at the 12 libraries acting as public repositories for the Exxon project. Copies may also be obtained by writing Robert Ramharter at DNR, Bureau of Environmental Impact. P.O. Box 7921, Madison, WI 53707.

For more information, contact Howard S. Druckenmiller, (608) 266-0860.

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Carroll D. Besadny
Secretary

May 11, 1983

File Ref: 1630 (Exxon)

Mr. Barry Hansen
Exxon Minerals Company
P.O. Box 813
Rhinelander, WI 54501

Dear Mr. Hansen:

We have completed our initial review of portions of your Environmental Impact Report (EIR) as submitted on December 22, 1982. While we have not completed our staff review of the EIR, we are providing the attached comments at this time in an effort to communicate our initial concerns and informational needs at the earliest opportunity.

Generally, we are impressed with the amount of baseline data provided in the EIR and believe the document is a major step forward in defining Exxon's mining plans. Your response to these and subsequent commments and informational requests will allow us to complete an environmental impact statement (EIS) and to proceed with regulatory decision-making.

DESCRIPTION OF COMMENTS

The attached comments do not reflect our ongoing review of consultant-prepared reports or other Exxon reports delivered to us since the EIR was submitted. In addition, this phase of our review does not include comments on Chapter 4 (Impacts), Appendix 4.1.A (Groundwater Modeling) or the bulk of the socioeconomic-related information in the EIR.

The attached comments are primarily those of Department staff. We have also received numerous substantive comments from other governmental agencies, local units of government, Indian tribes and the public. Some of these comments are reflected in this review. The remainder will be analyzed by our staff and included in subsequent reviews as appropriate.

This review also does not describe detailed regulatory requirements for necessary project permits and approvals. These requirements have been and will continue to be transmitted to you through reviews of the individual permit applications. However, the EIR cannot be considered complete until all of the necessary permit-related information has been submitted. As you know, this includes the information required by the Wisconsin Public Service Commission for review of the power supply and transmission facilities.

SUPPORTING DOCUMENTATION

The EIR does not yet contain all the information necessary to support many of the important conclusions contained in the report nor to allow an independent analysis of the project. Much of this information is evidently contained in other reports prepared by Exxon or its consultants.

We expect that many of the questions and concerns in the attached comments are addressed in these reports. Where this is the case, you may either indicate the previously submitted report and page(s) in which the subject is discussed, submit the report or portions of the report which address the issue or incorporate the relevant discussion in the text of the EIR.

Supporting documentation essential to the project review will be considered as part of the EIR and will be publicly distributed, analyzed and verified as appropriate. To help the Department determine the necessary supporting documentation we request a list of all consultant and Exxon generated reports pertaining to the project.

EXXON RESPONSE TO DNR COMMENTS

Your responses to our questions and comments should be direct and comprehensive as possible and should fully address the requested information. Only this can allow the most timely progress in completing the review of the EIR.

In general, our approach in compiling these comments was to discuss a particular question or issue only the first time it was encountered. We expect Exxon to address the matter as appropriate where it appears subsequently in the EIR.

In order for the Department to be in a position to deem the EIR complete, we need to have a clearly identifiable set of documents which comprise the EIR. To accomplish this, we request that you provide your responses in the following format:

1. Additions or modifications to the EIR should be made with pages replacing those in the current document so it is completely updated. Modifications in the text should be clearly identified with the use of underlining, italics, or with a vertical line on the page margin.

2. A compilation should be prepared in a separate Comments/Response format indicating the substance and disposition of your response and providing any necessary clarification. If requested information is provided outside the EIR (such as an addendum to your permit submittals), this separate compilation should indicate how the information was provided.

Forty-five copies of both the replacement pages packet and the Comments/Response document should be provided to the Department. We presume you will distribute these items directly to the parties you provided with copies of the original EIR.

PROJECT REVIEW STATUS

We would like to clarify an apparent misunderstanding concerning our initiation of the EIS. Most of our recent Crandon-project related activities, including the review of the EIR, are really part of the EIS preparation process. In other words, preparation of the EIS is now underway. The only reason to stop the preparation process would be if there were delay on your part in responding to our requests for information and analysis. A draft EIS cannot, of course, be completed until all major informational needs are met.

Based on the review to date, it is apparent that numerous aspects of the Crandon Mine proposal are of major concern to the Department, other governmental agencies, Indian tribes and the public. This concern results from both potential adverse effects and discomfort with the technical basis presently available for projecting these impacts. These project aspects include the following:

1. Impacts to groundwater quantity and quality resulting from mine dewatering operations.

2. Impacts to groundwater quality resulting from disposal, backfill, storage and reclamation operations.

3. Impacts to surface water quality and quantity resulting from mine dewatering and wastewater discharge.

4. Impacts to wetlands, aquatic and terrestrial habitat from mill, disposal and treatment facilities construction and operation.

5. Socioeconomic impacts including the full range of "boom-bust" social and economic factors, quality and quantity of private water supplies, noise generation, and future recreational use potential.

As Exxon continues preparing the EIR, it should focus its effort on assuring that a sufficient level of technical documentation is available to allow the Department to fully analyze the impacts listed above. We must also fully explore reasonable alternatives which would avoid or minimize potential adverse effects resulting from the project were it to be permitted and implemented. Thus, you should be aware that our attached comments concerning alternatives are preliminary in that additional alternatives requiring Exxon's evaluation may be identified upon review of the information we are requesting.

As indicated above, the attached comments represent our initial review of the EIR. Our continuing review will include further analysis of public and governmental agency comments, staff comments on Chapter 4 and identification and review of relevant consultant reports. In addition, we will be moving ahead with the analysis of socioeconomic and groundwater modeling information in conjunction with our consultants following upcoming discussions between Department staff and Exxon.

Despite the significant effort which the Department has devoted to date in reviewing the EIR, we believe a substantial amount of work remains before our review will be completed. This is due to many factors including the extent to which the EIR deviates from our October 1981 outline, the amount of technical information which has only recently been provided to the Department, and the quantity of information apparently available which has not yet been submitted. The degree of public interest in the project and our concomitant obligation to facilitate public participation in the review process will also require devoting considerable resources of both Exxon and the Department. We will prepare the next EIR review letter as soon as possible.

Finally, we note that the Department has made significant progress in preparing to meet its responsibilities under the Metallic Mining Reclamation Act. With mining rules now in place, the commitment of staff resources and development of procedural understandings with involved state and federal agencies, we believe we can carry out the remaining project review in a responsive and effective manner.

Should you wish to discuss any aspect of the attached comments or the EIR review effort in general, please contact us.

Sincerely,
Bureau of Environmental Impact

Howard S. Druckenmiller
Director

cc: Linda Bochert - ADM/5
John Brasch - NCD
Jim Huntoon - ADM/5
George Meyer - ADM/5
Lyman Wible - ADM/5
James Derouin - Madison
Joan Knoebel - Madison
Kevin Lyons - Milwaukee
Raymond Huber - Wausau
Donald Zuidmulder - Green Bay

See Attached Service List for state, federal and local agencies and library repositories

CHAPTER 1 - PROJECT DESCRIPTION

SECTION 1.1.1, ACTION REQUESTED OF THE DNR - Paragraph number 5) calls for the Department to coordinate with federal agencies to "insure" that the Department's EIS will be "responsible to the needs of the federal agencies". While we will continue to coordinate with the federal agencies and to be responsive to their needs, we cannot guarantee that our EIS will meet all those needs or that the EIS will necessarily satisfy all federal NEPA requirements. However, we have expressed our desire and willingness to incorporate federal agency NEPA concerns into the state EIS and thus avoid the necessity of a separate federal EIS. As of now, we see no reason that this goal cannot be met based on the discussions we have had with the involved federal agencies.

Paragraph 6) requests that the Department inform the Applicant after the NR 150.10 interagency procedure has been completed. This procedure will be ongoing throughout the permitting process and will not be completed until after the master hearing.

It should be made clear that the project sponsor for these permit applications is the Exxon Corporation and not the Exxon Minerals Company.

Review of the EIR and permit applications would be expedited by providing a contact person and telephone number for each of the consultants listed in Table 1.1-1 and by allowing direct and unencumbered communications between the Department and the consultants. Please let us know as soon as possible of your response to this suggestion.

SECTION 1.1.2, LOCATION OF PROPOSED ACTION - The land associated with the proposed surface water discharge pipeline corridor in Sections 32, 33, and 34 of T35N, R12E should be described as Exxon controlled land.

Figure 1.1-2 should show the water discharge pipeline route, access road, and the rail spur as being within the project site.

Figure 1.1-3 should specifically identify land ownerships for the "small tract areas" surrounding Little Sand Lake and Deep Hole Lake.

The lands identified on Figure 1.1-3 as owned by Connor under a mining lease east of the project area and lands owned by Mihalko under land purchase option in Langlade County should be addressed in terms of their relationships to the proposed project. What will be done with these lands if the project is permitted?

NR 182.07(1)(h) prohibits construction or operation of a mine waste disposal site within 200 feet of property lines. At least one non-Exxon owned parcel is within 200 feet of the proposed disposal area. Exxon should state their intent to purchase this parcel or request a variance from this locational criteria.

Figure 1.1-3 does not identify ownership of the NE NW, SW NW, W 1/2 SW of Section 2 and the NW NW, Section 11 of T34N, R12E, Langlade County. These are State of Wisconsin Trust Lands.

SECTION 1.1.3.1.3, USES AND OUTLOOK FOR RECOVERED METALS - The information detailing U.S. metals production was derived from 1978 data. Statistics through 1981 are currently available in the Minerals Yearbook (Bureau of Mines, 1982) and should be used.

Previous discussions with Exxon indicated that cadmium would be recovered as a smelting by-product. Is this no longer viable? Are there any other marketable smelting by-products besides gold and silver?

The description of the relative importance of the various metals obtained from this mine should be clarified with a tabular display of relative abundance and relative economic worth of each metal.

It is possible that the Crandon project could displace some marginal U.S. zinc production rather than reduce imports. Also, the U.S. has considerable unused copper capacity now. The need for a strong domestic mining industry, the uncertainties of foreign supplies, and the length of time required to develop new mines could be cited as reasons for the Crandon project.

SECTION 1.1.3.2, STATUTORY OBLIGATIONS - The WPDES permit application was not submitted with the EIR and has not been submitted as of this date. Also, preliminary wastewater treatment engineering plans have not yet been provided. Plans for the reclaim water ponds must be included in both of these submittals.

Table 1.1-2 has the following errors or deficiencies:

Federal Obligations - Only two federal permits are listed. Please provide a comprehensive list of all federally required actions in this section regardless of the agency or objective of the regulation. Also, the "operating license" listed for 33 U.S.C. 1344 reads "Dredge or fill permits for activities in or impacting navigable streams or wetlands". This authority actually addresses discharge of dredged or fill material.

Non-DNR Related Wisconsin Statutory Obligations - The requirement to obtain plan approval by DILHR for the private sewage system is the only non-DNR state obligation listed. The statutory citation for this approval is erroneously characterized as s. 144.20, Wis. Stats. The correct citation is s. 145.20, Wis. Stats. Also, s. 147.02 Wis. Stats., is cited as a statutory obligation and DNR is listed as an administering agency. While DNR will coordinate with DILHR on the sewage system plans, no DNR permit is required and DNR is not an administering agency.

Other non-DNR related state statutory obligations certainly exists. Please provide a comprehensive list of non-DNR Wisconsin statutory actions, including PSC approval of power supply facilities.

DNR-Related Statutory Obligations - The authority governing placement of structures on the bed of navigable waters is cited as s. 30.12(2)(a), Wis. Stats. This section has recently been revised by the Wisconsin Legislature and the appropriate citation is now s. 30.12, Wis. Stats.

For placement of riprap, s. 31.12 (2)(d), Wis. Stats. is cited. This apparently was intended to cite s. 30.12(2)(d). As mentioned above, this section has recently been revised and the appropriate citation for a riprap permit is s. 30.12(3), Wis. Stats.

Plan approval for the wastewater treatment system under s. 144.04, Wis. Stats., will also encompass the water reclaim ponds.

As indicated above, the reference to a s. 147.02, Wis. Stats., permit for the private sewerage system is erroneous.

Under air emission, s. 144.392, Wis. Stats. is cited. Both s. 144.391 and s. 144.392 should be cited.

For the mine waste feasibility report and plan of operation s. 144.44, Wis. Stats. is cited. Since it may be necessary to obtain a waiver under s. 144.44, from separation distance requirements, this should include a reference to s. 144.46, Wis. Stats., to recognize the availability of such variances.

When citing s. 144.85, Wis. Stats., Exxon indicates the administering agency as "DNR-Mining Permit", with blanks under the "Activity" heading and the "Action" heading. Under the "Administering agency" heading, only DNR should be listed. Under the "Activity" heading "Mining" should be listed. Under the "Action" heading, we presume the request to be for "permit issuance".

The reference to DNR and Forest County action regarding shoreland and flood plain zoning contains a number of errors. Section 54.471, Wis. Stats., is an erroneous citation and should read s. 59.971. Section 144.46, Wis. Stats., refers to separation distances of solid waste disposal facilities from navigable waters, and does not apply to the pipeline route. This reference should be dropped. Also, the shoreland (not shoreline) and flood plain zoning activity is local in nature and should not reference the DNR as an administering agency. Finally, the "Activity" and "Action" items appear to be transposed. The requested action is apparently the obtaining of necessary zoning and permits.

In addition to the mining permit under s. 144.85, Wis. Stats., Exxon must also receive formal authorization to commence mining under s. 144.86(3), Wis. Stats. Also, Exxon may need to acquire approvals for one-time disposal of wood ash, construction debris and waste wood. If arrangements cannot be made to dispose of mill refuse and other nontailings wastes in an existing landfill, it may also be necessary to pursue development and Department approval of a solid waste landfill pursuant to s. 144.44 Wis. Stats.

Local Obligations - In addition to the town ordinances governing activities within the town boundaries, Exxon will have to comply with certain County ordinances. As mentioned above, the pipeline will have to conform with all Forest County shoreland and flood plain ordinances or be granted variances from incompatible restrictions. The outfall structure and all stream crossings would also be subject to these ordinances. In addition, we expect that delineation of the ordinary high water marks of Duck Lake, Deep Hole Lake, Skunk Lake, and Little Sand Lake may place other project facilities within the 1,000 foot shoreland zoned area.

SECTION 1.1.3.3, PROJECT SCHEDULES - The present schedule fails to consider activities which must occur or be initiated prior to the start of construction. A pre-construction plan and schedule must be provided to identify those activities and to establish a more realistic time frame for the start of construction. This plan and schedule should include but not be limited to the following items:

1. Implementation of the various monitoring plans.
2. Corporate analysis of permit conditions and decision to proceed with a project.
3. Completion of required land acquisition including county forest lands.
4. Satisfactory legal and physical resolution of predicted private water supply problems.
5. Compliance with other post-permitting regulatory requirements, and as requirements for environmental mitigation.

Figure 1.1-4, which indicates projected peak manpower requirements, must be supported by detailed employment needs by job category in Sections 1.3.3.1 and 1.4.2. Manpower requirements must be broken down by year, and must be accompanied by the assumptions and data used to derive the projections.

The EIR seems to indicate three different levels of manpower requirements. Figure 1.1-4 indicates a maximum of less than 1,450 workers. In comparison, for the most likely scenario in Table 4.2-25 in 1989, there would be 1,080 construction workers and 580 operations workers for a total of 1,660 employees. Figure 1.3-15 apparently shows a maximum of about 1,450 construction workers for 1989 which would indicate a total work force for that year of over 2,000. Justification of these critical projections is essential since review of the literature relevant to large growth projects shows that estimates of manpower requirements are often too low ("Social Economic Impacts of Power Plants", Denver Research Institute and Browne, Bortz and Coddington prepared for the Electric Power Research Institute, Palo Alto, California, 1982, and "Chronic Under Projecting of Work Forces at Nuclear Power Plants", Robert B. Braid, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 1980).

SECTION 1.1.3.4, PROJECT FACILITIES AND EQUIPMENT COSTS - Table 1.1-3 should be significantly expanded to cover construction and operation costs of major project components. This includes individual cost estimates for mine equipment, mill equipment, and for major elements of the pollution control facilities (tailings pond liner, reclaimed ponds, water treatment units, etc.). Cost figures of all taxable capital equipment and improvements are also necessary. Justification or documentation for cost estimates must be provided.

SECTION 1.1.3.5, RELATED GOVERNMENTAL PLANS AND GOALS - This section must address the relationship of the proposal to lands entered under various governmental programs such as County Forest lands, Forest Crop Law lands, and Woodland Tax Law lands.

Describe development, recreation, transportation, resource, and educational plans for Antigo, Rhinelander, Oneida and Langlade Counties, the Nicolet National Forest, and the three local Native American communities.

Describe the 1981 State Comprehensive Outdoor Recreation Plan for Region 2 supply-demand-needs assessment of outdoor activities and the issues developed for Region 2. Discuss tourism activities, goals and objectives established for the area by the Department of Development-Division of Tourism, and Governor's Council of Tourism Reports.

SECTION 1.1.3.6, REQUIREMENTS FOR GOVERNMENT SERVICES - Governmental workloads have been or will be increased in areas such as job service, facility inspection, environmental inspection, revenue, employee training, planning, and impact funding.

There is no sludge disposal site in Forest County at this time. The disposal site for this sludge must be identified and described to assess potential demands on governmental services.

Disposal of refuse in a landfill in the Town of Nashville may be a significant service demand on the township. At this time, there appear to be no sites of sufficient capacity for the disposal of these wastes. Also, preliminary discussions with Town officials indicate that they may not accept Exxon refuse at the Town landfill. A new site in the Town of Nashville would take several years to develop and be approved. Exxon must describe the additional waste loading expected from the mine, mill and increased local population and must specifically identify and describe the disposal area. These comments also apply to the one-time disposal of ash, wood waste and construction debris.

Details on the available on-site fire suppression equipment, the manpower training proposal, and anticipated needs for fire protection must be provided along with existing fire fighting capability of nearby municipalities in order to adequately evaluate the total fire suppression capability. Also, the Soo Line Railroad is responsible for 4-5 fires per year in the area. How many additional fires would be expected annually from the increased rail traffic associated with the mine operation?

Why is it anticipated that outside law enforcement assistance would be required? The level of law enforcement assistance required by the project must be described along with the capabilities of nearby law enforcement units and any additional equipment or manpower needs.

Please discuss the need for upgrading town or county roads for use prior to the completion of the access road or during the mine operation.

SECTION 1.1.3.7, PROPOSED CHANGES IN LAND CLASSIFICATION -

Forest County - Forest County shoreland zoning permits and/or approvals may be required for the proposed access road and railroad crossings, the discharge structure, and other facilities located within 1,000 feet of a lake's ordinary high water mark. Specific plans should be provided to the Forest County Zoning Administrator for determinations of necessary permits and approvals.

Forest County is also in the process of developing and adopting a county flood plain ordinance. Upon adoption of the ordinance, additional county zoning permits and/or approvals may be required.

Town of Lincoln - The Town of Lincoln has recently adopted a town zoning ordinance. Under this ordinance, the mine/mill site, tailings ponds, and a portion of the reclaimed water ponds are located in areas that are zoned "forestry". A zoning change to "mining" would be required prior to development of any facilities at proposed locations in the Town of Lincoln.

Town of Nashville - The Town of Nashville is in the process of adopting a town zoning ordinance. Exxon should identify any necessary zoning changes required if and when an ordinance is adopted.

SECTION 1.1.3.8, RELATIONSHIP OF THE PROPOSED PROJECT TO OTHER SIMILAR PROJECTS - Please discuss the potential for processing ore from other deposits at the Crandon mill, and the general legal requirements which would apply if other ore was processed. Describe the effect implementation of the proposal would have on the technical and economic feasibility of the development of other ore bodies in the region.

This section should also indicate that this would be the first mine in Wisconsin to be initiated under the existing regulations and the first sulfide ore body developed.

SECTION 1.2, DESCRIPTION OF FACILITIES - Neither this section of the EIR or the Mining Permit Application contains the requisite level of engineering detail necessary for an adequate environmental and regulatory review. The two volumes of the Ralph M. Parson Report approached the level of detail which will be required. Unfortunately, the Parson's Report only covered portions of the complex and was outdated at the time of its transmittal to the Department. Mr. Hansen's letter of November 18, 1981 assured us that "an additional phase of engineering studies is presently being planned." The results of those studies are necessary for our evaluation.

This section should include a small scale map or scale drawing showing all of the major project facilities. A base map such as USGS Planimetric Quadrangle sheet could be used.

Include a description of the proposed pilot plant in this and subsequent sections.

This section also lacks any description of the aesthetics features of the surface facilities.

The acreage cited for the area of the surface facilities should include the railroad, access road and discharge pipeline corridors.

SECTION 1.2.2, VENTILATION SHAFTS - Describe the shaft surface discharge structures, fan size, noise suppression, air quality controls, and access roads. Exxon had previously indicated that the fans would be located underground in order to reduce ambient noise levels. Why were the fans moved to the surface?

SECTION 1.2.1.2.3, DRIFTS - Describe in detail the mining plan as it relates to the control of surface subsidence. Describe controls to prevent the piping of overburden materials into the mine.

SECTION 1.2.1.2.9, MINING EQUIPMENT - How will large equipment be taken underground?

SECTION 1.2.1.2.10, ORE SLURRY TRANSPORT FACILITY - The dust control system on the primary crusher and related ore handling facilities is not adequately described. Where will the ducts and dust collection hoods duct to? A drawing showing the crusher, dust collection system and any other control devices should be included.

SECTION 1.2.1.2.12, SANITATION FACILITIES - Provide further details on the underground sanitation facilities including the ventilation, transportation, and disposal of sanitary waste. Discuss any waste preservation chemicals which would be used and the compatibility of chemically treated waste with the surface septic system.

SECTION 1.2.1.2.13, WATER SUPPLY - Provide a plan for potable water supply testing and reaction to unsafe samples.

SECTION 1.2.1.2.14, FUEL HANDLING AND STORAGE - Describe the surface handling facilities for the fuel pipelines running to underground fuel storage tanks and any spill contingency plans.

SECTION 1.2.1.2.16, MINE DRAINAGE - Considerably more detail is necessary for the mine inflow control systems. Describe the grouting proposal including methods, number and location of surface boreholes, and documentation of the effectiveness of this measure. Provide an analysis of the economic and technical considerations which will control the extent of grouting. When does Exxon intend to decide if grouting is economically and technically feasible and therefore part of the proposed mine operation?

Provide additional details including cross-sections and drawings of the groundwater interceptor system. Discuss why water intercepted within the bedrock, even though at a shallow depth, can be considered "clean". The mine dewatering will create a drawdown of the aquifer in the area, thus introducing oxygen to a previously anaerobic environment. This may substantially change the chemical characteristics of the groundwater. How will the interceptor system water be protected from contamination?

Describe contingency measures available for mine inflows in excess of 2,000 gallons per minute.

This section implies that grouting could reduce inflow by 1,000 gallons per minute and that the groundwater interceptor system would also collect 1,000 gallons per minute. What is the theoretical maximum effectiveness of both systems?

This section should indicate where the water from the two collection systems will be routed.

Describe the groundwater collection sumps within the mine and disposition of the settled solids removed from the sump.

SECTION 1.2.2, MILL - Provide plans and specifications for any equipment used for the storage or distribution of hazardous materials including spill detection and control facilities.

SECTION 1.2.2.1, ORE HANDLING - Will there be any need for exterior ore surge piles in the event of system failure? Will there be any surface storage of low grade ores other than at the mine waste disposal facility? How will the preproduction ore laydown area be prepared?

Are the wastewaters generated in the ore handling facility and the contaminated runoff generated on the preproduction ore and waste rock storage areas accounted for in the water balance? Provide calculations showing the volume of runoff generated in a 10-year 24-hour storm event.

SECTION 1.2.2.4, ORE TREATMENT - The discussion of the dewatering and storage of the thickened concentrates needs elaboration. There is some potential for SO_2 formation and emission from the concentrates during storage. In addition, sulfide mineral concentrates have potential for spontaneous combustion which requires some residual moisture content and control. Please clarify if the concentrates will be stored and loaded as a filter cake or in some other form.

SECTION 1.2.2.5, REAGENT STORAGE AND MIXING - Provide detailed plans and specifications for this facility and its equipment with an emphasis on spill control, containment and emission control. Describe the segregation of noncompatible reactive reagents, dusts, vapors, and gases.

Many of the reagents will be hazardous materials. Exxon will be required to comply with NR 181 and RCRA in regards to storage and disposal of these materials. How long will storage of chemicals and reagents not meeting specifications be necessary before disposal? The facility may require a hazardous waste storage license. Please provide a mass balance study to indicate the reagents used and their expected concentrations in the various waste streams.

Table 1.2-5 describes "typical" reagents. Will other unlisted reagents be required? Some of the reagents listed in Tables 1.2-5 and 1.2-6 are not adequately described chemically. Please define xanthates, flocculents, dewatering aid, and "other xanthates."

SECTION 1.2.2.6, CONCENTRATOR CONTROL ROOM - All remote environmental monitoring equipment should be described here or under the appropriate section.

SECTION 1.2.2.8, TAILING THICKENING - Provide details and diagrams describing the equipment, overflow rates, separation efficiencies, etc.

SECTION 1.2.2.9, CONCENTRATE HANDLING AND LOAD OUT - Provide information regarding the design of the covered railcars and/or trucks to be used for concentrate shipping.

Approximately eight days production storage for each concentrate is specified here while on page 1.4-15 and in Table 1.4-2, ten-day storage is indicated. Which figure is correct? The planned eight- or ten-day storage capacity does not allow much flexibility in the event of extended storage transportation or market problems. What alternatives are available other than mill shutdown?

SECTION 1.2.2.10, SPILL CONTROL FACILITIES - Where could recovered reagents be disposed?

SECTION 1.2.2.12, BACKFILL TRANSPORT, STORAGE, AND RECLAIM - Provide detailed plans and specifications for the backfill storage area, including the bottom liner, water decant system, ancillary facility, and backfill recovery equipment. Construction of the storage area will also need to be addressed. Describe how backfill sands will be reslurried, how the liner will be protected, and how the equipment listed on Table 1.2-4 will be used.

Will surge tanks be provided for containing the contaminated runoff prior to use in the backfill preparation facility? If not, runoff could become highly contaminated while residing in the backfill pile. Would this affect its use in backfill preparation?

SECTION 1.2.2.13, CONCRETE BATCH PLANT - Describe plans for concrete preparation prior to completion of the permanent batch plant. Discuss the quantity of aggregate needed during various construction and operation phases and the availability of suitable aggregate on-site and off-site. Could waste rock or reclaimed cobbles be used? Will the batch plant include aggregate crushing, screening and washing facilities? If so, describe the disposal of aggregate wash water. Why will the batch plant be needed after the mill is constructed?

SECTION 1.2.3, WASTE DISPOSAL FACILITY - The feasibility report states that the waste disposal facilities will cover 500 acres including the embankments while this section indicates that the four tailing ponds will have a total surface area of 500 acres inside the pond crests. What is the total area of the ponds as measured from the outside toe of the dikes?

SECTION 1.2.3.1, WASTE ROCK TRANSPORT AND STORAGE - Will surge piles be needed for waste rock and preproduction ore during the construction phase? Will roads at the dump sites contain high sulfide materials which could be released by traffic? Will the large diameter waste rock contain enough fines to adequately fill the voids between rocks and prevent piping of cover material into the pile? Will surface crushing of waste rocks be required to provide riprap material during the construction phase? Will the haul road be directly on top of the liner?

SECTION 1.2.3.2, WASTE ROCK DISPOSAL AND PREPRODUCTION OR TEMPORARY STORAGE - Specifically discuss how the integrity of the liner will be protected during placement and reclamation of materials. How will the preproduction ore be separated from the waste rock and removed without damage to the liner?

SECTION 1.2.3.3, TAILINGS TRANSPORT - Provide detailed plans and specifications for the construction, operation, and maintenance of the transport system. Describe the specifications (ASTM, etc.) which the High Density Polyethylene (HDPE) pipes should meet. Indicate the types of pipe strength and pressure ratings which will be selected and what types of trenching or backfill conditions will be used. Describe items such as resistance to crushing for a design overburden and live load, soil types used for trench and backfill, resistance to collapse in a vacuum situation, and ability to resist damage either from blockage by settled solids or by pipe freezing. Discuss the pipeline installation, leak detection and repair, necessity for redundant pipe, and storage or disposition of water drained from the pipe during normal pump maintenance or loss. Describe measures which will be taken to prevent groundwater contamination in the event of a pipeline failure. Specify capacity for each pump for each of three pipeline systems.

SECTION 1.2.3.4 TAILINGS DISPOSAL -

Waste Volumes - More detail is needed on the carbonate sludge and the potential effect it will have when pumped to the tailings ponds. Will the calcium carbonate fines occupy 1 million m^3 or will it fill voids which exist in the tailings? Also, why does the Golder Report No. 11 recommend 3 feet of freeboard versus the 5 feet required in the NR 182.11(1)(q)?

Mine Waste Disposal Facility Location - The discussion of the MWDF location is not correct with regard to water users. There are several users downgradient of the disposal site.

Soil attenuation should be addressed in greater detail by describing the contaminants likely to be found in the tailings and those which are likely to be attenuated.

Why does the MWDF design call for 4:1 inside slopes and 3:1 outside slopes when the outside slopes will have to remain stable over a longer period of time?

Provide more detail on the accesses to the MWDF from both the mill and the Woodlawn Siding.

Seepage Control System - As we have indicated to you in the past, we have a number of concerns regarding the feasibility, reliability, and effectiveness of your proposed seepage control system. These issues will be discussed further in the review of your Mine Waste Disposal Facility Feasibility Report.

SECTION 1.2.3.5, WATER TREATMENT WASTE DISPOSAL - What are the potential market locations for the sodium sulfate? How and with what frequency would it be transported to its destination? Where would the sodium sulfate be disposed if a suitable market is not available?

SECTION 1.2.3.6, RECLAIM POND SLUDGE - Describe the method and frequency of sludge removal. Discuss the effect of sludge removal on the reclaim pond liner. Specifically characterize the reclaim pond sludge composition. Discuss the effect of disposing the sludge in the top layers of the tailings ponds and the effects this will have upon placement of final cover.

SECTION 1.2.4.1, RAIL SPUR - Discuss right-of-way maintenance as it relates to aesthetics, erosion control, and the prevention of railroad initiated fires. Provide cross-sectional design drawings detailing the physical dimensions of the right-of-way and proposed rail structures.

Figure 3.4-7 does not show the proposed siding location as indicated in this section.

SECTION 1.2.4.2, ACCESS ROAD - Provide cross-sectional design drawings detailing the right-of-way and structures. Describe the road surface material. Will there be any limitations of access to this road by the general public and/or adjacent landowners?

SECTION 1.2.4.4, ADMINISTRATION BUILDING - Will a separate environmental laboratory be provided?

SECTION 1.2.4.5, COMBUSTIBLES STORAGE BUILDINGS - Construction, operation, safety and fire protection of the combustible storage building will also have to meet federal, state and local requirements.

SECTION 1.2.4.6, SANITARY WASTE FACILITIES - What will the peak flow to the sanitary treatment system be? What is the basis for the 31.9 gallons per minute average flow value? Provide documentation for these figures.

Discuss the effect of having drainage from the absorption field in close proximity to the mine. Estimate the land area needed and available for land spreading of sludge. Discuss the availability of a commercial sludge disposal facility and the anticipated volumes and frequency of sludge disposal. Discuss the potential for needing sludge storage during winter months. Describe the separation of laboratory and other chemical wastes from this system.

Describe the size and location of the sludge absorption field.

SECTION 1.2.4.7, POWER SUPPLY FACILITIES - Please provide plans for the substation which detail measures taken to suppress transformer and emergency generator noise. Describe the locations and construction techniques for the site underground and above-ground power distribution system. Describe the above-ground structures which will be utilized.

SECTION 1.2.4.8, FUEL STORAGE DISTRIBUTION - Will the area within containment dikes be lined or paved to prevent spills from reaching groundwater? Will collection and treatment of runoff from the fuel oil storage area and the tank loading area be provided? Describe the quantity of runoff and the type of treatment proposed. Provide a map showing the location of on-site fuel distribution pipelines. Provide specifications for pipeline construction, particularly in areas of potential earth settling or mine subsidence.

SECTION 1.2.4.10, POTABLE WATER FACILITIES - The Department has not yet received an application for a high capacity well approval. This application will need to include all proposed groundwater withdrawals on the property.

The EIR indicates that a chlorinator treatment system will be provided if necessary. We recommend that such a system be installed on a stand by basis. It would have to be approved by the Public Water Supply Section. Chemical treatment or additions to the well or the total water supply pumped from the well for the purpose of quality control, when the additions are made ahead of the pressure tank or reservoir, will require approval from the Department.

The potable water well and distribution piping must be in compliance with NR 112 and H62, respectively. If the mine is approved and a potable water distribution system is constructed, we recommend that Exxon periodically inspect cross-connections and sample the distribution system and wells for bacteriological quality.

SECTION 1.2.4.11, WATER TREATMENT FACILITIES - Provide details of the surge tank for the "uncontaminated" water. Discuss the monitoring program and how the necessary treatment will be determined.

Provide the details of the water discharge pipeline as requested under Section 1.2.3.3 for the tailings transport pipeline.

What is the estimated scale of Figure 1.2-18? Indicate a "low water" level on the section drawing and define the high and low levels.

SECTION 1.2.4.12, RECLAIM WATER PONDS

Provide engineering plans and specifications for these ponds and ancillary facilities.

Specify the thickness of the synthetic liner and discuss the compatibility of the liner with the wastewater. Provide evidence to that this wastewater will not degrade the membrane. Discuss potential ice and frost damage to the pond liner, dams, and ancillary facilities. Discuss potential gas formation below the membrane liner. Provide details of the discharge and pump points to assure that movement of water will not erode the blanket or expose and rip the liner.

Explain why a double-liner system is needed. The design illustrated seems inconsistent with published geomembrane liner design guidelines as it includes no provision for leak detection or collection of the liquid that leaks through the membrane and collects on the soil bentonite liner. If the second liner has the capacity to collect liquids, there should be some mechanism to either remove them or at least detect their presence.

Provide the rational for the location of the reclaim ponds, and discuss the factors influencing the ponds' siting. Is there an advantage to placing the ponds such that water may flow back to the mill under gravity flow? The reclaim water pond combined with the mine waste disposal facility appear to significantly reduce Duck Lake watershed. The resultant loss of water flow through the lake and wetland complex must be thoroughly addressed in Section 4.1.4.1.2.

Provide detailed information on the mechanisms by which the reclaim ponds will function in the treatment of organics, thiosulfates, and polythionates. Give examples of the concentrations of these chemicals and breakdown products. Include analytical work conducted at other mining installations which utilize reclaim ponds for water treatment purposes. Discuss the potential of deeper portions of the reclaim pond becoming anaerobic and resulting in reducing conditions and the generation of hydrogen sulfide and the effect this would have on treatment of the water and generation of noxious odors.

Discuss the pond's fertility and the potential for algae and weed growth with resulting operational and sludge disposal problems. Describe the effect of extremely cold temperatures on the treatment efficiency.

What is meant by adequate retention time in the reclaim ponds? How will this be achieved if one of the ponds is taken out of service? Please explain why the storage volumes for each pond are the same but the dimensions of the ponds are different.

Provide information on how "the reclaim ponds and the tailings ponds will provide surge capacity for the water management system." The reclaim ponds will apparently be filled to capacity during normal operation. Describe the effect of surge water storage on consolidation of tailings, operation of the underdrain system and stability of the dikes. How long could the mine or mill continue operation in the event of an extended water treatment plant shutdown?

Provide details on the removal of the reclaim pond sludge and liner protection. Describe a contingency plan in the event of liner failure and discuss the feasibility of repairing Hypalon after vulcanization.

Please provide adequate documentation for the above discussions.

SECTION 1.2.4.14, SHOP, GARAGE, WAREHOUSES - Where will drainage of the southside unloading dock be routed?

SECTION 1.2.4.15, OTHER WATER FACILITIES - In addition to the fueling station drainage, what other waste streams will be routed to the oily water sewer system? What is the volume of water which will flow through the oily water sewer system. Discuss the compatibility of the oily water waste stream with the reclaim ponds and water treatment systems.

What approved off-site waste disposal area will be used for oil particle disposal? What is the estimated volume which would be produced? How will the oil be removed and stored prior to disposal? Describe the methods and frequency of waste oil transportation. If the oil particles have a flashpoint under 140°F, they are classified as hazardous waste and would need to be disposed of at an approved hazardous waste site.

SECTION 1.3, CONSTRUCTION - In this section, Exxon states that "the construction sequence is realistic for this stage of planning. The actual sequence is subject to optimization along with equipment and techniques, during final engineering". This statement illustrates the tentative nature of the construction schedule and the general lack of engineering and scheduling details presented in this chapter. The further statement that "the schedule for construction will be . . . sequenced to assure the availability of all environmental protection systems well in advance of the need date" does not satisfy our need for a critical review prior to action on the mining permit application.

This section also states that the construction technologies are " . . . well established and readily quantifiable." Please provide documentation and quantification of the technologies to be employed in constructing the tailings ponds' and reclaim ponds' liners.

SECTION 1.3.1.1, MINE/MILL SITE PREPARATION - The clearing of trees and shrubs during periods of snow cover is preferable because the wildfire hazard is minimized, salvage wood increases in volume and value because logs are protected from dirt, and the lack of leaves reduces the slash volume.

Commercial whole tree chipping contractors and the sale of chips for fuel or pulp should be investigated as an alternative to burning. The burial of stumps under a one-time disposal permit may also be an alternative. A license for a wood burning site from the Department may be necessary.

Please provide a grading plan for all disturbed areas showing interim and final grades along with earth material balances. If negative balances are derived, specify the source of imported fill and/or topsoil. If positive balances are found, specify the use or disposal of surplus material. Include in the plans the specifics of the runoff and erosion control program and further describe the scheduling relationship between grading and runoff control. Calculate anticipated maximum runoff volumes from each stormwater collection area and maximum flow rates in major collection ditches. Provide plans for all temporary and permanent stormwater impoundments, specifying design capacity, detention times, control structures, overflow pipes, weirs, energy dissipators, and surface stabilization materials or methods. Define and differentiate between short-term and long-term erosion control measures; Use of short-term measures for a long period of time may actually aggravate erosion due to the need for frequent maintenance.

Would upgrading existing roads involve partial filling of wetlands along the right-of-way of the Little Sand Lake Road? If so, would the extent of filing be the same as those used for the calculations in Table 3.4-3 for road access alternate E?

SECTION 1.3.1.2, TEMPORARY FACILITIES - Modifications of previously granted high capacity well approvals will be required prior to the use of existing wells for drinking water purposes. The use of several strategically located wells should be considered in order to minimize the need for tank trucks and potable water dispensers.

Describe the existing electrical power transmission lines and discuss the extent to which the existing system could be modified and used to reduce the need for on-site power generation.

SECTION 1.3.1.3, ACCESS ROAD CONSTRUCTION - Please provide a summary of organic deposits on the access road and railroad (Section 1.3.1.9) corridors along with estimates of the total amounts of marsh materials to be excavated. What is the estimated volume of waste wood and the likely destination for off-site disposal.

Please describe the road surfacing process and material. Specify the total amount of road base material which will be brought in.

SECTION 1.3.1.4.2, SHAFTS AND COLLAR - Provide details on the soil freezing process including well design, brine containment, and waste brine disposal. What type of brine will be used? How large will the holes be and how will they be spaced? How much area will be affected by the soil moisture freezing? What diameter will the total excavation actually be?

What is the projected volume of water that will be generated during the shaft construction? The water treatment facility will not be completed until approximately one year following commencement of main shaft and air shaft construction. Waste rock and preproduction ore storage runoff will also go to reclaim pond No. 1. While reclaim pond No. 1 should be completed within three months after the start of the main shaft and eight months after the start of the air shaft construction, where will the water be stored during the three- and eight-month period when this pond is not in service?

Provide calculations showing that the storage volume will be adequate to handle construction wastewater before the surface water treatment systems are completed. What contingency measures are available if the volume is not sufficient?

SECTION 1.3.1.4.3, UNDERGROUND DEVELOPMENT - Describe in detail the construction of the groundwater interceptor system. Describe the temporary water containment and pumping facilities.

Describe in detail the placement of the grouting and indicate approximately how much of the ore body-unconsolidated deposits interface would be grouted.

Discuss contingency measures for inflows of more than 2,000 gallons per minute during construction.

SECTION 1.3.1.4.4, WASTE ROCK AND PREPRODUCTION ORE - Discuss the affect of operating the equipment transporting waste rock and preproduction ore on the liner integrity.

SECTION 1.3.1.6, MINE WASTE DISPOSAL FACILITY AND RECLAIM POND SITE PREPARATION - What characteristics will determine if topsoil is "suitable"? Provide descriptions of topsoil stockpiling quantities, location and method of protection.

SECTION 1.3.1.7, MINE WASTE DISPOSAL FACILITY AND RECLAIM POND CONSTRUCTION - Considerably more information is needed on the construction techniques and the quality assurance and quality control measures referred to for construction of the liners and underdrain system. It has not yet been demonstrated that the tailings pond liner, drainage layer, and filter layer, as a total structure, will work. All Exxon-sponsored studies related to the liner systems should be submitted to the Department for evaluation. Also, please provide documentation from other facilities which have successfully used these or similar construction procedures.

How long will it take to actually put a liner in place? How will the earliest constructed areas be protected from erosion and any other potentially damaging forces? How will a uniform 6-inch layer of bentonite modified soil be placed and held on slopes?

When will the bentonite modified soil be hydrated? Is the 6-inch thickness wet or dry? How will the liner be protected from dehydration? What particle size of bentonite will be used?

Will the wetlands under the MWDF be excavated during construction. What affect will leaving the wetland soils in place have upon the liner construction and stability and the dike integrity? How will excavated organic soils be disposed?

Provide drawings and describe the batching and mixing plant and the screening plant including processes, quality control, and waste products.

Describe the route for hauling bentonite from the Woodlawn Siding and the need for new road construction and/or upgrading. What, if any, modifications will be necessary for the existing Woodlawn siding facility?

Figures 1.3-3 through 1.3-8 indicate that two tailings ponds will be under construction simultaneously while the project schedules show that only one pond will be constructed at a time. This contradiction should be clarified. Please provide full size plan sheets of these figures.

Additional comments and questions on the reclaim ponds and tailing ponds construction will forwarded to you under the respective permit reviews.

SECTION 1.3.1.8, PIPELINE CONSTRUCTION - Provide construction and design details for all pipelines. Indicate where and why the tailings and reclaim ponds pipelines will be buried. Describe installation of any monitoring systems designed to detect pipeline leaks or failures.

SECTION 1.3.1.11, WATER SUPPLY - Please indicate the location and construction details of the water supply well(s). As noted earlier, any well which is used as a potable water supply must be in conformance with NR 112. We recommend a regular program for testing the bacteriological quality of the wells, tank trucks, and work area water dispensers. Due to the possibility of contaminated backflow through the temporary construction water system, we also recommend that a distinction be made between construction water and potable water wells.

The estimated peak demand for water of 45.3 cubic meters/day appears conservative. Please provide the data used for this estimate.

SECTION 1.3.1.13, SANITARY FACILITIES - This section states the sewage treatment facilities will be completed during the first year of construction; Figure 1.3-9 shows the facilities as scheduled for completion during construction year 2. Please indicate the actual expected completion date. Provide calculations and estimated flows for both the chemical toilets and the temporary septic tank systems before and after completion of the permanent treatment facilities. Describe the volumes, method and frequency of transportation, and the likely disposition of sewage hauled off-site. Provide a description of the temporary septic tank. Is Exxon proposing a holding tank or a septic tank and drainage field.

SECTION 1.3.2, CONSTRUCTION SCHEDULE - As mentioned under Section 1.1.3.3, a preconstruction schedule is needed which would include the mitigation or resolution of impacts to private water supplies. Other impacts of construction which could be reduced by revising the construction schedule include the following:

1. Reduce damage to town roads by the completion of permanent rail and road facilities prior to the start of major on-site activities.

2. Phase the construction schedule to eliminate the need for on-site electrical generation.

3. Reduce impacts to wetlands and surface waters by the early completion, stabilization, and revegetation of key erosion and runoff control facilities. This may take as much as two growing seasons to accomplish depending on the stabilization techniques used.

4. Reduce activities during high seasonal population periods by placing more emphasis on winter activities.

Please provide discussions of these and other mitigative measures in the appropriate sections of Chapter 3.

Please list and discuss factors which could extend the construction period and describe the likelihood of delays. These factors should include inclement weather, labor problems, unavailability of required equipment and supplies, design or engineering modifications, and other factors you may identify.

Please describe the construction schedule for the backfill sand storage area, pilot plant and training facility, and the water discharge pipeline and outlet structure.

SECTION 1.3.3.1, MANPOWER - As previously indicated, projected manpower requirements must be accompanied by detailed employment needs by job category over the construction period. The data and assumptions used as a basis for Figure 1.3-15 are needed.

SECTION 1.3.3.3, FUEL AND ENERGY - What are the multiplier units on the yearly use figures in Table 1.3-5? How will fuel be stored on-site prior to completion of the bulk fuel storage area?

SECTION 1.3.3.4, TRAFFIC CONTROL - What are the units of numbers in the table presented in the text of this section? What assumption were used to derive these numbers?

SECTION 1.3.4, LANDSCAPE PLAN - Figures 1.3-16 and 17 should include the backfill sands and explosives storage areas along with the tailings slurry and haul road corridor.

Please provide a discussion of the screening process used to select suitable plantings. Birch and balsam fir may not be appropriate species because of high incidence of disease and insect problems.

What is the "open water" indicated in the northeast corner of the mill site?

SECTION 1.3.5.1, MINE/MILL SITE, RECLAIM PONDS AND MINE WASTE DISPOSAL FACILITY DEVELOPMENT -

Air Emissions - This section should include estimates of emissions from mine construction. Also, estimates of emissions from several air contaminant sources previously mentioned are not included in Tables 1.3-6 and 7. Provide estimates for: 1) the burning of stumps and brush, 2) a temporary on-site diesel powered generator, 3) the existing gravel access roads, 4) wind erosion from the mine waste disposal facility stockpiles, and 5) the screening and stacking plant used to produce materials for the liner and underdrain.

Noise Emissions - Provide the data, analyses, and assumptions utilized to generate the figures in Table 1.3-8. Discuss measures by which Exxon is proposing to control noise emanations.

Solid Wastes - It appears the solid waste disposal facility in the Town of Nashville will have to be upgraded to handle the amount of waste projected to be generated from site construction. Please provide more detail on the types of wastes expected to be generated along with estimates of the amount of each type of waste.

Erosion Control - Include a discussion of the water discharge pipeline corridor. Describe the handling, treatment and discharge of contaminated water during the construction period. What water treatment equipment will be required during the construction period? Describe the locations, dimensions, construction schedules, and specifications for the "influent surge system". Describe the specifications and duration of use of the temporary lined holding pond and include it on Figures 1.3-10 through 14. Describe the chemical characteristics of the contaminated water.

How can the maximum effluent flow rate during the third year of construction be 2,000 gallons per minute when the mine water inflow alone is estimated at 2,000 gallons per minute at this time?

Describe the discharge location from sedimentation ponds and the use of other sediment traps such as silt fences made of geotextiles.

Include the temporary pond used to store runoff from the waste rock embankment on the appropriate figures. Provide the dimensions and design criteria for this pond. What figures were used to derive the net annual precipitation gain estimate of 7 inches? What will the chemical characteristics of this contaminated runoff be? Discuss the effect of the contaminated water and bacterial activity on the liner's integrity.

SECTION 1.4.1, SCHEDULE - This section describes a steady state production phase of 26 years. Please provide a discussion of temporary mine shutdowns (both short and long-term), the potential causes of shutdowns, and the ramifications of these shutdowns on schedules, operations and pollution control facilities.

Please provide the actual design capacity for concentrate storage and contingency plans should additional storage be necessary.

SECTION 1.4.2.4, MINE AND BACKFILL DEWATERING - Provide all data, methods and assumptions used to calculate groundwater seepage into the mine. Describe in detail the operation of the groundwater interceptor system and the continuing grouting of the ore body and the interface with the unconsolidated deposits.

Describe contingency plans for inflows in excess of 2,000 gallons per minute.

SECTION 1.4.2.5, WASTE ROCK - Describe the continued use of waste rock as riprap on the sides of the tailings ponds. Provide estimates of the quantities of waste rock for each destination.

SECTION 1.4.2.6, BACKFILL HANDLING UNDERGROUND - Please explain why backfill may have to be supplemented by glacial sand and why tailings fines cannot be used in its place. Golder Report 11 indicates that fines from the soil screening process may be disposed of within the mine backfill. If soil fines can be used, why aren't tailings fines suitable? If glacial sands are required, what would be the source of the material?

Discuss the kind and amount of cement required to stabilize the backfilled stopes and the thickness of rock which will be left on the sides and bottoms for each stope. Discuss the sulfide resistance of the cement and how the cement will function with a predominantly sulfide aggregate.

Discuss the sizes of waste rock hauled directly from headings to stopes and the possibility of voids in the backfill.

SECTION 1.4.2.7, WATER BALANCE - Please define what constitutes mine "process" water which will be collected and discharged to the surface water treatment system. How much mine process water will be generated and transported to the surface? Are the 200 gallons per minute of processed water accounted for in the maximum mine pumping rate?

SECTION 1.4.3.1, COURSE OR TRANSPORT AND FINE CRUSHING - Provide plan elevation drawings of the crushing circuits (secondary and tertiary) showing the configurations of crushing and conveying equipment, dust collection points, duct and air pollution control equipment.

SECTION 1.4.3.2, GRINDING AND FLOTATION - Provide additional discussion on the grinding and floating processes with diagrams and photographs. Discuss in general terms the use of reagents such as frothers and collectors.

SECTION 1.4.3.3, CONCENTRATE HANDLING AND SHIPPING - Provide a detailed description of the physical characteristics of the concentrates.

SECTION 1.4.3.4, SURFACE BACKFILL SYSTEM - Provide additional information on the operation of the mine backfill storage and preparation plant. Describe how the backfill sand will be recovered and prepared for replacement into the mine while maintaining a sufficient level of quality to assure stability of the backfilled stopes.

SECTION 1.4.3.6, WATER BALANCE - The tailings ponds and reclaim ponds should be included in Figure 1.4-10. Do the numbers and this figure represent maximum flows in each stream? If not, please show the maximum flows expected.

What will be the source of the fresh water required for the mill process start-up? What will be the source of the standby water?

Please provide the data, methods, assumptions and model used to derive the water balance.

SECTION 1.4.3.7, REAGENT RECEIVING, STORAGE, AND USE - Provide a diagram illustrating how and where various reagents are introduced into the flotation process.

What will be done with reagents in damaged containers? How will nonreturnable reagent containers be disposed?

SECTION 1.4.3.9, LUBRICATION - What type of storage facility will be available for waste oil and grease?

SECTION 1.4.3.10, SPILLS AND ODORS - Describe the reagents and odors which may need to be exhausted through the atmosphere. Discuss the odors' nature, frequency, duration and intensity of odors. Discuss the potential of generation of hydrogen sulfide and other odors from the concentrator and if possible mechanisms for control.

Where would spilled reagents be disposed of if necessary?

SECTION 1.4.4.2, TAILINGS SLURRY AND WATER TRANSPORT SYSTEMS - Describe any leak detection systems and proposed facilities or actions designed to prevent groundwater contamination in the event of a pipeline failure. What inspection, maintenance and replacement procedures are planned?

SECTION 1.4.4.3, MINE WASTE DISPOSAL PONDS - Describe a "suitable" water depth in the tailings pond. Provide details on how the slurry discharge into the ponds will be conducted in order to prevent degradation of the filter and drainage layers.

This section should also describe operation of the seepage control systems during both short and long-term mine shutdowns.

SECTION 1.4.5.1, WATER RECLAIM SYSTEM - Provide additional detail on the operation and the maintenance of the reclaim ponds. Describe specifically the chemical constituents the ponds are designed to control. Describe the chemical and physical characteristics of the water going into and out of both ponds. Please be more specific than "trace" and "small amounts". Provide data to support the projected treatment which will occur in the ponds. Provide data which will support the expected cyanide reduction due to treatment in the ponds.

How will anaerobic decomposition affect the thionate oxidation process? Provide data to demonstrate the compatibility of the liner materials with the chemical characteristics of the water.

While the volume of the reclaim ponds will provide surge capacity when both ponds are in operation, what will happen if one of the ponds is taken out of service?

SECTION 1.4.5.2, WATER TREATMENT SYSTEM - While the maximum flow of contaminated groundwater is shown in Figure 1.4-17, the other flow values given are average. Please provide maximum flows for each of the processes shown in this figure. What are the flow values for the "brine" "condensate" and "reverse osmosis permeate". The area for "discharge to environment" shows two flow blocks. Since one is labeled Maximum, is the other Average? What is the projected maximum which could be recycled back to the mill? Provide a discussion of factors which could prevent recycle of water to the mill. What effect would elimination of the recycle to the mill have on the projected maximum discharge flow?

Will the treatment system be designed to accommodate full treatment of the "uncontaminated" mine water? What measures will be available if the mine inflow exceeds the expected 2,000 gallons per minute?

What are the projected wastewater characteristics going into each of the treatment systems? What are the projected treatment system effluent characteristics? Exxon does not need the effluent limits to derive this information.

Under what circumstances would or would not the "uncontaminated" mine water go through the water treatment system? Assuming all "uncontaminated" mine water would need to be treated, how long could the mine and mill continue to operate in the event of a treatment system failure?

SECTION 1.4.6., OVERALL WATER BALANCE - The overall water balance provided was for "mature" operation. When will the mine/mill complex become "mature"? Provide a discussion of the water balance over the startup, development, operation, and closure of the mine.

This section states that the average amount of water expected to be discharged will be up to 1,893 gallons per minute. Section 1.4.5.4 indicates that this figure is the maximum flow to be discharged. Please specify the maximum flow to be discharged.

The maximum flow rate previously provided to the Department by Exxon of 3.34 cubic feet/second was used to developed preliminary effluent limits for Swamp Creek. This is substantially less than the apparent anticipated maximum flow. Final effluent limits will be based on a maximum flow rate. Thorough documentation of the estimated maximum flow rate will be necessary.

SECTION 1.4.7, OPERATIONS TRAFFIC - What was the basis for assuming 1.25 persons per vehicle? Please provide estimates of vehicle miles traveled. Quantify by type the truck traffic throughout the operation phase including trucks removing materials from the site.

SECTION 1.4.8.2, TREATMENT OF SANITARY WASTES - Provide the basis for the average daily flow rate of 32 gallons per minute. The Wisconsin Administrative Code referenced in Figure 1.4-20 should be H 63.14 rather than H 63.10.

SECTION 1.4.8.3, REFUSE - This discussion of waste disposal is very general and does not substantially add to previous sections. Please discuss in detail the production, transport and disposal (including off-site disposal) of all waste materials.

SECTION 1.4.8.4, FUELS AND OTHER ENERGY REQUIREMENTS - The CPCN application estimates the peak electrical demand level at 37 MW while the EIR indicates a demand between 40 and 45 MW. Please resolve this discrepancy and provide a detailed electric load forecast, including a detailed list of equipment with electrical load data which comprise the mine energy requirements (including lighting, heating, etc.).

SECTION 1.4.9, POLLUTION CONTROL, EMISSIONS AND EFFLUENCE TS - Discuss the disposition of all air pollution control nonrecyclable dusts and sludges.

Please provide a description of the separate burnt pebble lime facility in Section 1.2, including plan elevation drawings of process equipment and air pollution control equipment.

SECTION 1.4.10, OPERATIONS PERSONNEL - Please provide a detailed account by job category of operations workers including the hiring schedule by year to indicate work force buildup. Discuss the job categories which could be filled locally, and provide a detailed discussion on Exxon's hiring policies. Provide an estimate of the minimum and maximum number of positions filled locally, and the basis for those estimates. Discuss any contracts or agreements at other Exxon operations which could impact employment opportunities at the Crandon mine.

SECTION 1.5.1, FACILITIES REMOVAL - Concrete and masonry waste material used as fill will need to be disposed of in accordance with solid waste requirements.

Please provide us with the documentation supporting the conclusion that "the proposed mining practices would have a negligible affect on surface topography."

What types of equipment would likely be left underground? No equipment which may pose a threat to groundwater will be allowed to remain underground.

It is extremely doubtful that the hydraulic gradient will be restored to that which existed prior to the beginning of mining. It is also doubtful that "no flow through the mine workings will be possible." Some flow through fractures will occur.

Please state specifically whether all shafts and galleries of the mine will be filled prior to flooding. Discuss contingency measures available should the mine cause groundwater degradation after closure.

This section should include permanent abandonment of water wells on the property.

Further comments and questions on the facilities closure and reclamation will be provided in a review of the Reclamation Plan.

CHAPTER 2 - DESCRIPTION OF THE ENVIRONMENT

Please provide plan sheet maps of the site area with appropriate coordinates documenting existing conditions including all roads, trails, disturbed areas, reclaimed areas, drill holes, borings, private wells, dust pits, contours and other significant landmarks. Most of the maps previously provided by Exxon are at least three years old and do not show the work done since then or the current network of roads and trails.

SECTION 2.1.1.4, ANALYTICAL PROCEDURES - The method used for particulate characterization was inadequate. The use of a dissecting needle with mounting liquid to lift a portion of the filter particulate does not provide a representative sample. The recommended procedures include cavitation in an ultrasonic bath to remove particulates from a section of the filter excised by surgical cutting. Low temperature ashing of the particulates is also recommended.

There is no indication of how many microscopical fields were examined and/or how many total particles were counted.

The analysis conducted failed to account for sulphates and nitrates; verification by DNR indicated these were major components. These components are usually found in the filter matrix and the methodology employed would not provide access to those particles.

SECTION 2.1.1.5, QUALITY CONTROL - The statement that "the DNR observed and approved the calibration of the air quality monitors is inaccurate." DNR does not "approve" calibrations.

The laboratory procedures utilized for analyses did not meet EPA requirements and were not approved until November 1, 1977 when the sample handling and sample conditioning procedures were changed. Thus, the data certification date for Station 1 and Table 2.1-2 is in error. The correct date should be November 1, 1977.

SECTION 2.1.4, DISPERSION METEOROLOGY - The meteorological data used for air dispersion modeling in the air permit application is inadequate. This issue will be discussed in further reviews of the air permit application.

SECTION 2.1.5.1, TOTAL SUSPENDED PARTICULATES - This section states that the second highest 24-hour TSP concentrations ranged from 60 to 72 ug/m^3 while Table 2.1-8 indicates that they actually ranged from 61 to 77 ug/m^3.

Our computations of the data submitted reveal some differences from those in Table 2.1-8 as follows:

		Table Value	DNR Value
October-December 1977	Station 1	13.2	13.0
January-March 1978	Station 2	11.1	11.5
January-March 1978	Station 3	11.6	11.2
July-September 1978	Station 1	18.8	18.9
Annual Geometric Mean	Station 3	17.9	17.1

Please explain these differences, in particular, the annual geometric mean for Station 3.

As mentioned in previous correspondence, the results of your particulate characterization study are inadequate. These results failed to provide the breakdown of the classes of particles. The data sheets generally indicate the specific components of the classes, but there is no indication that any of those components were specifically identified in the analyses. Also, the statement that the samples were about evenly divided between large and small particles appears inconsistent with the data in Appendix 2.1B.

SECTION 2.1.5.3, TRACE ELEMENTS - Copper was found in the highest concentration, not lead. The possible anomalous nature of the copper concentration does not necessarily discount the observed values.

SECTION 2.1.6, EXISTING AIR QUALITY MONITORING PROGRAMS - Some of the air quality concentration units in this section are not identified.

The ozone and nitrogen oxide data collected in Marathon County are meaningless. The data were only collected through April which misses the entire season (May-September) when ozone concentrations are high. Comparing a four month average nitrogen dioxide concentration with an annual standard is not acceptable. Please provide the most recent years worth of nitrogen oxide data from the nearest Northwoods or rural site.

SECTION 2.1.7.3, AREA SOURCES - There are area sources of air pollution within the environmental study area. These sources include agricultural, residential heating, motorboats, snowmobiles, and aircraft. These are all minor sources.

SECTION 2.2, GEOLOGY - Discuss the geologic relationship of the Crandon deposit with the Mole Lake deposit and the potential for other deposits within the study region.

SECTION 2.2.1, FIELD AND LABORATORY METHODS - This section covers only a small portion of the overall geological investigation methodology. Include a description of all tests that were run for both glacial geology and bedrock geology. Discuss the reasons for conducting the tests, the methods used in obtaining the samples and analyzing them, and the quality assurance programs that were employed. Describe the methodologies for drill hole and soil borings abandonment.

SECTION 2.2.1.1, PRELIMINARY INVESTIGATIONS - Provide additional information on the process by which the surficial glacial geology map was prepared. Describe the technical resources utilized in this process.

SECTION 2.2.1.2, DRILLING PROGRAM - Please provide plan sheets and summarize tables indicating all of the borings within the study area and the parameters analyzed in these borings.

SECTION 2.2.1.3, SOIL TESTING - ASTM or equivalent procedures were used except for pH testing. In the pH procedure, the ratio of soil to water was 25 g to 100 ml instead of the ASTM ratio of 3 g to 50 ml. The different proportions of soil and water would cause slight differences in the measured pH. The soil and water mixtures were equilibrated for 24 hours instead of 30 minutes as specified by ASTM. pH values would change during the 24 hour period because of CO_2 exchange between the sample and the atmosphere. Please explain this deviation from the ASTM procedure.

Appendix 2.2.A states that the clay mineral analysis results are reported as parts per ten because of plus or minus 2 percent variability in the test. Table 2.2-5 reports these results as percentages, rather than parts per ten.

This section should include a discussion of procedures used in obtaining the samples from borings and should indicate what drilling fluids were used. Include a discussion of the potential for contamination of the samples from drilling fluids.

The thin sections for asbestiform mineral testing were verified by the Wisconsin Geologic and Natural History Survey geologists, not DNR geologists.

The methods described for asbestiform are adequate for a gross analysis for geological purposes, but are insufficient for determining the potential impact on air quality of small or trace quantities of asbestiform fiber in the tailings material or glacial tills. Additional analyses will be necessary to evaluate these potential asbestiform sources. Please consult with our Bureau of Air Management prior to initiating additional testing.

This section should include a separate subsection entitled "Bedrock Testing" and should include the methodology used for the physical, chemical and radiological testing of bedrock samples. Both the soil testing and bedrock testing sections need to provide more detail regarding the logic used in the selection of samples for testing purposes, and the methods used for preparing composite samples.

SECTION 2.2.1.4, QUALITY CONTROL - This section contains no detailed information. Describe the quality control procedures used by the field and laboratory personnel. Provide quality control data collected when Exxon's samples were analyzed (i.e., results of spikes, duplicates, standard reference samples) and describe the evaluation of the quality control data. Without this information, we can reach no conclusions as to the accuracy and precision of the soil testing data.

SECTION 2.2.2.1, BEDROCK GEOLOGY - The ranges in time for the ages of the Pleistocene given in Table 2.2-1 are incorrect. The correct ranges, in millions of years, are as follows:

Wisconsinan	-	0.007 - 0.075
Valderan	-	0.007 - 0.011
Twocreekan	-	0.011 - 0.0125
Woodfordian	-	0.0125 - 0.022
Farmdalian	-	0.022 - 0.028
Altonian	-	0.028 - 0.075

Characterization of the Pleistocene deposits as "sand and gravel" is inaccurate. A more general term such as "glacial drift" should be used and a description of the drift provided.

Please provide boring logs for all data points utilized in preparation of the bedrock surface map (Figure 2.2-2). Include geophysical data such as resistivity, conductivity, spontaneous potential, and gamma and neutron absorption.

The discussion of bedrock weathering indicates that it took place since the end of glaciation. It seems more likely that the bedrock surface was weathered prior to deposition of the glacial deposits. Please provide additional discussion and documentation of Exxon's interpretation.

SECTION 2.2.2.2, SURFICIAL GEOLOGY - The discussion of physiography indicates that Rolling Stone Lake is west of the ore body. It is actually south of the ore body.

The DM series of borings expressed the carbonate content of the sample as a percentage of the pebble count. All parameters should be indicated in uniform units such as percent $CaCO_3$ for the total sample.

SECTION 2.2.3.2, BEDROCK - The average ore grades given are inconsistent with other figures provided elsewhere in the report. Estimates in this section are 5.5 percent zinc, 1.1 percent copper, and no estimates for lead, gold or silver. Volume V, appendix 1.2A indicates grades of 5.8 percent zinc, 1.4 percent copper, and 0.5 percent lead. Please indicate the actual estimated average grade for all recoverable metals.

What is the basis for the statement that the glaciers striped off about 50 feet of weathered rock?

SECTION 2.2.4, GEOLOGY OF THE SOLID WASTE DISPOSAL SITE - This section should contain a definitive statement regarding the presence or absence of valuable mineral deposits (both metallic and nonmetallic) in both Sites 40 and 41 along with a discussion of the methods and information used to arrive at the conclusions.

SECTION 2.3.1.1., PIEZOMETER INSTALLATIONS - Some variations from the described typical piezometer installation did occur, most of which appear to be detailed in the referenced appendices. These construction variations should be carefully reviewed during the final selection of permanent monitoring wells. Figure 2.3-2 should show the layer of fine sand between the sand/gravel and bentonite slurry.

The piezometer design has resulted in damage to the upper portions of some piezometers by frost heaving. Periodic field inspections should be scheduled to assure that the wells are properly secured, identified, and maintained. The design of any new piezometers should be modified to eliminate the frost heaving problem. The casing elevation of any damaged piezometers will need to be reestablished.

SECTION 2.3.1.2, GROUNDWATER LEVELS - The Department was not involved in the September, 1980 water levels survey of the 109 piezometers or in subsequent water level surveys. Collection of another data set with appropriate

Department participation is necessary. Prior to doing this survey, it is essential that Exxon complete the piezometer inspection and repair work mentioned above.

SECTION 2.3.1.3, GROUNDWATER QUALITY - This section should note that inert gas was used whenever air lifting was the selected method for well evacuation prior to sampling.

Describe filtration of samples in the field including the reasons for filtering and the types of filters and apparatus used. A new DNR quality assurance manual covering the sampling of groundwater is being developed and should be reviewed prior to the collection of any future groundwater samples.

SECTION 2.3.1.4, SOIL PERMEABILITY - How was well efficiency determined or what value was assumed for well efficiency for the in-situ field permeability test calculations?

The Dames & Moore groundwater report briefly describes the TW-1 and WW-2 pumping tests and the exploration borehole packer test, but the level of detail is insufficient for the Department's review and verification purposes. Please provide further documentation on these tests.

Please provide discussion and documentation of the CDM pumping tests of 1981.

The use of the Hazen approximation to estimate the permeability of soil samples is questionable. This method was intended to be applied to clean, uniformly graded sands, not to gravels or sands with silt or clay. Please apply the Fair-Hatch approximation to confirm permeabilities from a broad range of soil types previously analyzed with the Hazen methods.

Provide detailed discussion and documentation of all Packer tests performed in deep exploration bore holes and clarify the relation of bore holes to the ore body.

SECTION 2.3.1.5, WATER WELL INVENTORY - Now that the extent of the potential groundwater drawdown has been delineated, further information regarding the private water wells and systems within the drawdown area is needed in order to properly project impacts to individual water systems. Additional data needed include pump type, pump capacity, depth of pump intake, well elevation, along with the data currently missing from the various columns of Appendix 2.3-G.

In order to assure that replacement water supplies will be at least equivalent in quality and capacity to the existing supplies, it will be necessary to establish baseline capacity and quality for each of the existing wells. Because of the variability of the aquifer in both quality and capacity, this cannot be accomplished accurately by extrapolating data from the existing monitoring system. We suggest that Exxon meet with the Department to further delineate the scope of the necessary studies. Study goals should include a determination of the potential for water quality changes resulting from the redirection of groundwater flow, the needs for well and pump modification or for a centralized water distribution system, and the potential for significant increases in operation, maintenance and pumping costs.

SECTION 2.3.1.6, SPRING SEEP AND INTERMITTENT STREAM SURVEY - Where are the results of the September, 1978 spring seep and intermittent stream survey presented? These results should be included on appropriate maps and tables.

Several residents have reported observing springs in Little Sand Lake. Did the reconnaissance confirm the presence of this type of flow into otherwise perched lakes, and how is this flow incorporated into the overall water balance of the surface water bodies?

SECTION 2.3.1.7, CHEMICAL ANALYSES - Please provide details regarding the quality assurance procedures used for the chemical preservatives contained in the sample collection bottles.

SECTION 2.3.2.2, GROUNDWATER OCCURRENCE - The statement that "the groundwater contained within the Precambrian rocks are highly mineralized and unsuitable without treatment for many domestic, industrial or agricultural uses" is not accurate and should either be substantiated by facts or removed. Please provide a more detailed discussion on the occurrence and availability of groundwater in the region.

SECTION 2.3.3.1, GEOLOGY - Please clarify the range of thickness of drift material within the environmental study area. This section states that the drift ranges from less than 8 m to more than 91 m, while on page 2.2-31 the overburden at the solid waste disposal area is characterized as up to 98 m thick.

The Precambrian bedrock in the proposed mine area strikes approximately north 80° west.

SECTION 2.3.3.2, GROUNDWATER OCCURRENCE - This section needs to be expanded to include more area-specific information on the occurrence of groundwater and the extent of perched, unconfined and confined aquifer conditions.

Please provide all available groundwater maps and supporting documentation. Provide maps showing the seasonal groundwater fluctuations. These maps should be on the large plan sheet format on a suitable base map with the data control points indicated. The resolution for the MWDF should be increased by adding one meter isopleths.

SECTION 2.3.3.3, GROUNDWATER RECHARGE-DISCHARGE REGIME - It is stated that the rate of groundwater recharge from Skunk, Oak, Little Sand and Duck Lakes is unknown. It is possible that some of these rates will need to be ascertained in order to accurately assess the project's impacts. Additional data needs will be evaluated during our review of the groundwater modeling effort.

Additional detail on the hydraulics of Little Sand Lake are necessary. Is this an area of strictly groundwater recharge or is there some groundwater flow through the lake? Provide water level data from beneath the lake (in msl elevations) and describe the well construction. Discuss the relationship of lake levels to groundwater elevations and the saturated/unsaturated conditions beneath the lake.

The statement on the top of page 2.3-23 that the bottom of Little Sand Lake is 6.1 meters (20 feet) below the groundwater table is inconsistent with the findings of the Little Sand Lake drilling project. The lake has a reported maximum depth of 21 feet and the water table is approximately 11 feet below the surface. The lake bottom, therefore, is approximately 10 feet below the regional water table. Were incorrect figures used for the lake seepage rate calculations?

The extent of groundwater basins and location of groundwater divides should be shown on Figure 2.3-4.

Please provide a north-south oriented hydrogeologic cross-section through the mine/mill area.

Provide additional detail on other "local" aquifer conditions present. Did Exxon make any attempt to delineate the extent of these zones? Please indicate where these conditions are known to exist.

Please provide a comparison of the groundwater hydrographs with precipitation data and with representative lake and/or stream hydrographs.

Document the rationale for use of the selected intermittent piezometer hydrographs.

Well DMB-14 seems to be a poor example for discussing seasonal water level changes because of its extremely short period of record. How can seasonal trends be discussed when this well was not observed for a full seasonal cycle?

Please elaborate on the conclusion that changes in groundwater storage can be considered negligible. The proceeding statement that the rate of groundwater discharge was influenced by long periods of high or low precipitation appears to conflict with this conclusion rather than support it.

SECTION 2.3.3.4, MAIN GROUNDWATER AQUIFER CHARACTERISTICS - Please expand this section to include a detailed discussion of the geology, hydrology and hydrologic characteristics of the main aquifer.

SECTION 2.3.3.5, GLACIAL DRIFT - Please describe the methodology used to determine which samples were to be tested for permeability in the appropriate section.

Very little information on the vertical component of groundwater flow is provided. Additional information will be necessary for an evaluation of potential impacts to the groundwater system. At minimum, the vertical head distribution in the groundwater flow system must be presented by the addition of groundwater flow nests to the vertical hydraulic cross-sections in Section 2.3, Appendix 1.2A and Appendix 4.18. This requires at least two piezometer nests in each cross-section and will necessitate reorientation of some of the cross-sections and the installation of piezometers at some of the existing well locations to provide an adequate number of piezometer nests.

The boundaries utilized in the groundwater flow modeling need to be documented by fully penetrating the indicated discharge points. Multiple piezometers will be needed to indicate the orientation of the gradients at these points.

I suggest that you consult with Department staff before installing additional piezometers.

SECTION 2.3.3.6, BEDROCK - Please provide a detailed description of the groundwater flow through the bedrock. Include a detailed analysis of the horizontal and vertical gradients, permeability, and changes of flow through time. Describe the type and number of rock fractures and the associated flows.

The absence of large vertical gradients between the bedrock and overburden materials does not preclude vertical contaminant transport. It has not yet been demonstrated that minor gradients do not exist. Other transport mechanisms such as convection flow resulting from thermal and chemical density variables may also be in operation.

Where is the relationship between potentiometric surface and deep boreholes and drift addressed in the Recharge/Discharge Section?

SECTION 2.3.3.7, GROUNDWATER USE - Please provide estimates on categories and amounts of water use in the area.

Please indicate the locations of all wells in the area. Were the well owners not available during the initial field survey ever recontacted? Additional attempts to contact these owners should be made.

This section indicates that WW-1 has a specific capacity of 5.0 gpm/foot. The correct figure for this well should be less than 0.5 gpm/foot based on its total capacity of less than 10 gpm. The poor yield of WW-1 is the reason that it was necessary to construct WW-2.

The quote from Olcott, 1968 and Borman, 1971 does not agree with the results of the various Exxon studies which indicate that water well yields of less than 10 gpm to more than 1,500 gpm are possible in the immediate vicinity.

SECTION 2.3.4, GROUNDWATER QUALITY - Please include data points on Figures 2.3-14, 15 and 16.

SECTION 2.4.1, FIELD AND LABORATORY METHODS - Locating the staff gauges below culverts at road crossings likely produced lower than actual flow values, particularly during higher flows, due to attenuation caused by the culverts. Undisturbed natural settings provide more accurate flow information.

Table 2.4-1 does not indicate a gauging station on Squaw Creek at CTH "M". SG-20 is indicated at that location on a Dames and Moore map dated November 9, 1977. On October 11, 1977 a gauging station was established there as well as on Spider Creek (SG-21). Please provide discussions of these gauging stations.

Sampling stations R, T, W and X are not included in Table 2.4-2 or Figure 2.4-2. Please provide a discussion of these stations.

SECTION 2.4.1.1, LAKE LEVELS - Apparently lake gauges were read only in April of 1979, the second wettest year in the period of record. This means that little information is available on the expected lake fluctuation in a wet year.

Table 2.4-4 should indicate that sediment sampling was conducted concurrently with the water discharge monitoring at the locations listed.

SECTION 2.4.1.2, STREAM FLOW RATES - Since the staff gauges installed in the streams had to be corrected for ice movement each spring, the readings obtained during the winter are of questionable accuracy. Stream flow values were determined only for the reliability limit for the gauges. Higher and lower flow values were not determined. This incomplete data base is of questionable value for preparation of hydrographs and for estimating base flow.

SECTION 2.4.1.4, WATER AND BOTTOM SEDIMENT CHEMISTRY - Table 2.4-10 describes the method for "Total Sulfur" analysis as "acid cook, analyze for sulfate, sum with sulfide". Please provide a description of the method or a reference.

The detection limit listed in Table 2.4-10 for sulfate (as SO_4) is 1 mg/l. The detection limit for total sulfur (as S) is 0.01 mg/l. If the final analytical procedure for both parameters is the turbidimetric measure of sulfate, the detection limit for total sulfur (as S) should be 1 mg/l x Formula weight of S/Formula weight of SO_4 0.3 mg/l. All total sulfur data in the EIR are reported to the nearest 0.01 mg/l while SO_4 data and reported to the nearest 1 mg/l. Please explain how total S data can be reported to a greater number of significant figures than the SO_4 data from which it is partially derived.

For almost all of the water samples, total sulfur values are almost exactly 1/3 of the sulfate values. However, for the sediment data, all samples except Swamp Creek Station D have total sulfur values much greater than sulfate/3 plus sulfide. This seems to be a discrepancy if the total sulfur method is measuring the sum of sulfate and sulfide. Is it possible that sediment components interfered with the turbidimetric method? Please explain this discrepancy.

Heavy metals (except mercury and arsenic) in sediments were run on a solution of the ashed sample rather than on an acid digestate. This is not a standard procedure and spike recovery data should be provided to demonstrate the suitability of the method.

Are the detection limits for the parameters listed in Table 2.4-10 the same as the reporting limits? Are the detection limits for fecal streptococcus and fecal coliform one organism per ml or one organism per 100 ml? Why is the detection limit for total chromium 0.0001 mg/l when Cr^{+3} is 0.001 mg/l and Cr^{+6} is 0.01 mg/l? Should the filter pore size in the footnote be 0.45?

The arithmetic mean for pH should be "negative log" instead of "anti log" of the geometric mean of the H^+ ion concentration.

Fecal coliform for Station E was the only parameter reported as having a "greater than" value. The parameters should be reported as such in the text rather than stating that a parameter may occasionally be reported as "greater than" in the appendices.

SECTION 2.4.1.5, QUALITY CONTROL - Please provide descriptions of the quality control procedures governing field activities. Reference the "standard methods" of field calibrations which were used.

SECTION 2.4.2.4, REGIONAL EVAPOTRANSPIRATION - The assumption that evapotranspiration is the difference between precipitation and runoff is too general for the surface water analysis.

SECTION 2.4.2.5, SURFACE WATER USE - Permits are not required for all diversions, only agricultural or irrigation diversions. Domestic uses may be occurring. Also, water rights are separable from riparian lands.

Most of Table 2.4-16 is out-of-date. Permits number 1, 3, 4, and 5 have been revoked. There is no pending court review. The permit for number 7 is now under Schroeder Bros. Farms. The application for the permit under number 8 has been dismissed. The reference cited as the source for this information is incorrect.

SECTION 2.4.3, HYDROLOGIC CHARACTERISTICS OF THE ENVIRONMENTAL STUDY AREA - The statement that the glacial drift of the area allows water to move under the ground and stores water percolating from the surface conflicts with the generalized assumption about evapotranspiration is discussed earlier.

The characterization of stream dynamics should include the storing and flow dampening effects of wetlands.

It should be made clear that the hydrographs (Appendix 2.4J) only partially show the seasonal stream discharges. By not determining certain high or low values, the hydrographs are not an accurate presentation of actual stream flows that occurred.

SECTION 2.4.4, SWAMP CREEK DRAINAGE BASIN

SECTION 2.4.4.1, DRAINAGE LAKES AND ASSOCIATED STREAMS - Table 2.4-18 does not indicate that there is considerable marl present in Ground Hemlock Lake.

Rice Lake - What were the reasons for the concentration for iron (4.34 mg/l) in January, 1978 at Station F and the low values for alkalinity (1 mg/l on 7/7/77 and 7 mg/l on 9/7/77) at Station N? Are these actual values or the result of contaminated samples or laboratory errors?

Please discuss the ranges of parameter concentrations measured in sediments and characterize the values as polluted, moderately polluted, or unpolluted.

Hemlock Creek - Ten of the stations listed in Table 2.4-19 had undetermined flow values lower than the estimated base flows. Please provide a detailed discussion on how the estimated annual average base flows were derived. Footnote B describes the normal procedure for determining base flow. How can base flow be accurately estimated on the basis of incomplete and possibly erroneous data due to ice movement of gauges?

The flow data at SG-6 Hemlock Creek (Table 2.4-19) are incomplete since higher and lower flow values could not be quantified.

Please provide the temperature and percent saturation of dissolved oxygen on page 2.4-30 where the concentrations of dissolved oxygen is discussed.

Please discuss the high (66.2 ppm) value for Cr in the bottom sediment sample at Station A-1 on Hemlock Creek. How many composites were made for the bottom sediment samples?

Swamp Creek - The small tributary stream system flowing into Swamp Creek from the north Section 24 of T35N, R12E, should also be discussed.

The statement on page 2.4-34 that no metals were measured above detection limits at Stations D and E during the 1979 and 1980 sampling is inaccurate. Appendix 2.4F, Table F-29 for Station D indicates detectable levels of aluminum, iron, manganese, and zinc were found. Please provide the water chemistry collected by USGS that corresponds to the period of sampling by Exxon. Explain why iron, manganese, phenol, and sulfates were all very high at Station D in comparison to other stations in the study area.

Outlet (Metonga) Creek - Higher and lower flow values for Outlet Creek occurred on numerous occasions but could not be quantified. Please discuss how this affects the accuracy and reliability of the base flow estimate.

Hoffman Creek and Springs - This section states that the base flow for Hoffman Creek was estimated from limited discharge data. Please discuss the accuracy and reliability of the estimate of base flow.

SECTION 2.4.4.2, SPRING LAKES

Ground Hemlock Lake - Please include a discussion of any wetland influence on lake level variation. Also, marl is a common lake substrate.

The metalimnion temperature change is described as 16°C which is not equivalent to 61°F.

SECTION 2.4.5.1, DRAINAGE LAKES AND ASSOCIATED STREAMS

Rolling Stone Lake - Again, no mention is made of the possible effects of wetlands on water level fluctuations. Rolling Stone Lake has a shoreline of 40% wetland.

Please provide a discussion of why Station M-4 had much higher sediment concentration levels of Cr, Cu, Fe, Pb, phenol and sulfate than Station M-2.

Pickerel Creek - Although a measured flow of 1.2 cfs was recorded and low flow rates occurred on numerous occasions but could not be quantified, the base flow estimate for Pickerel Creek is 2 cfs at SG-19. Please discuss this apparent discrepancy.

Creek 12-9 - Flows lower than the base flow estimate of 3 cfs occurred but could not be quantified. Please discuss the reliability of this base flow estimate and the base flow contribution provided by the extensive adjoining wetland.

Skunk Lake does not intermittently contribute surface water drainage to Little Sand Lake. Page 2.5-99 states "Skunk Lake has no surface water discharge...".

SECTION 2.4.5.2, SEEPAGE LAKES

Little Sand Lake - Dissolved oxygen levels below 5.0 mg/l were described at Station H in March, 1977 and 1978 and at Station I in March, 1978. Appendix 24H, Table H-7 indicates dissolved oxygen below 5.0 mg/l were found at Station I in March, 1977, at both stations in February, 1978, and at Station H in February, 1980. Please discuss these findings.

Explain the discrepancies between sediment samples Stations H and I for total sulfur, Fe, Pb and Mn.

Duck Lake - The intermittent outlet stream from Duck Lake should be described as passing through a major wetland before discharging into Little Sand Lake.

Although the base flow estimate for the outlet of Duck Lake was estimated at 0.5 cfs, most low flow discharges recorded in Table A-14 are lower. This indicates that the base flow estimate is too high. Please provide the basis for this estimate and a discussion of its reliability.

The water chemistry data presented reflects conditions prior to the 1980 pump test discharge. Since this discharge significantly altered the water chemistry of the lake, these data do not represent current baseline conditions. Please include a discussion of the affect of the discharge on the lake chemistry and provide baseline data describing the current water chemistry.

Deep Hole Lake - Please describe the two intermittent outlets from Deep Hole Lake.

Deep Hole Lake is described as a lake with a neutral pH. However, the water quality data in Appendix 2.4F show that Deep Hole Lake has a pH range of 5.4-6.6 which reflects a slightly acidic condition.

Mole Lake - Please provide additional discussion and clarification on the drainage to and from Mole Lake. District personnel have observed the stream flowing into Mole Lake.

SECTION 2.4.6, WOLF RIVER DRAINAGE BASIN - The dissolved oxygen concentrations at Station Y on the Wolf River were consistently above 5 mg/l. Dissolved oxygen ranged from 1.4 to 2.7 mg/l at Station Z in the summer of 1978. Please provide a discussion of the possible explanations for the low level of dissolved oxygen observed at Station Z.

SECTION 2.4.7, HYDROLOGICAL RELATIONSHIPS - This section states that a major portion of the water generated during precipitation events infiltrates into the groundwater. Discuss how this statement relates to the assumptions used in calculating regional evapotranspiration in Section 2.4.2.4.

Water Balances - Please discuss the relationship of the various water budgets developed to the project proposal. Provide additional justification for the groundwater inflow and outflow estimates based on available hydrogeological data. Explain in detail why the available data were sufficient to establish a water budget upstream from SG-19 and for Swamp Creek at Highway 55.

Why don't the water balances for sub-basins SG-6 and SG-23 (summer time) sum to zero?

Water Quality - A comparison of mean values of alkalinity between Hemlock Creek (Stations A-1 and A-2) and Swamp Creek (Station V) is not valid since alkalinity varies seasonally and Station V lacks a complete year's worth of data.

SECTION 2.4.8, SUMMARY AND CONCLUSIONS - Conclusion number 7 is contradicted by unexplained, unusually high metal concentrations reported for both water and sediment samples at several stations.

SECTION 2.5., AQUATIC ECOLOGY

SECTION 2.5.1.1, PHYTOPLANKTON - This section indicates that samples for phytoplankton were collected with "two calibrated centrifical pumps that were deployed in tandum." What was the purpose of using two pumps?

Were the 50-liters phytoplankton samples collected at each one meter interval or did the sample reflect a depth composite? If the sample was depth-composited, how was this accomplished?

Samples were preserved with three buffered formalin. Problems with cell distortion and disruption would likely occur using formalin particularly with sensitive algal forms such as Crytophyceae and Chrysophyceae. How were these samples stored prior to enumeration and identification? What was the approximate length of time between field collection and analysis?

A Sedgewick-Rafter (SR) counting cell was utilized for identification and enumeration of species present. How was Exxon able to identify to the species level and occasionally variety level using the SR cell? Use of the SR cell usually precludes the use of high magnification required to identify many forms to this level. Were other methods used to identify to the lowest taxon level? What power of magnification was used? Were any other algal concentration techniques used in counting? Were fresh (unpreserved) samples ever collected for identification purposes?

The chlorophyll method utilized in this work (APHA, 1971) differs from that more recently recommended (APHA 1975, 1980). The main difference is that one N HCL is recommended in the pheophytin a correction technique. The use of a stronger acid solution may lead to significant errors. What was the normality of the HCL used in the chlorophyll analysis? What were the typical ratios of optical density at 663 nm or 665 nm before and after acidification? Did this ratio ever exceed 1.70?

What type of filter was utilized in the chlorophyll a analysis? How much water was usually filtered to collect the chlorophyll a sample? What extraction method was used?

SECTION 2.5.1.5, BENTHIC MACROINVERTEBRATES - Where are the "miscellaneous substrate" recorded? Please provide a describe of the substrate types actually sampled qualitatively.

Please describe in more detail how the diversity index was calculated and what taxa level was used to calculate diversity.

SECTION 2.5.1.7, TISSUE CHEMISTRY - As acknowledged in your March 11, 1983 letter, the study design for tissue chemistry was not adequate to establish baseline metal concentrations in plant and animal tissues. It is essential that these conditions be established as part of the pre-operational program. This program should utilize single species samples, not composites of unknown proportions. Representative species should be selected by a review of the literature to identify indicator species, and should represent each trophic level. A taxonomic reference collection must be made of organisms used in the program, and excess material for each sample must be collected and secured for future verification or reconfirmation.

Monitoring activities for fish tissue analyses should include the fillets with the skin left on the muscle tissue. This is consistent with the Department's monitoring programs and is necessary for accurate comparison with FDA standards.

It is is unnecessary to use 20 to 25 fish for one composite sample. Five to 10 individuals will provide an adequate sample.

SECTION 2.5.2, SWAMP CREEK DRAINAGE BASIN

SECTION 2.5.2.1, DRAINAGE LAKES AND ASSOCIATED STREAMS - The statement "Biological sampling stations were established near...habitat that was representative of the overall stream or lake system" is misleading. Even though that habitat type may be predominant, it cannot be considered representative for an entire lake or stream system.

Phytoplankton-Rice Lake - In Table 2.5-8, Cryptophyceae were reported in one collection from Rice Lake. Appendix 2.5A indicates the genus and species are unknown. Did this Cryptophyceae count represent one specific algae or were a number of different Cryptomonads included in this count? It is unusual that Cryptomonads weren't reported more frequently in other phytoplankton samples from Rice Lake especially when they were reported in high concentrations in the August 1, 1981 sample at Station N. Please elaborate on this apparent anomaly.

The occurrence of the unknown "Chrysococcus-like" algae at high concentrations is surprising. Was MacFarland's tentative identification of this algae confirmed by other phycologists. Please describe the "quality of preservation" which apparently inhibited this identification. Were any samples collected fresh and analyzed before preservation?

Does the chlorophyll data reported represent pheophytin corrected data? If so, what pheophytin levels were reported?

Periphyton - The "Chrysococcus-like" algae was reported in abundance in the periphyton community at Station D on Swamp Creek in March and August of 1977. If this algae was Chrysococcus, it does not seem reasonable since this algae is free-swimming and would not be expected to be an important member of the periphytic "attached" algae community.

SECTION 2.5.2.3, PONDS

Fish - Brook trout are reported locally in Hoffman Springs. We will conduct additional sampling to verify their existence.

SECTION 2.5.2.4, ECOLOGICAL RELATIONSHIPS OF SWAMP CREEK DRAINAGE BASIN - This section is inadequate due to a lack of data for the portion of Swamp Creek below Rice Lake. The discussion needs to include the biotic and physical sub-watershed contributions to downstream segments and the groundwater and ecological linkages of this watershed to adjacent watersheds (e.g. in-out migration, recolonizations, water and nutrient exchanges, etc.).

As indicated on page 2.5-46, there are at least 9 species of macrophytes in Oak Lake, not 5.

SECTION 2.5.3, PICKERAL CREEK DRAINAGE BASIN

SECTION 2.5.3.2, SEEPAGE LAKES - The reddish colored algal bloom in July, 1977 and Little Sand Lake was attributed to Phacus pyrum. This seems unusual since Prescott (Algae of the Western Great Lakes Area) does not indicate this species is noted to form algal blooms. Smith (Freshwater Algae of the United States) reports that the genus Phacus is rarely found in abundance. Was this finding confirmed by the phycologist responsible for verifying phytoplankton identification?

At what depths were the March, 1978 phytoplankton samples in Skunk Lake collected when chlorophyll a levels exceeded 300 ug/l? Was the lake ice and snow covered at the time?

What were the distinguishing features between Chrysococcus-like algae and Chrysococcus major found in the periphyton community of Duck Lake.

Aquatic Macrophytes - What is the "rush" listed for Little Sand Lake? The waterwort listed is probably Elatine minima rather than Elantine (sic) triandra.

Department personnel have also found three-way sedge (Dulichium arundinaceum), Robbin's pondweed (Potamogeton robbinsii), sedges (Scirpus sp.), cattail (Typha latifolia), bladderwort (Utricularia sp.), bulrush (Scirpus sp.), sphagnum moss (Sphagnum sp.), leatherleaf (Chamaedaphne calyculata), and water moss (Drepanocladus sp.) in Skunk Lake.

SECTION 2.5.3.4, ECOLOGICAL RELATIONSHIPS OF PICKERAL CREEK DRAINAGE BASIN - Please see Section 2.5.2.4 for applicable comments.

SECTION 2.5.4, WOLF RIVER - This section needs to include a discussion on macrophytes occurrence, particularly the existence and extent of wild rice beds. Also, please provide an explanation for the low dissolved oxygen readings at Station Z.

SECTION 2.5.5, ECOLOGICAL AND HYDROLOGICAL RELATIONSHIPS

Threatened and Endangered Species - The references cited for state and federal government listings of threatened or endangered species should be updated to reflect the current Chapter NR 27, Wis. Admin. Code and the 1982 Federal Register, respectively. Also, the references to the DNR "watch list" are misleading. This list only identifies species for which additional information on their status in needed. Use of the "watch list" implies knowledge of a species status which does not exist.

SECTION 2.6, TERRESTIAL ECOLOGY

SECTION 2.6.1, FIELD AND LABORATORY METHODS - This section should include discussions of methodologies employed by consultants doing EIR - related studies, such as Mine Waste Reclamation, Ltd. (soils), Normandeau Associates, Inc. and IEP, Inc. (wetlands), Steigerwaldt (forestry) etc.

SECTION 2.6.3, VEGETATION

SECTION 2.6.3.2, PROJECT AREA - The integration of relevant consultant reports (e.g. Steigerwaldt, 1982, Normandeau Associates, 1982) is cursory and does not provide the necessary descriptive detail. These reports must either be incorporated in or appended to the EIR.

The two large areas in Section 1, T34N, R12E, classified as "F" should be "N". These are aspen regeneration sites.

As we have previously stated, the transect selected for characterization of the "swamp conifer type" was not representative of a typical swamp conifer wetland in the area.

Please provide the referenced addendum to the Normandeau Report to the Department.

The species identified as green ash (Fraxinus pennsylvanica) in this and other sections appears to include individuals which are actually black ash (Fraxinus nigra). Please discuss the identification of these species.

SECTION 2.6.4.1, MAMMALS - The white-tail deer densities should be eight to nineteen per 259 ha (1 square mile) of deer range. Table 2.6-12, columns 3 and 4 should be titled "Total Gun Harvest". The 1979 gun harvest was 563 in Unit 44.

The heron rookery indicated on Figure 2.6-9 south of County Trunk Highway "K" is no longer active.

SECTION 2.6.4.2., BIRDS - Bald eagles should be included in the listing of summer resident raptors. Please identify where the three broad-winged hawk nests were located.

SECTION 2.6.5, THREATENED AND ENDANGERED SPECIES - The distance between an endangered or threatened species occurrence and the mine site should be given as the distance to the closest mine-related development rather than to the ore body.

SECTION 2.6.5.2 - WILDLIFE - Three, not four listed mammals are found in Wisconsin. The Indiana Myotis is not considered a Wisconsin species and it should be deleted from Table 2.6-21.

The Canada Lynx is a state-listed endangered species that might occur in the study area considering habitat types and known locations in northeast Wisconsin. Please include a discussion of the Lynx in this section.

Table 2.6-21 should be updated with current information. Please see NR 27, Wis. Adm. Code. Also, there are 12 state-listed bird species, not 11.

The discussion of bald eagle productivity needs to be updated. See the attached report by C. Sindelar. The discussion of osprey productivity should similarly be updated with the attached summary table.

There are now ten, not 12 species of amphibians and reptiles on the Wisconsin lists. The wood turtle is considered threatened and the spotted salamander has been deleted from the threatened list.

SECTION 2.6.6, SENSITIVE RECEPTORS - This section must include a discussion of sensitive receptors in the aquatic environment and must identify the most probable pollutants expected from the mining operation. For example, a detailed description of the sensitivity of wild rice to water borne sulfates is needed.

SECTION 2.6.7, ECOLOGICAL RELATIONSHIPS - This section is exceedingly brief and narrow in scope. The discussion should characterize the area as a remote, low population density region possessing intrinsic values for both human use and ecological relationships. These values enable the area to support species preferring solitary habitats and support the tourism industry, an essential element of the area's economy.

The statement that "the forests of the site area are primarily second-growth northern hardwood pole timber that are managed for pulp wood production" is not correct. These forests are managed for production of quality saw logs employing intermediate cuts to release saw log crop trees. These intermediate cuts result in production of hardwood pulp.

Other notable resources of the area include a small southern flying squirrel population, and breeding bald eagles, osprey and Cooper's hawks.

SECTION 2.6.8, SUMMARY AND CONCLUSIONS - The forest reconnaissance survey results should be summarized under vegetation along with a summary of "special importance wetlands" identified in the wetland assessment report. As stated previously, the description of white cedar as a dominant overstory species for the Swamp Conifer type is misleading.

The statements regarding threatened and endangered species need to be updated.

SECTION 2.7, ARCHAEOLOGICAL AND HISTORICAL RESOURCES - With one exception, the proposal is in compliance with State and Federal regulations concerning the protection of historic and archeological sites. The exception is the proposed water discharge pipeline corridor which has not been surveyed. It is our understanding that this corridor will be surveyed this spring.

SECTION 2.8, NOISE - We are currently evaluating the technical expertise available within state agencies to address the portions of the EIR dealing with noise. If sufficient expertise is not available, we intend to employ a qualified consultant to conduct this portion of the review. In either case, we will provide you with our comments at the earliest opportunity.

SECTION 2.9, LAND USE AND AESTHETICS

SECTION 2.9.2.1, FORESTRY - This section states that "...Forest Crop Law and Woodland Tax Law ... lands ... must be opened to public hunting and fishing." This is incorrect. Only Forest Crop Law lands are required to be opened for public hunting and fishing.

The average growing stock volume of six cords per acre is too low unless this includes non-productive cover types; the average saw timber volume of 4,050 board feet per acre is too high unless this includes only saw timber stands. Please provide the basis for these volume estimates.

SECTION 2.9.2.3, RECREATION - We know of no public access on Walsh Lake as shown on Figure 2.9-3. Also, the public access indicated on the south shore of Rolling Stone Lake is undeveloped.

Kramer's Ski Trails discontinued operations several years ago.

The Spider Creek Wildlife Area should also be mentioned in the discussion of public land open to recreational activities.

SECTION 2.9.2.7, PUBLIC LANDS - Not all state lands in the area are State Trust Lands. The Department owns the NW 1/4, Section 28, T35N, R13E, and the Lily Lake Wildlife Area lands.

SECTION 2.9.3 - AESTHETICS - Please include a discussion of the presence or absence of intrusive man-made features such as towers, airport beacons, etc., that affect the natural aesthetics of the area.

SECTION 2.10, SOCIO-ECONOMICS - Our review of this section will be primarily conducted by our consultant(s). Portions of the reviews which we have provided to you critiquing the methodology papers are relevant to this section and are herein incorporated by reference. The remainder of our comments on socio-economics will be provided at the earliest opportunity.

CHAPTER 3 ALTERNATIVES TO THE PROPOSED ACTION

SECTION 3.1, NO ACTION - Please include a discussion of areas already affected by the mining proposal and the ramifications of the "no action" alternative on these areas. Include descriptions of Exxon activities that have already occurred, mining impact funds which have been distributed, land speculation and housing impacts, and other economic and social influences occurring from the existence of the Exxon office, its payroll, and its families.

SECTION 3.2, EXPAND THE PROPOSED PROJECT - Provide a detailed discussion of the alternative of expanding the project by servicing other ore bodies in the area. Include an evaluation of the technical or economic feasibility of such an expansion and describe the design modifications which would be necessary. Discuss the likelihood and ramifications of ore reserves exceeding the current estimate.

Please provide a specific discussion of ore cut-off points at various metal prices. Include an explicit description of the function relating ore cut-off points with the various metal prices.

SECTION 3.4.1, MINE/MILL FACILITIES SITING - Include a discussion of the social, political and economic ramifications of relocating the mill facilities within Site Area A across the township boundaries.

SECTION 3.4.2.1, MINE WASTE DISPOSAL FACILITY - Issues related to siting of the MWDF have been addressed in a November 23, 1982 letter from the Department. This section does not respond to the comments and questions contained in that letter which are incorporated herein by reference.

The wetlands identified in Figures 3.4-2 through 3.4-5 are inconsistent with the Normandeau Report, particularly the wetland drainages. The small wetland northeast of Deep Hole Lake is not shown on Figure 3.4-3. Please resolve these inconsistencies.

Please include data describing the indirect wetland destruction resulting from alternate layouts and a discussion of the relationship of alternative layouts to different sub-watersheds.

Please provide a separate discussion of siting alternatives for the reclaim water ponds.

SECTION 3.4.2.2, TAILINGS AND RECLAIM WATER PIPELINE AND HAUL ROAD CORRIDOR - Please provide the assumptions utilized in calculating the area of wetlands affected by the various alternatives. Previous discussions with the Department indicated a proposed corridor width of approximately 66 feet. Chapter 1 of the EIR does not provide any description of the corridor and Chapter 4 indicates a width approximately 200 feet.

Discuss the proximity of Route 1 to Skunk Lake and potential impacts to waterfowl. Discuss a "no wetland impact" alternative.

Describe the significance of the route length. Why was Route 1 chosen over Route 2 when Route 2 is shorter, has comparable topography and affects the same acreage of wetlands?

SECTION 3.4.3.1, RAILROAD SPUR - At least 5 alternate routes were evaluated by Exxon. Please include in this section a discussion of Alternate "F" and any other routes which were considered.

Discuss additional alternative siding locations south of Swamp Creek including locations at or near the mill site. The information requested in a June 8, 1982 letter from the Department regarding the Industrial Spur Agreement must also be submitted as part of the EIR.

Please describe the basis for the wetland impacts presented in Table 3.4-2. Define the extent of wetland destruction necessary for the proposed and alternative siding locations. Revise Table 3.4-2 to show that alternative C crosses Hemlock Creek rather than Swamp Creek.

The discussion of Route C should include the wetland-spring pond complex along the east end. The description of Alternate C siding should include the potential for disturbance and erosion problems affecting the wetland to the west.

SECTION 3.4.3.2, ACCESS ROAD - Please include discussion of all other alternate road corridors which were considered. Provide the methods and assumptions which were used to calculate the aerial extent of wetland destruction.

This section states Route A-1 reflects an alignment adjustment made to minimize wetland destruction. However, as stated in our June 8, 1982 letter, Route A-1 appears to cross approximately 400 feet more wetlands than A-2. Please resolve this discrepancy.

The discussion Route E should clarify if the projected amount of wetland destruction includes the affects of upgrading Little Sand Lake Road.

SECTION 3.4.3.4, SURFACE WATER DISCHARGE - Please describe and discuss the alternative corridor locations for Route A along with the reasons they were not selected or attainable. Describe the "various environmental reasons" which led to the selection of the proposed route. Discuss alternative discharge structures and alternatives for the access road needed to maintain the structure.

SECTION 3.4.3.5, GROUND WATER DISCHARGE - Please provide the available data for the four alternative seepage lagoon sites. Include information on groundwater conditions, subsurface stratigraphy, permeabilities, seepage rates, and other site-specific data.

SECTION 3.5., STRUCTURAL/OPERATIONAL ALTERNATIVES - This section must include discussions of structural and operational alternatives which could reduce emissions and effluents. For example, there is no discussion of alternatives which would reduce noise emissions such as relocating the compressor and mine exhaust fans underground, utilizing electric instead of diesel powered locomotives above ground, and using conveyors instead of trucks for moving earth and preproduction ore. Additional details on alternatives which mitigate environmental impacts are needed.

SECTION 3.5.1, MINING METHODS - Please provide a discussion of the various types of underground mining considered for the Crandon project. Describe how an open pit operation would be conducted. Why would the potential environmental affects of the caving methods be greater than those of the proposed methods.

Considerably more information is needed on alternatives for controlling groundwater inflow to the mine. Discuss additional methods of controlling mine inflow including freezing portions of the upper levels of the ore body and construction of a slurry cut-off wall or other barrier to groundwater flow around the ore body in the unconsolidated deposits. Provide an economic comparison of inflow control alternatives.

Provide documentation for the estimated effectiveness of pumping the overburden aquifer. Describe the likely quality of the water which would be pumped along with the potential environmental ramifications of utilizing this alternative.

SECTION 3.5.2, PROCESS ALTERNATIVES - Considerably more documentation will be necessary to evaluate the alternative of pyrite flotation. Please provide information to support your conclusions that pyrite is not marketable and that production of other pyrite products is not economically feasible.

Provide additional detail on the operational advantages and disadvantages of separating pyrite. Provide the capital and operating cost estimates and describe in greater detail the operational requirements for pyrite separation. Explain why more disposal area would be required. Examine the alternative of producing sulfuric acid and other compounds utilized in the mine/mill process.

Discuss the potential for a pyrite market appearing in the future and disposal alternatives which would allow reclaiming pyrite if a market did develop.

SECTION 3.5.3, WASTE ROCK TRANSPORT - Please provide additional information on the operational and economic disadvantages of conveyor transport of waste rock and preproduction ore. Include a discussion of the air emissions expected from both the truck and conveyor transport system. Evaluate the alternative of storing preproduction ore at the mill site.

SECTION 3.5.4, TAILINGS TRANSPORT SYSTEM - Discuss the capability for early leak detection in both the surface and buried systems and the associated environmental considerations. Describe the anticipated repair and/or replacement frequency and discuss alternatives for a more reliable pipeline along with procedures for replacing lines in both systems.

SECTION 3.5.1, TAILINGS DISPOSAL METHODS - Include a discussion of the effects of various tailings disposal techniques on the tailings chemistry, leachate generation, acid production, stabilization, etc.

Please include a discussion of the alternative of constructing the proposed tailings ponds and practicing the subaerial method of tailings deposition.

Another advantage of the subaerial method as depicted in Figure 3.5-5 is the greater ease of pipe cleaning.

SECTION 3.5.5.1, TAILINGS POND SEEPAGE CONTROL - Please provide additional discussion and documentation on the seepage control system selection process. Provide a cost analysis of the alternatives considered. Evaluate the alternative of using two or more liner materials in conjunction with each other. Include a discussion of specific geomembranes, especially High Density Polyethylene. Provide additional evaluation of the alternative of using the fine fraction of the site till materials. Discuss the alternative liners' performance in the event of a failure of the underdrain system. Provide an evaluation of alternatives for the underdrain system.

Provide a discussion of the disadvantages of the proposed bentonite admixture liner such as the difficulty of maintaining a uniform thickness during construction, the threat to the structural integrity by construction and operation activities, the problem of maintaining the liner in a saturated state and the possibility of cracking and intrusion of the coarse-grained drainage blanket, and the difficulty of rehydrating the bentonite in a high-salt environment.

Please provide additional discussion on the elimination of the surface sealant and polymeric material options and describe why they were eliminated from consideration. Compare and contrast the quality assurance and control requirements for construction of a geomembrane and a six-inch soil-bentonite liner.

SECTION 3.5.5.3, MINE WASTE DISPOSAL FACILITY RECLAMATION CAP - Three capping systems were analyzed but only two are described. Please provide a description and discussion of Alternative 3. Please provide a detailed analysis of using a geomembrane in the cap structure.

Describe revegetation of the cap and discuss the effect of revegetation on the alternatives (required species limitation, potential root penetration of the bentonite layer, etc.). Describe the disposition of the water collected in the drain layer for Alternatives 2 and 3. Discuss the use of native clay materials in the cap along with the use of two or more liner materials in conjunction with each other. Discuss the shrink/swell potential of bentonite admixtures and the possibility of dehydrating the cap.

In Table 3.5-1, please explain why runoff is less for Alternative 2 in a wet year than in a normal year.

SECTION 3.5.6.1, WATER TREATMENT SYSTEMS - Table 3.5-2 should define the meaning of Very High, High, Moderate and Low. These discussions should also note that, while each of the unit processes described in the table by itself may not be suitable for use to treat mine/mill water, when used in conjunction with other process units, the resulting treatment system could alleviate some of the problems listed in the comments section. Table 3.5-2 does not identify the 10 treatment systems selected for further evaluation as stated on page 3.5-17. Please provide a table listing each of the 10 treatment systems and comparing performance capability and reliability (based on similar plants currently in use), and cost. Provide specific projections of effluent quality for each of the treatment alternatives analyzed.

Provide a discussion of facility and operational alternatives for the unit processes of the proposed treatment system. Could the reclaim pond size be reduced by adding mechanical aeration and more frequent sludge removal? Describe other available alternatives.

Hydrocarbons are noted as a potential operating problem for System 7. What will prevent this same problem from occurring in the proposed system?

SECTION 3.5.6.2, EXCESS WATER DISCHARGE METHODS - This section should recognize the proposal to separate "uncontaminated" water from treated process water. Please provide a discussion of the alternative of using different discharge methods for the two wastewater streams. Include a detailed analysis of using excess water to mitigate surface water impacts resulting from the groundwater drawdown.

Please provide more detail on the wetland discharge alternative. This discussion should recognize the sensitivity of wetlands to hydrological changes, metals and organics, and the potential to accumulate metals in this soil. Water quality standards for a wetland discharge would be designed to protect fish and aquatic life against acute toxicity effects as well as protecting plants against phyto-toxicity effects. Effluent limits developed for a wetland discharge would not necessarily be less stringent than those for a surface water discharge. Exxon has not provided enough information to allow a thorough evaluation of this alternative.

Please describe in greater detail why the wetlands and groundwater discharge options were removed from consideration.

SECTION 3.5.7, Energy Sources - Please provide a discussion of the alternatives of using propane as a fuel for the mobile vehicles and using natural gas as a fuel for the emergency generators. These gaseous fuels would be cleaner alternatives to diesel fuel and gasoline.

Provide an analysis of alternatives to the 115 kV transmission line including the use of a 69 kV transmission line source and the use of on-site self generation to meet some or all of the electrical requirements.

SECTION 3.6, CONCENTRATE TRANSPORT - Please discuss the transportation methods, volumes, and most likely or preferred final destinations for each of the concentrates.

This chapter must include a section on closure and final use alternatives. Provide a detailed analysis of potential uses of the mine/mill facility by other industries. Reference the discussion of extending the project by milling ore from other localities in Section 3.2.

Based on our knowledge of the Department of Energy's requirements for high level radioactive waste, the use of the proposed mine as a repository does not appear to be a feasible final use alternative. However, you should include any information you have related to use of the mine/mill complex as a high level radioactive waste repository facility.

APPENDIX 2.3B

Please provide all available groundwater elevation data. These data should be tabulated and converted to actual mean sea level elevations. Please specifically identify the data sets used to develop groundwater models.

APPENDIX 2.3C - TABLE C-36

Why was the Walantowski well frozen on sampling dates 11/20/77 and 02/01/78? The well is located near Little Sand Lake where the groundwater level should be fairly deep (20-30 ft) with respect to the land surface. Is this an artesian well?

APPENDIX 2.4E - TABLE E-1

SWAMP CREEK STATION D - Percent solids are reported as 1.02. This is approximately 10,000 mg/l. Iron is reported as 19,894 mg/l, which is greater than the reported total solids. Please explain this discrepancy.

APPENDIX 2.4F

The last sample date for Station K (page F-201) is August 13, 1980. More recent water quality data have been collected (see July 15, 1981 letter from Lewis Blair to Archie Wilson). There were also some sample collections and analysis performed by Northern Lakes Services. Please provide these and all other data which have been collected.

Organic nitrogen values were recorded as very high in comparison to the range of values observed on the 8/1/77 sampling date at the following sampling sites: Station L (18.97 mg/l), Station H (11.12 mg/l), Station I (7.81 mg/l), Station O (5.72 mg/l), Station F (4.03 mg/l), Station N (11.12 mg/l), Station J (6.86 mg/l), Station M-1 (5.76 mg/l), Station A-1 (4.81 mg/l), Station H (4.09 mg/l), Station D (4.23 mg/l), Station E (3.69 mg/l). There may have been some sample contamination on 8/1/77 that caused the high values for organic nitrogen at these stations. Please provide an analyses of these data.

APPENDIX 2.4H

TABLE H-1, Site M-5 - Dissolved solids plus suspended solids do not equal total solids.

TABLE H-10 - The March, 1977 sample pH is reported as 1.5. Conductivity and turbidity are also significantly higher than for the other sampling data for this station. Please provide an analysis of these results.

APPENDIX 2.4L

SECTION 1.2, SAMPLE COLLECTION AND HANDLING PROCEDURES - This section does not reflect any changes in the sample collection and handling procedures as requested in our July 9, 1982 letter. We recommended discontinuing the procedure of handling the procedure of hand-dipping preserved bottles just below the water surface. Later field visits indicated that this procedure was changed. This variation in procedure should be explicitly stated in this section.

We also requested that water quality samples be iced in the field immediately after collection. Please describe the procedure actually utilized.

SECTION 2.1.3, SAMPLE ANALYSES - As noted in our July 9, 1982 letter the Hydrolab 6D was not used during either of the Department field inspections. A Hydrolab Model 750 was used during the first inspection, and individual field meters for conductivity and pH were used during the second visit with the dissolved oxygen being checked with the modified Winkler method. We also noted problems in the procedures used to calibrate the meter. Please indicate if the procedures were modified as requested and provide a description of the methods actually utilized.

Were alkalinity, conductivity and pH tests run in the laboratory and checked against field measurement? What quality control procedures were followed to assure that data collected by the Hydrolab were accurate and reliable. Does the Hydrolab stay calibrated well in cold weather? Are the detection limits given in Table L-2 different than the reporting limits for water and sediment sampled parameters? If so, please provide the reporting limits for those parameters being analyzed as part of the Swamp Creek monitoring program. Also, a detection limit of 0.0002 mg/l is necessary for mercury analysis. Is the detection limit for mercury of 0.002 mg/l correct?

As noted in our July 9, 1982 letter the US Geological Survey recommends that "no more than 5% of the total flow will be in any one segment". Please indicate the number of segments used, the percent flow in each segment, and whether all flow was accounted for in the gauging measurements.

SECTION 3.1.1, WATER CHEMISTRY - Please relate the dissolved oxygen concentrations given to the percent saturation values for dissolved oxygen. The apparent detection limits for selenium, mercury and phenol vary between samples (Tables L-3, L-5 and L-6) and from the limits reported in Table L-2. Please explain these variations.

Are the concentrations given in Tables L-5 and L-6 reported as dry weight?

The replicate sediment samples taken at Station 3 show significantly different values for total sulfur, total Cr, Fe and Mn. Please provide an explanation of these discrepancies between replicate sediment samples.

SECTION 4.0, DISCUSSION

SECTION 4.1.1, WATER - Table L-8 shows significant variations in dissolved oxygen saturation during the period of data collection. It is likely that there are significant swings in the diurnal dissolved oxygen in Swamp Creek. Thus, it will be necessary for Exxon to collect mostly diurnal dissolved oxygen samples at various times during the year when dissolved oxygen levels are critical. This issue is being further addressed in our review of the most recent Swamp Creek monitoring proposal.

SECTION 4.2, HYDROLOGY - The conclusion that the area of Swamp Creek between County Trunk Highway "M" and Station 3 is an area of groundwater recharge is not adequately supported. The greatest increases of flow between the USGS and SG 24 measurements were in April and, to a lesser extent, in May. Runoff from the watershed between the two sampling points may have contributed a large portion, if not all, of the difference. Also, in July there was less flow measured by SG 24 than USGS. Please provide additional discussion and analysis of the groundwater contribution to this stream segment. If the groundwater flow is sufficient, trout may occur in the area.

APPENDIX 2.5A

The species list for the project's lake are lacking an algal group, the Crytophyceae, which were commonly encountered in samples collected by the Department. The use of Formalin as a preservative may have destroyed organisms in this group. At a minimum, the phytoplankton samples collected in Oak, Little Sand, Skunk, Deep Hole and Duck lakes should be reevaluated. The quality of the preservation techniques should be analyzed to determine if sensitive algal groups have been destroyed.

APPENDIX 2.5D

Qualitative benthos results are presented only as presence/absence data. If numbers of individuals were recorded for the qualitative sampling, please provide these data.

There are several editorial errors in this section; Orthoclaiinae (Orthocladiinae), Sdigara (Sigara), Talitridaea (Talitridae), Dipteraoridae (Diptera), Tanypodinaeus (Tanypodinae), Boetidae (Baetidae), Boetus (Baetis).

APPENDIX 2.5E

Please provide length-frequency summaries by water body as requested in our August 3, 1982 letter. What was the purpose of the individual collection numbers for each fish? Were all these fish taken to the laboratory?

Are the unidentified cyprinoids still available for examination? These specimens were apparently not identified because they " . . . were all immature and were not formally identified . . . ", and " . . . they could not be verified through scale counts." The fish in question, however, ranged from 36 mm (1.4 inches) to 67 mm (2.6 inches) total lengths according to Tables E-35, E-36 and E-47, and should have been identifiable. This information was previously requested in our August 3, 1982 letter.

APPENDIX 2.5G

SECTION 2.0, METHODS - As requested in our July 30, 1982 letter, please define "kick-seining".

Only two substrate types were collected qualitatively while the other substrates were collected quantitatively (Ponar dredge). By limiting qualitative samples to only those substrates not sampled with the Ponar dredge, some organisms may be unrepresented in the collection. The small sampling area of quantitative samplers is usually not considered adequate to collect a representative sample where a maximum representation of taxa is desired. Qualitative methods which sample a large area are necessary for complete representation of taxa in a sample.

Biotic index values were calculated based on qualitative samples of only shoreline habitats, which contradicts Hilsenhoff's recommended methods for sample collection (ripple or fast current areas). This modification to the biotic index calculation does not address the habitat problem which may invalidate the biotic index results.

SECTION 3.0, RESULTS - This section must recognize the possibility that many of the fish captured by seining and electrofishing in the same or adjacent stations were the same fish recaptured.

The relative abundances in Table G-13 should be reported in actual percentages based on numerical data rather than in general occurrence category. The data presented in Tables G-14 and G-15 should be supplemented by graphic displays of percent composition by Order and Family.

The statement that rheophilic benthic taxa were present in low densities is contradicted by *Cheumatopsyche* sp. which was "abundant" at Station 2 and "common" at Station 3.

The discussion of the Biotic Index should address the non-recommended sampling techniques mentioned above. Future Biotic Index samples should be collected from the fastest current areas possible at each station and, if possible, at physically similar sites to allow comparisons between stations.

APPENDIX 2.5GA

The exact location of the benthos sampling stations should be indicated on Figure GA-1 to allow identification of the segments/habitat data corresponding to each sampling location. The habitat specification (depth, velocity, substrate type) for each benthos sampling station should be listed to allow comparison with segment physical data.

APPENDIX 2.6A

The orchid *Arethusa bulbosa* also occurs in the study area.

The accepted common name for *Nuphar varietum* is the yellow water lily.

APPENDIX 2.6C

The green-wing teal has been positively identified on Skunk Lake. Ring-neck ducks are common at times on study area lakes.

The red-neck grebe, double-crested cormorant, and the great egret should be listed as state-threatened.

APPENDIX 2.6D

The five-lined skink is not a turtle.

The wood turtle is now listed as threatened and the spotted salamander is no longer listed.

APPENDIX 2.10A

Much of the socio-economic data is at least three years old and no longer accurate. For example, the Oneida County Jail construction was completed about two years ago. One of the two "deteriorated bridges" listed in Table 2.10A-6 was replaced in 1982. Our needs for updated socio-economic baseline data will be identified during our consultant's review of the EIR.

2912Q

WISCONSIN BALD EAGLE BREEDING SURVEY - 1982

GENERAL REPORT

Done under contract with
the WI DNR (with matching
fund assistance from the
U. S. Fish & Wildlife Service)

by

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October 1, 1982

ACKNOWLEDGEMENTS

Many WI DNR personnel helped in varying degrees, but the most notable are Ray Vallem (Hayward), Ron Eckstein (Rhinelander), and Jim Hale and Randy Jurewicz of the Madison DNR Office of Endangered and Non-Game Species.

U. S. Forest Service Biologists Anthony Rinaldi (Rhinelander) and Howard Sheldon (Park Falls) again funneled nest reports to me as well as doing the April aerial survey on their respective Forests (the Nicolet and Chequamegon National Forests).

John W. Winship, U. S. Fish & Wildlife Service Regional Pilot-Biologist, piloted the plane on both of the aerial surveys.

Helen Cummings again furnished us with equipment and lodging while working in the NorthCentral District.

Many others helped in varying degrees, each in their own way. My sincere thanks to all.

WISCONSIN BALD EAGLE BREEDING SURVEY - 1982

INTRODUCTION

The 1982 eagle work was funded with Fish and Wildlife Service money administered by the WI DNR (Office of Endangered and Non-Game Species). I was under contract with the State of WI to do the survey.

David L. Evans was hired by the Madison Office of Endangered and Non-Game Species of the WI DNR for the duration of the field work. His assistant, Mary Jane Evans, although essential to the project, was not officially hired. She was on the project on an "expenses only" basis, supported through monies raised by donations solely through the efforts of Helen Cummings and administered by the NorthEast Wisconsin Audubon Society.

Reproduction continued to be excellent. The total production of young was the best to date. We again had increases in occupied territories and territories with at least some degree of activity as well as total young produced.

METHODS

Two aerial nest checks were done with Sindelar as the observer and John W. Winship (FWS Regional Pilot-Biologist) maneuvering the FWS Cessna 337 (Skymaster).

The first check was done April 12, 13, 14, 15, 20, 21, and 22 and the second flight was done May 24, 25, 26, and 28. The first aerial checks on the Nicolet and Chequamegon National Forests were done by Forest Service Biologists Toni Rinaldi and Howard Sheldon, April 5th and 7th and April 27th and 28th respectively. Their reports did not indicate the type of aircraft utilized.

On May 26, while I was still in the air working on the second aerial nest check, my field assistant, David L. Evans, began "ground checking" sites to confirm aerial observations, band the young, collect addled eggs, etc. He was assisted during this period by Mary Jane Evans.

Upon completion of the "flight", Ron Eckstein (WI DNR Wildlife Manager, Rhinelander) and I began ground checks in the NorthCentral District.

For the 15-day period June 1st to June 15th both crews operated nearly continuously and simultaneously. Then for the three day period of June 17th, 18th, and 19th only one crew consisting of Sindelar and Evans was operational, and with one final day's work by Sindelar and Eckstein on June 22nd the "ground checking" was terminated. Total time spent on ground checking -- 39 crew days.

RESULTS AND DISCUSSION

New pairs continued to appear, showing up in the following counties: Ashland, Barron, Bayfield, Burnett, Douglas, Dunn, Iron, Marinette, Oneida, Polk, Rusk, Sawyer, and Vilas. Some of these showed up in old numbered territories that had been vacant for many years -- in two cases utilizing the original nest structure that had been abandoned for the last one and a half decades.

In other cases, new pairs showed up in new areas not known to have had previous eagle use.

Three hundred ninety two separate nest structures were located within 368 numbered territories.

Twenty "new territories" were numbered, and 38 new nests were located.

within old numbered territories.

I again did not search all of the Apostle Islands. I merely checked known nests and was encouraged by the results -- at least four and possibly five pairs amongst the Islands, three of which apparently laid eggs. There is now little doubt that "something" is wrong here. We now have had five attempts over a three year period, all of which ended in failure.

The eagles nesting on Wisconsin's mainland of Lake Superior also again did very poor. There are probably still five pairs, only two of which were seen incubating this year and only one of these was productive (one young). Two of the remaining three pairs were thrown into the S.D. category by the presence of a single adult seen in the territory. In the fifth territory I saw no adults but I feel it likely the pair is still present as they seldom lay eggs, and this year's observations are consistent with a pattern established by this pair.

Reproductive statistics have remained remarkedly unchanged for the past six years. Percent nest success, brood size, and number of young raised per nest attempt remain all essentially unchanged.

The total young produced (251) increased 10% plus from 1981 but is fully accounted for by the 10% increase in the number of breeding pairs.

The expansion of the breeding population is extending outward as well as filling in vacant territories. If the breeding population continues to expand, it might be reasonable to expect pairs to show up soon on the Lake Michigan shoreline.

A very substantial effort was made to band young (U. S. Fish & Wildlife Service #9 rivot type leg bands) with 232 so marked (92% of the known production). Twelve addled eggs were collected and will be analyzed for chemical contaminants by the U. S. Dept. of Interior, FWS, Patuxent Wildlife Research Center, Laurel, Maryland.

SICK, INJURED AND DEAD YOUNG: 1982 YEAR CLASS

During routine banding procedures, one of two young in MT-2a (Lake Noquebay Outlet) was injured. It was sent to Dr. Pat Redig at the University of MN Raptor Rehabilitation Center. Although I never learned the extent of those injuries, I have since learned it did recover, and on June 30, 1982 it was shipped to Missouri to be hacked back to the wild from atop a man-made tower.

At least five young were lost to natural causes:

1) One June 10th, while banding the two young at SA-30b (Pine Point), the remains of a third young was noted.
2) On June 4th while banding the two young at IR-11, Rice Lake, the remains of a third young were present.
3) One June 16th the banding crew at BY-18, Dawn Lake, found only the remains of young. The aerial observation on May 27th indicated two young present at that time.
4) One June 3rd all that remained in VI-65a, Arbor Vitae L., was a few bones and feathers. The aerial observation of May 25th indicated one young.

DEAD YOUNG, 1981 YEAR CLASS, NOT FOUND UNTIL 1982

The remains of one of two young banded 6-9-81 at DU-8, Buckley Creek, were found under the same nest 5-27-82. At the time of banding it's primary wing feathers were approximately two inches long, and it was slightly smaller than it's nest mate. Feathers found on the remains in 1982 indicate the flight feathers were not "hard pinned" at the time of death; therefore it died prior to fledging but it lived approximately two weeks after banding, making the time of death approximately June 23, 1981.

The remains of one of two young banded 6-20-81 at AS-22, Bad River, were found under the nest 6-18-82. Feather development on the remains indicated it never fledged and died within a week of banding, ± 6-25-81. It's nest mate was found very sick ten miles north of Lyman Lake (Douglas County), August 8, 1981 and died the following day (a straight line distance of about 60 miles).

SUMMARY

The WI eagles experienced another good year. We know of 10% more breeding pairs this year and the state's known production of young was also up 10% over last year. Percentage of nest success, brood size, and number of young raised per breeding attempt remain essentially unchanged at a very acceptable level.

Those eagles nesting along Lake Superior, although increasing slowly in numbers (probably due to recruitment from the inland population), continue to experience an exceptional high rate of reproduction failure.

Wisconsin Bald Eagle Breeding Survey - 1982
Breakdown by County and State Totals

County	Terr. w/@ least S.D. of Activity	Occ. Terr. w/ Known Outcome	Succ. Terr.	# of young Produced
Ashland	9	8	4	7
Barron	4	4	4	6
Bayfield	9	7	4	6
Burnett	10	9	9	17
Chippewa	1	1	1	1
Douglas	13	11	7	11
Dunn	4	4	2	2
Florence	2	2	1	2
Forest	10	10	7	13
Grant	1	1	1	3
Iron	17	15	10	16
Jackson	0	0	0	0
Juneau	1	1	0	0
Langlade	3	3	3	6
Lincoln	7	5	4	5
Marathon	1	1	1	2
Marinette	5	5	3	5
Menominee	2	2	2	4
Oconto	1	1	1	3
Oneida	33	25	15	26
Polk	3	3	2	4
Price	8	7	6	8
Rusk	2	2	1	1
Sawyer	29	26	17	31
Taylor	1	1	0	0
Vilas	44	40	31	54
Washburn	14	13	9	18
Wood	0	0	0	0
TOTAL	234	207	145	251

WISCONSIN BALD EAGLE REPRODUCTIVE COMPARISON
(1973 - 1982)

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Terr. w/@ least S.D. of activity					154	166	172	196	202	234
Occ. Terr.	108	107	111	149	151	140	151	175	188	207
% nest succ.	61%	55%	62%	61%	72%	70%	70%	75%	73%	70%
Ave. # yg/occ. terr.	.94	.94	1.0	.95	1.2	1.2	1.2	1.3	1.2	1.2
Ave. # yg/succ. terr.	1.6	1.7	1.6	1.6	1.7	1.7	1.7	1.8	1.7	1.7
Total # yg produced	107	101	112	139	181	168	179	231	227	251

WISCONSIN BALD EAGLE BREEDING SURVEY - 1982

Statewide

70% nest success
1.2 yg/occupied territory
1.7 yg/successful territory

Successful Territories

	1 yg	2 yg	3 yg	Dist. Total
North Central Dist.	22 (36%)	33 (54%)	6 (10%)	106 young
Northwest Dist.	27 (37%)	40 (55%)	6 (8%)	125 young
Lake Michigan Dist.	1 (14%)	5 (71%)	1 (14%)	14 young
West Central Dist.	3 (100%)	0 (0%)	0 (0%)	3 young
Southern Dist.	0 (0%)	0 (0%)	1 (100%)	3 young
STATE TOTAL	53 (37%)	78 (54%)	14 (10%)	251 young

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Department of [illegible]ral Resources

Osprey Survey
1973-1976

DISTRICT	# Active Territories				#Productive Territories				% Nest Success				# Young Produced				#Young/Productive Territory				#Young/Active Territory			
COUNTIES	'73	'74	'75	'76	'73	'74	'75	'76	'73	'74	'75	'76	'73	'74	'75	'76	'73	'74	'75	'76	'73	'74	'75	'76
NORTHWEST																								
Sawyer	8	6	12	11	6	6	7	7	75	100	58	64	8	4	14	11	1.3	*	2.0	1.6	1.0	*	1.2	1.0
Rusk	0	0	1	1	0	0	1	1	0	0	100	100	0	0	1	1	0	0	1.0	1.0	0	0	1.0	1.0
Washburn	10	7	10	8	6	7	3	4	60	100	30	50	9	5	6	6	1.6	*	2.0	1.6	1.0	*	0.6	0.7
Burnett	6	4	4	9	4	3	3	3	67	75	75	33	6	7	6	4	1.5	2.3	2.0	1.3	1.0	1.7	1.5	0.4
Polk	1	-	-	3	1	-	-	2	100	-	-	67	1	-	-	4	1.0	-	-	2.0	1.0	-	-	1.3
Iron	13	12	10	10	6	8	8	9	46	67	80	90	8	8	13	15	1.3	1.0	1.6	1.7	0.6	0.7	1.3	1.5
Douglas	5	5	4	4	3	3	3	3	60	60	75	75	4	4	6	4	1.3	1.3	2.0	1.3	0.8	0.8	1.5	1.0
Bayfield	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	43	34	41	46	26	27	25	29	60	79	61	63	36	28	46	45	1.4	1.0	1.8	1.6	0.8	0.8	1.1	1.0
NORTH CENTRAL																								
Marathon	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lincoln	2	3	2	3	2	2	2	3	100	67	100	100	2	4	3	7	1.0	2.0	1.5	2.3	1.0	1.3	1.5	2.3
Langlade	2	2	0**	3	1	0	0	1	50	0	0	33	1	0	0	3	1.0	0	0	3.0	0.5	0	0	1.0
Oneida	14	12	13	15	3	9	6	9	21	75	46	60	3	11	11	17	1.0	1.3	1.9	1.9	0.2	0.9	0.8	1.1
Vilas	12	4	9	8	4	4	2	4	33	100	22	50	4	5	3	9	1.0	1.3	1.5	2.3	0.3	1.2	0.3	1.1
Forest	9	22	13	20	5	9	12	13	56	41	92	65	10	13	27	26	2.0	1.4	2.3	2.0	1.1	0.6	2.1	1.3
Juneau	4	4	4	6	3	3	4	4	75	75	100	67	5	6	8	8	1.7	2.0	2.0	2.3	1.2	1.5	2.0	1.5
Portage	0	0	0	1	0	0	0	1	0	0	0	100	0	0	0	3	0	0	0	3.0	0	0	0	3.0
Wood	1	1	2	1	1	1	2	1	100	100	100	100	2	2	4	2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Adams	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	44	48	43	58	19	28	28	36	43	58	67	62	27	41	56	76	1.4	1.5	2.0	2.1	0.6	0.8	1.3	1.3
LAKE MICHIGAN																								
Waupaca	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Florence	2	-	-	-	1	-	-	-	50	-	-	-	1	-	-	-	1.0	-	-	-	0.5	-	-	-
Oconto	0	-	-	-	0	-	-	-	0	-	-	-	0	-	-	-	0	-	-	-	0	-	-	-
Subtotal	2	-	-	-	1	-	-	-	50	-	-	-	1	-	-	-	1.0	-	-	-	0.5	-	-	-
SOUTHERN																								
Marquette	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	2.0	0	0	0	2.0
WEST CENTRAL																								
Chippewa	3	-	-	1	0	-	-	1	0	-	-	100	0	-	-	1	0	-	-	1.0	0	-	-	1.0
Buffalo	0	-	-	1	0	-	-	1	0	-	-	100	-	-	-	2	0	-	-	2.0	0	-	-	2.0
Subtotal	3	-	-	2	0	-	-	2	0	-	-	100	0	-	-	3	0	-	-	1.5	0	-	-	1.5
Grand Total/State	92	82	84	106	46	55	53	67	50	67	63	63	64	69*	102	124	1.4	1.3*	2.0	1.9	0.7	0.8*	1.2	1.2

* 15 nests still had adults on them in incubating posture. If each nest with incubating adult birds produced one young, production could be 43 young (1 flight only).

** Could not locate.

\- Indicates no information received.

DEPARTMENT OF NATURAL RESOURCES

Wisconsin Osprey Survey
1977-80

DISTRICT	# Active Territories				# Productive Territories				% Nest Success				# Young Produced				#Young/Productive Territory				#Young/Active Territory			
Counties	'77	'78	'79	'80	'77	'78	'79	'80	'77	'78	'79	'80	'77	'78	'79	'80	'77	'78	'79	'80	'77	'78	'79	'80
NORTHWEST																								
Taylor	0	0	0	1	-	-	-	1	-	-	-	100	-	-	-	2	-	-	-	2.0	-	-	-	2.0
Sawyer	14	12	17	14	8	6	14	8	57	50	82	57	12	11	27	15	1.5	1.8	1.9	1.9	0.9	0.9	1.6	1.1
Rusk	1	1	2	1	0	1	1	1	0	100	50	100	0	1	2	1	0	1.0	2.0	1.0	0	1.0	1.0	1.0
Washburn	8	7	10	12	3	5	9	7	38	71	90	58	4	10	16	15	1.3	2.0	1.8	2.1	0.5	1.4	1.6	1.3
Burnett	6	6	5	7	2	1	4	4	33	17	80	57	3	3	8	6	1.5	3.0	2.0	1.5	0.5	0.5	1.6	0.9
Polk	3	2	2	2	2	2	1	1	67	100	50	50	4	4	3	1	2.0	2.0	3.0	1.0	1.3	2.0	1.5	0.5
Iron	10	10	14	13	6	7	11	11	60	70	79	85	12	11	20	18	1.8	1.6	1.8	1.6	1.2	1.1	1.4	1.4
Douglas	3	5	7	6	3	3	4	4	100	60	57	67	7	7	4	7	2.3	2.3	1.0	1.8	2.3	1.4	0.6	1.2
Bayfield	0	1	1	1	0	1	1	1	0	100	100	100	0	1	3	2	0	1.0	3.0	2.0	0	1.0	3.0	2.0
Subtotal	45	44	58	57	24	26	45	38	53	59	78	67	42	48	83	67	1.8	1.8	1.8	1.8	0.9	1.1	1.4	1.2
NORTH CENTRAL																								
Marathon	3	2	3	5	1	2	3	4	33	100	100	80	2	3	7	8	2.0	1.5	2.3	2.0	0.7	1.5	2.3	1.6
Lincoln	4	4	4	3	2	2	3	1	50	50	75	33	2	4	9	2	1.0	2.0	3.0	2.0	0.5	1.0	2.3	0.7
Langlade	5	5	5	5	3	1	4	4	60	20	80	80	4	2	7	8	1.3	2.0	1.8	2.0	0.8	0.4	1.4	1.6
Oneida	17	22	25	28	12	11	15	14	71	50	63	50	25	20	25	30	2.1	1.8	1.6	2.1	1.5	0.9	1.0	1.1
Vilas	16	15	16	23	10	10	10	16	62	67	63	70	16	18	16	25	1.6	1.8	1.6	1.6	1.0	1.2	1.0	1.1
Forest	21	18	19	20	15	7	10	9	71	39	53	45	26	10	20	15	1.7	1.4	2.0	1.7	1.2	0.6	1.1	0.8
Juneau	5	6	6	7	4	5	6	3	80	83	100	43	8	7	11	7	2.0	1.4	1.8	2.3	1.6	1.2	1.8	1.0
Portage	2	2	2	3	2	2	2	2	100	100	100	67	5	5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	1.7
Wood	2	1	0	3	2	1	0	1	100	100	0	33	3	2	0	3	1.5	2.0	0	3.0	1.5	2.0	0	1.0
Adams	1	2	0	1	1	1	0	0	100	50	0	0	1	1	0	0	1.0	1.0	0	0	1.0	0.5	0	0
Subtotal	76	77	80	98	52	42	53	54	68	55	66	55	92	72	100	103	1.8	1.7	1.9	1.9	1.2	0.9	1.3	1.1
LAKE MICHIGAN																								
Manitowoc	0	0	0	1				1				100				1				1.0				1.0
Waupaca	-	1	0	1	-	1	0	1	-	100	-	100	-	1	0	2	-	1.0	-	2.1	-	1.0	-	2.0
Florence	-	-	0	0	-	-	0	0	-	-	-	-	-	-	0	0	-	-	-	-	-	-	-	-
Oconto	-	-	1	0	-	-	0	0	-	-	-	-	-	-	0	0	-	-	-	-	-	-	-	-
Subtotal	-	1	1	2	-	1	0	2	-	100	-	100	-	1	0	3	-	1.0	-	1.5	-	1.0	-	1.5
SOUTHERN																								
Marquette	0	1	1	1	0	1	0	-	0	100	0	-	0	3	0	-	0	3.0	0	-	0	3.0	0	-
Subtotal	0	1	1	1	0	1	0	-	0	100	0	-	0	3	0	-	0	3.0	0	-	0	3.0	0	-
WEST CENTRAL																								
Chippewa	1	1	2	2	1	1	0	0	100	100	0	0	1	3	0	0	1.0	3.0	0	0	1.0	3.0	0	0
Buffalo	1	1	1	1	1	1	1	1	100	100	100	100	2	2	2	2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Subtotal	2	2	3	3	2	2	1	1	100	100	33	33	3	5	2	2	1.5	2.5	2.0	2.0	1.5	2.5	0.7	0.7
Grand Total/State	123	125	143	161	78	72	99	95	63	57	69	59	137	129	185	175	1.8	1.8	1.9	1.8	1.1	1.0	1.3	1.1

DEPARTMENT OF NATURAL RESOURCES

Wisconsin Osprey Survey
1981-84

District	# Active Territories				# Productive Territories				% Nest Success				# Young Produced				# Young/Productive Territory				# Young/Active Territory			
Counties	'81	'82	'83	'84	'81	'82	'83	'84	'81	'82	'83	'84	'81	'82	'83	'84	'81	'82	'83	'84	'81	'82	'83	'84
NORTHWEST																								
Taylor	1	1			1	0			100	0			3	0			3.0	0			3.0	0		
Sawyer	15	16			10	9			67	56			15	20			1.5	2.2			1.0	1.3		
Rusk	1	1			1	-			100	-			1	-			1.0	-			1.0	-		
Washburn	14	12			8	7			57	58			18	17			2.3	2.4			1.3	1.4		
Burnett	7	10			5	5			71	50			10	12			2.0	2.4			1.4	1.2		
Polk	1	2			1	1			100	50			2	3			2.0	3.0			2.0	1.5		
Iron	16	19			10	17			63	89			14	32			1.4	1.9			0.9	1.7		
Douglas	5	3			3	2			60	67			6	3			2.0	1.5			1.2	1.0		
Bayfield	2	2			1	1			50	50			2	2			2.0	2.0			1.0	1.0		
Subtotal	62	66			40	42			65	64			71	89			1.8	2.1			1.1	1.3		
NORTHCENTRAL																								
Marathon	6	6			3	5			50	83			5	10			1.7	2.0			0.8	1.7		
Lincoln	4	4			2	2			50	50			5	5			2.5	2.5			1.3	1.3		
Langlade	6	6			4	4			67	67			6	9			1.5	2.3			1.0	1.5		
Oneida	29	35			19	18			66	51			34	36			1.8	2.0			1.2	1.0		
Vilas	25	29			16	16			64	55			26	27			1.6	1.7			1.0	0.9		
Forest	20	21			5	13			25	62			6	25			1.2	1.9			0.3	1.2		
Juneau	6	6			5	3			83	50			9	10			1.8	3.3			1.5	1.7		
Portage	4	4			2	3			50	75			4	7			2.0	2.3			1.0	1.8		
Wood	2	2			2	1			100	50			4	2			2.0	2.0			2.0	1.0		
Adams	1	1			1	1			100	100			1	1			1.0	1.0			1.0	1.0		
Subtotal	103	114			59	66			57	58			100	132			1.7	2.0			1.0	1.2		
LAKE MICHIGAN																								
Manitowoc	1	-			0	-			0	-			0	-			0	-			0	-		
Waupaca	1	1			1	-			100	-			2	-			2.0	-			2.0	-		
Shawano	1	1			1	1			100	100			1	-			1.0	-			1.0	-		
Florence	1	-			-	-			-	-			-	-			-	-			-	-		
Menominee	3	1			-	-			-	-			-	-			-	-			-	-		
Oconto	0	-			0	-			0	-			0	-			0	-			0	-		
Subtotal	7	3			-	-			-	-			-	-			-	-			-	-		
SOUTHERN																								
Jefferson	1	-			0	-			0	-			0	-			0	-			0	-		
Marquette	1	1			1	-			100	-			2	-			2	-			2	-		
Subtotal	2	1			1	-			50	-			2	-			-	-			1	-		
WEST CENTRAL																								
Jackson	1	-			-	-			-	-			-	-			-	-			-	-		
Chippewa	2	2			-	0			-	0			-	0			-	0			-	0		
Buffalo	1	-			1	-			100	-			2	-			2	-			2	-		
Subtotal	4	2			1	-			25	0			2	0			2	0			0.5	0		
Grand Total	176	(186)			(101)	(109)			(57%)	59			(175)	(221)			(1.7)	(2.0)			(1.0)	(1.2)		

- Indicates No Information Received
( ) Based Only on Territories With Known Outcome
0671L